Costs and Financial Risks of Geothermal Projects

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Geothermal Exploration

Best Practices Launch Event

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Outline

- Cost Components of Geothermal Development
- Factors Affecting Costs
- Costs by Stage of a Project
- Origin and Types of Financial Risk
- Mitigation of Financial Risk

Components of Geothermal Development Cost

- Site ("Establishment") Costs
- Resource Exploration / Confirmation
- Production / Injection Wells
- Production / Injection System
- Power Plant
- Connection / Transmission
- Administration / Management

Site Costs

- Concession / Lease Acquisition
- Permitting
- Environmental Studies
- Civil Works
  - Roads
  - Drilling Pads
  - Plant Site and Infrastructure
  - Water Supply
- Camp / Support Facilities

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Resource Exploration / Confirmation

- Surface Exploration
- Shallow Drilling
- Assessment (Pre-Feasibility / Feasibility Studies)

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Production / Injection Wells

- Mobilization / Demobilization
- Drilling
- Logging
- Testing

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Production / Injection System

- Production piping
- Separators / production equipment
- Injection piping
- Production pumps
- Injection pumps
- Scale / corrosion inhibition systems

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Power Plant

- Design / Engineering
- Plant procurement / Construction
- Testing / Commissioning

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Connection / Transmission

- Switchyard
- Grid Connection
- Transmission

Administration / Management

- Project management
- Corporate administration
- Legal
- Insurance
- Financing fees

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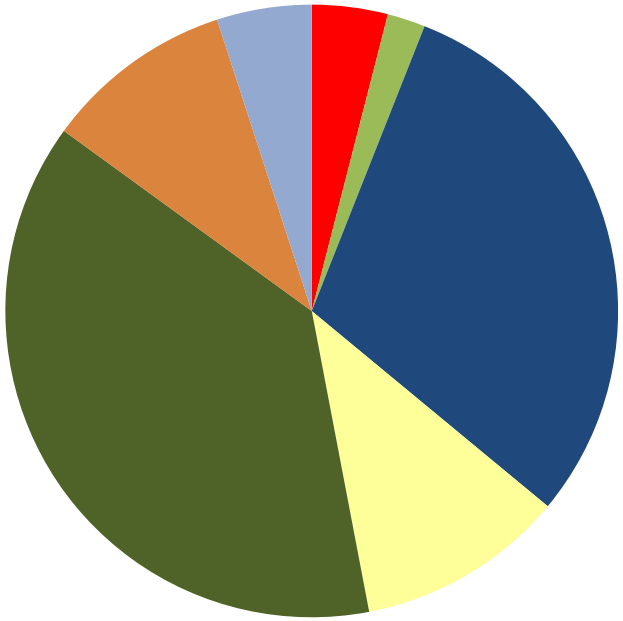
Representative Cost Breakdown

(20 MW Project)



	Cost (US millions)	US$/kW	% of Total
Site ("Establishment") Costs	$4	$200	4%
Resource Exploration / Confirmation	$2	$100	2%
Production / Injection Wells	$30	$1,500	30%
Production / Injection System	$11	$550	11%
Power Plant	$38	$1,900	38%
Connection / Transmission	$10	$500	10%
Administration / Management	$5	$250	5%
	$100	$5,000	100%

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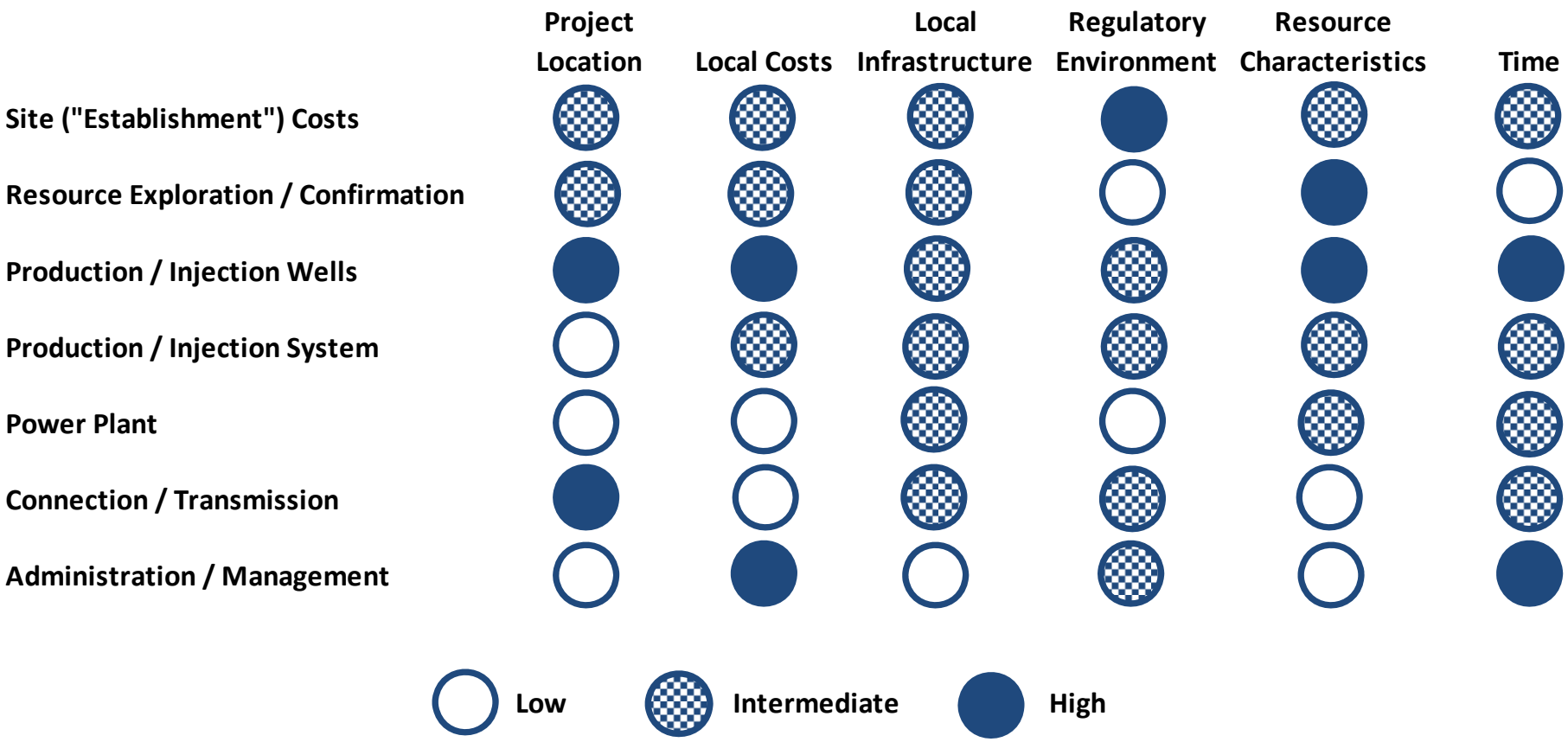
Global Cost for Development

~US$3,000 to $6,000 per kW installed*

*It can be even more, if risks are not properly managed

Impact of Different Factors on Costs



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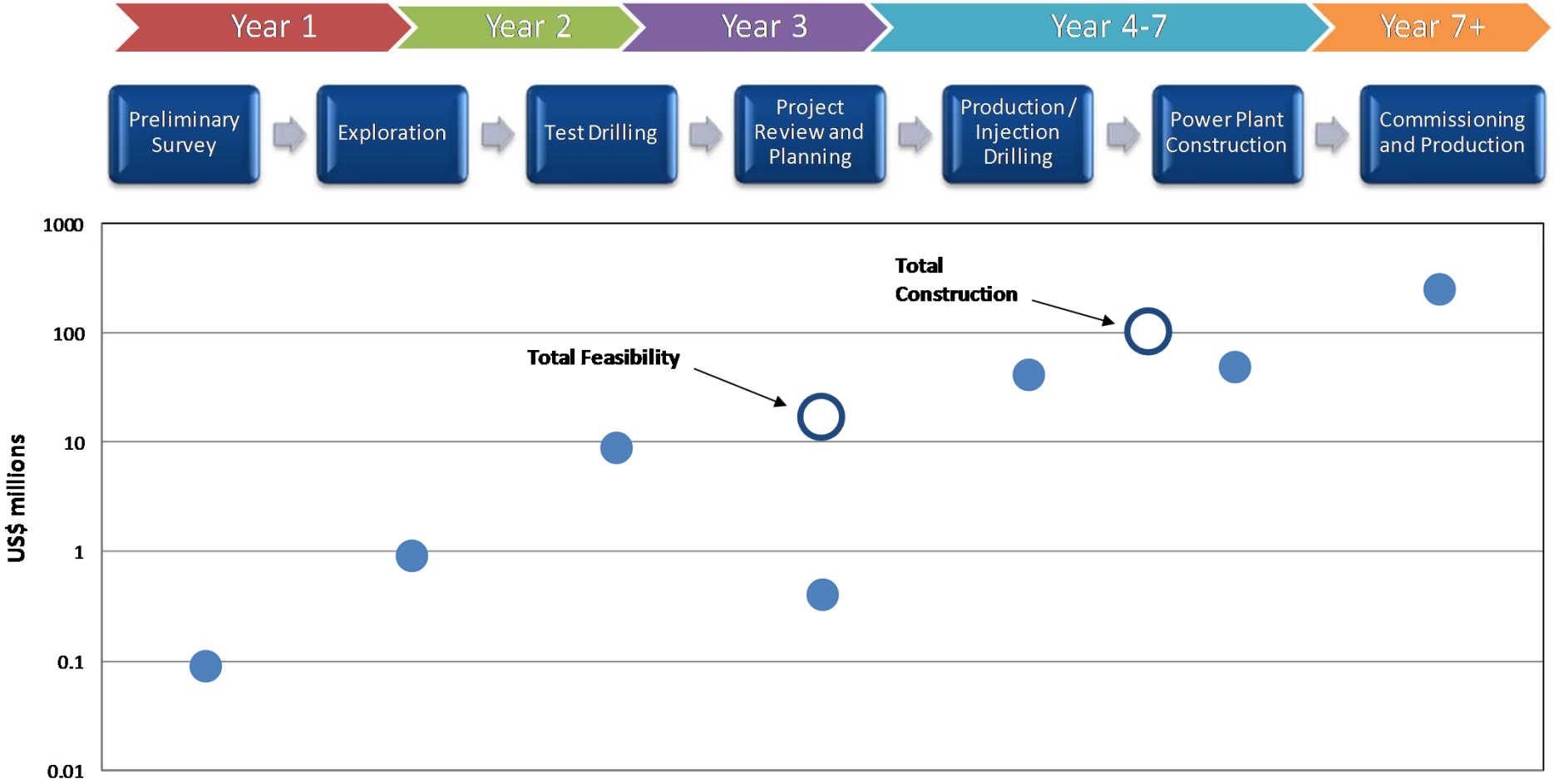
Cost by Stage



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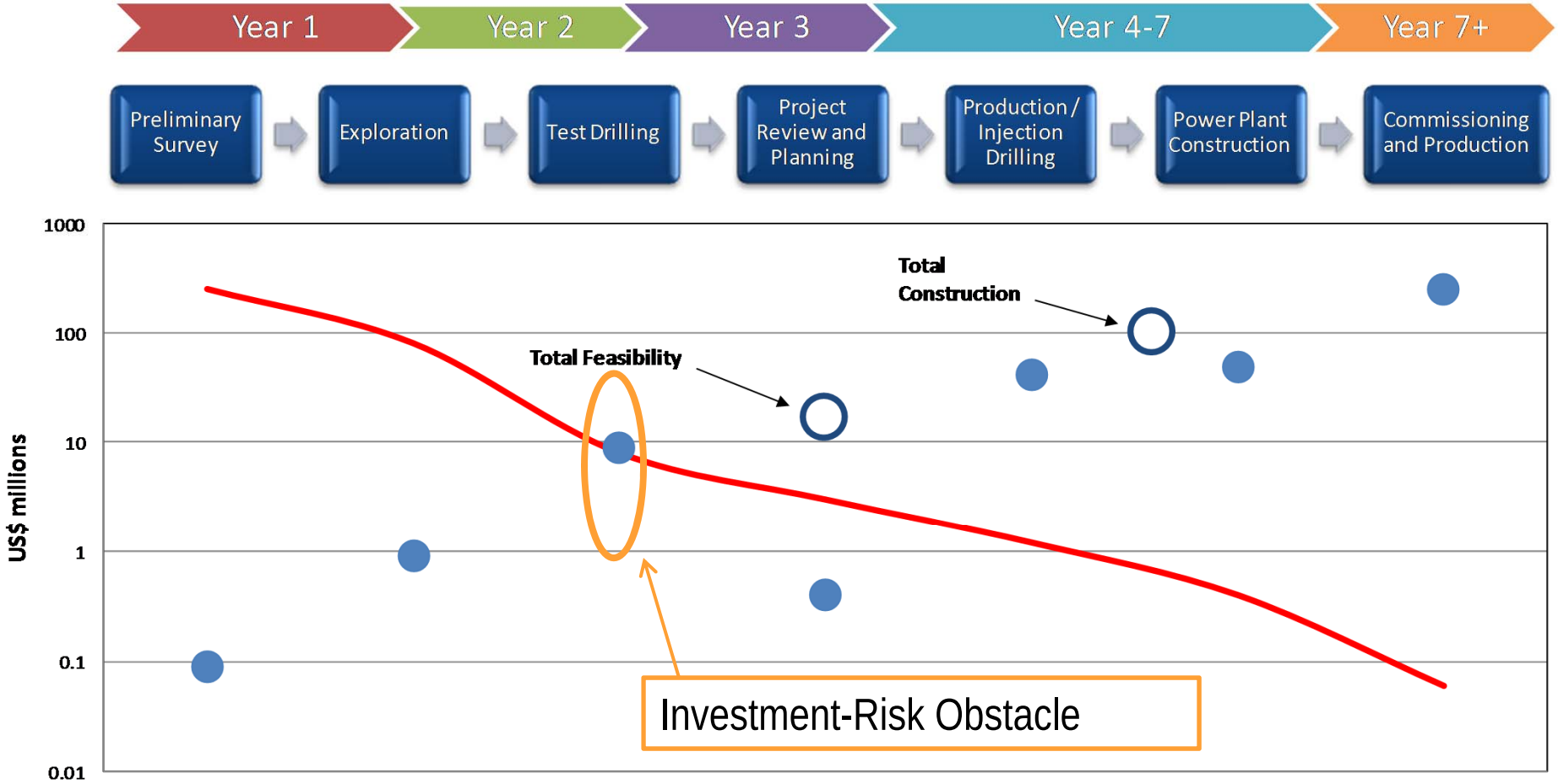
Risk by Stage



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Financial Risks

Tend to occur when technical plans and needs are not well matched to investment / finance needs

Financial Risks

Examples:

- Difficulties obtaining investment money when needed to maintain concession / license
- Difficulties in meeting PPA requirements due to investment / finance schedule

Financial Risks

Examples:

- Investment / loan terms do not accommodate unexpected results
- Short-term needs to meet financing requirements conflict with technical “best practices”

Mitigation of Financial Risks

- Plan development program realistically
  - Allow reasonable contingencies for time and budget
  - Stress-test financial models, using reasonable “worst-case” scenarios
  - Allow for program changes in response to unexpected results

Mitigation of Financial Risks

- Consider requirements of investors / lenders:
  - Risk tolerance matched to stage and status of project
  - Investment / loan terms consistent with project status and uncertainties
  - Flexibility to deal with changes in program

Mitigation of Financial Risks

- Disclose problems and changes promptly to investors / lenders