

Exploration for Geothermal Energy

Some Insights



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Presentation II - 6



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Exploration for what purpose

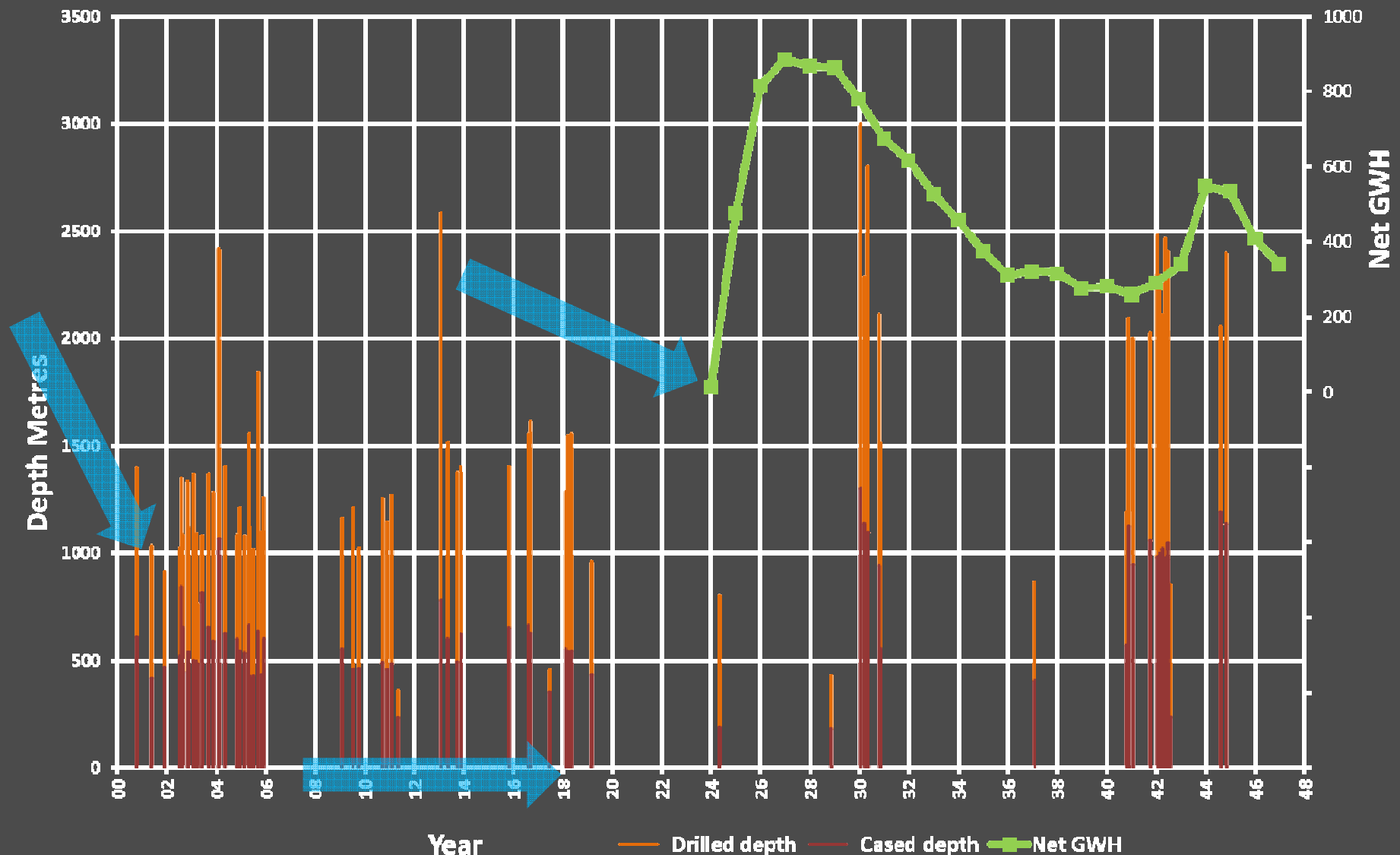


The purpose

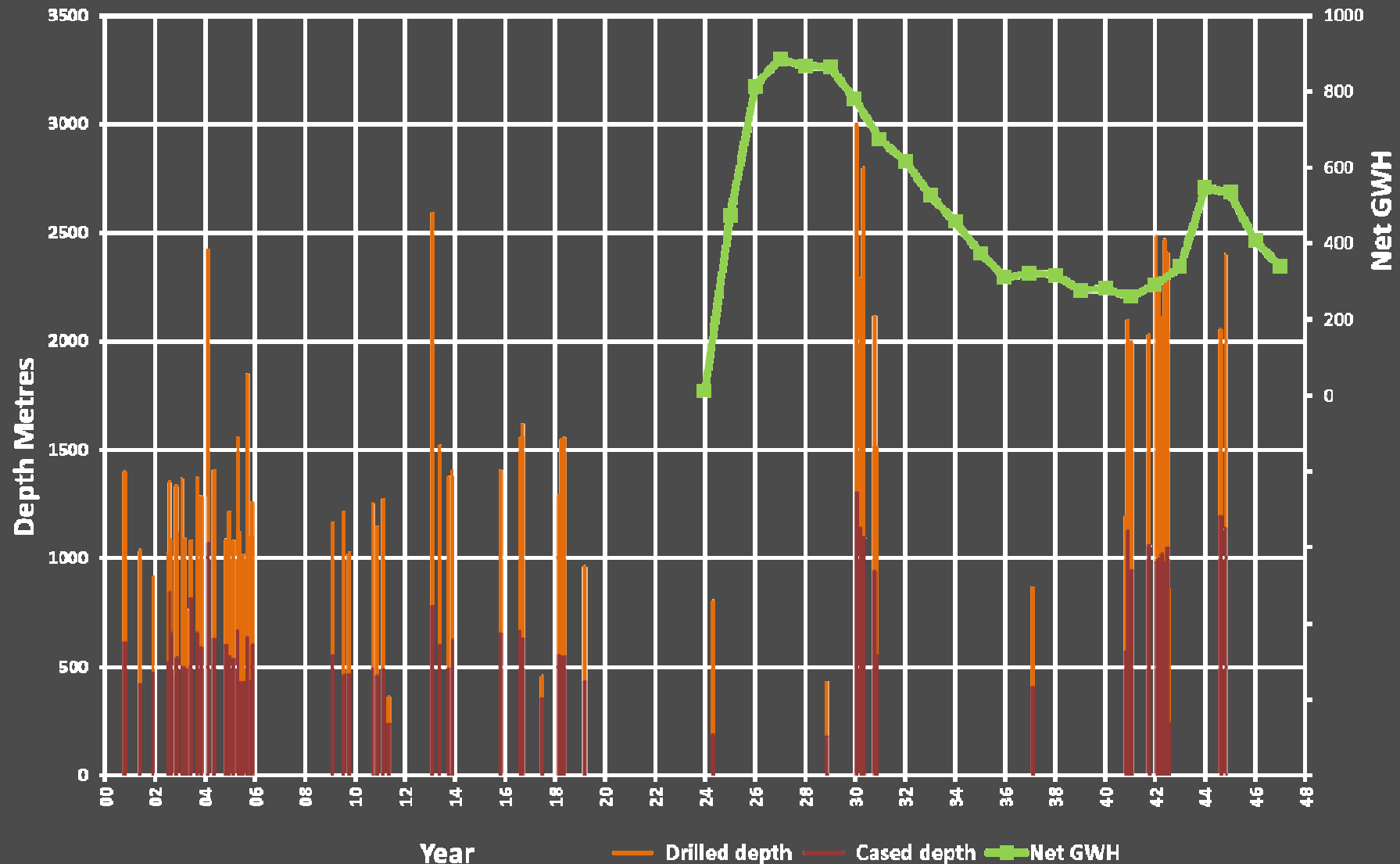
- **Agency Resource Identification**
 - National inventories
 - Regional / Provincial inventories
 - Planning purposes
- **Energy Generation from a Resource**
 - New development on a green field
 - Expansion at an existing field

Examples of resources in different countries

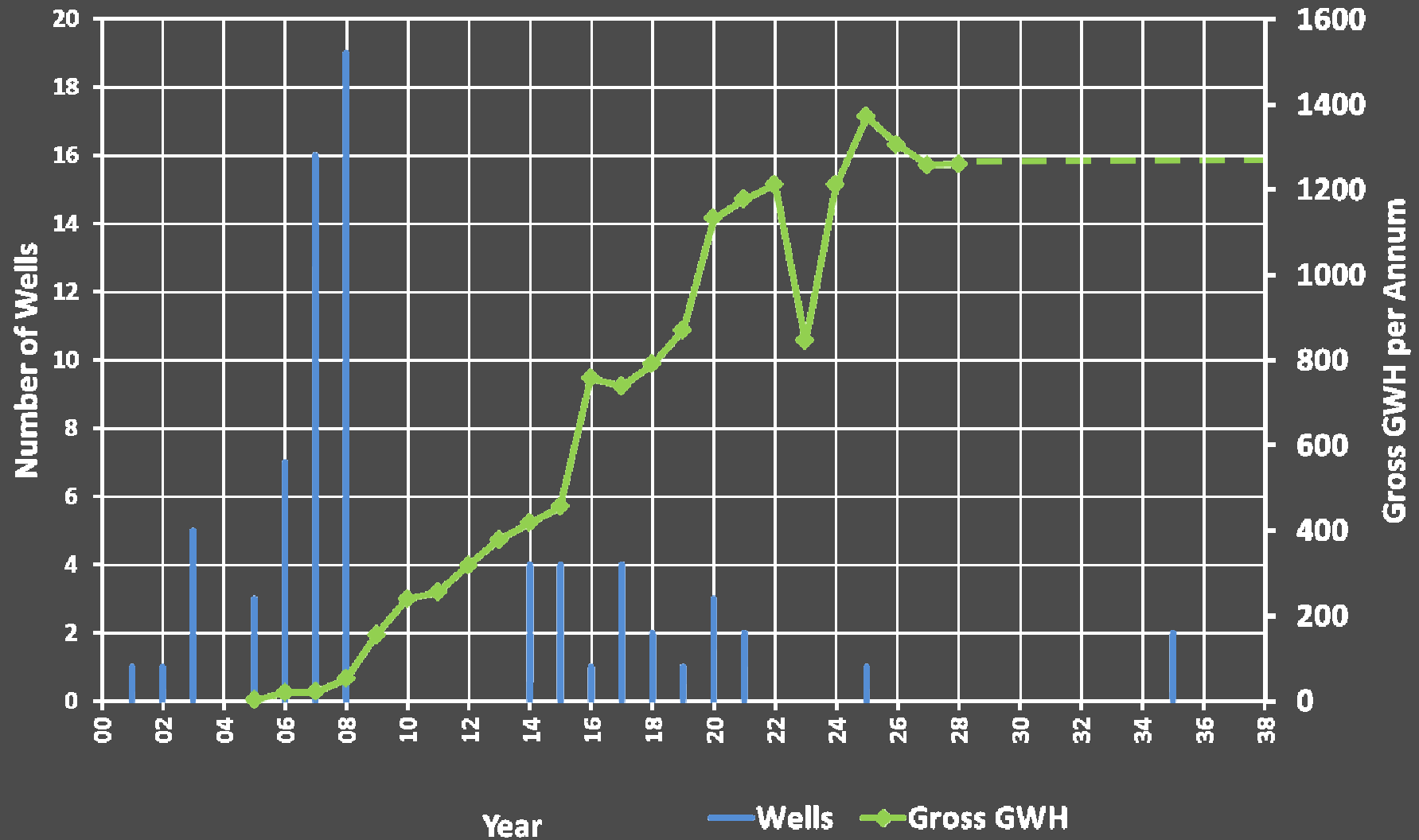
Exploration through 25 years Production



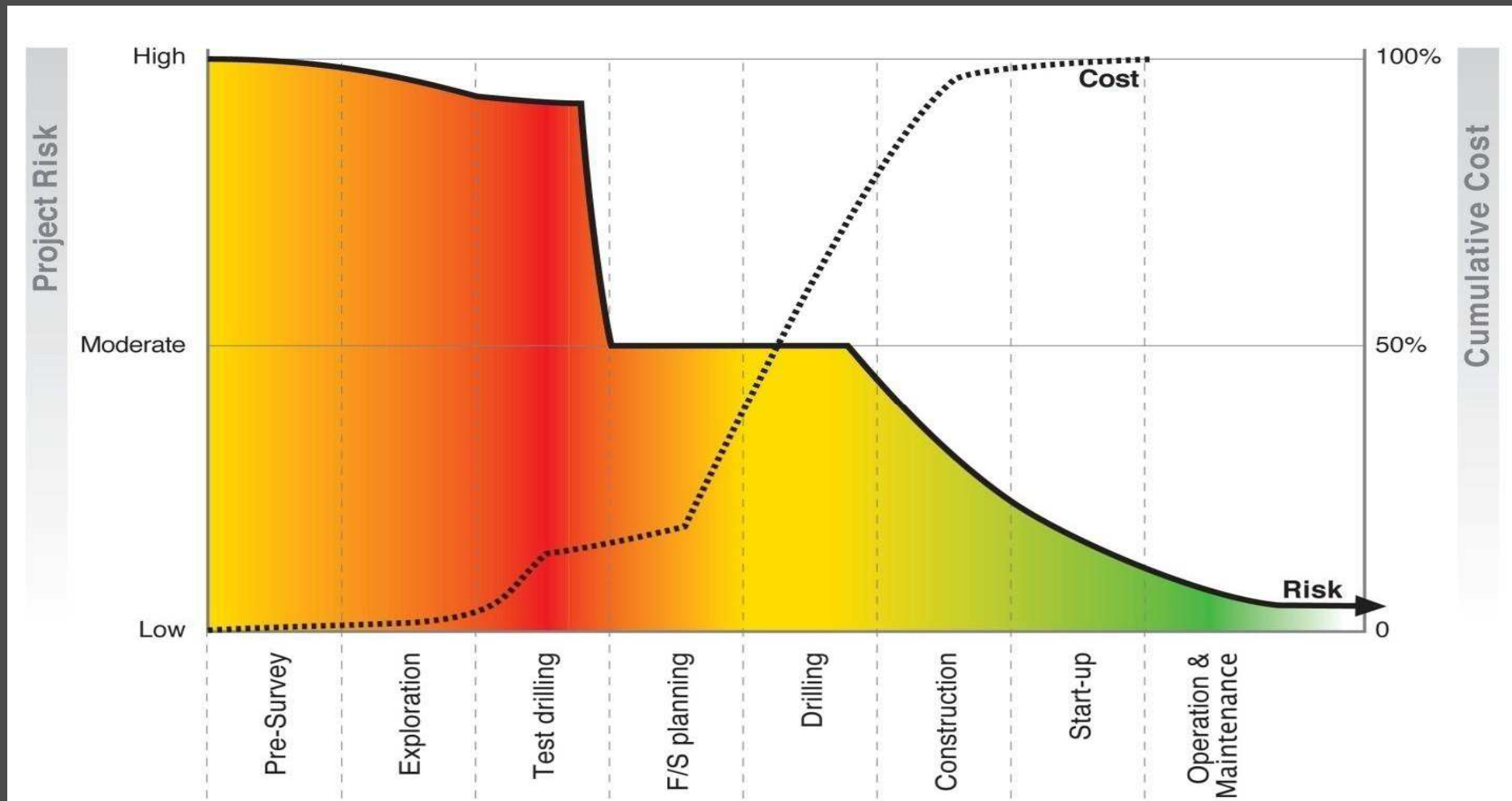
Exploration through 25 years Production



Shorter Lead Time – Two stages

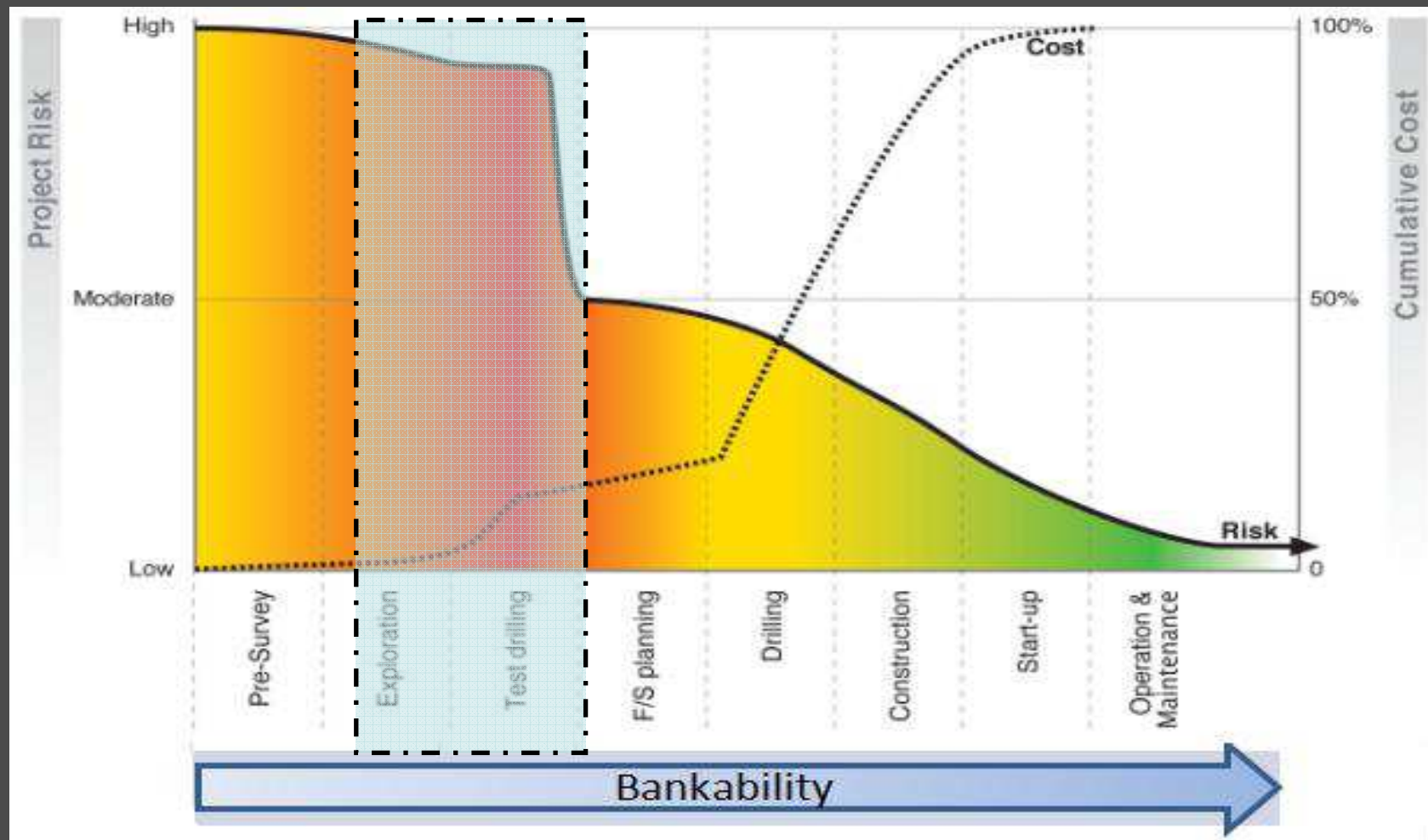


Project Progression



From Energy Sector Management Assistance Program World Bank Geothermal Handbook 2012

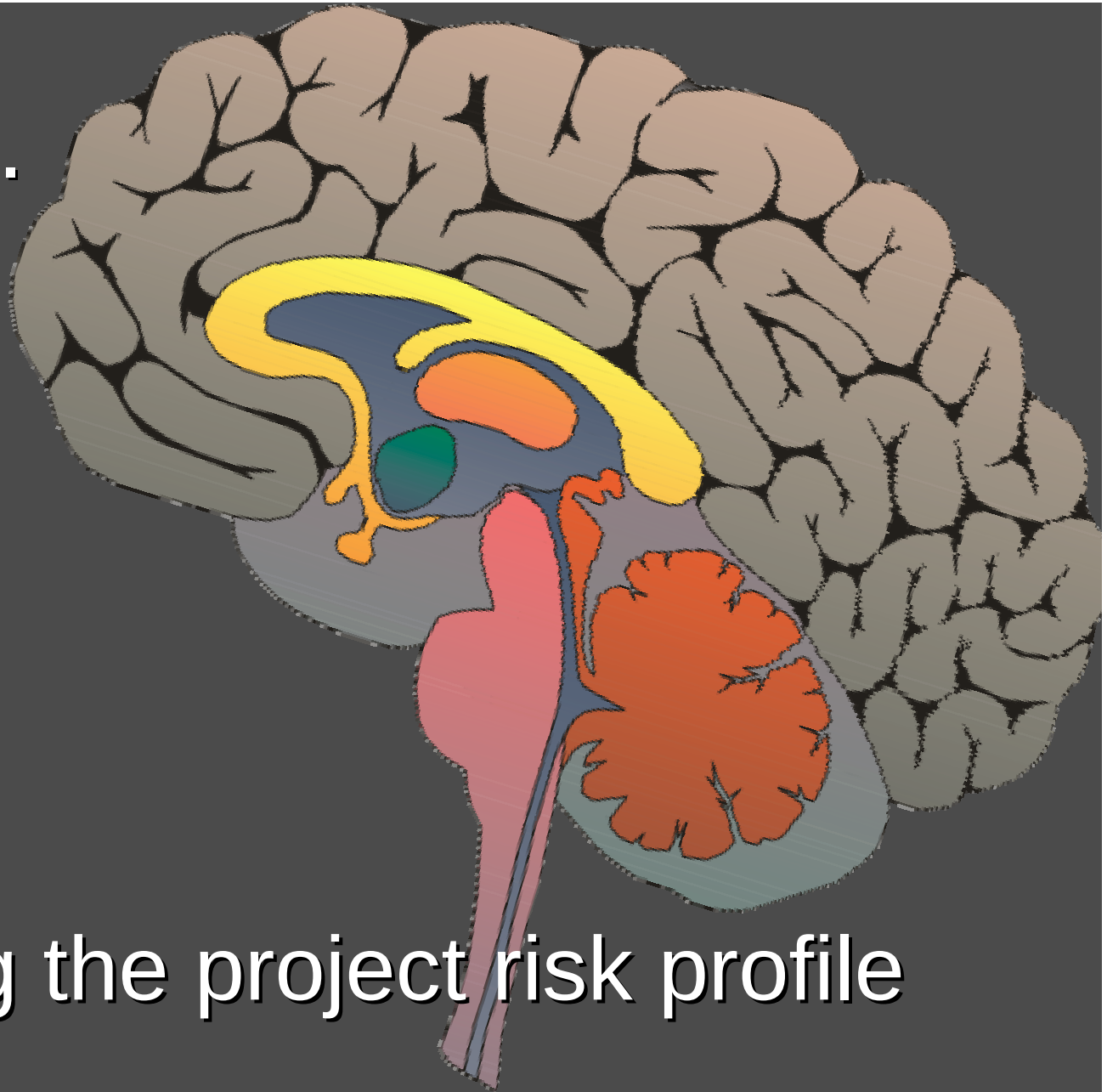
The toughest part.....



The geothermal risk reward equation

- **Capital intensive – 50 MWe**
 - USD 200 to 300 M
- **Lead time till revenue starts**
- **Mid to long period to recoup investment**
- **Quality of the outcome depends on the broader management capability of the project team**
 - From conception through delivery

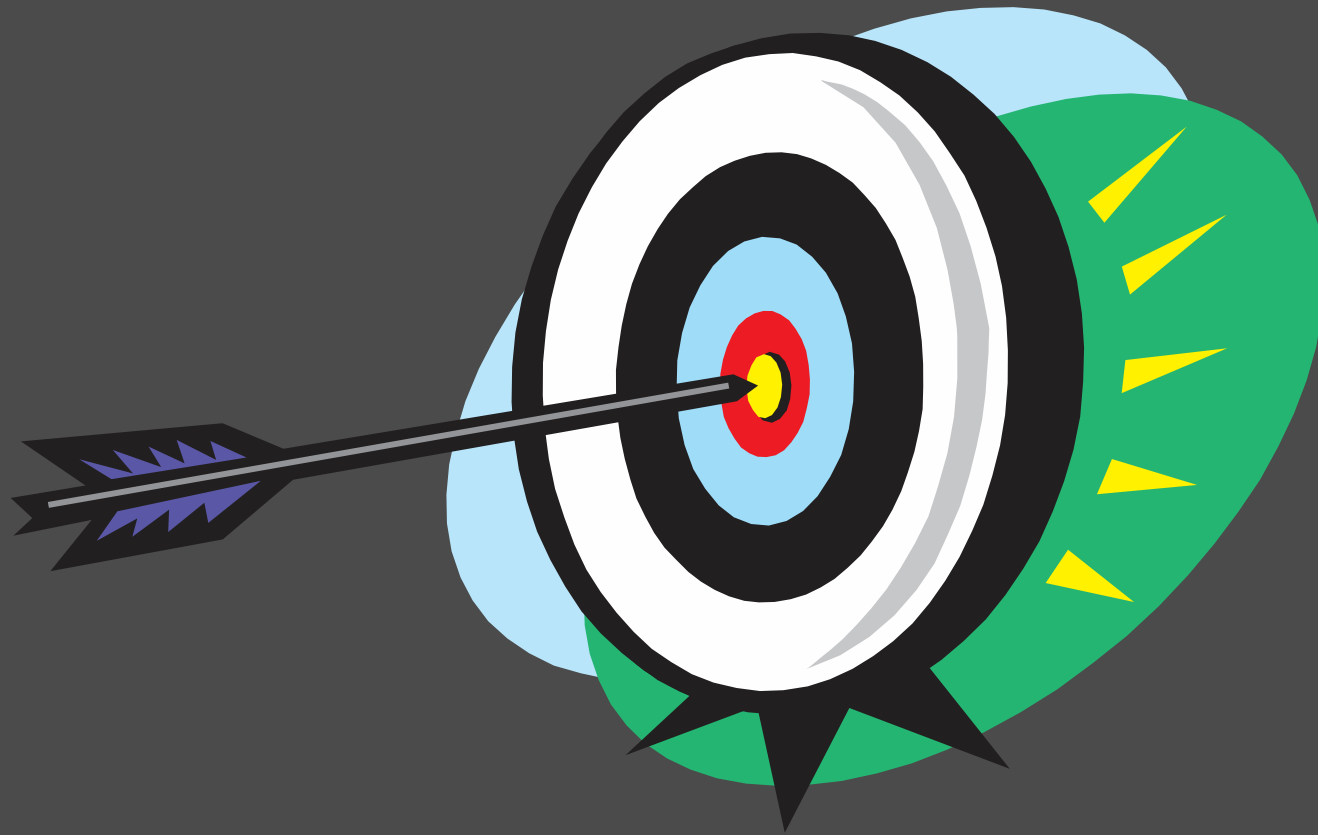
Thoughts



Managing the project risk profile

Geothermal Resource Development

- A Complex Multidisciplinary Undertaking
- Focused on the end game



Geothermal Resource Development

- **Savvy in the country in project delivery**
- **Expertise in the planning and legal system**
- **Quality geothermal expertise**
- **Quality engineering and construction expertise**
 - A lower size limit that an exploration prospect will need to support to support the exploration and proving investment
- **Holistic view of the community**
 - The project has to operate in it for 20 to 30 years
- **Meet the financiers criteria**

What risks

- **Less control over :**
 - Resource risk – experienced resource management
 - Country
 - Political / legal / regulatory
- **Some you can influence:**
 - Construction Risks – an EPC approach
 - Financial risks – appropriate financial structuring
 - Market risks – security of off take agreement
 - Operational risks – experienced management
- **Management**
 - choose the very best in the business

Management of Geothermal Resource Risk

- **Capture Quality Data**
 - Surveys specified and overseen by experienced advisors who interpret the data
 - Quality spatial and time referencing
- **Use Experienced Interpreters**
- **Look after your data**
 - Important to keep field survey notes
 - Field samples stored
 - Sometimes not able to return and collect again

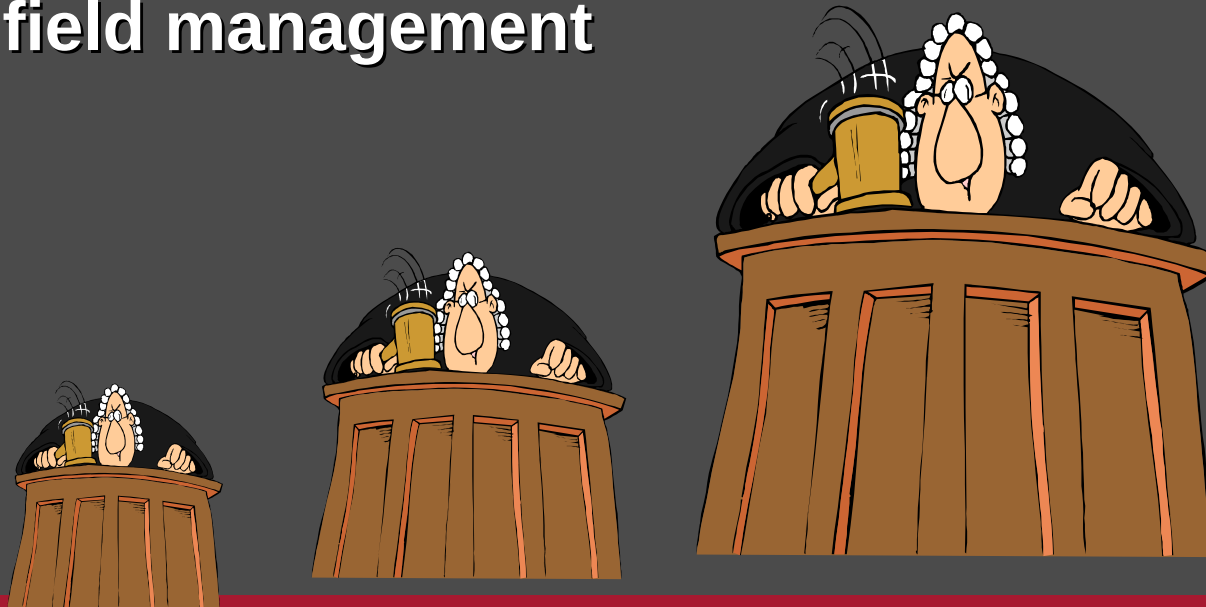
Management of Geothermal Resource Risk

- **Use Data Quality and Interpretation Review**
 - Avoids wasted time and resources
 - A number of jobs GNS has undertaken where the data is simply not good enough
- **Depth dimension is critical**
 - find different system architecture as drilling progresses to deeper levels
- **Blinded by what we observe and think we know**
- **Not the place for a new kid on the block**



A stable platform for investment

- Legal frame work that long term asset based companies are happy to work in
- Surety of resource access
- Once granted need surety of permits
- Operators need the ability to move with time to adapt field management



A stable platform for investment

- Operable Industrial focused planning framework
- Once access open to an area people will come
- Significant constraint on the future

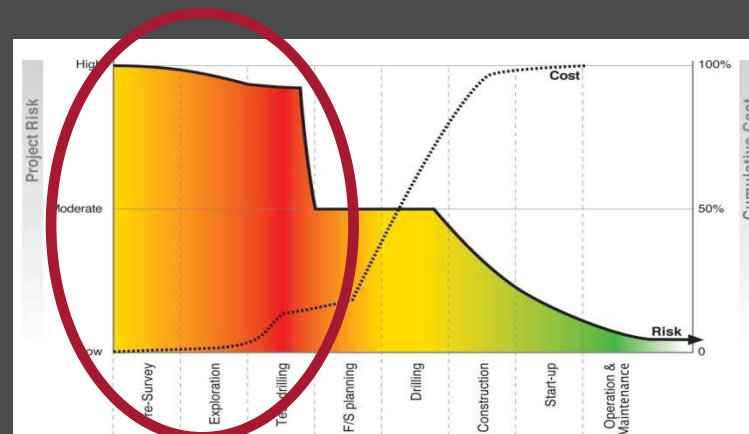


A stable platform for investment

- **Habitation**
 - Communities are sensitive
 - Significant increase in rigor of effects management
 - H+S moves from industrial to residential
- **Geothermal Surface Expressions**
 - Sensitive – particularly the liquid feed ones
 - Don't expect large scale energy use and surface feature coherence to be compatible
- **Community acceptance**
 - Important for long term sustainability

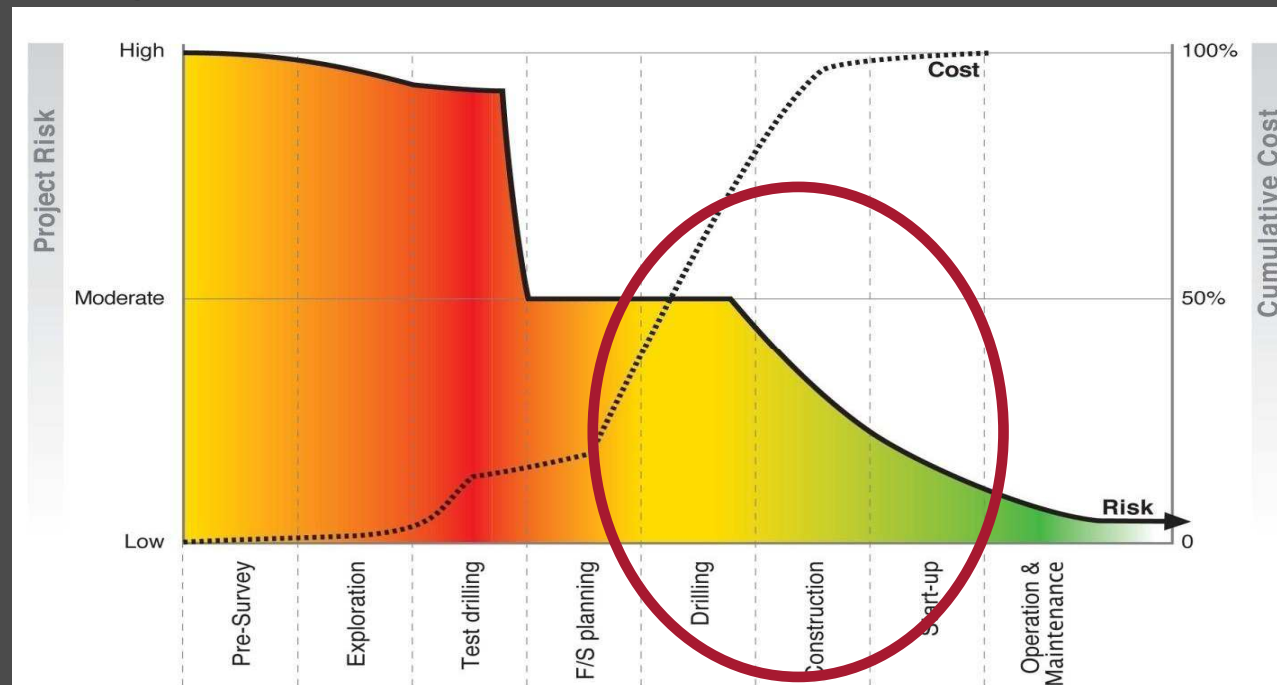
What is needed to move forward ?

- **Equity for the early phases**
 - Need a strong balance sheet (corporate or institutional)
 - Need investors who will take appropriate risks
 - Need project returns that meet these investors needs
 - Risks are resource, economic, financial and political



What is needed to move forward ?

- **Debt for later stages once risk is reduced**
 - Resource capacity and performance defined
 - PPA in place
 - Design and construction committed

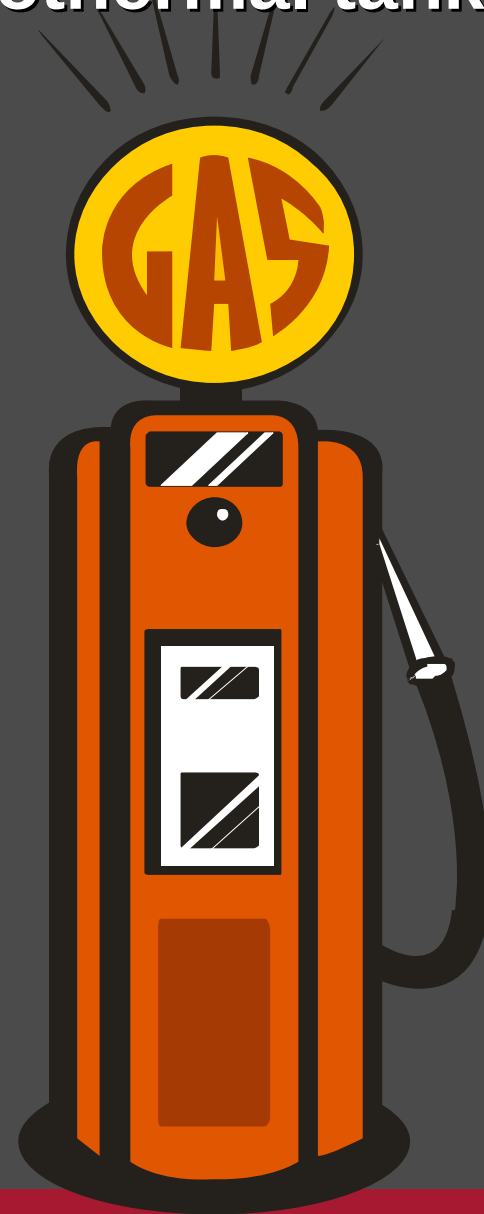


Key Challenges

- **To finance the exploration / drilling phase in developing a geothermal resource**
- **Attracting investment**
 - the risk reward profile must be appropriate

Lots more energy in your geothermal tank

Get Into it



GNS Science passionate to assist



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A group of people are sitting on a ledge, silhouetted against a bright sunset. The sun is low on the horizon, creating a warm, golden glow. In the foreground, there are dark silhouettes of leaves and branches. The text "Kia Ora" is on the left and "Thank You" is on the right.

Kia Ora

Thank You

