27th October 2005, Park Central Hotel, New York

RENEWABLE ENERGY
YESTERDAY, TODAY AND TOMORROW

A PRIVATE DEVELOPER'S PERSPECTIVE

L. Y. Bronicki, Chairman and CTO
ORMAT Group

1 THE GEOTHERMAL WEDGE
2 ORMAT 40 YEARS OF GREEN ENERGY EXPERIENCE
3 RAISING CAPITAL FOR RENEWABLE ENERGY PROJECTS
4 AGENDA FOR ACTION: PUBLIC PRIVATE PARTNERSHIP

The Wedge of Geothermal Energy

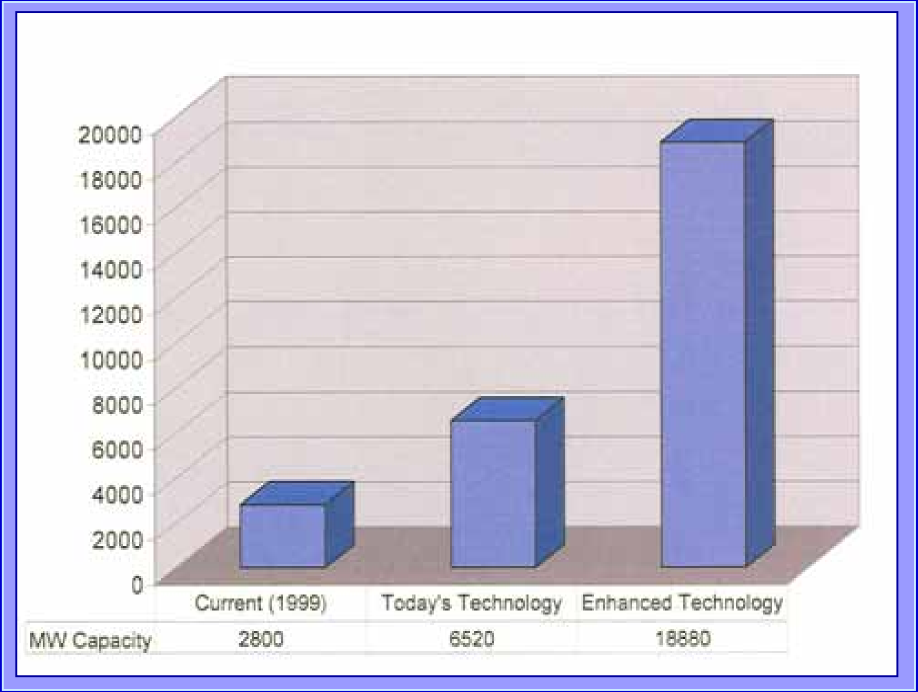
Electricity Generation and Direct Use Heating

WEDGE ELEMENT	CAPACITY IN MWe	CAPACITY IN MWt
GEOTHERMAL ELECTRICITY		
Installed World Wide Capacity	8,500	
Potential: Existing Technology	70,000	
Advanced Technologies (EGS)	140,000	
GEOTHERMAL DIRECT USE HEATING		
Installed World Wide Capacity		15,000
Potential World Wide Capacity (est.)		100,000

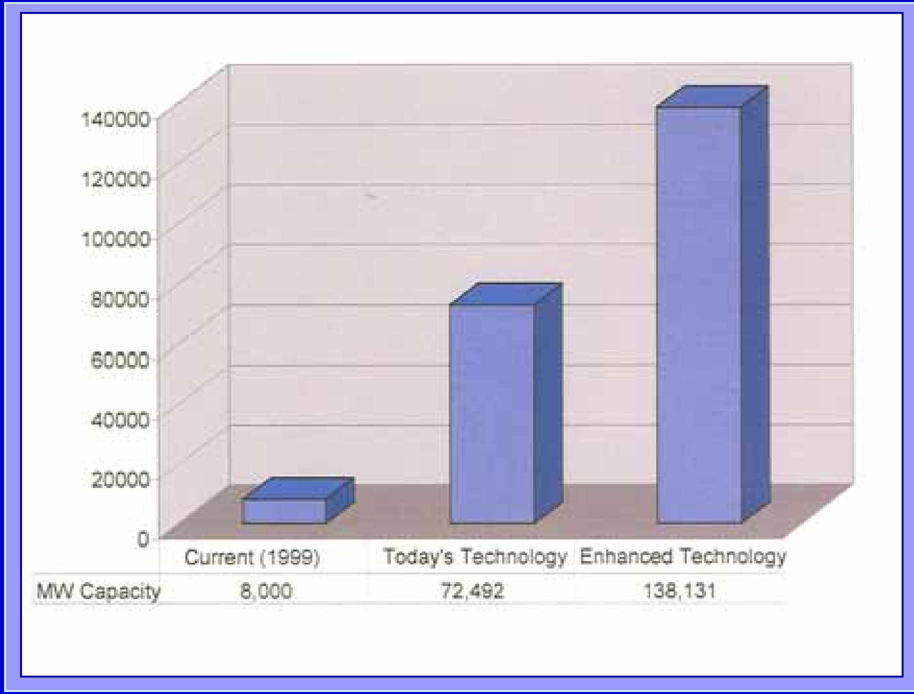
Source: DOE, GRC, IGA

Geothermal Energy Potential

U.S. Geothermal Potential



World Geothermal Potential



Source: GEA, A Guide to Geothermal Energy and Environment, 2005

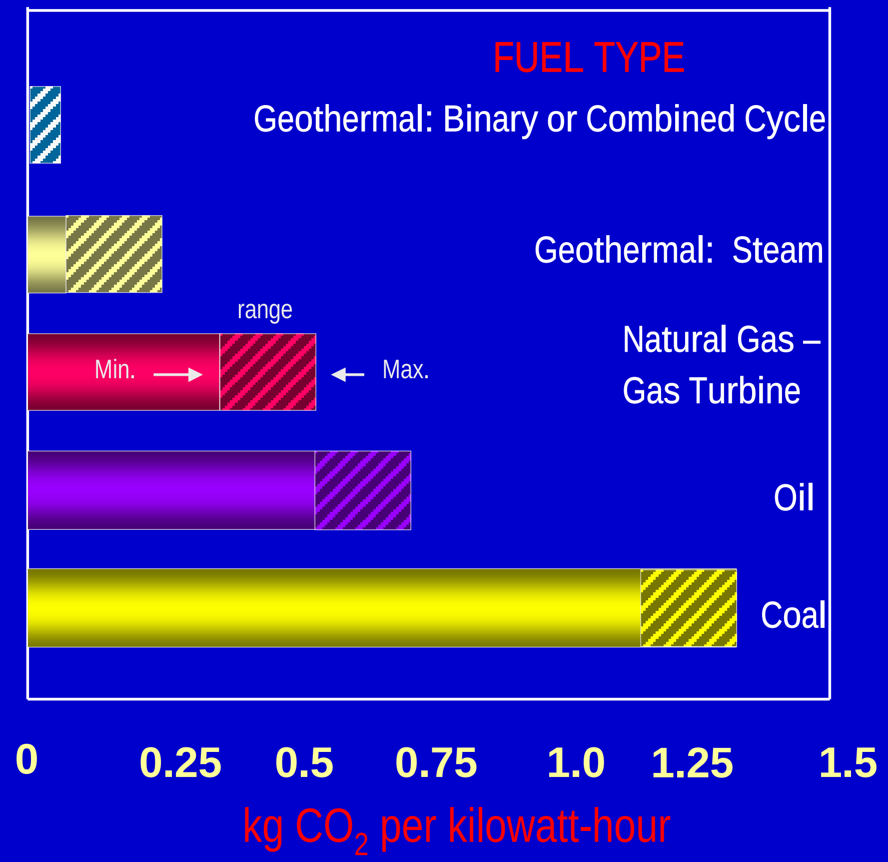
Environmental Features of Geothermal Energy

Comparison with Other Energy Sources

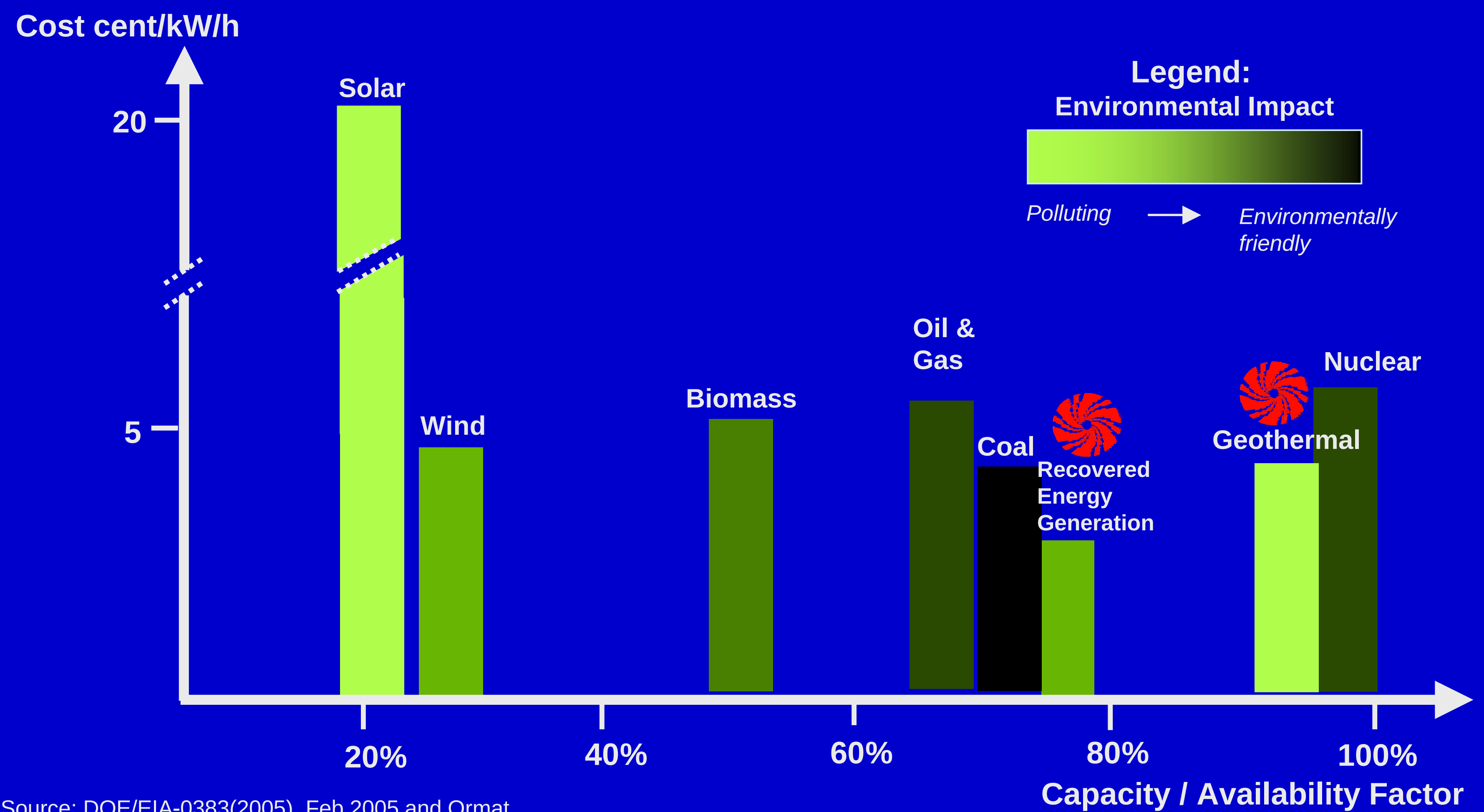
Land Area Occupied

Technology	Land area (m2 per GWhr/year for 30 years)
Geothermal	404
Wind (land with turbines and roads)	1,335
Photovoltaics	3,237
Solar Thermal	3,561
Coal (including open pit mining)	3,642

CO_2 Emissions



Geothermal & Recovered Energy – Green, Dependable and Cost Effective



Source: DOE/EIA-0383(2005), Feb 2005 and Ormat

THE FUTURE OF SMALL ENERGY RESOURCES

An International Conference

Organized by

The United Nations Institute for Training and Research

and co-sponsored by

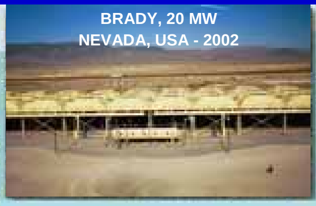
The United Nations Development Programme
The United Nations Environment Programme
The Government of Japan
The Government of Mexico through the Comisión Federal de Electricidad
The Government of the United States through the Department of Energy
The Government of the State of California through the State Energy

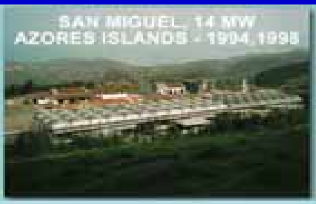
9–18 September 1981
Los Angeles, California, USA

Joseph Barnea
Scientific Secretary

INTRODUCTION

ORMAT - 40 YEARS OF GREEN ENERGY EXPERIENCE

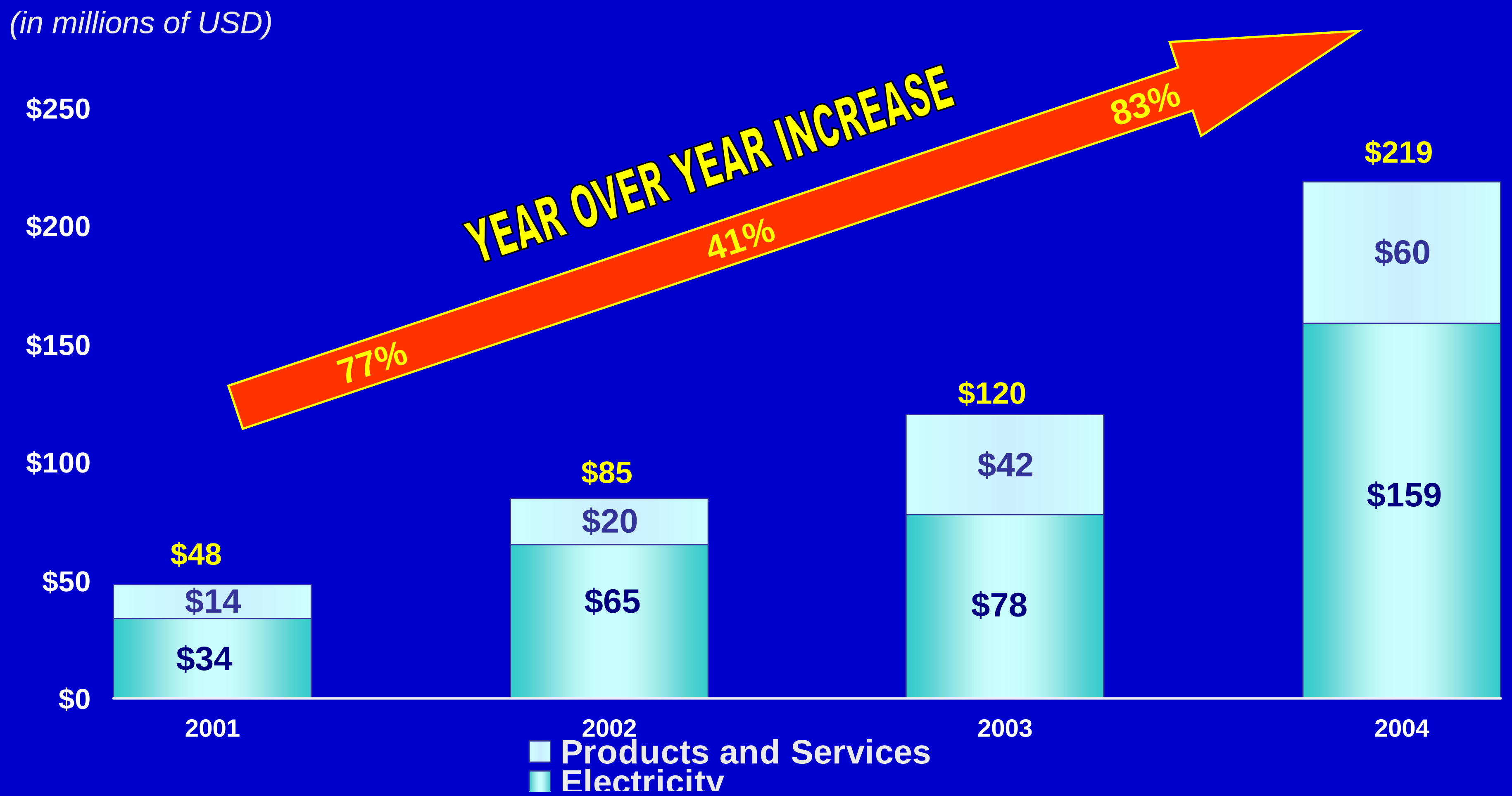




- Developed an original technology
- Constructed 800 MW of power plants, both geothermal and recovered energy generation (cement plants and compressor stations)
- Raised over $1B in project finance
- Experience with MFI and ECA in 270 MW of projects (the Philippines, Guatemala, Nicaragua, Kenya)
- Owns and operates 349 MW (235 MW in the USA, 114 MW in Developing Countries)

As of October 2005 ORMAT build power plants have saved 10 million tons of fuel, and have avoided the emission of over 22 million tons of CO_2.

Annual Revenue Growth



Green Before it was Fashionable

Stand Alone Solar Microturbine

Solar Water Pumping System

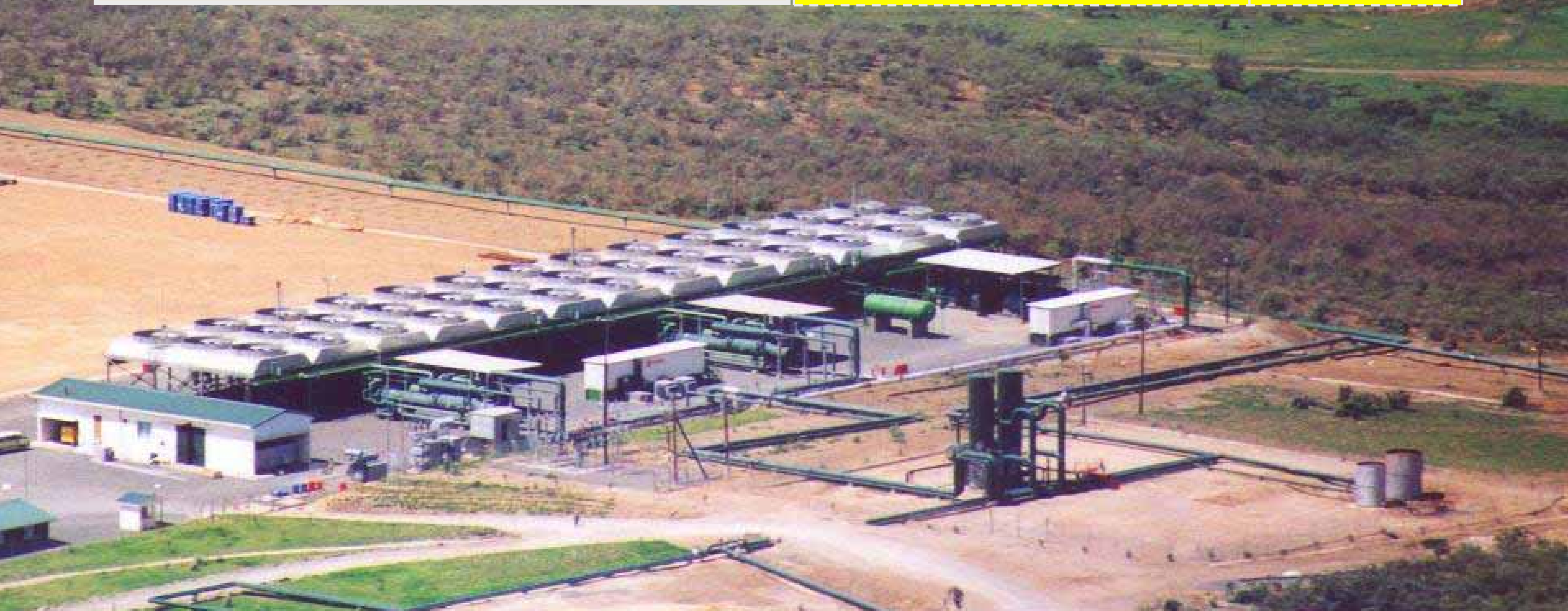
Example of ORMAT Projects

48 MW Olkaria III Geothermal Power Plant, Kenya

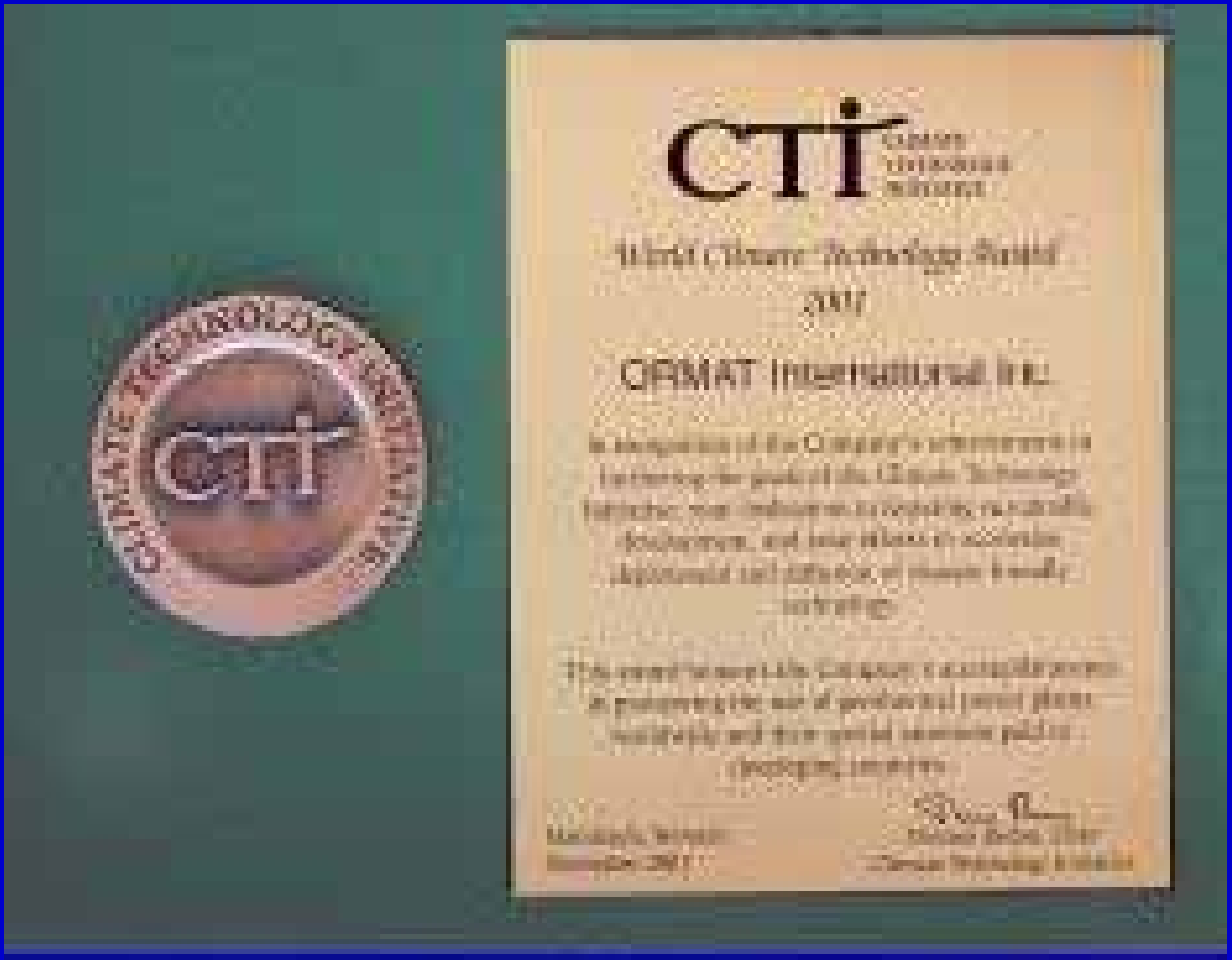
PROJECT STRUCTURE: BOO

Phase 1+	13 MW ORC. Wells for 120% of full capacity Phase 2	
Phase 2	Nominal Capacity: 48 MW	
	Net maximum deliverable capacity: 53 MW, including steam turbine and ORC	
Design Steam Flow		80 kg/s (average NCG: 3.5%)
Design Gross Output		53 MW
Design Net Output		48 MW

Award	Feb. 1998
Contract Effectivity	Oct. 1999
Start Construction	Oct. 1999
MIGA Policy	May 2000
Commercial Operation (Ph.1)	July 2000
Commercial Operation (Ph.2)	**Q2 - 2006**



World Climate Technology Award 2001



60 MW Mokai I Power Plant

Steam Pressure	bar.a	18.5
Steam Flow	T/hr	288.6
Brine Flow	T/hr	666.5

Ambient Temp.	°C	14.5
Plant Net Power	MW	53.3
Plant Net Steam Rate	kg/kWh	5.42

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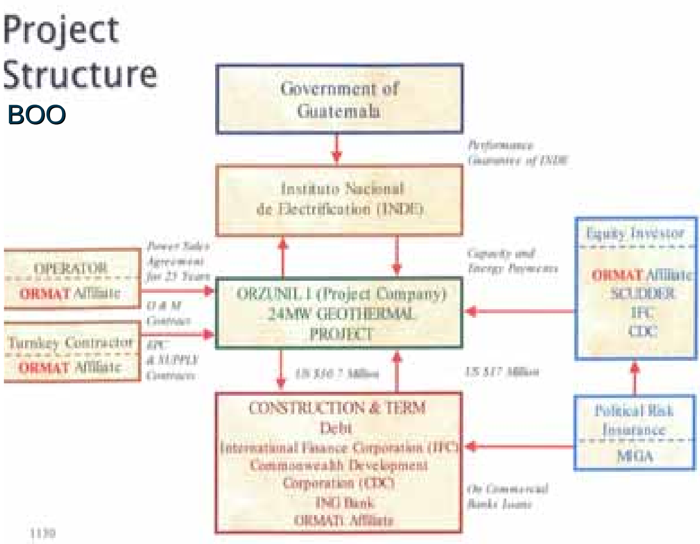
Example of an ORMAT Project
24 MW Zunil Geothermal Power Plant, Guatemala

Award	*May 1995*
Contract Effectivity	*October 1997*
Financial Closing	*August 1999*
Construction Started	*June 1999*
Commercial Operation	*September 1999*

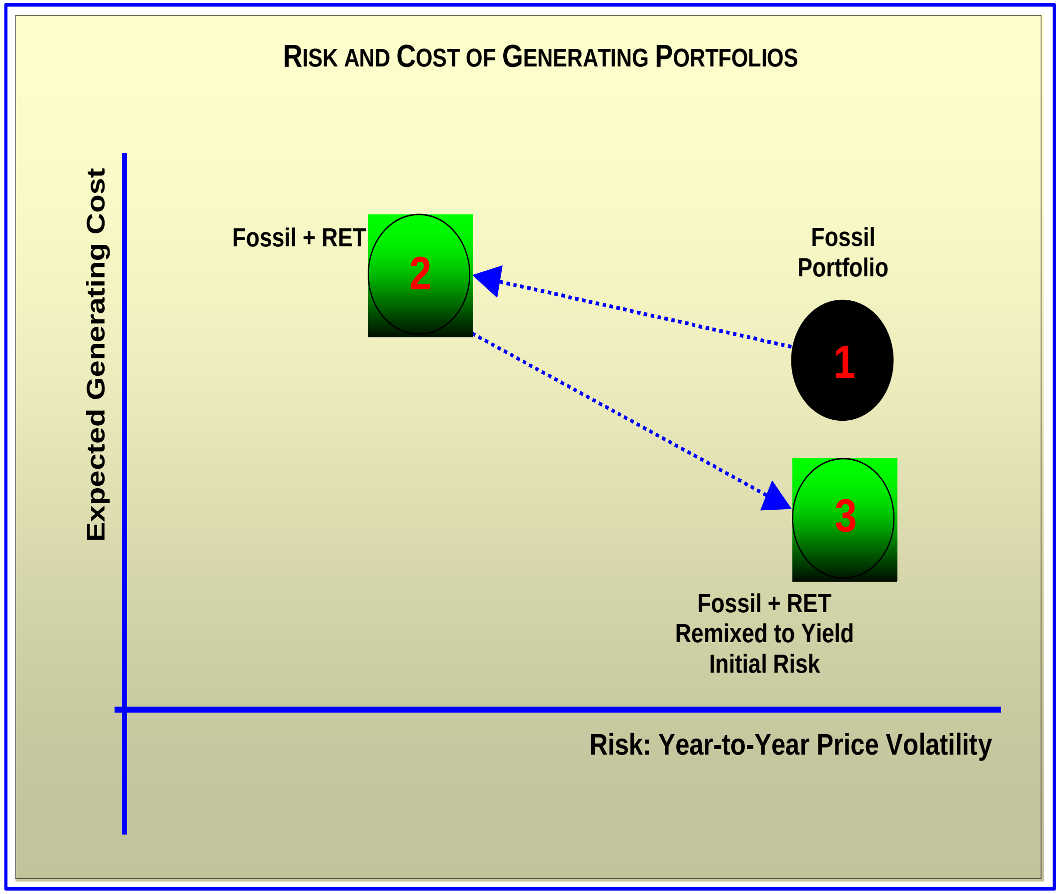


Raising Capital for Renewable Energy Projects

Hurdles and Barriers

- COMMERCIAL FINANCING: barriers due to relatively small sizes and high initial investment costs
- CREDIT ISSUES: barriers due to risks: political, resource and off-takers
- INSTITUTIONAL ISSUES: barriers due to fossil fuel subsidies, no accounting for GHG emissions, oil price risks, and societal costs of fossil fuels
- STRUCTURAL ISSUES: Need mechanisms enabling market entry of renewables under deregulated structures (RE set aside)

Energy Portfolios Need More Non-fossil Fuel Generation to Hedge Oil Price Risks



Mexican example:

At 95% Portfolio Risk (standard deviation) adding to the mix 11% geothermal and 9% wind reduces the expected generation cost from 4.76 to 3.7 cents/kWh

(increases portfolio return from 0.21 to 0.27 kWh/cent)

Courtesy of Shimon Awerbuch, Ph.D.

Portfolio-Based Electricity Generation Planning: Implications for Renewables and Energy Security

A demonstration project funded by *REEEP* and *UNEP* in collaboration with *ECN* of The Netherlands and BASE

Comparison of Public and Private Sector Financing

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<u>Assumptions</u>:

1. *Discount rate*
   - Public sector: 3-8%
   - Private sector: 13-18%% (in case of 30% equity, and 70% debt financing)
2. *Resource risk allocation* (drilling success rate not more than 70%)
   - Public sector: generally assumed by the IFI
   - Private sector: fully accounted for by investors
3. *Commercial risk*
   - Public sector: none
   - Private sector: fully accounted for
4. *Political risk*
   - Public sector: none
   - Private sector cost of insurance: 2-3%
5. *Soft costs*
   - Public sector: often not budgeted to project
   - Private sector: fully accounted for by investors

AGENDA FOR ACTION
Public-Private Partnerships
Key Points for Success

- Risk Sharing
  - Private industry to underwrite risks in construction, performance, and operation
  - LDCs, MFIs, ECAs and national agencies to underwrite other risks: country, payment

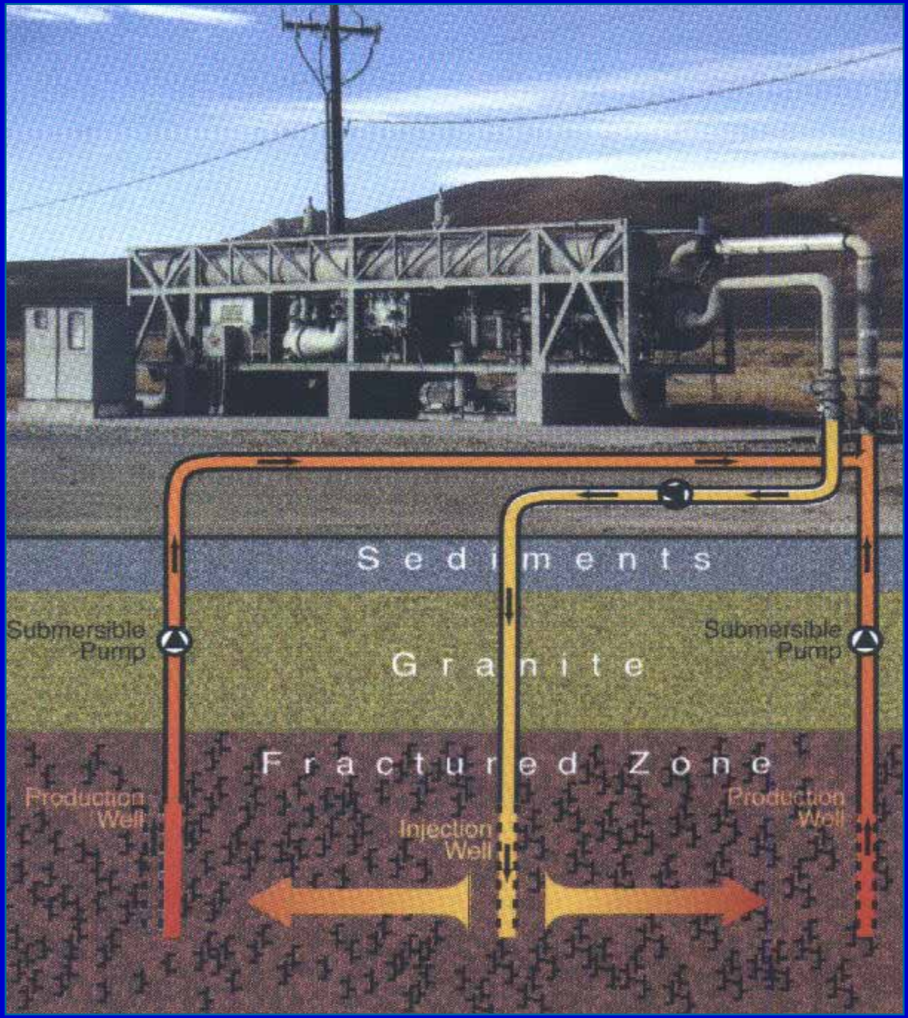
- National Policy Legislation: level the playing field
  - Finance-oriented, portfolio-based models should be promoted to take advantage of renewables in the generation mix (to hedge oil price risk)
  - Use market mechanism set asides for renewable energy technologies, e.g. RPS
  - But adapt deregulation to renewables (merchant plant issue)

- In LDCs Financial Institutions to Seek Innovative FAST TRACK Solutions
  - Streamline the review process – avoid micro management
  - One stop financing
  - Innovative technologies should be welcomed (performance guaranteed by private sector)
  - In IFIs harmonize public and private sector department efforts

Resource Recovery: Hot Fractured Rock (HFR)

Geothermal System

HFR technology is the extraction of heat from the earth by circulating fluid through natural and artificial fractures to access the virtually unlimited amounts of moderate temperature heat widely distributed the world over.



Unattended Combined Heat and Power MICROTURBINES Provide Quality Power for Telecom and SCADA

- 122 propane fueled OEC units of 600 W along 1277 km
- In continuous operation since 1976
- Powers VHF radio, SCADA, instrumentation, and remote gate valves
- Designed for maximal reliability and minimal maintenance (1 visit/yr)