Experiences with geothermal energy development around the world

Formation of Geothermal Energy Policy and Laws in Uganda:
Stakeholder Engagement Programme

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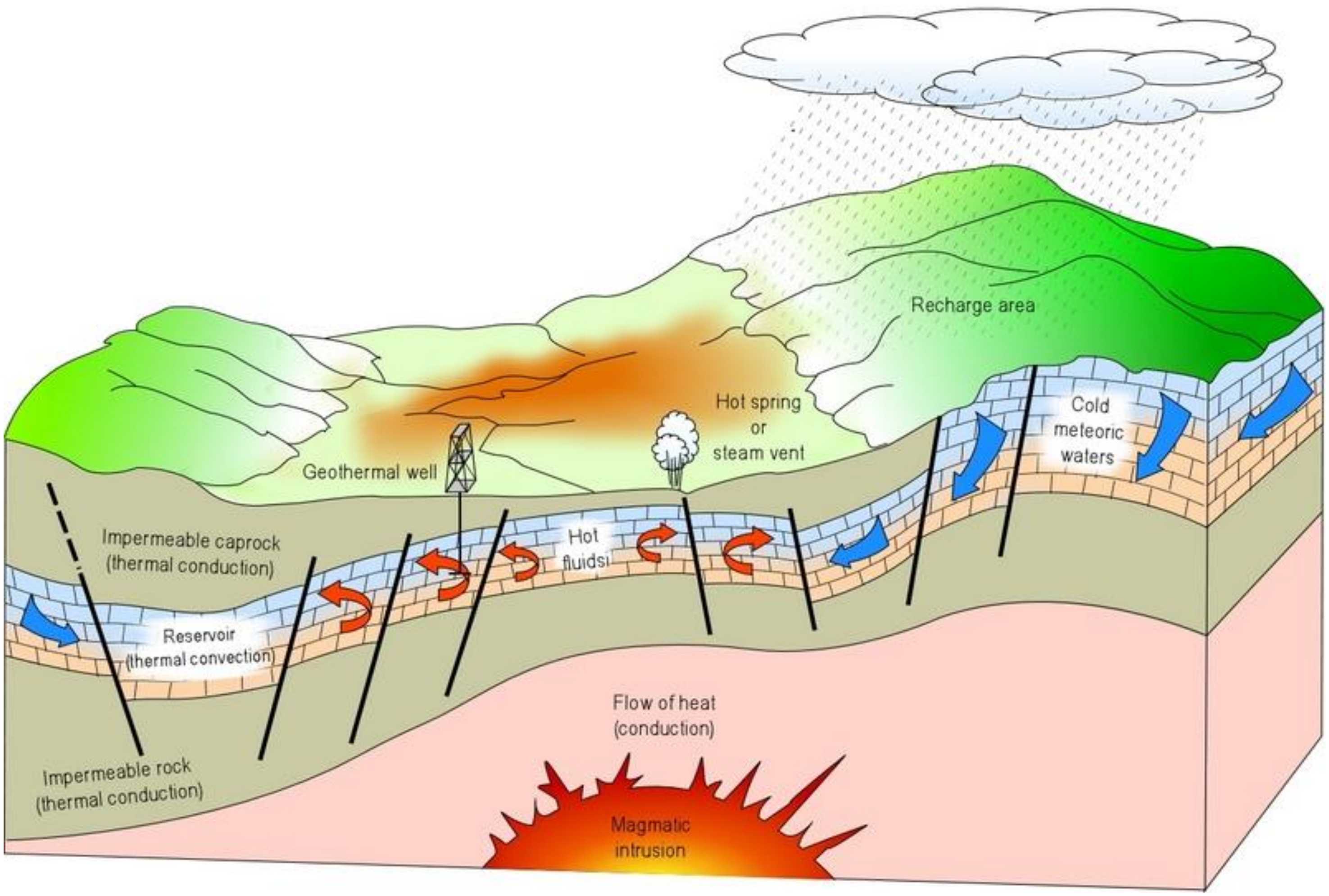
Overview

1. What is geothermal energy?
2. Where is it being used today?
3. How is geothermal energy developed?
4. How much does it cost?
5. How are projects structured and financed?
6. What is its role in Uganda?

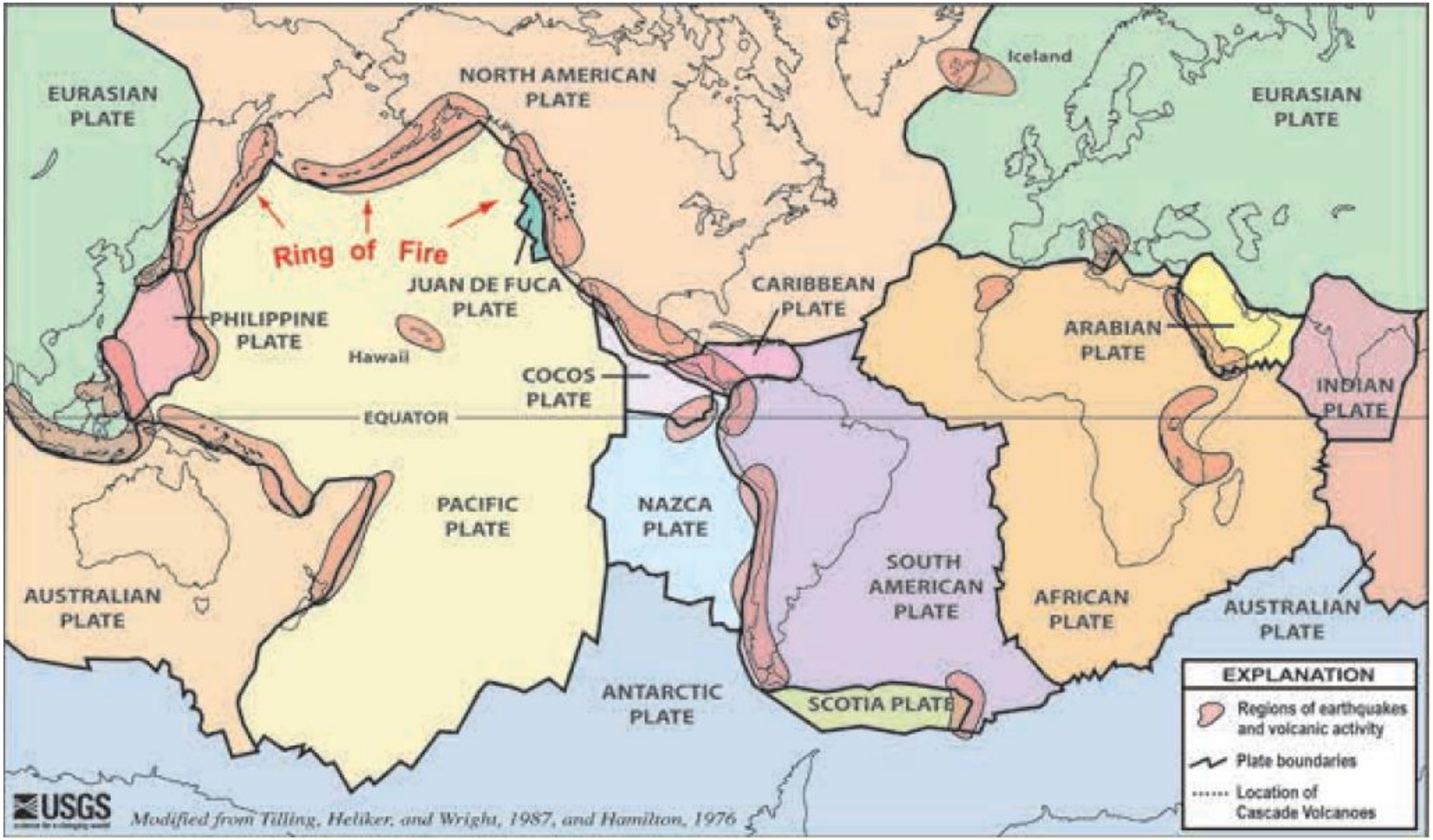
Geothermal energy

- Geothermal energy is heat from the Earth
  - Global energy potential is huge
- Hydrothermal system:
  - Natural reservoir of water deep in rocks
  - Rain water to recharge the reservoir
  - Shallow heat source form core of the Earth to heat the water in the reservoir (< 3km deep)
  - Caprock to retain hot steam in the reservoir
- Other systems exist, but of limited interest to Uganda (e.g. Enhanced Geothermal Systems)

Geothermal system



Geothermal locations



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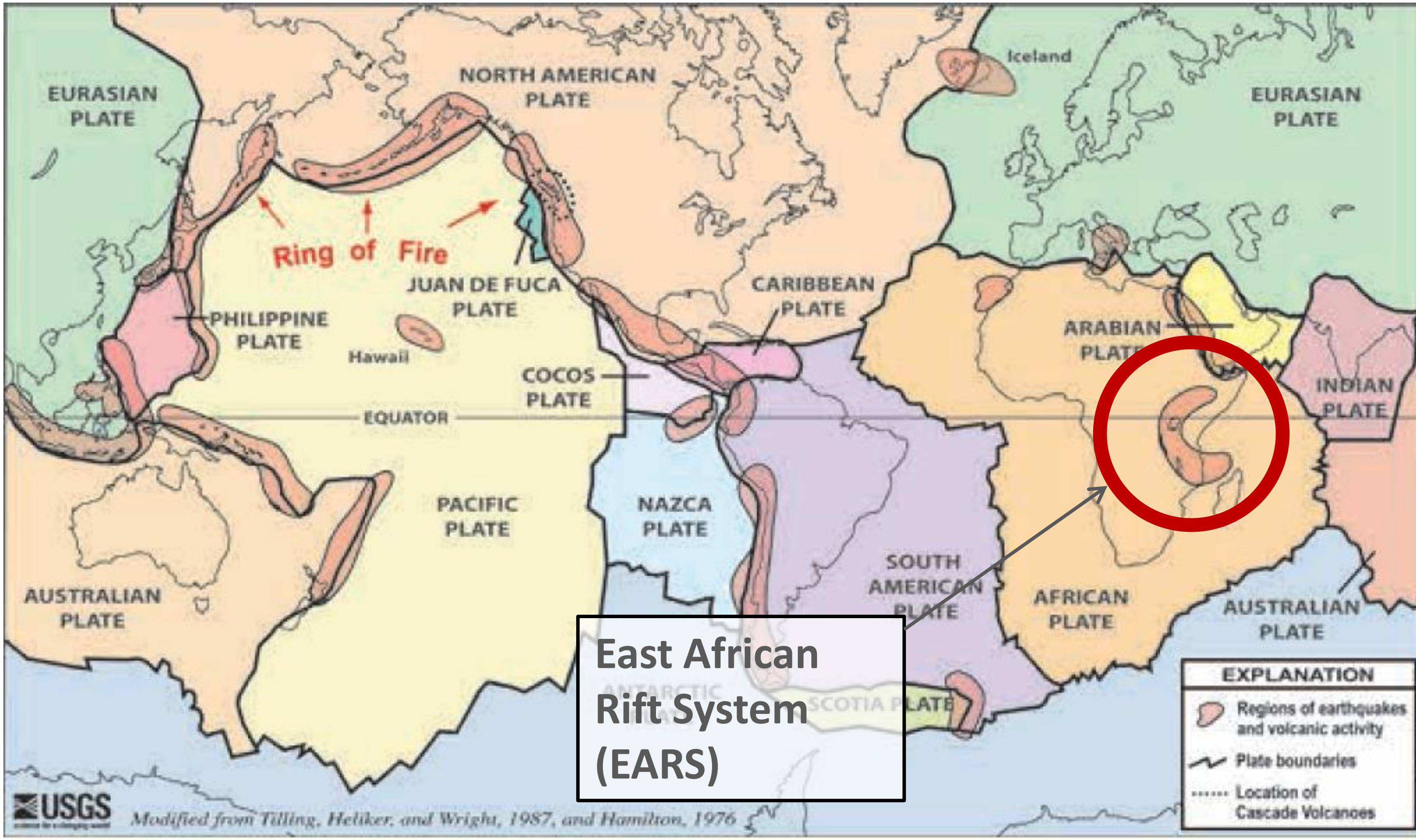
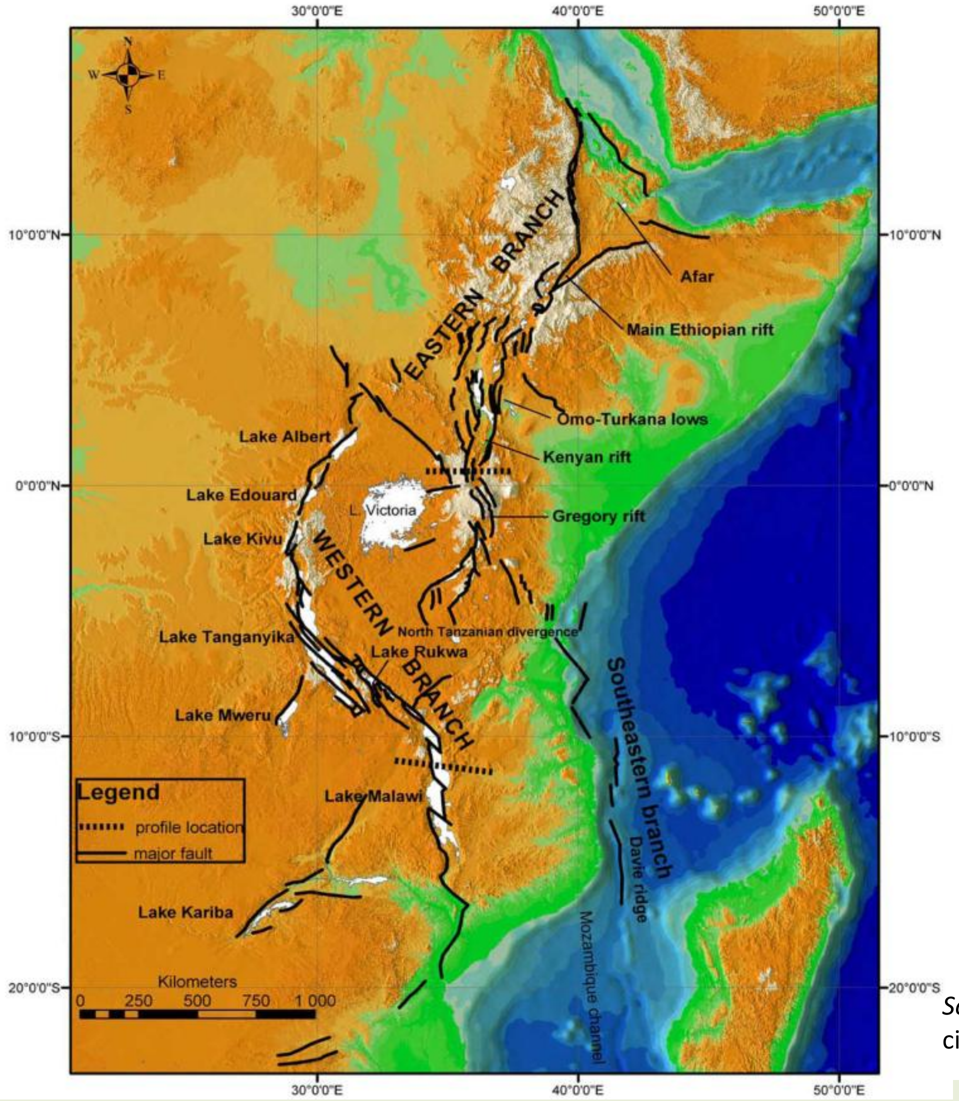


East African Rift System (EARS)

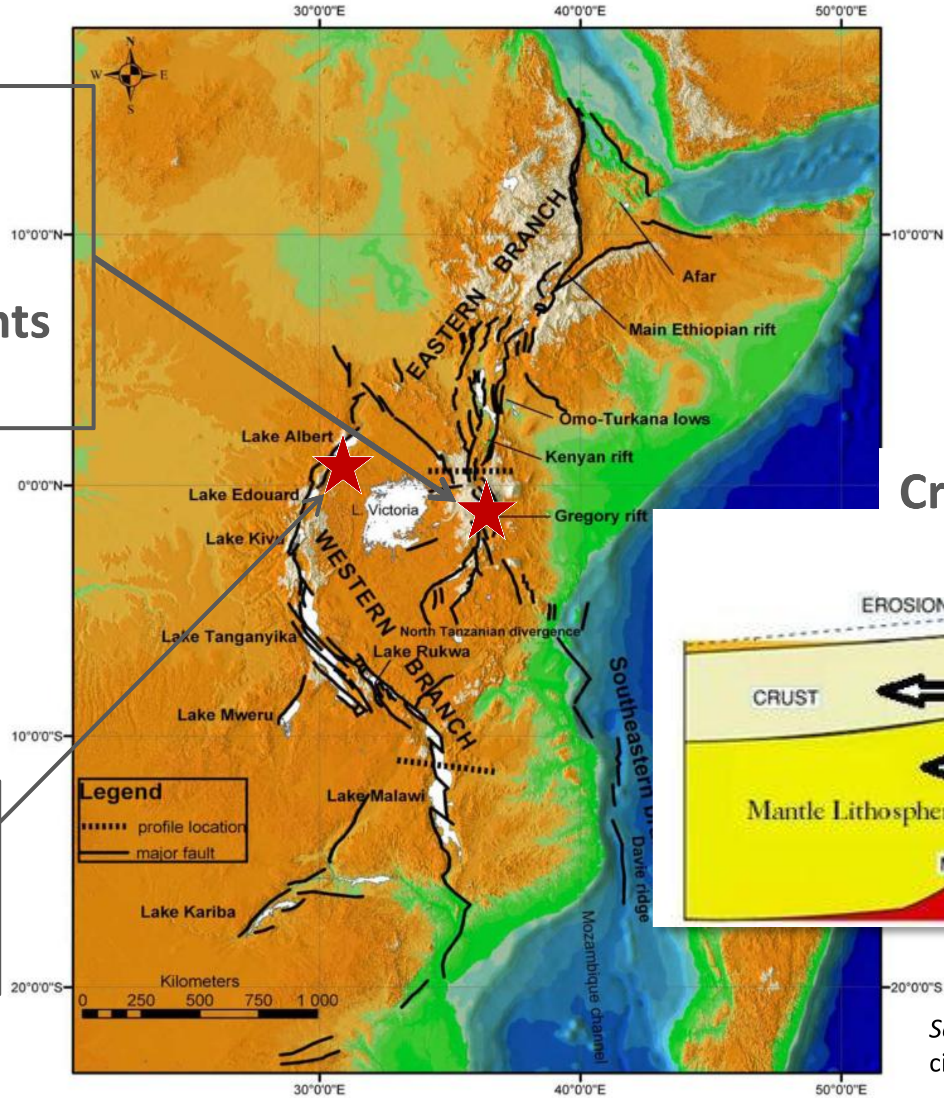


Source: After Chorowitcz, 2005, cited in Harðarson, 2014

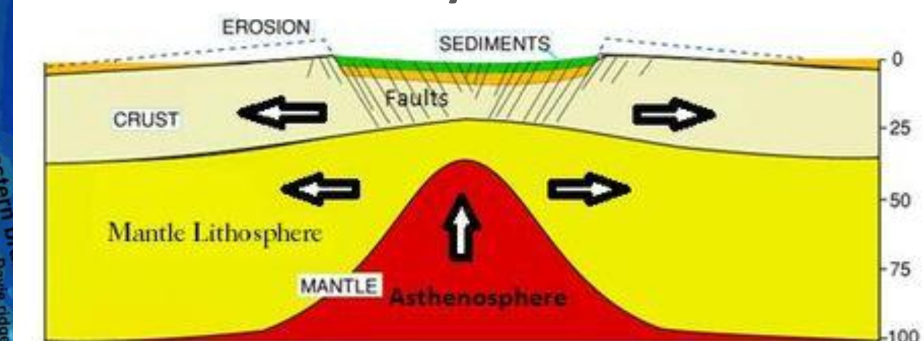
East African Rift System (EARS)

Main EARS geothermal energy developments are here

Uganda's resources are here



Cross section of a Rift System



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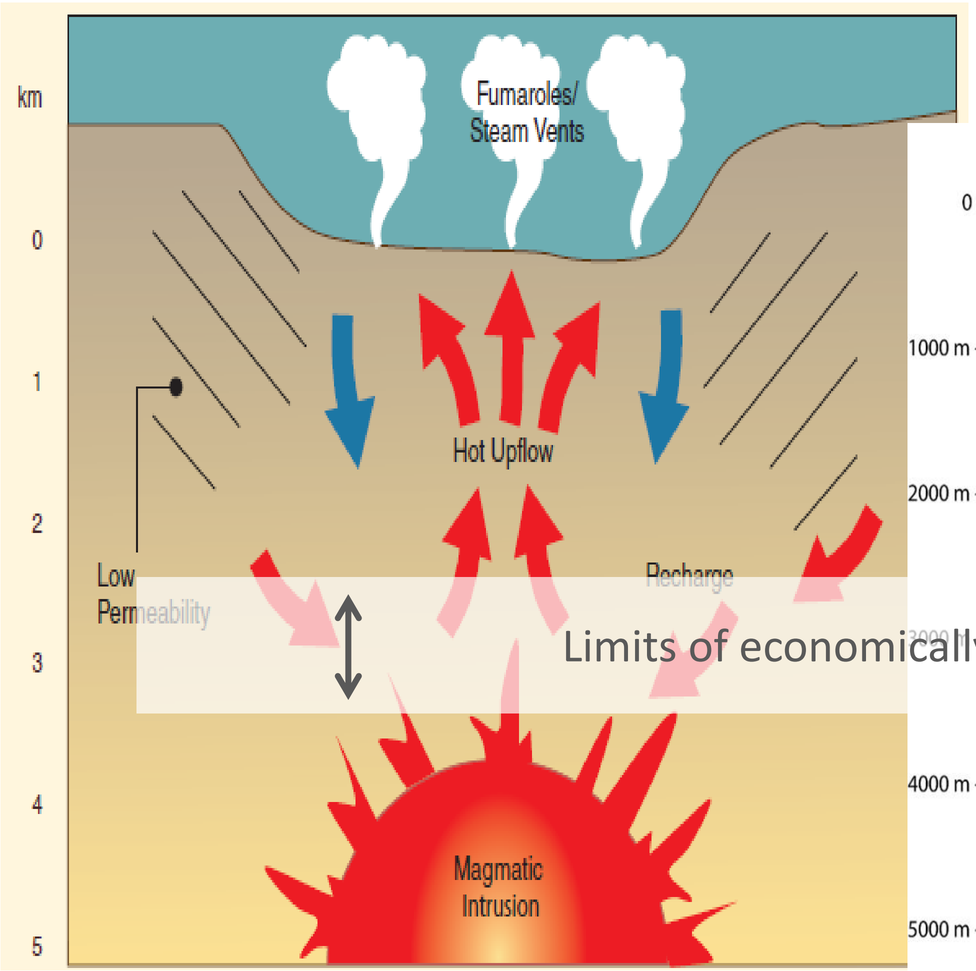
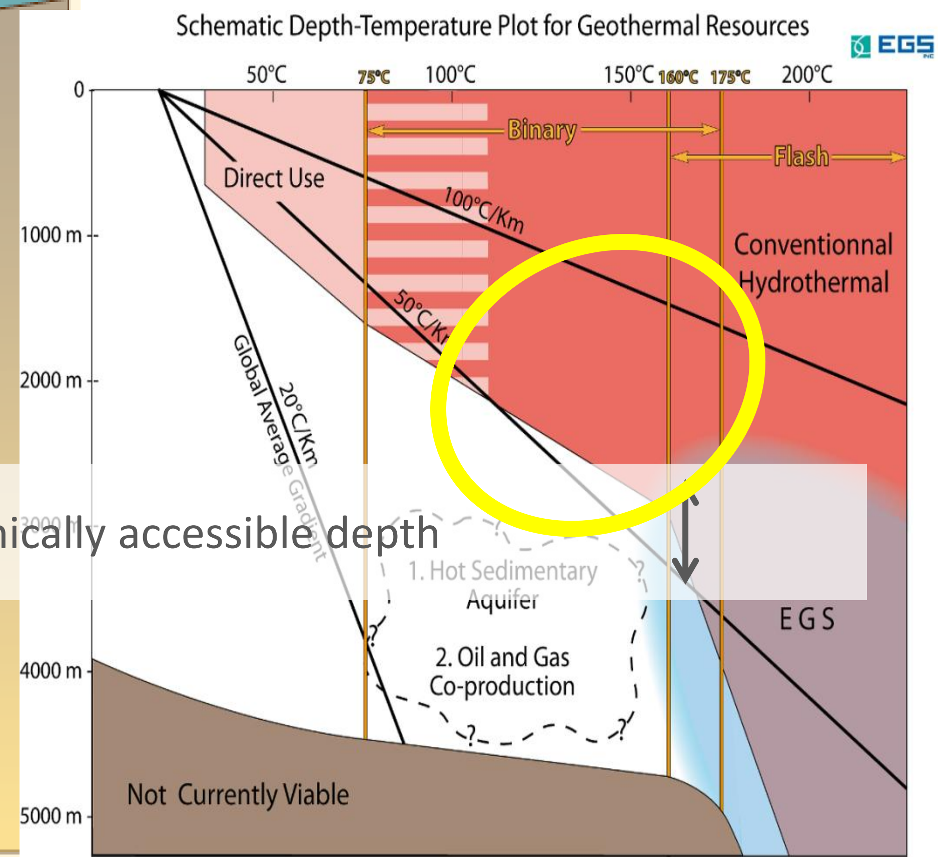
Geothermal gradient





Limits of economically accessible depth

Geothermal energy use

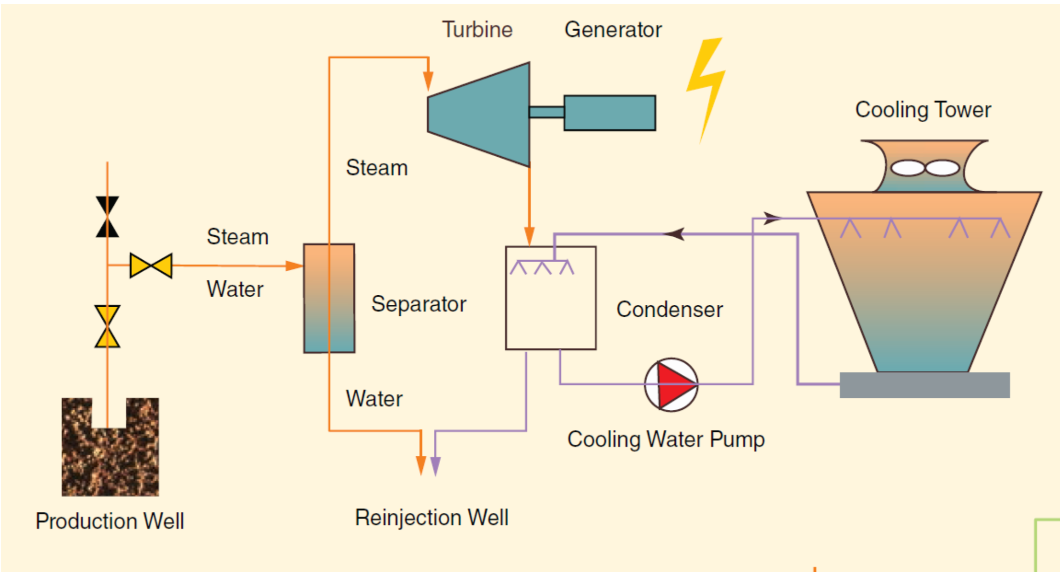
POWER GENERATION
- Resources >150°C

DIRECT USE
-Resources <150°C
- Includes waste water discharged from power plants

Character of geothermal energy

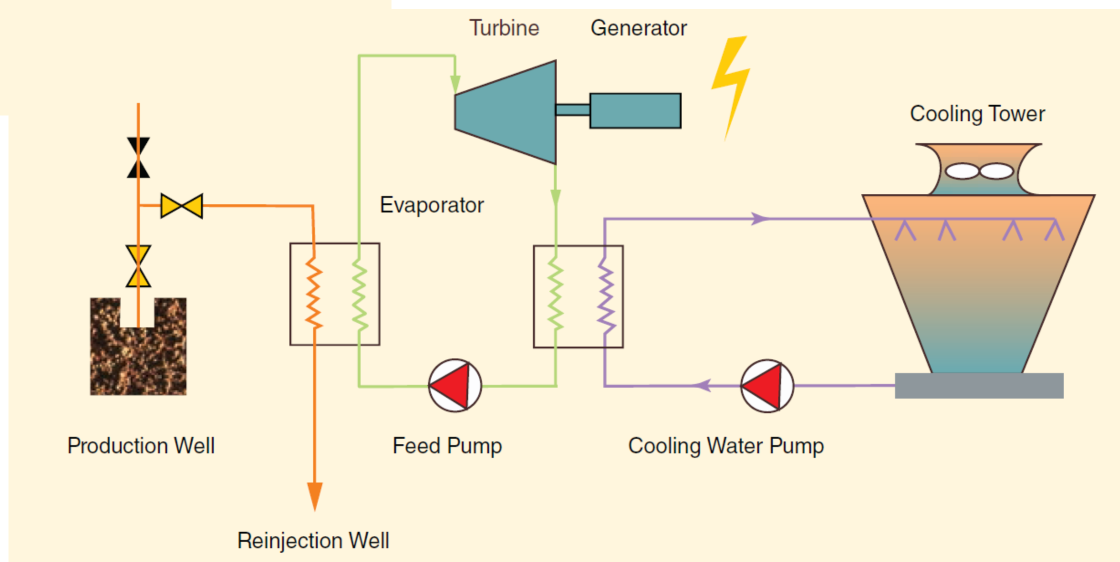
- Geothermal can be a source of clean, reliable, secure energy for electricity supply
- Complex source of energy to develop, however, with several barriers
  - Resource uncertainty = risks and costs
  - Difficult to finance as a result
- In Uganda it must compete with other sources of power (e.g. hydropower)

Geothermal power plants



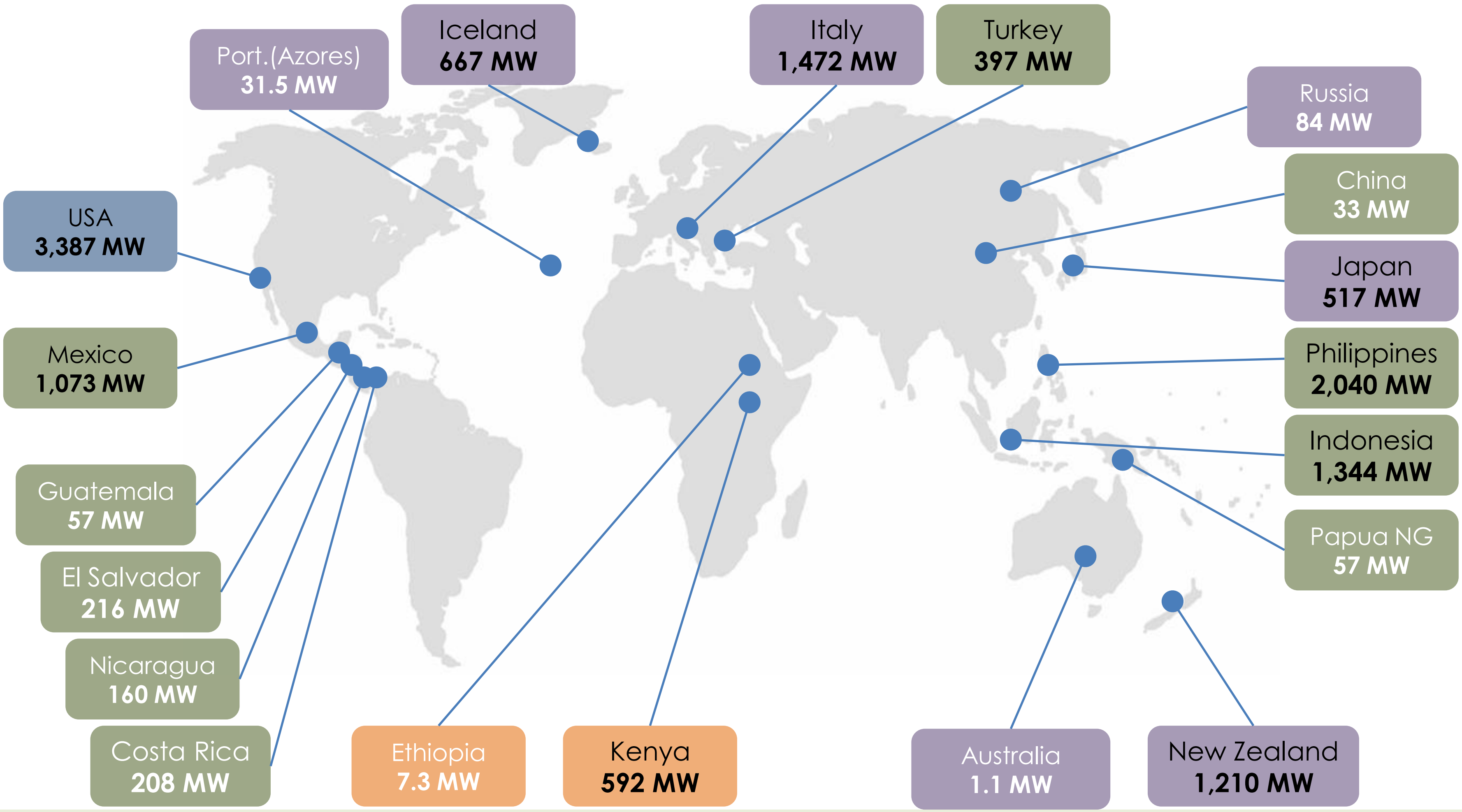
STEAM (single/double/triple etc)
- Most common type globally
- Requires temperatures >200+°C

BINARY PLANT
- Less common, but growing
- Temperatures 120-200°C
- More complex and costly than Flash plant



Geothermal power around the world

INSTALLED CAPACITY – 12,500 MW_e



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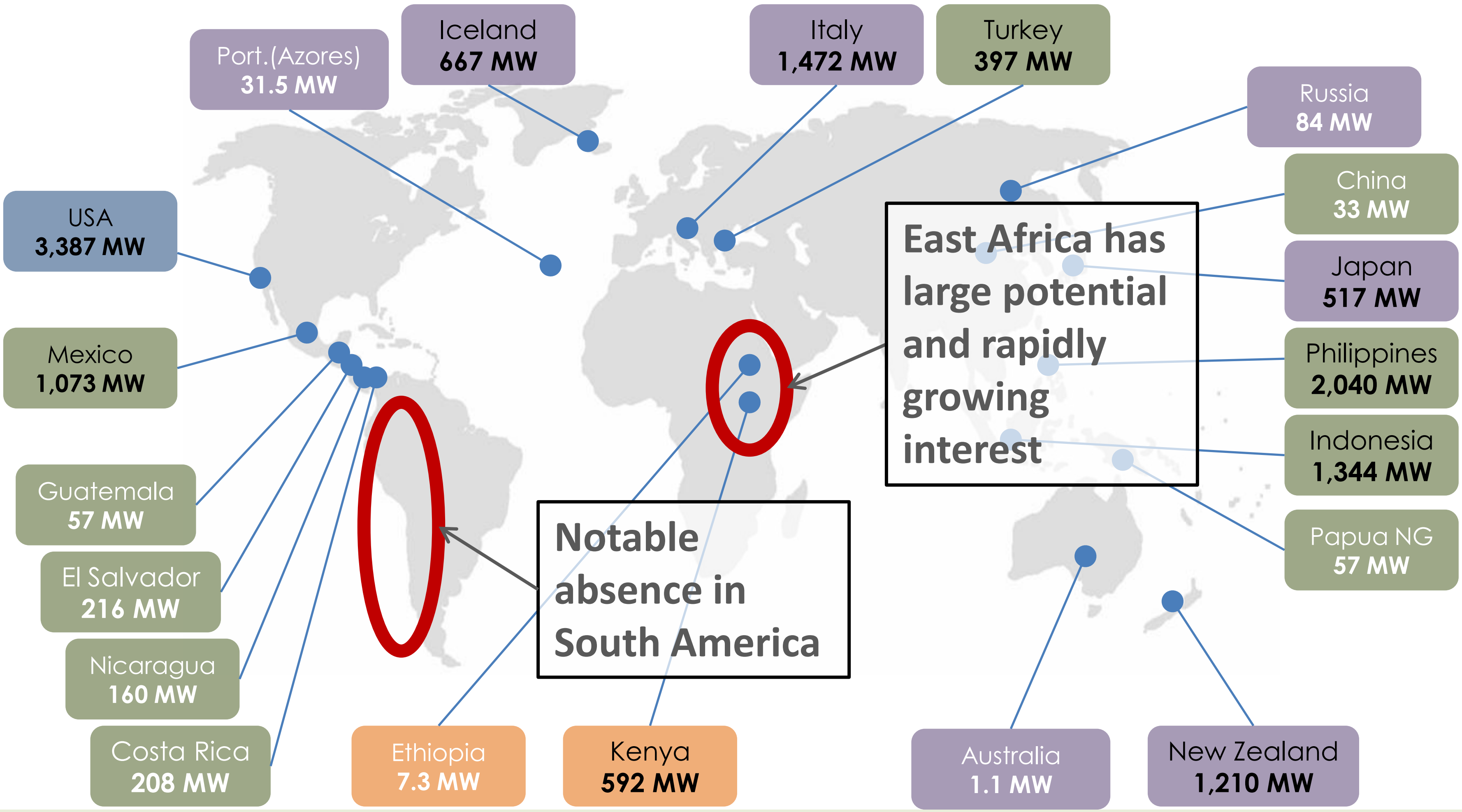
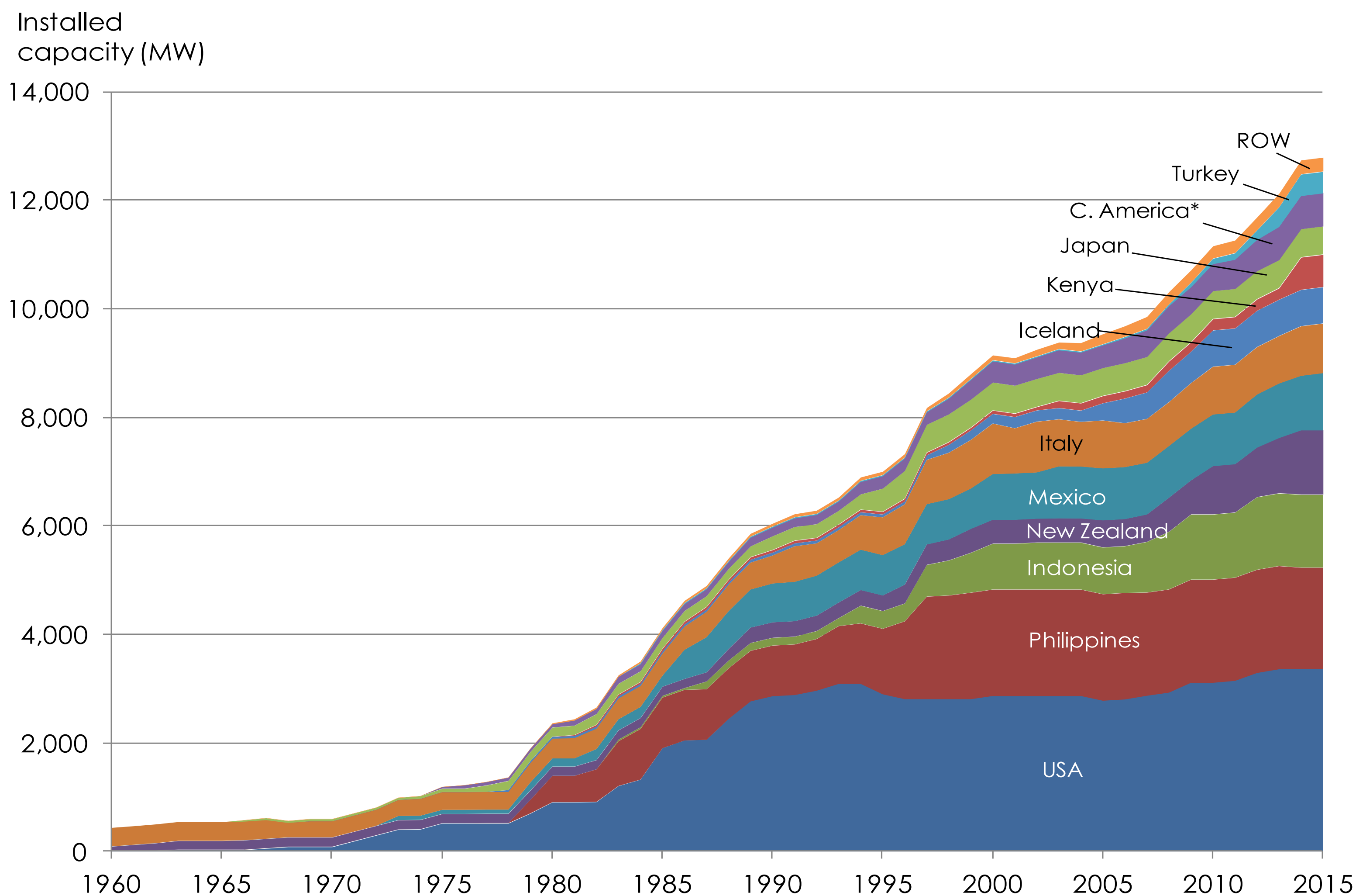


PRO-UTILITY Promoting Utility Excellence NORTON ROSE FULBRIGHT CARBON COUNTS

Geothermal power over time (MW)



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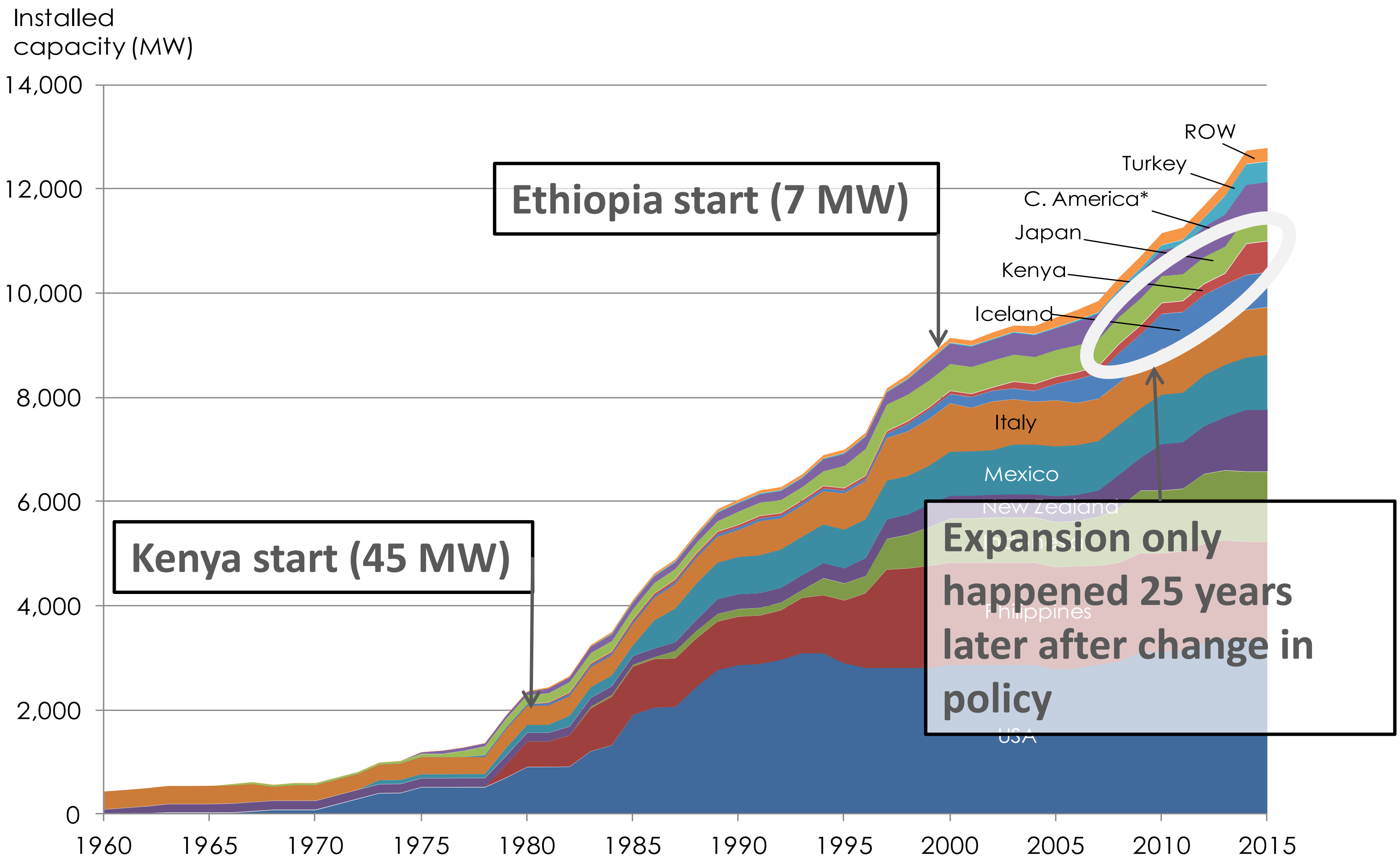
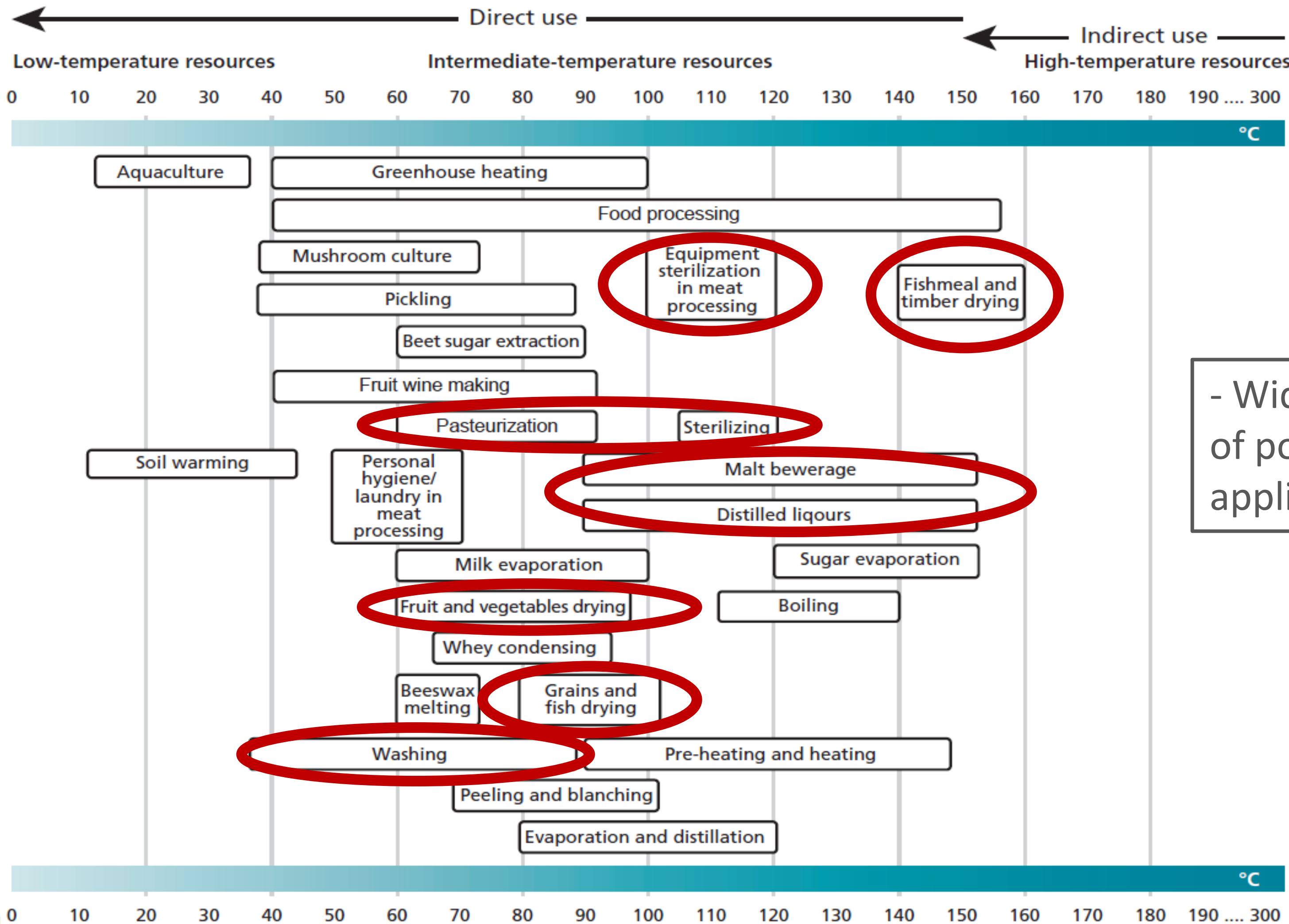


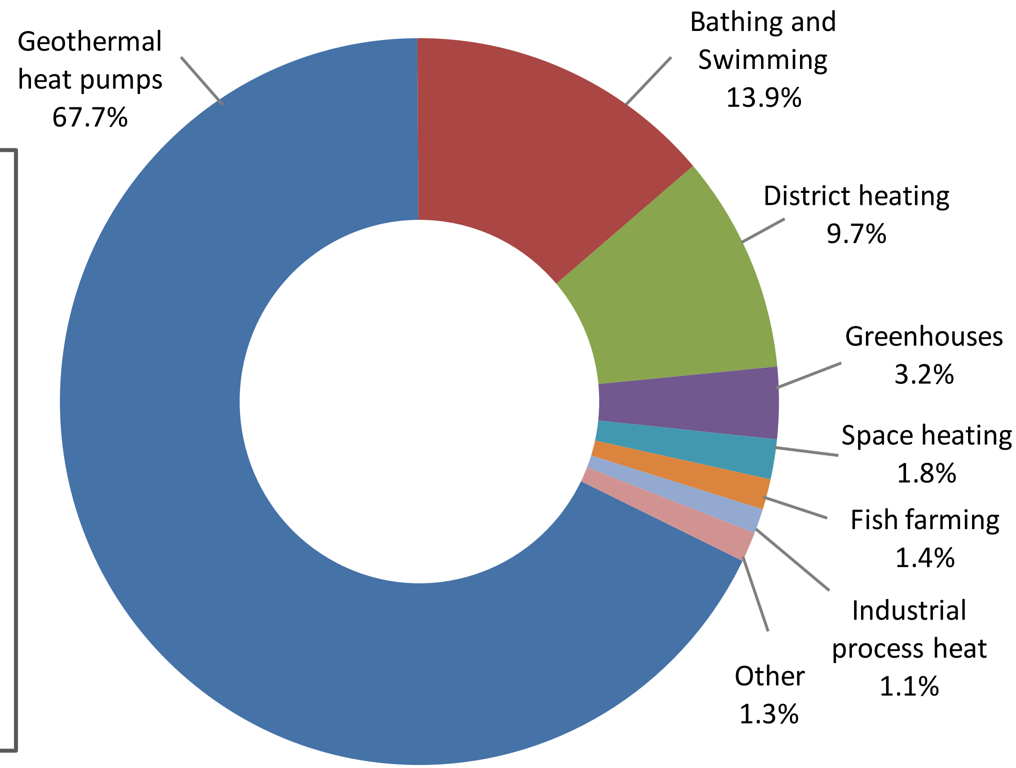
Direct uses of geothermal heat



- Wide range of potential applications

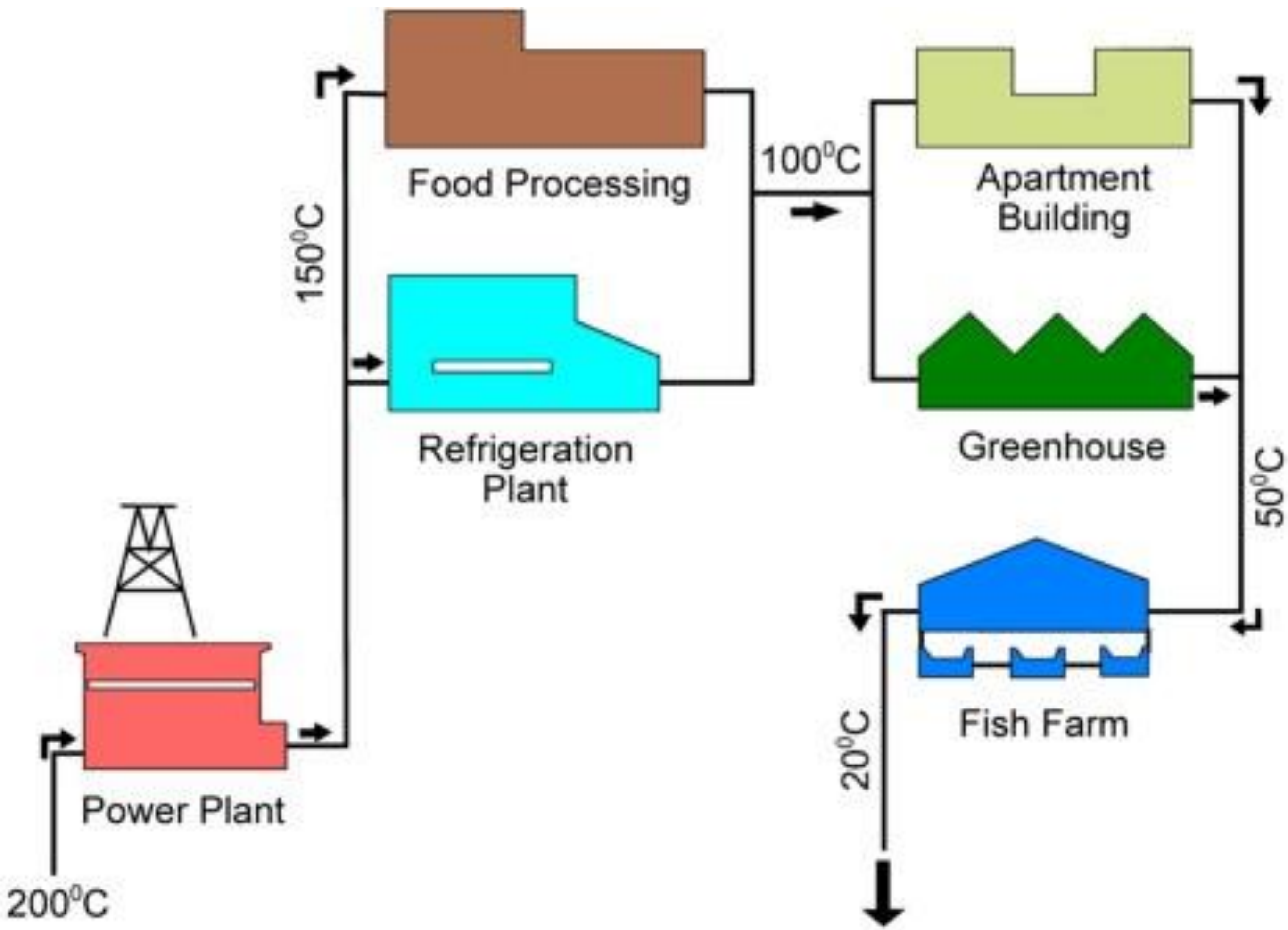
Global direct use

INSTALLED CAPACITY – 48,000 MW_{th}



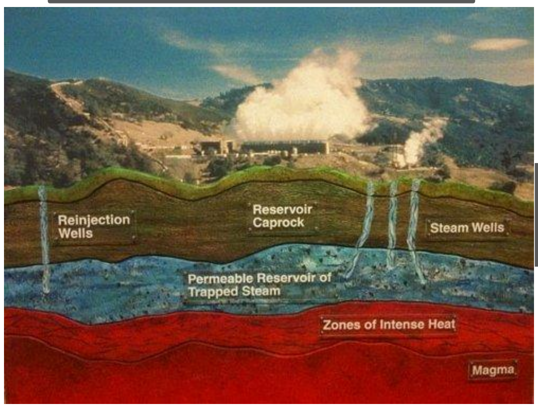
- Usage not widespread other than heat pumps
- Industrial use approx 3,000 MW_{th}
- New uses emerging through “cascade” systems
- Pilot being developed in Kenya at the moment involving dairy, laundry, greenhouse and vegetable farm

Cascade geothermal system



Geothermal resource development

1. STEAMFIELD



1. **Preliminary survey**
   Reconnaissance etc.
2. **Exploration**
   Surface studies; geophysics/geochemistry
3. **Test drilling**
   Full or slim holes
4. **Review & Planning**
   Permits, access rights, EIA
5. **Field development**

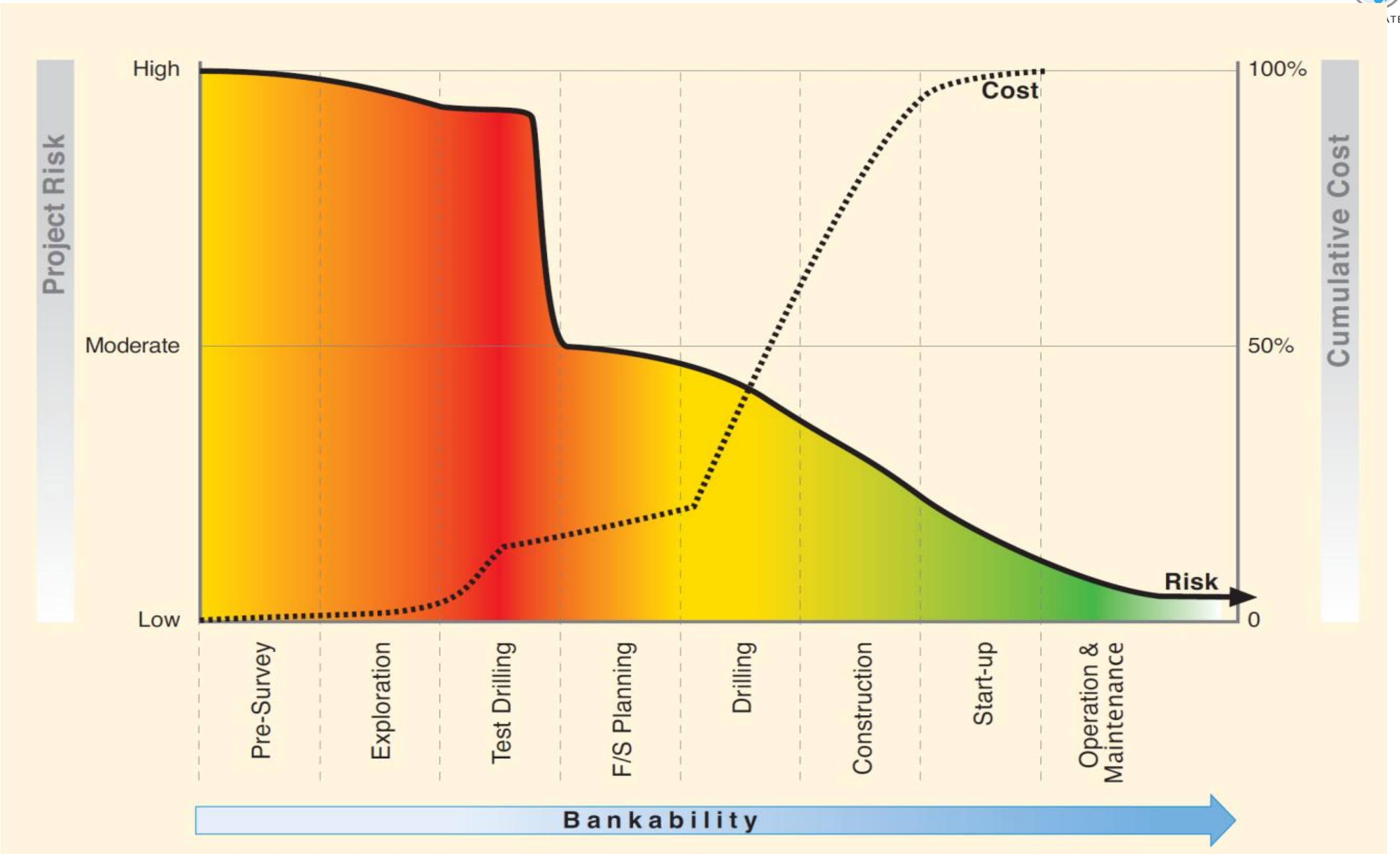
2. POWER PLANT

1. **EPC contracts etc**
2. **Steam gathering system**
3. **Plant siting and construction**
4. **Cooling and water management**

3. POWER EVAC.

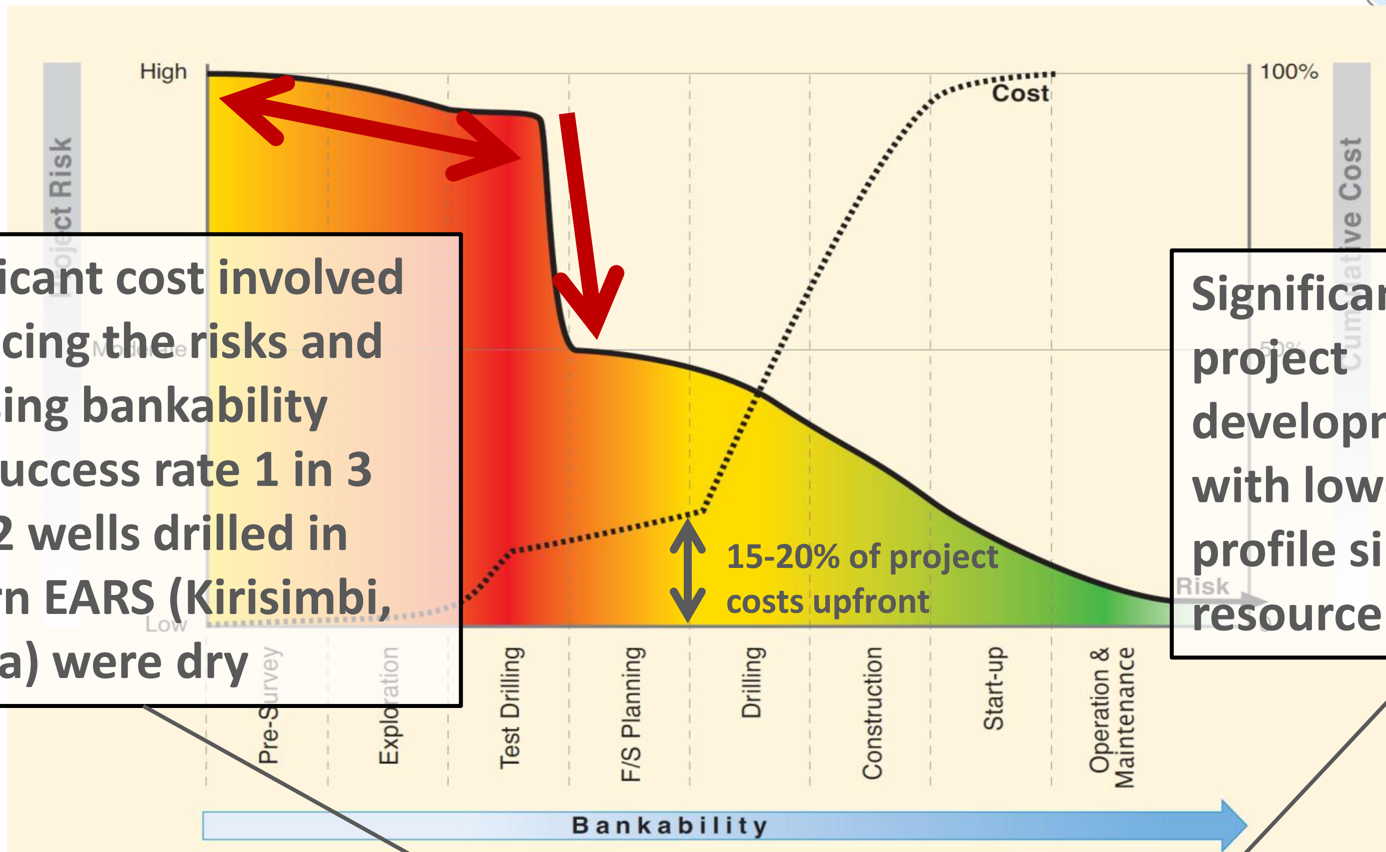
1. **Off-taker agreements (PPA)**
2. **Grid connection**

Geothermal development risks & cost



		Pre-survey	Explor	Test drill	Plan	F/dev	Steamfield	Power plant	O&M	**Total**
Low	**(US$ M)**	0.5	1	11	5	45	10	65	3	**142**
Medium	**50 MW power plant**	1	2.5	18	7	70	16	75	5	**196**
High		5	4	30	10	95	22	95	8	**274**

Geothermal development risks & cost



- Significant cost involved in reducing the risks and increasing bankability
- Drill success rate 1 in 3
- Only 2 wells drilled in Western EARS (Kirisimbi, Rwanda) were dry

Significant cost in project development, but with lower risk profile since steam resource proven

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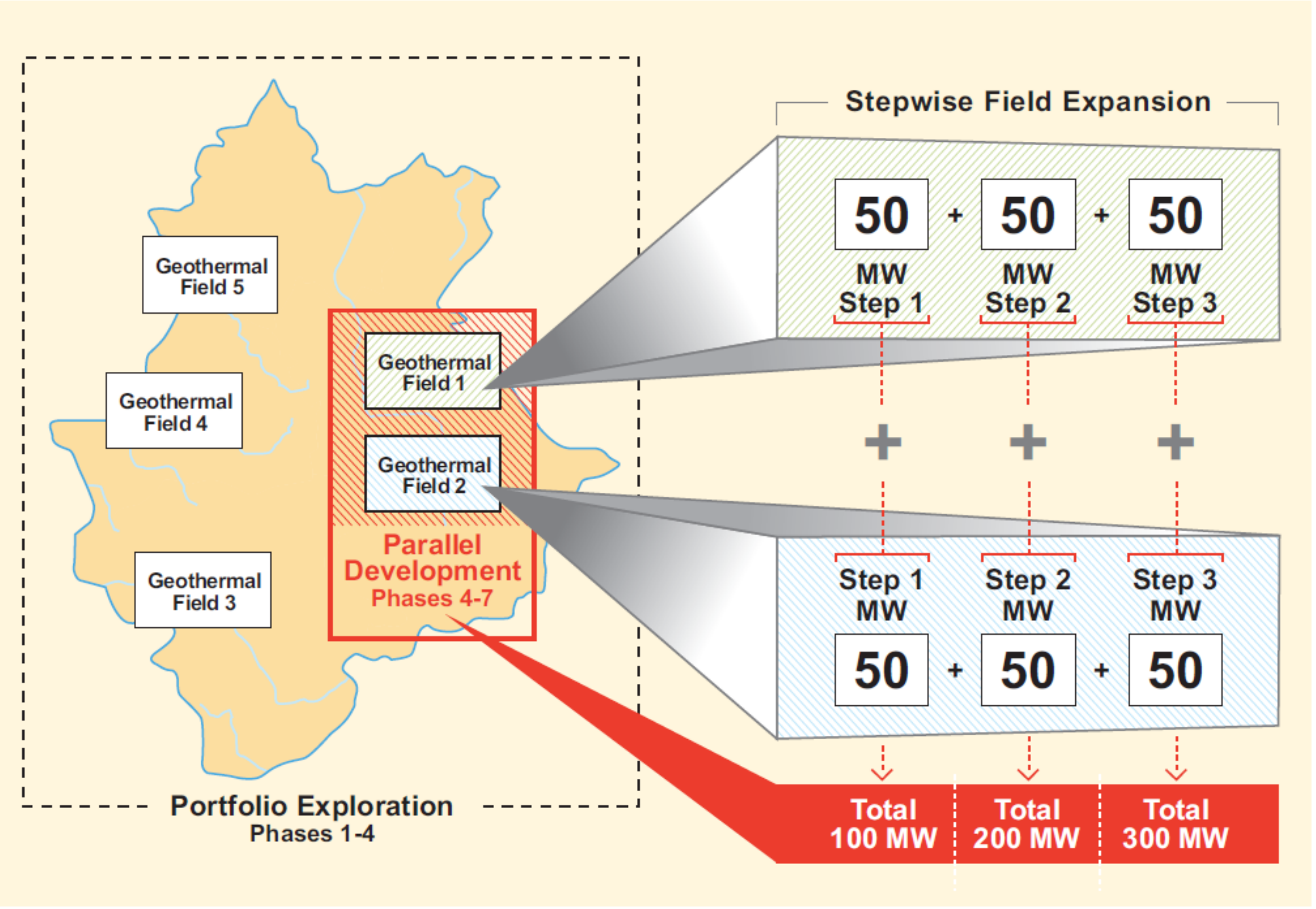
Geothermal field development

INCREMENTAL STEP-OUT DEVELOPMENT

-Necessary for a range of reasons

- Resource uncertainty
- Investment risk etc.
- Most sites grow over time



Cost of geothermal power

Plant type	Capital costs (US$ m/MW)	Operation and Maintenance costs (US$/kWh)	Levelised cost of electricity (LCOE; US$/kWh)	Notes
All	2.8 – 5.5	0.009 – 0.027	0.04 – 0.08	Gehringer and Loksha, 2012
			0.04 – 0.05	(Costa Rica)
			0.04 – 0.055	(Philippines)
			0.045 – 0.07	(Indonesia)
			0.05 – 0.08	(Ethiopia)
			0.043 – 0.08	(Kenya)
			0.08	(Mexico)
Flash	1.0 – 2.0	-	0.06 – 0.09	Augustine *et. al*, 2012 For US sites (2008 prices).
Binary	2.0 – 6.5	0.022	0.04 – 0.15	
Greenfield binary	-	-	0.049 – 0.072	Goldstein *et. al*, 2011 (2005 prices)
Typical flash			0.031 – 0.13	
Typical binary			0.033 – 0.17	
Dual flash	6.24	132 [a]	-	US Energy Information Administration
Binary	4.36	100 [a]		
Flash	2.0 – 4.5	-	0.05 – 0.12	IEA, 2010 (2008 prices)
Binary	2.4 – 5.9		0.07 – 0.20	
All	4.0 – 5.0	-	0.072 – 0.089	ESMAP, 2012
	2.5		0.05 – 0.06	
Average	**3.0 – 5.0**		**0.05 – 0.15**	

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Geothermal REFiT US¢7.7/kWh

30 MW power plant in the range US$90-150 million

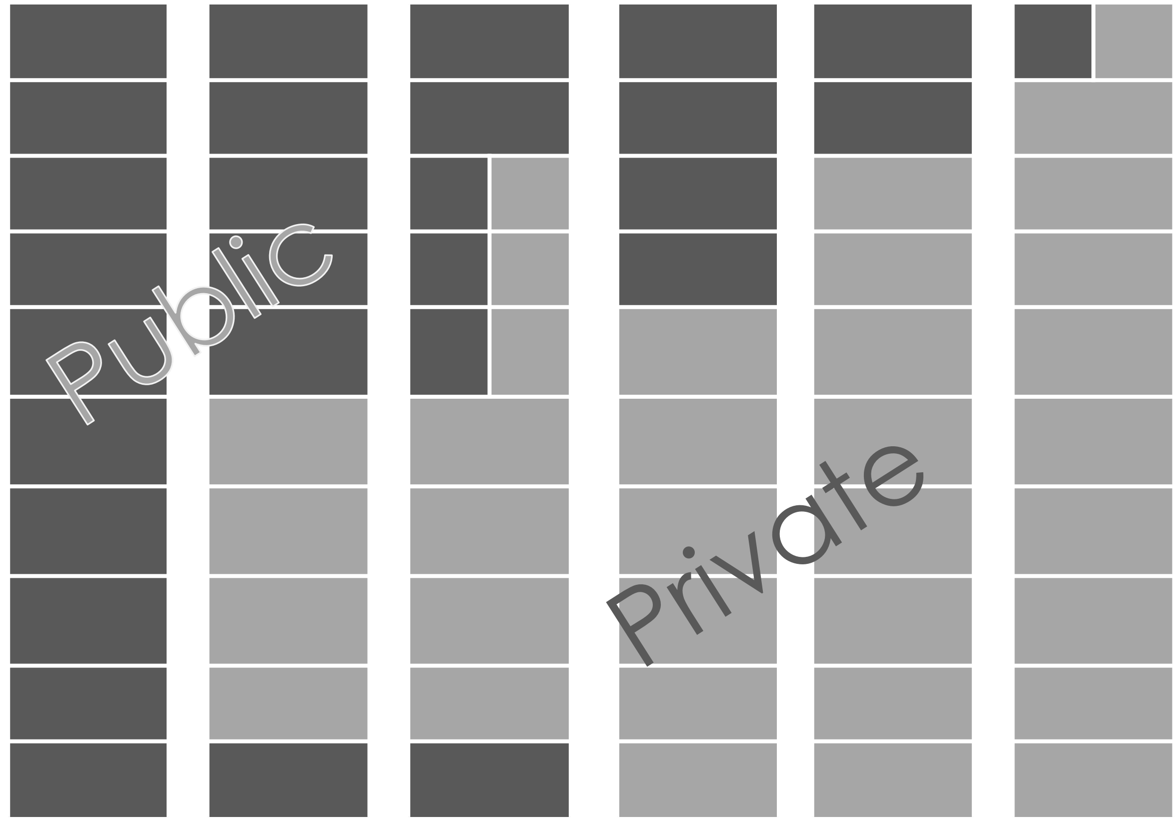
Bujagali US¢10.2-12.9/kWh
Eskom (Jinja) US¢ 8.5-11.7/kWh
Hydromax US¢13.5/kWh
Electromaxx US¢14.7-29/kWh
Jacobsen US¢14-26/kWh

Data from ERA

Project structuring

Year	Phase	Activity
1-2	1	Preliminary survey
2-3	2	Exploration
3-5	3	Test drilling
5	4	Review/ planning
6-8	5	Field (steamfield) development
8-10	6	Power plant construction
10	7	Start-up and Commissioning
10+	8	Operation & Maintenance
		- *Power plant*
		- *Steamfield*

Lead entity

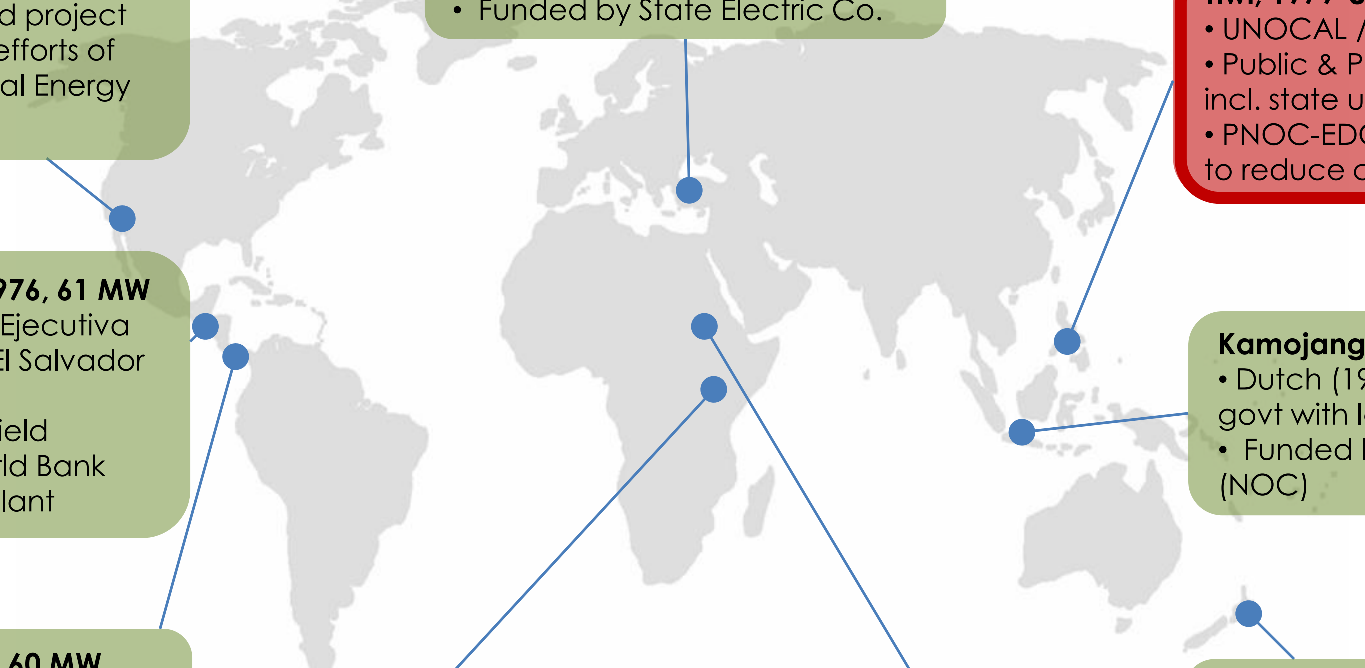


Example countries

- C. Rica
- Kenya, El Salvador, Mexico
- Kenya (alt), Philippines
- Indonesia, Turkey, N. Zealand
- USA
- Chile, Italy, Nicaragua, Philippines

First of a kind geothermal projects

PUBLIC SECTOR & DONORS KEY TO FOAK GREENFIELD DEPLOYMENT



Cerro Prieto, 1973, 75 MW
- CFE (State Electric Utility) led and financed project
- Built on earlier efforts of CEG (Geothermal Energy Commission)

Kizilidere, 1984, 20 MW
- Mineral Research & Exploration Co. (parastatal) led
- Funded by State Electric Co.

Tiwi, 1979-80, 230 MW
- UNOCAL /PGI led
- Public & Private finance, incl. state utility NAPOCOR
- PNOC-EDC formed 1976 to reduce costs

Ahuachapan, 1976, 61 MW
- CEL (Comision Ejecutiva Hidroelectrica) El Salvador state utility led
- UNDP funded field exploration, World Bank funded power plant

Kamojang, 1978-83, 30 MW
- Dutch (1920s), then NZ govt with local partner led
- Funded by Pertamina (NOC)

Miravalles, 1994, 60 MW
- Instituto Costarricense de Electricidade (ICE) led and funded project

Olkaria I, 1980-81, 30 MW
- KPC (KenGen predecssor) led project
- Funded by World Bank grant and EIB loan

Aluto-Langano, 1999, 7.3 MW
- Ethiopia Electric Power Corporation (EEPCO) led and funded project

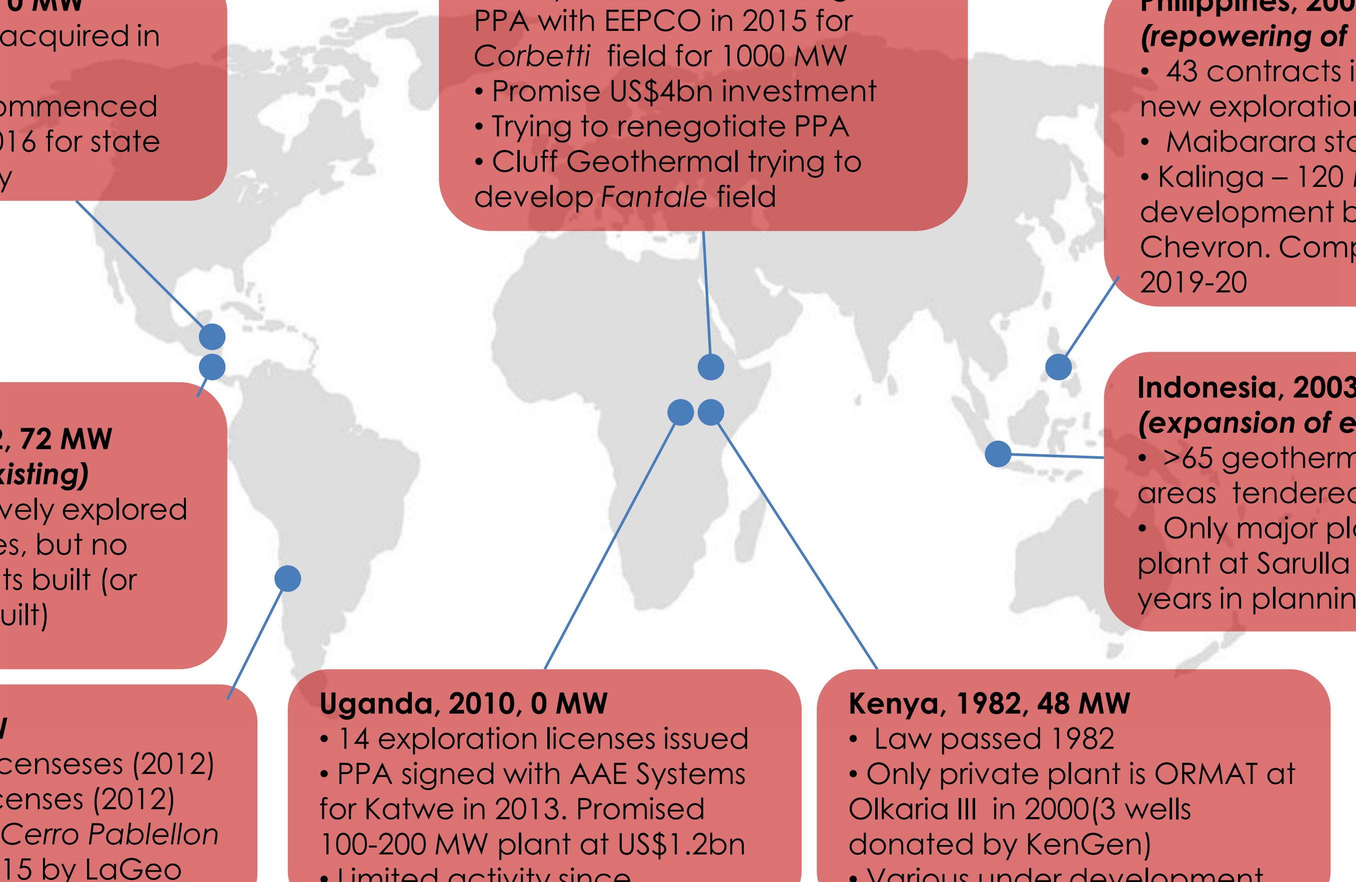
Wairakai, 1958-63,193 MW
- NZ Govt & UK Atomic Energy Authority led
- Public financed

Issues for private sector development

- Resource risk is major impediment
  - Commercial debt challenging to raise (5-10% cost of capital)
  - Equity investments expensive (>25% WACC)
- Development phase and payback period long and tied to electricity tariff, often regulated
  - Could take 20 years to break even
  - Does not make for an attractive investment for private equity
- Policies and measures can be used to stimulate market for private investment
  - Soft loans; tax allowances; risk insurance; REFiT
- Usually still requires “copper bottom” guarantee from Government
- GDC (Kenya) estimates following LCOEs:
  - Fully private (at 25% WACC) = **US¢14-17/kWh**
  - Public (steam) and private (power) = **US¢6.5-10.5/kWh**

Examples of private sector activity

RECORD OF PRIVATE DEVELOPMENT OF GREENFIELD PROJECTS IS POOR



Honduras, 1994, 0 MW
- *Plantares* field acquired in 2013 by ORMAT
- 35MW plant commenced production in 2016 for state power company

Ethiopia, 2013, 0 MW
- Rekyavik Geothermal signed PPA with EEPCO in 2015 for *Corbetti* field for 1000 MW
- Promise US$4bn investment
- Trying to renegotiate PPA
- Cluff Geothermal trying to develop *Fantale* field

Philippines, 2008, 20 MW + *(repowering of existing)*
- 43 contracts in place – only 2 new exploration contracts
- Maibarara started 2014
- Kalinga – 120 MW under development by JV incl. Chevron. Complete maybe 2019-20

Nicaragua, 2002, 72 MW *(expansion of existing)*
- 3 fields extensively explored by various entities, but no new power plants built (or close to being built)

Indonesia, 2003, 67.5 MW *(expansion of existing)*
- >65 geothermal working areas tendered
- Only major plan is 330 MW plant at Sarulla (almost 30 years in planning)

Chile, 2000, 0 MW
- 76 Exploration licenseses (2012)
- 6 Exploitation licenses (2012)
- 48 MW plant at *Cerro Pablellon* announced in 2015 by LaGeo

Uganda, 2010, 0 MW
- 14 exploration licenses issued
- PPA signed with AAE Systems for Katwe in 2013. Promised 100-200 MW plant at US$1.2bn
- Limited activity since

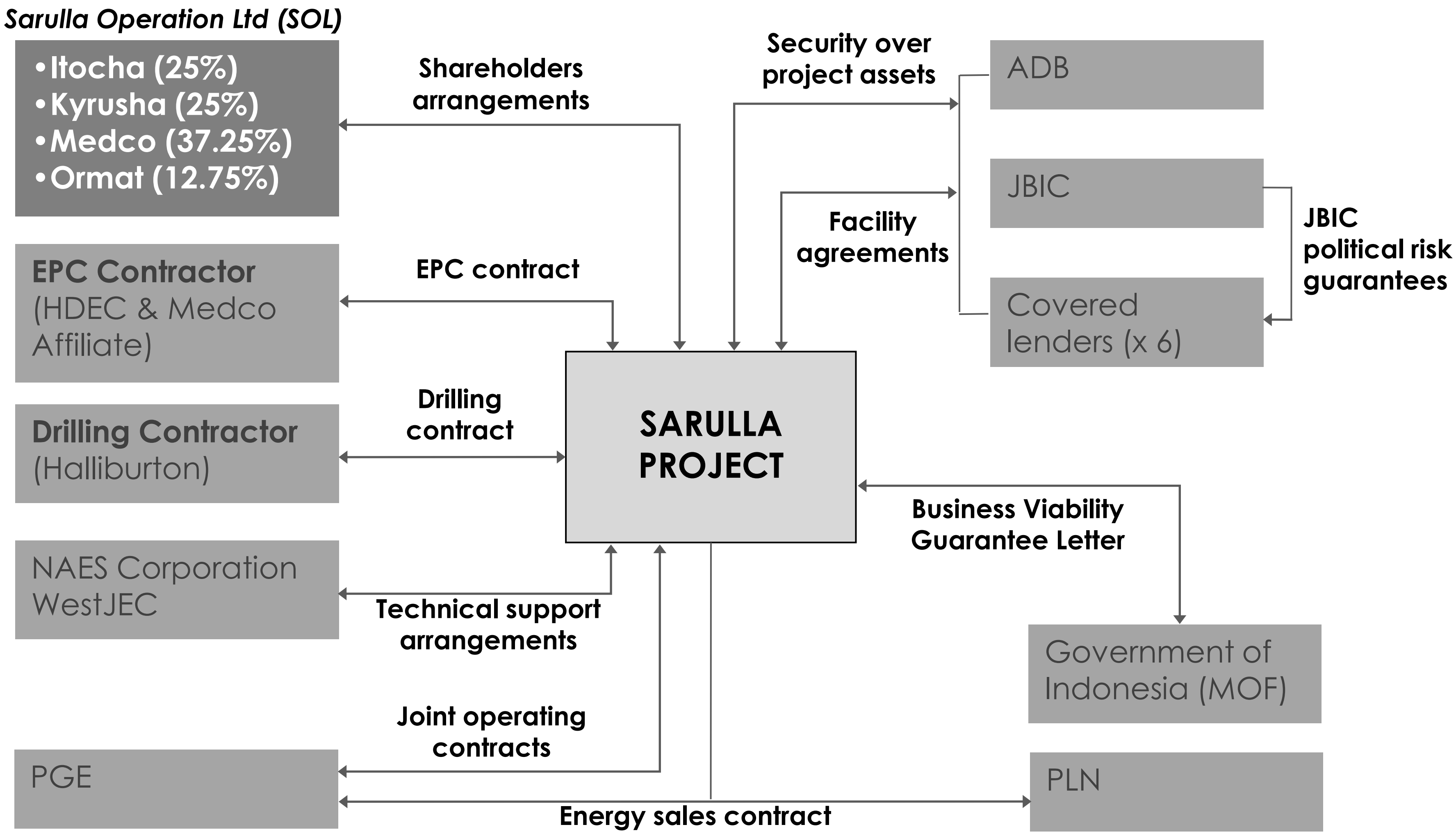
Kenya, 1982, 48 MW
- Law passed 1982
- Only private plant is ORMAT at Olkaria III in 2000(3 wells donated by KenGen)
- Various under development

Menengai steamfield finance

Lender / Investor	Amount
African Development Bank	US$120 M (loan)
World Bank Scale-up Renewable Energy Program (SREP)	US$ 40 M (loan & grant)
World Bank	US$100 M (loan)
Agence Francaise du Developpment (AFD)	US$166 M (loan)
European Investment Bank	US$ 36 M (loan)
GDC/GOK	US$284 M (equity)
Total	**US$746 million**

- Menengai steamfield estimated 1600 MW potential
- Phase I (above) is for 400 MW of steam development
  - Power plant could cost further **US$600 million** (overnight cost of US$1.4 bn total = **US$3.5m/MW** installed)
  - 3 IPPs selected. Each constructing 35 MW at **US$120 million** (initial overnight cost of **US$8.25m/MW** installed)

Sarulla project structure (simplified)



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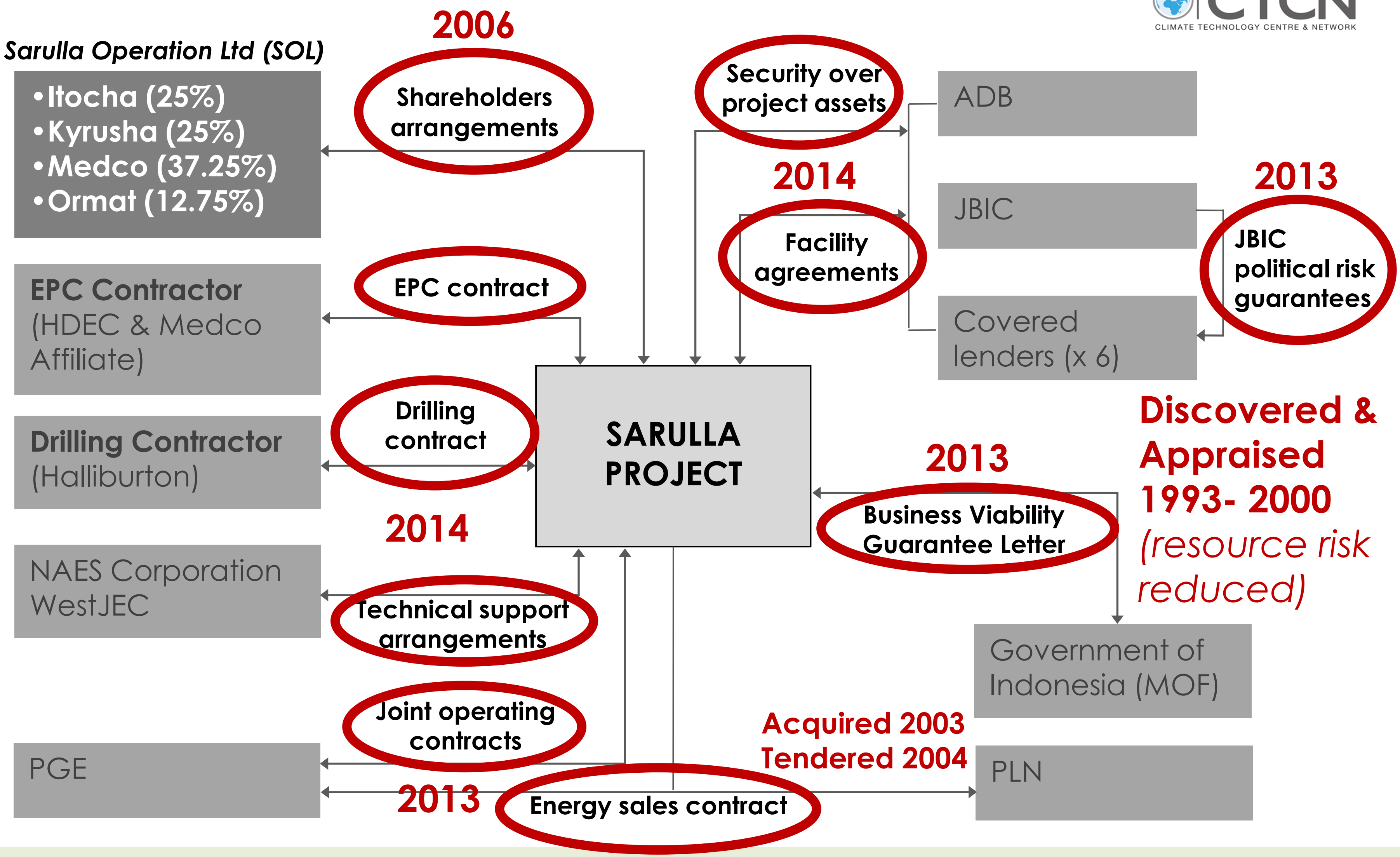
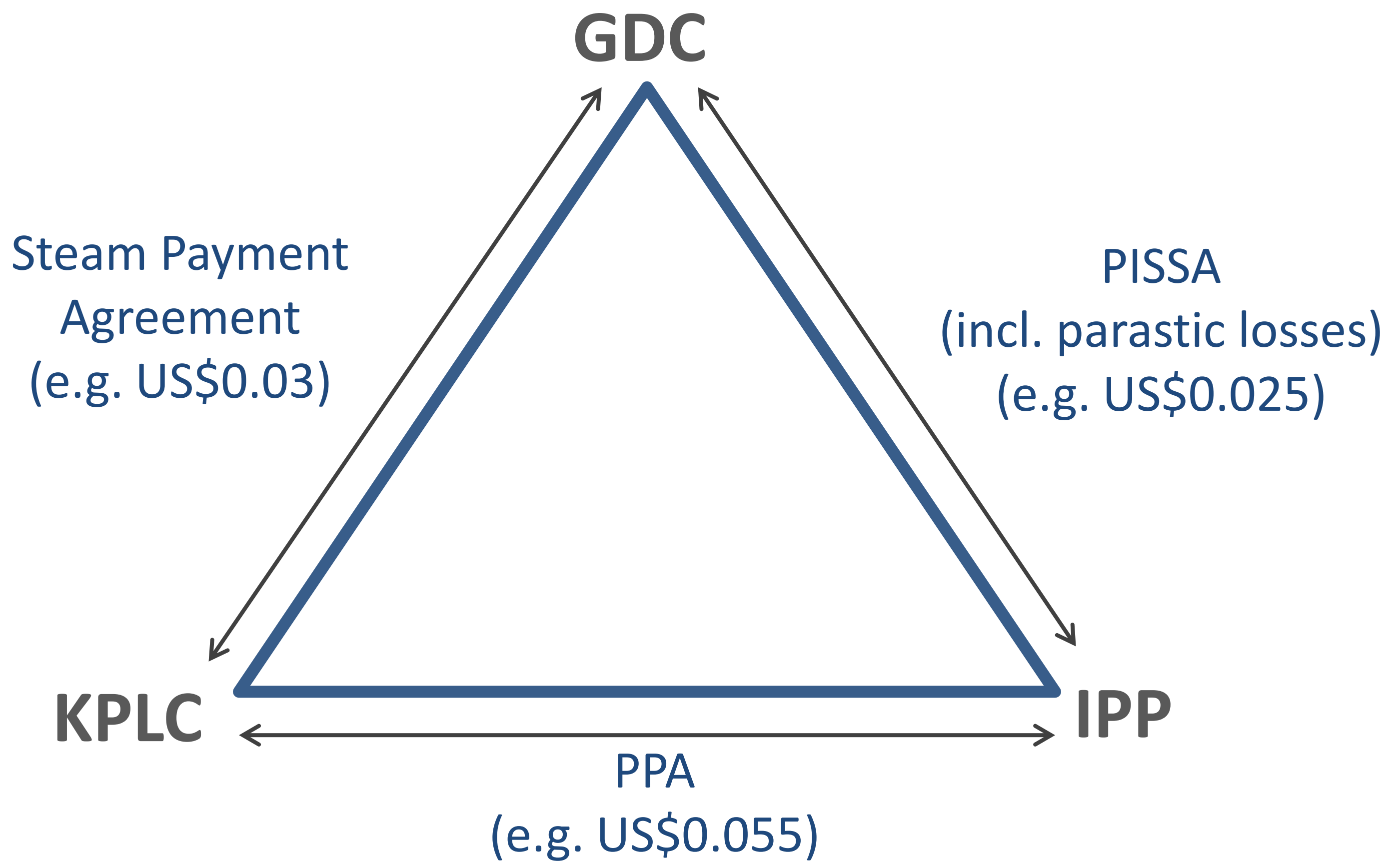


Kenya – Project Implementation and Steam Supply Agreement (PISSA)



Local community aspects

- Geothermal smaller footprint than other energy technologies
  - Approx. 1200-1500 m^2/MW installed
  - 30 MW_e plant need 4-6 hectares
  - Exploration area much larger (10,000+ ha.)
- Geothermal laws can grant rights to explore and exploit geothermal resources
- But not title rights giving unfettered access to land
- Must be negotiated with Land Owner

Local community aspects (2)

- Land access can present challenge
  - Title holder not always obvious or locally present (e.g. for customary tenure/tribal lands)
  - May not necessarily act in interest of locals
- Issues have arisen in Kenya (Olkaria IV) where communities resettled:
  - Resettlement Action Plan intended to give livelihood restoration commensurate with levels prior to move
  - Some issues arose regarding being moved close to other drill sites, uncompensated loss of earnings etc.

Local community aspects (3)

- *Environmental and Social Impact Assessment* will likely be required for geothermal development:
  - Under NEA, EIA Regulations No. 13 of 1998; and
  - Where international funding provided (e.g. World Bank)
- Opportunity to discuss issues and air grievances with developers

Geothermal field development

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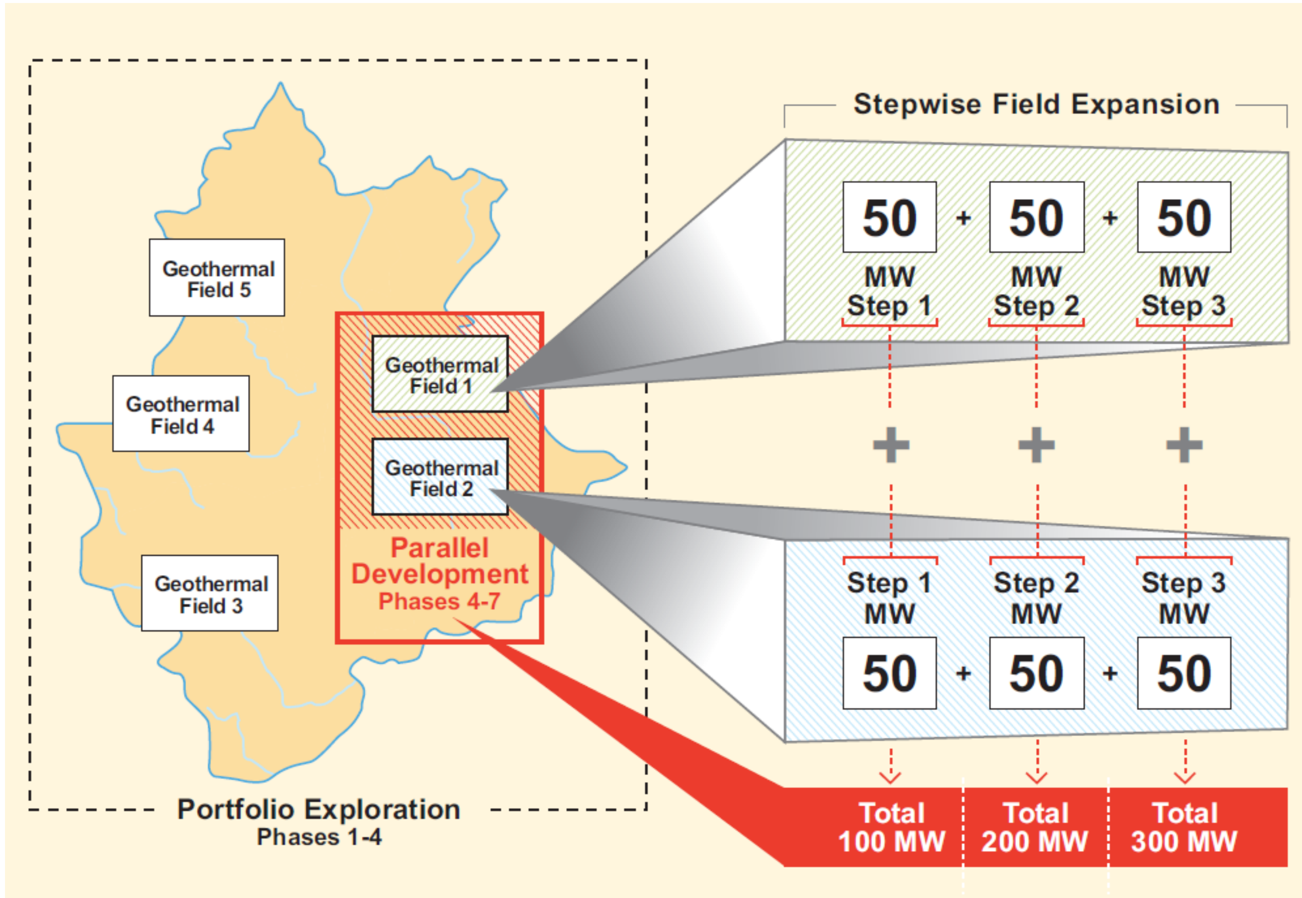
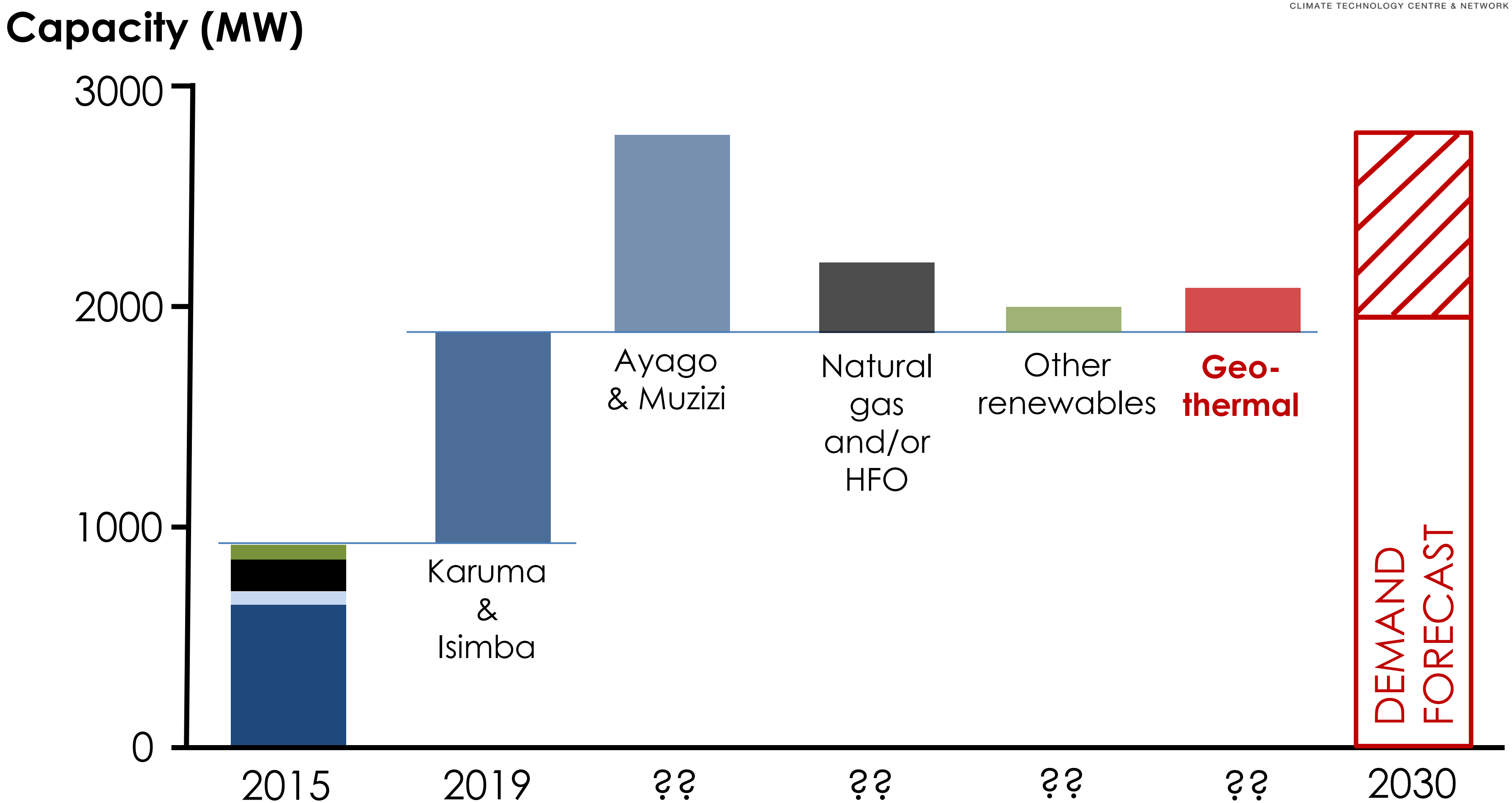


Energy outlook in Uganda



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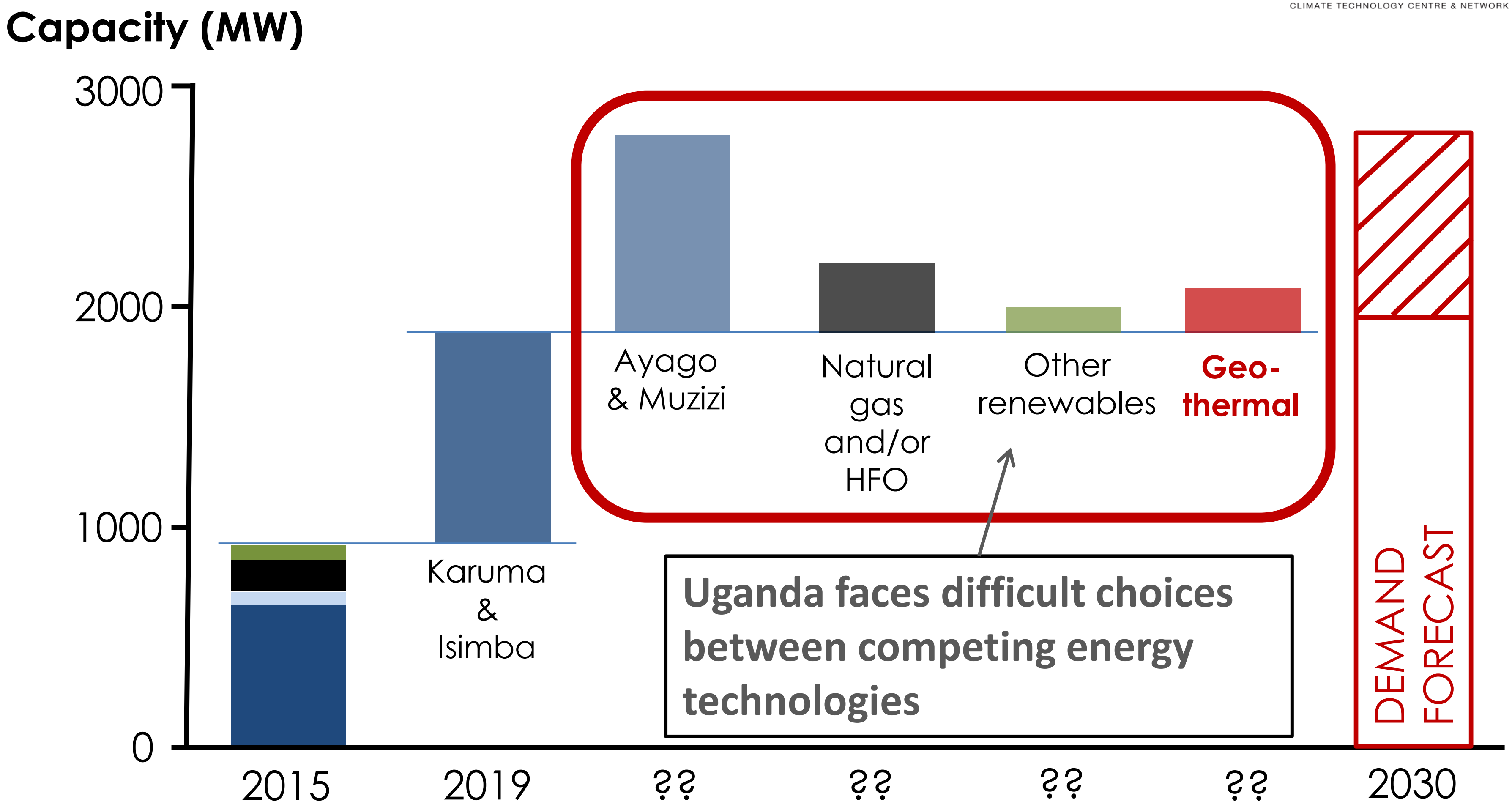

Financing energy in Uganda

Energy type	GOU		Development Partners	
	UGX (bn)	US$ (m)	UGX (bn)	US$ (m)
Large hydro	92.5	27	1386.25	410
Thermal (fossil)*	72.3*	21*	n/a	
Other renewables	2.2	0.66	8.8	2.6
Nuclear (uranium expl.)	14.1	4.2	n/a	
Geothermal	**5.1**	**1.5**	**2.3**	**0.7**

**capacity payments*

Wide range of development partner funding opportunities available for geothermal energy in Uganda

Development partner opportunities

	AIM	HOST	AMOUNT	ACTIVITIES SUPPORTED
GRMF	Fund geothermal energy in EARS	AUC, Addis Ababa	**~US$75 million** (including country contributions)	(1) Infrastructure grants: 20%; (2) Surface studies grants: 80%; (3) Drilling grants: 40%; (4) Continuation Premium: up to 30%
ARGeo	Support geothermal energy in EARS	UNEP, Nairobi	**~US$110 million** (excluding co-finance)	(1) Regional Networking, Information Systems, Capacity Building, Policy Advice and awareness creation; (2) Technical Assistance for Surface Exploration Studies.
DFID	*EAGER* - catalyse private and public investment in geothermal	Adam Smith Intl, Nairobi	**~US$8 million**	Advice to Governments on strategy, policy and regulation to attract investment in and overcome barriers to geothermal power
Scaling Up Renewable Energy Program (SREP)	Assist in achieving SE4All and *Vision 2040*	MEMD, Uganda	**~US$100 million** (geothermal, excl. co-finance)	Use of GOU and donor grants/concessional loans to leverage private sector investment into renewable energy
iceida	Assist EARS countries with geothermal exploration	ICEIDA	**~US$13 million**	(1) Reconnaissance, exploration up to drilling; (2) Technical assistance and capacity building including: training, institutional support; policy and legal framework

Others include: The World Bank, African Development Bank, JICA, Agence Française de Développement, European Investment Bank

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DFID	*EAGER* - catalyse private and public investment in geothermal	Adam Smith Intl, [illegible]	~US$8 million	Advice to Governments on strategy, policy and regulation to attract investment in and [illegible] thermal power
SREP	Assist in achieving SE4All and Vision 2040	MEMD, Uganda	[illegible] (geothermal, excl. co-finance)	[illegible] and donor grants/concessional loans to leverage private sector investment into renewable energy
iceida	Assist EARS countries with geothermal exploration	ICEIDA	**~US$13 million**	(1) Reconnaissance, exploration up to drilling; (2) Technical assistance and capacity building including: training, institutional support; policy and legal framework

Should Uganda act now to take advantage of the technical and financial support available from development partners?

Are donors convinced that geothermal energy is a priority technology development area?

Others include: The World Bank, African Development Bank, JICA, AFD Agence Française de Développement, European Investment Bank

What next for geothermal in Uganda?

1. **What is the *urgency* to deploy geothermal energy**?
   – Should the approach be *opportunistic* (passive) or *necessity* (focussed active support) oriented?
2. **What are the *policy needs* for geothermal energy?**
   – What instruments and measures can be used to promote geothermal?
3. **How should geothermal projects be *structured* between *public* and *private* entities?**
   – This will be key to understanding the type and level of financing that will be needed
4. **How can opportunities for *funding* geothermal exploration and project development, in particular from donors, be accessed?**
   – What challenges will be faced in accessing these funds?
5. **What are the *legal and regulatory* needs for geothermal energy?**
   – For government, donors, developers and local communities.

Issues and options for geothermal energy policy

CLIMATE TECHNOLOGY CENTRE & NETWORK

Formation of Geothermal Energy Policy and Laws in Uganda:
Stakeholder Engagement Programme

FOR GOD AND MY COUNTRY

Dr. Paul Zakkour

Project Manager, Carbon Counts

4th – 8th July 2016, Kabira Country Club, Kampala

ECA Sbonubi Musoke & Co. PU PRO-UTILITY Promoting Utility Excellence NORTON ROSE FULBRIGHT CARBON COUNTS

Overview

1. What is the purpose of geothermal policy?
2. What is the purpose in Uganda?
3. What are experiences around the world?
4. What are the choices and options for Uganda in designing such a policy?

Purpose of a geothermal policy

- To define the objectives and ambitions of government in pursuing the technology
- To guide the structure, approaches, legal, regulatory, institutional arrangements and financing and incentives options it wishes to adopt in achieving the objectives in its territory
- Often encompassed into broader energy and/or renewable energy policies

What is the purpose in Uganda?

- A new, dedicated, geothermal policy will help to give clearer direction as to:
  - how geothermal energy projects should be developed
  - by whom
  - over what time frame
  - using which sources of finance and support mechanisms
- It may also outline a vision to guide development
  - A outline roadmap or
  - Geothermal Energy Master plan

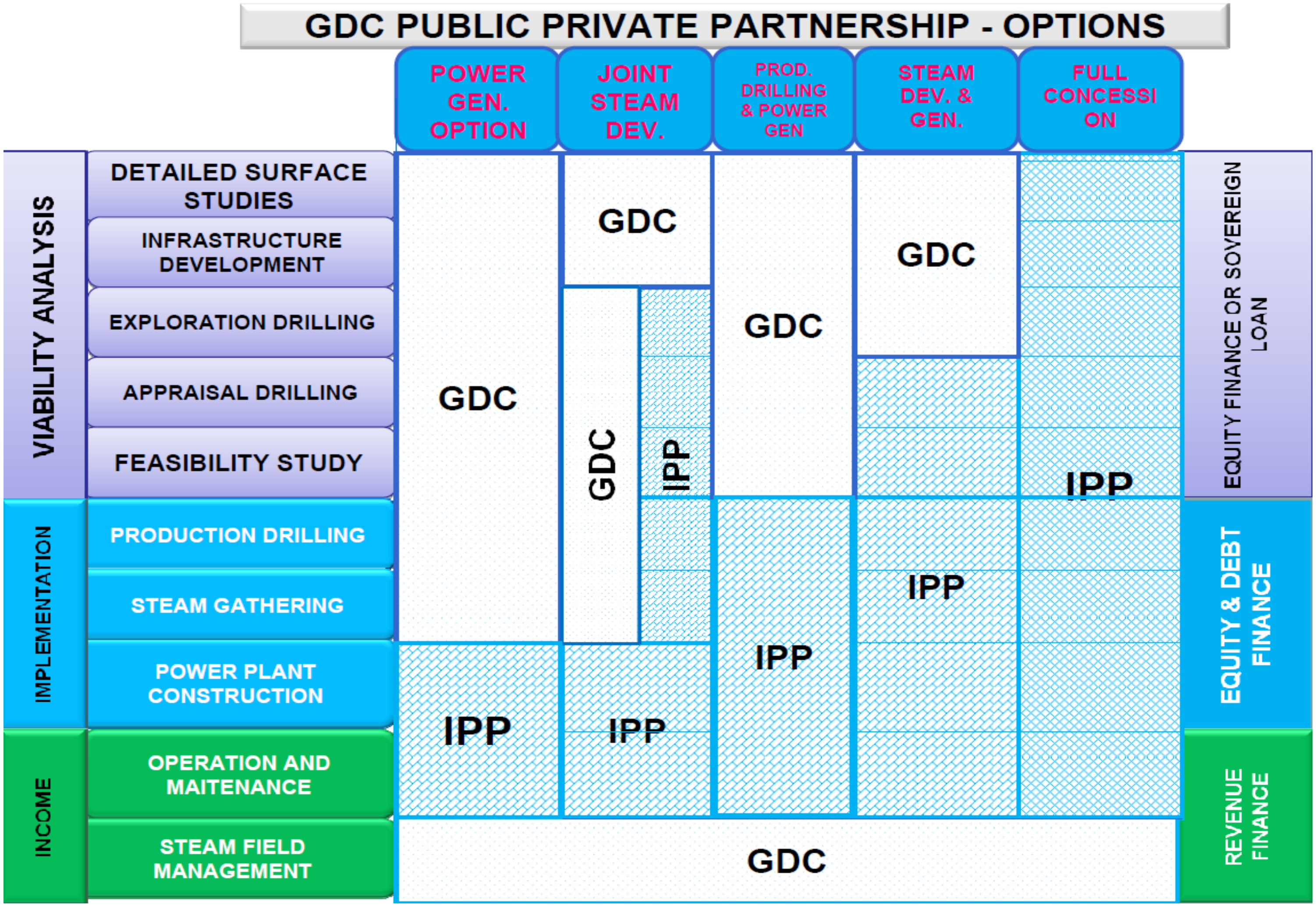
Experiences around the world

- Two main drivers apparent for geothermal globally:
  1. **Necessity**. lack of other obvious sources of energy, and an over-reliance on variable hydro-power, have given rise to the importance of geothermal energy for baseload generation (e.g. in NZ, Kenya, C. America) ➔
     - **significant government efforts** to get the industry off-the-ground;
  2. **Opportunity**. the quality of the resource has tended to be manifest using information acquired as from other activities e.g exploration (such as in Philippines and Indonesia, where NOCs and IOCs have led).
     - Interest emerged in response to the **clear opportunity** presented.
- In reality, often a mixture of the two, but useful to note

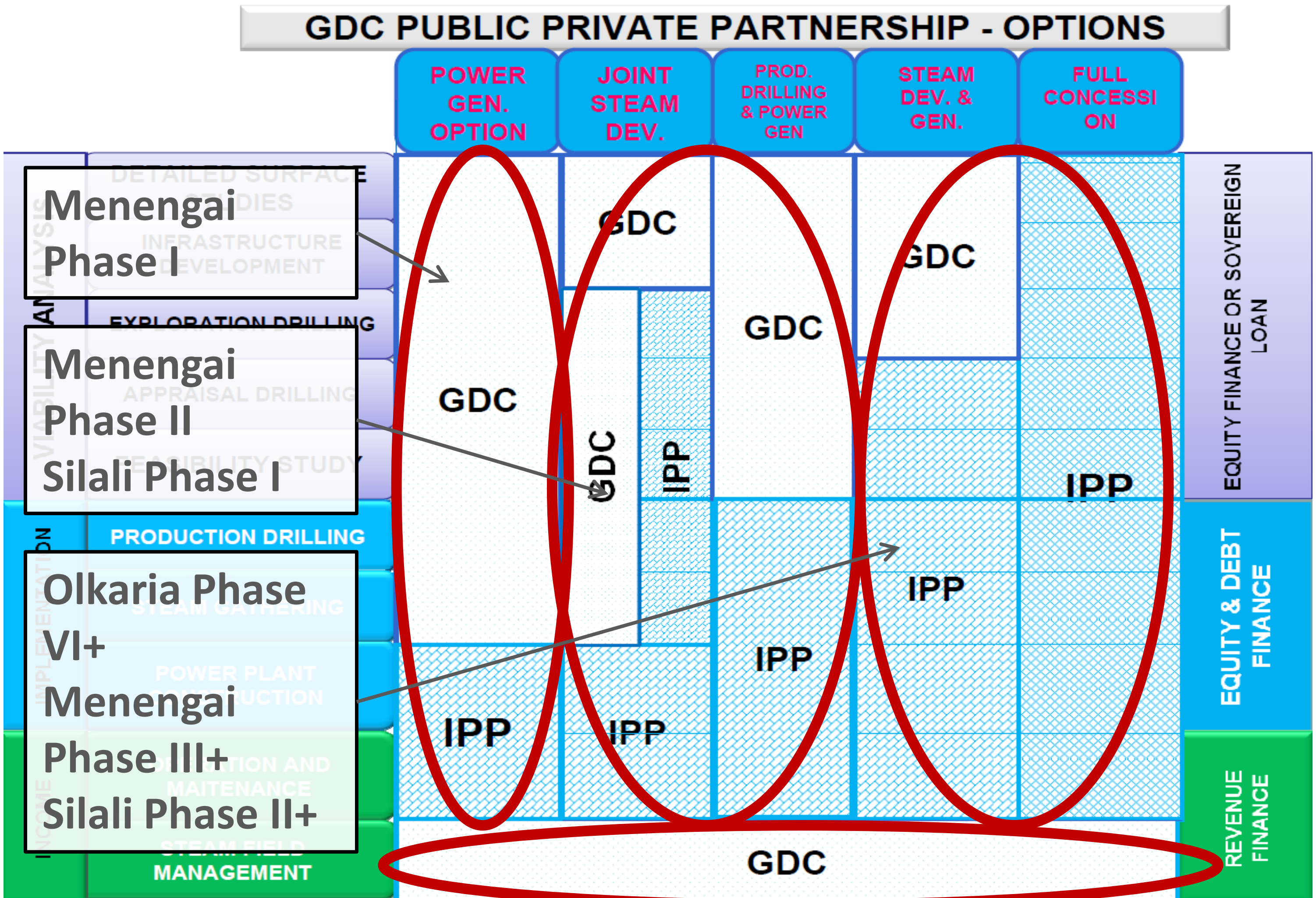
Experiences around the world (2)

- Nearly every FOAK geothermal project around the world has been publically-led and funded
- Risks too high for private financing
- But, policies tend to be *evolutionary:*
    1. Public-sector (and donor) leads efforts for FOAK
    2. Move towards PPP models for other *greenfield* development
    3. Opening up *brownfield*, *step-out*, production opportunities to 100% private sector led development

Kenya GDC vision



Kenya GDC vision



A word of caution

“There is little appetite from the private sector to fund projects where the nature and extent of the resource are unknown. The private sector only financed all stages of the project in 7.5% of the utility-scale projects in our database. 58.5% of projects had the costs entirely borne by the public sector, while 34% projects had the private sector bear costs at later stages in the development chain once the resource had been proved.”

and that:

“private financiers are not willing to provide financing until all or at least 70% of the MW capacity has been drilled”

Source: Micale et. al. (2014). Report for Climate Investment Funds (CIF)

Situation in Uganda today

- No policy supporting geothermal energy development
- GOU is *passive*, relying on the organic evolution of the industry based on 100% *private sector* led investment, incentivised by geothermal REFiT
- Concessions are held by *passive speculators*
  - poorly capitalised
  - Lacking technical competencies needed to develop such complex and long-term projects
- GRD mandate is unclear:
  - Research and data management unit?
  - Centralised point of contact for coordination of private sector-led development? or
  - Empowered to take projects forward itself?

Choices for Uganda today

1. The *opportunistic* approach. Carrying on with the current strategy of *private sector led* development. Possible enhance the enabling environment for *private sector led* development:
   - A revised Concession allocation process, greater role of government in compiling resource information, better safeguards against passive speculation etc;
   - Clearer rights over tenure and land access, perhaps with government guarantees over supporting permits;
   - A new set of enhanced incentives for geothermal energy (e.g. enhanced tax breaks etc.).
2. The *necessity* approach. Creating enhanced *public sector led* arrangements, e.g., through GRD or a parastatal company approach similar to Kenya or Tanzania. Take either fully-public or PPP approach to development of steamfield and power plants

Summary of options

	Description	Pro's	Con's
A	**Carry on with business as usual, relying on the private sector to develop the resource**	Limited exposure of GOU to full project costs and risks.	Experiences to date in Uganda, as well as examples of successful deployment around the world, suggest low chance of projects being built. High LCOE.
B	**As Option A, but increase GOU-led resource exploration with a view to bringing in private sector to develop when more resource certainty is achieved**	Could accelerate deployment compared to Option A Exposure of GOU to full project costs is still limited.	Higher cost than Option A. Limited control over rate and scale of development – uncertain if private sector will respond effectively to the incentive provided Potentially high LCOE.
C	**As Option B, but also provide new set of enhanced incentives for private sector to develop geothermal energy**	Could accelerate deployment compared to Options A and B Lower LCOEs than Option A or B Exposure of GOU to full project costs is still limited	Potentially high cost to GOU Limited control over rate and scale of development – uncertain if private sector will respond effectively to the incentive provided
D	**GOU leads on project development, through either:** - **GRD** - **New parastatal agency ("UGDC")** - **An existing parastatal agency (e.g. UEGCL; NOC)** **Include PPP approaches.**	Greater control over rate and scale of development. Able to access to donor grants and concessional loans. Lower LCOEs than Option A, B or C (assuming concessional finance) Private sector could lead on power plant development as PPP approach.	GOU takes on significant debt. GOU needs to provide core funding to responsible agency Full exposure to project costs and risks.

Legal and regulatory choices for geothermal energy

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Overview

1. What is the purpose of geothermal energy law and regulations?
2. What are the main elements of geothermal energy laws?
3. What are experiences around the world?
4. What are the norms, standards and issues that have arisen in different jurisdictions?
5. What are the key questions for Uganda to consider in designing such laws and regulations?

Purpose of geothermal law/regulations

- Vest tenure rights into private-sector (or parastatal agencies) to explore for and exploit geothermal resources
- Various elements typically included:
  - Government power to declare geothermal resource areas
  - Methods for allocating concessions
  - Permitting regime:
    - Exploration terms
    - Exploitation terms

      } Any financial requirements (e.g. Bonds, guarantees, royalties etc.)
    - Conversion of exploration to exploitation permits
  - Regulatory regime:
    - Permitting authority
    - Regulatory authority
  - Interaction with other laws (water, wildlife, environment etc)

Concession allocation

- **Direct request**
  - Developers make unsolicited applications to Government for the rights (i.e. a permit or license) to explore for geothermal resources within an area defined by the applicant, in either *declared geothermal resource areas* or outside.
- **Public tender**
  - Government solicits tenders from developers for the right to explore and develop geothermal resources for *declared geothermal resource areas* on a competitive basis (e.g. as in Chile and Indonesia). The release of areas for concessions may be dictated by a geothermal resources master plan;
- **Dual system**
  - Involving public tendering for *defined geothermal resource areas*, and also non-competitive approaches for undefined areas, allocated on a first-come-first-served basis.

Permit applications

1. **Legal status of the applicant**
   - Many geothermal laws restrict applications from foreign enterprises and nationals, usually requiring the applicant to be registered in the country.
2. **Technical capability of the applicant**
   - Based on track record of previous geothermal project development or similar undertakings.
3. **Financial capability of the applicant**
   - Details on the financial status of the company and its directors. In some cases geothermal laws specify requirements for financial guarantees.
4. **Delineation of the area to be explored**
5. **Detailed technical work programme including**:
   - methods to be employed
   - any potential adverse effects of activities
   - estimated expenditures for work to be carried out (by phase/period/quarter)
6. **Other environmental permits needed for activities**
   - Environmental permits and terms of reference for an EIA study can also accompany applications, where needed (e.g. in national parks)

Example dedicated geothermal laws

Turkey
2007 Law No. 5686 of 2007 on Geothermal Resources and Mineral Waters
2007 Regulation No. 26727 of 2007 on Geothermal Resources and Mineral Water Law Implementation

Mexico
2014 Geothermal Energy Act and Regulations

Philippines
1978 Presidential Decree 1442 (Geothermal Service Contract Law)
2008 Republic Act 9513 (Renewable Energy Act)

Nicaragua
2002 Law 443 on Exploration and Exploitation of Geothermal Resources
2010 Decree 45-2010, Implements Regulation of Law 443

Indonesia
2003, Geothermal Energy Law 27-2003 (old)
2014, Geothermal Energy Law 21-2014 (new)

Chile
2000, Law 19.657 of 2000 on Geothermal Concessions

Kenya
1982, Geothermal Resources Act, 1982 + amendments
1990 Geothermal Resources Regulations

Approaches around the world

<table>
<tr><th rowspan="3">Country</th><th rowspan="3">Allocation of Concessions</th><th colspan="4">Concession periods</th><th rowspan="3">Notes</th></tr>
<tr><th colspan="2">Exploration</th><th colspan="2">Exploitation</th></tr>
<tr><th>Initial</th><th>Renew/Extend</th><th>Initial</th><th>Renew/Extend</th></tr>
<tr><td rowspan="2">Chile</td><td rowspan="2">Dual system. Public tender may also be launched in cases of overlaps. Last tender in 2010</td><td>2 years</td><td>2 years (with >25% progress)</td><td colspan="2">Indefinite duration</td><td rowspan="2">Streamlined through various Decrees (32-2004; 14-2013). Convert to Exploitation permit within 2 years</td></tr>
<tr><td colspan="2">Max. 100,000 ha.</td><td colspan="2">Max. 20,000 ha</td></tr>
<tr><td rowspan="3">Indonesia</td><td rowspan="3">Geothermal Working Areas defined by Government. Public tender for Working Areas. Award to bidder with lowest estimated cost per kWh_e</td><td>3 years (+2 yr feas. study)</td><td>1 year (twice)</td><td>30 years</td><td>Indefinite extension</td><td>Enabled municipalities to lead exploration. Revoked by new law</td></tr>
<tr><td colspan="2">Max. 200,000 ha.</td><td colspan="2">Max. 10,000 ha.</td><td>Enabled private participation in exploration</td></tr>
<tr><td>5 years (max. incl feasibility study)</td><td>1 year (twice)</td><td>37 years</td><td>20 years</td><td>Removed geothermal from ambit of mining, thus allowing activity in forests/parks</td></tr>
<tr><td rowspan="2">Kenya</td><td rowspan="2">Direct request, FCFS basis. Geothermal Resources Area may be defined by Minister.</td><td>1 year</td><td>1 year</td><td>30 years</td><td>5 years</td><td>Convert to Exploitation permit within 12 months</td></tr>
<tr><td>5 years</td><td>No limit (as initial)</td><td colspan="2">Indefinite duration.</td><td>Introduced detailed drilling codes & model license</td></tr>
<tr><td rowspan="2">Mexico</td><td rowspan="2">Direct request. Production (exploit.) permits only to exploration permit holder</td><td>3 years</td><td>3 years</td><td>30 years</td><td>Indefinite extension</td><td rowspan="2">Allows private sector involvement. Production permits issued by National Water Commission</td></tr>
<tr><td colspan="2">Max. 150,000 ha.</td><td colspan="2">No larger than exploration area</td></tr>
</table>

Approaches around the world

Country	Allocation of Concessions	Concession periods: Exploration – Initial	Exploration – Renew/Extend	Exploitation – Initial	Exploitation – Renew/Extend	Notes
Nicaragua	Dual system. *Resource Areas* released by declaration through Ministry of Energy & Mines.	3 years	2 years (>2 wells must be drilled)	25 years	10 years	Convert to Exploitation permit within 9 months
		Max. 10,000 ha. (declared areas) Max. 40,000 ha (undeclared areas)		Max. 2,000 ha.		
Philippines	*Geothermal Reservations* set by Presidential Decree. GSC introduced	-	-	-	-	Basis for Dept of Energy to regulate activities and to contract out to the third (private) parties
	Public tender. GRESC covers both Exploration and Exploitation. Award through OCSP system[a]	2 years	1 year	25 years	25 years	New incentives (See Annex B) and contracts (GRESC)
Turkey	Direct request. Prospecting License on FCFS basis. Where overlap occurs, fastest/highest gets award	3 years	1 year	30 years	10 years	Issued by Local Administration. Convert to Exploitation permit before end of term, and implemented within 2 years
		Max. 5,000 ha.		As for Exploration area		

Approaches around the world

Country	Allocation of Concessions	Concession periods				Notes
		Exploration		Exploitation		
		Initial	Renew/Extend	Initial	Renew/Extend	
Nicaragua	Dual system. *Resource Areas* released by declaration through Ministry of Energy & Mines.	3 years	2 years (>2 wells must be drilled)	25 years	10 years	Convert to Exploitation permit within 9 months
		Max. 10,000 ha. (declared areas) [illegible] ha. (undeclared areas)		Max. 2,[illegible]0 ha.		
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		Max. 5,000 ha.		As for Exploration area		

Not going to review all this in detail – suffice to say, the framework being drafted will be *evidence-based*, drawing in experiences, norms and standards from different parts of the world

Permitting around the world

- **Concession allocation**
  - Range of systems used
  - Dual systems are fairly common
  - Various methods used to handle overlapping applications
- **Exploration permits**
  - Typically permits granted for 2-3 years. Usually areal limits apply
  - Renewal usually for 1-2 years
  - In some cases renewal only allowed where demonstrable progress against workplan is shown
  - Rules governing conversion to Exploitation Permit highly variable – range from before permit expiry (Turkey) to within 2 years of expiry (Chile)
- **Exploitation permits**
  - Typically permits granted for 25-37 years
  - Renewal usually indefinite

Financial instruments around the world

- **Fees**
  - Turkey: US$350 Exploration; up to 4x this amount for Exploitation
  - Nicaragua: US$25/km^2 rising to US$50/km^2 after yr 2
  - Kenya: US$500 for Exploration; US$1200 Exploitation
- **Royalties**
  - Chile: US$8.50/yr/km^2
  - Kenya: none applied although law allows for it
- **Guarantees and bonds**
  - Mexico: Performance Bond of 1% and a Guarantee of 0.5% of the proposed cost of the work to be carried out
  - Nicaragua: security in favour of the Ministry for US$50,000
  - Turkey: 1% of the licensing fees per hectare, with the discretion to increase this by as much as 50%.

Common issues

Tying-up of concessions with operators that do not necessarily posses the interest, technical competence or financial capabilities to explore and exploit the resource, e.g. passive speculators - Widespread.

- Geothermal development in Chile has long been constrained by this problem, alongside other factors
- In Indonesia, concessions are awarded to the bidder offering the lowest power price, despite the bidder having very limited capacity to calculate this amount due to uncertainties about the resource i.e. due to the lack of public data access ahead of bidding. This has encouraged speculators
- Common problem in East Africa

Common issues (2)

Disputes over land access, and the multiple and often complex frameworks through which developers need to operate

- In many cases, in addition to executing a PPA, government guarantees are often needed to support the creditworthiness of the offtaker and to facilitate additional permitting requirements, typically enacted through an *Implementation Agreement*.
- Kenya (Olkaria III), Chile, and Ethiopia (Corbetti geothermal field) all experiencing this problem
- Indonesia, New Geothermal Law (2014) allows geothermal developments in conservation forests and national parks

Environmental and social impact assessment requirements

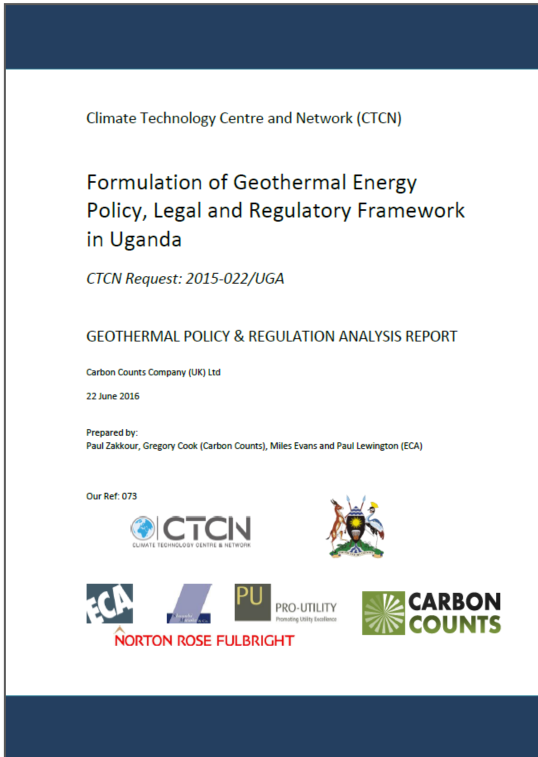
- Noted to be a challenge in Chile and Kenya (e.g. obtaining permits from the Kenya Forestry Service).

Issues to consider in Uganda

- **Concessions allocation**
  - how concessions should be defined and allocated?
  - Through government led tender/auction or bidding, or through a more *ad hoc* direct request process?
  - In part, this will be determined by the policy choice as to how government wishes to structure investments in the sector
- **Institutional arrangements**
  - Which authority will be responsible for running any bidding rounds, issuing and renewing permits etc?
- **Regulatory arrangements**
  - License application requirements and processing
  - The terms for concessions with respect to their time limit and renewals
  - The maximum area to which permits should apply
  - Technical and financial standards to be incorporated in the licenses

Issues to consider in Uganda

- **Financial arrangements**
  - Charges for licenses – what level? To which department?
  - Royalties (on steam production) – should they be charged, at what rate, who does the money go to? What about local communities?
  - Use of guarantees/performance bonds (as applied in e.g. Turkey, Mexico)?
- **Interactions with other laws** – mining, petroleum, groundwater, surface water, health, safety and environment, wildlife, civil protection and national content etc.
  - Do any modifications need to be made which prevent geothermal exploration/exploitation taking place?
  - What norms and standards can be drawn from existing regulations – e.g. Petroleum Act?
  - What about land access and tenure rights?


Climate Technology Centre and Network (CTCN)

Formulation of Geothermal Energy Policy, Legal and Regulatory Framework in Uganda

CTCN Request: 2015-022/UGA

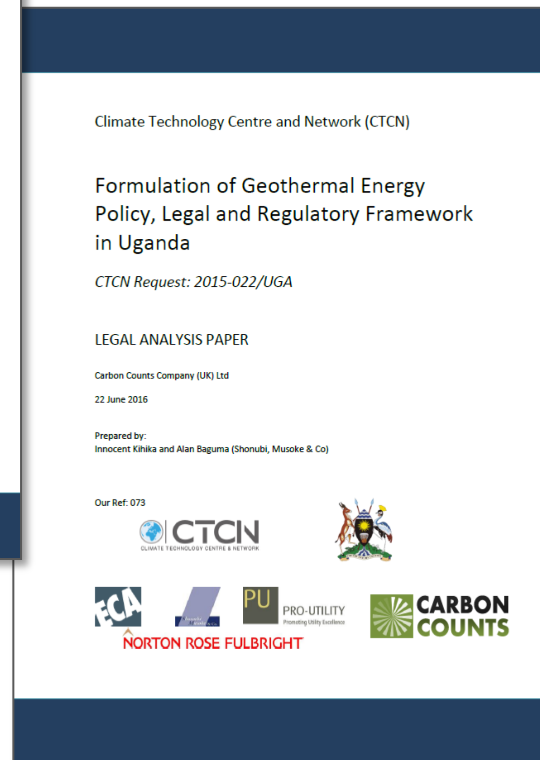
GEOTHERMAL POLICY & REGULATION ANALYSIS REPORT

Carbon Counts Company (UK) Ltd

22 June 2016

Prepared by:
Paul Zakkour, Gregory Cook (Carbon Counts), Miles Evans and Paul Lewington (ECA)

Our Ref: 073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LEGAL ANALYSIS PAPER

Carbon Counts Company (UK) Ltd

22 June 2016

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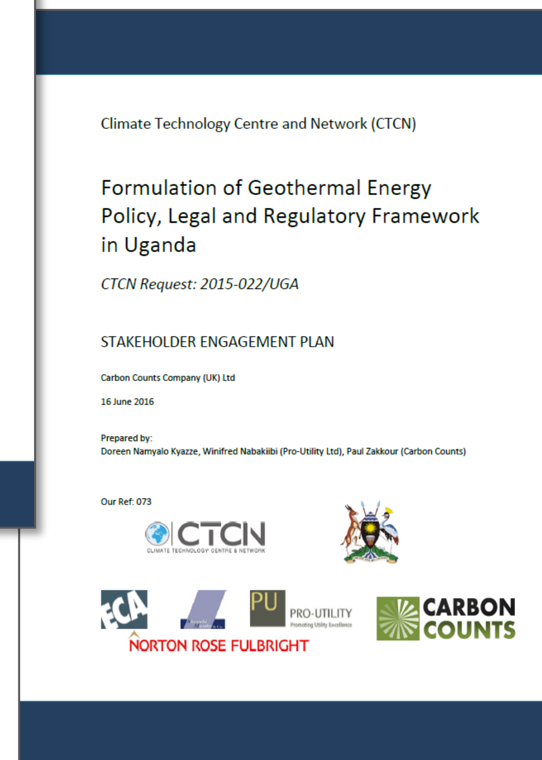
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STAKEHOLDER ENGAGEMENT PLAN

Carbon Counts Company (UK) Ltd

16 June 2016

Prepared by:
Doreen Namyalo Kyazze, Winifred Nabakiibi (Pro-Utility Ltd), Paul Zakkour (Carbon Counts)

Our Ref: 073

More detailed information available in our reports:

(Available from Geothermal Resources Department)

Thank you

CLIMATE TECHNOLOGY CENTRE & NETWORK

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