Geothermal Resource Insurance

IRENA – Nairobi
January 2018
Geothermal Life

**Geological, geophysical & geochemical field work & analyses**

- Preliminary conceptual model

**Focused exploration**
- Temperature gradient holes
- Slim holes
- Targeting full-diameter wells

**Drilling and testing**
- (discovery and confirmation wells)
- Capacity estimate
- Resource model
- Feasibility Study

**Production & injection well drilling**
- Well testing
- Confirmation of power cycle and plant size

**Injection optimization**
- Well field O&M
- Power plant O&M
- Make-up well drilling

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**Year 1**
- Exploration
  - Geological, geophysical & geochemical field work & analyses
  - Preliminary conceptual model

**Year 2**
- Pre-Feasibility
  - Focused exploration
    - Temperature gradient holes
    - Slim holes
    - Targeting full-diameter wells

**Year 3**
- Feasibility
  - Drilling and testing
    - (discovery and confirmation wells)
    - Capacity estimate
    - Resource model
    - Feasibility Study

**Year 4-5**
- Development Drilling
  - Production & injection well drilling
  - Well testing
  - Confirmation of power cycle and plant size

**Year 5+**
- Plant Construction
- Routine Operation
- Injection optimization
- Well field O&M
- Power plant O&M
- Make-up well drilling

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**EXPLORATION**

**DRILLING**

**OPERATION**
Geothermal Risks

- Resource uncertainties
  - Size and temperature
  - Where to drill, and why
  - Drilling success rate
  - Average well productivity

- Regulations
- Infrastructure / access
- Environmental and social issues
- Power price
- Creditworthiness of off-taker
- Cost of capital (equity / debt)

Time
Geothermal Risk Mitigation Schemes

- KFW
- GDF Latin America
- DFID
- EAGER
- IDB
  - Mexico GFRMP
  - Chile MiRIG
  - Caribbean
- NDF
- IRENA ADFD
  - Supporting Energy Transition
- European Bank for Reconstruction and Development
  - PLUTO
- WORLD BANK GROUP
- iceida
- Parhelion Underwriting Ltd.
Project Risk and Costs during Geothermal Development

**Project Risk and Cost during Geothermal Development**

![Graph showing project risk and cost over different stages of development.]

- **Pre-Survey**
- **Exploratory**
- **F/S Planning**
- **Development Drilling**
- **Construction**
- **Start-up**
- **Operations**

**Equity / Concessional**

**Well Output Insurance**

**Project Finance**

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Geothermal Risk and Reward

- Risk profile is unattractive to equity investors (i.e. potential for large capital impairment, albeit low probability)
- Low probability / high severity risk more appropriate to insurance market
- Parhelion insurance structure puts a ‘floor’ on the downside for investors and so makes it easier for developers to raise equity
Risk Profiles

- Uninsured Risk Profile
- Insurer Risk Profile
- Insured Risk Profile

Profit vs. Loss Diagram:
- Project Success
- Uninsured Risk Profile
- Insurer Risk Profile
- Insured Risk Profile
GeoFuture Fund 1

- Complements existing Technical Assistance facilities
- Includes support for infrastructure development
- Leverages experience in other risk mitigation instrument
  - Builds on KfW’s GRMF and GDF LAC
  - IDB Mexico contingent recovery scheme
- Allows continued support for drilling after GRMF
- Covers exploratory and confirmation drilling
- Simplifies and streamlines application process
- Has a milestone-based disbursement scheme
GeoFuture Fund 2

- Provides support throughout the project life cycle
- Addresses risks that are acknowledged by stakeholders
- Provides support to all types of developers
  - Public sector, private sector, PPPs
- Focuses initially on Ethiopia and Kenya, but will expand
- Uses different support mechanisms in 3 funding pillars
  - Direct Finance
  - Risk Mitigation Finance
  - Innovation implementation
<table>
<thead>
<tr>
<th>Activity Addressed</th>
<th>Pillar 1 - Direct Finance</th>
<th>Pillar 2 - Risk Mitigation</th>
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<tr>
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<td>Coverage</td>
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<tr>
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**Intervention Type Key**
- NRG  Non-Recoverable Grant
- CL   Convertible Loan
- N/A  Not Applicable

**Sector Key**
- Any  Any sector (public, private or PPP) eligible
- Pri  Private Sector Eligible
- PPP  Public Private Partnership Eligible
Next Steps

• Much useful risk mitigation work done but gaps remain
  • for issues that commonly arise during various development stage
  • for issues that are specific to conditions in East Africa

• Next Steps:
  • Accredited Entity
  • Government ‘No Objection’