

Geothermal Development in Eastern Africa

Recommendations for Power and Direct Use

IRENA

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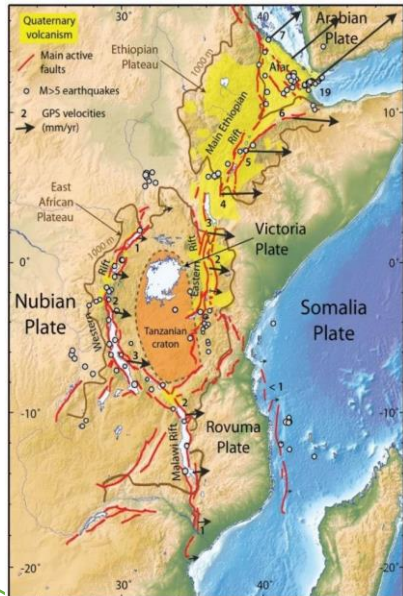


Introduction

- ❑ Outcomes of the Regional Workshop on Geothermal Financing and Risk Mitigation in Africa
- ❑ Assessment: experience in Comoros, Djibouti, Ethiopia, Kenya, Tanzania, Uganda and Zambia



- ❑ Provide the updated status of geothermal development, both electricity and direct use
- ❑ Identifies the key barriers to geothermal development
- ❑ Provides recommendations for accelerating development of geothermal electricity and direct use

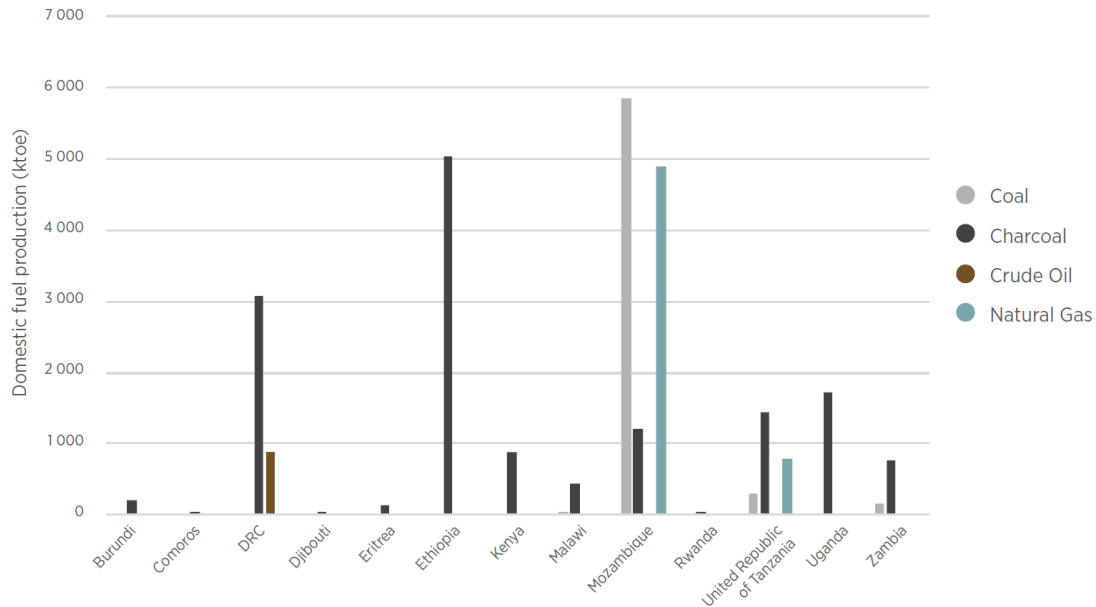


- ❑ Vast geothermal potential exists in the EAR
- ❑ Economic growth rate: higher the average African and global rate (6.2%)
- ❑ Population: 437 million, 2.8%
- ❑ Electricity access rate: <50% in most countries
- ❑ Meet the regions needs for electricity and heating

Introduction

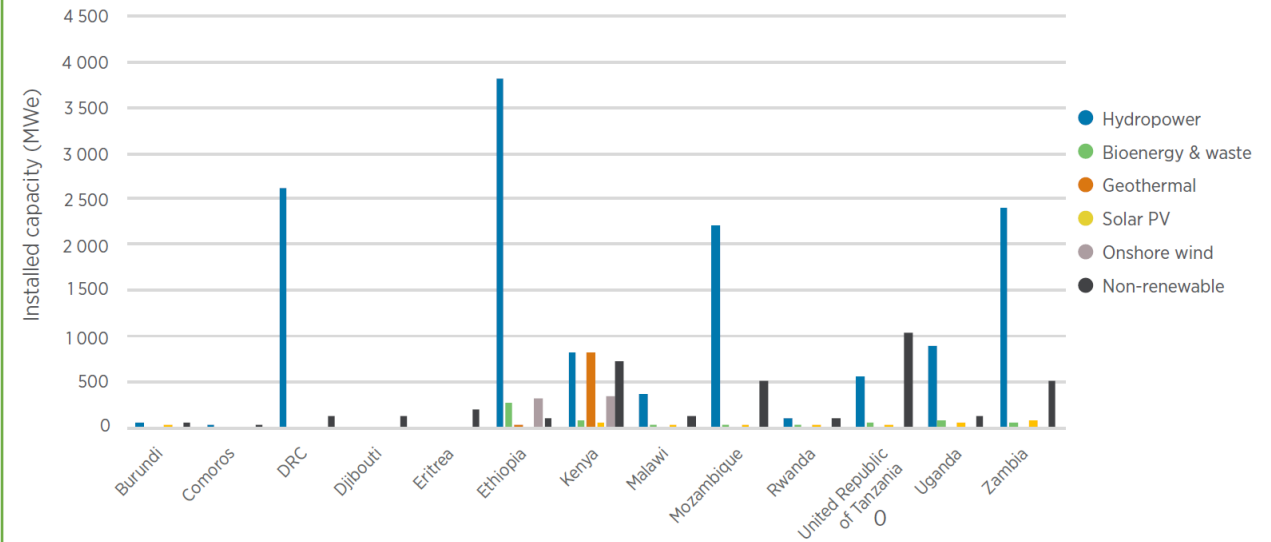
Primary sources of Energy

- ❑ Charcoal is the main source of primary energy
- ❑ Coal is significant in Mozambique
- ❑ Natural gas in Mozambique and Tanzania



Grid electricity

- ❑ Hydropower is the main source except in Djibouti, Eritrea and Tanzania
- ❑ Most countries have solar installations
- ❑ Geothermal only in Kenya and Ethiopia



Status of Geothermal Development - Electricity

	Surface studies	Exploration & appraisal drilling	Feasibility study & production drilling	Under construction	Installed (MWe)	Commercial Direct Use
Comoros	Karthala					
Djibouti	Arta North –Ghoubhet	Asal-Fiale Gale Le Koma				
Ethiopia	Corbetti, Tendaho- Alalobeda (tendering) Fantale, Butajira, Wondo, Genet, Boku,Daguna, Fango	Aluto-Langano Tulu Moye	Aluto-Langano		Aluto-Langano (8.5)	
Kenya	Suswa, Barrier, Silale	Paka Korosi	Olkaria (140, 280) Menengai (60)	Olkaria (83)	Olkaria (878) Eburru (2.5)	Oserian, Olkaria, Menengai (18MWt)
Tanzania	Ngozi, Songwe Lake Natron	Kiejo-Mbaka				
Uganda	Panyimur, Buranga, Kibiro					
Zambia		Kafue Trough, Kapisya				

Policy, institutional and Regulatory Frameworks

Comoros

Proposed regulatory framework for RE

Proposed unbundling of the water and electricity Management

Djibouti

Djibouti vision 2035 aims: 100% renewable electricity

Geothermal included in NDC: 40% reduction by 2040

ODDEG is responsible for geothermal development

Framework/Plan for the development of geothermal resources

Prepare the legal and regulatory framework

Plans to open up space for IPPS

Ethiopia

Ethiopia's Climate Resilient Green Economy Strategy allowed IPP (2009)
PPA for geothermal signed (2020)

Key institutions :

Geological Survey of Ethiopia
Ethiopia Electric Power
Ethiopia Energy Authority
Streamlining of GSE and EEP

Geothermal proclamation No.981/2016

Grade I resources: Suitable for power and combined heat and power
Grade II resources: Suitable for direct use
Issued by regional/National government

Provides for incentives

Policy and Regulatory Frameworks

Kenya

Least Cost Power Development Plan 2017-2037 (Geothermal – 2 647 Mwe)

Feed-in Tariff introduced in 2008, retained in Energy Act of 2019 (USD 0.088/kWh)

Direct government financing through medium-term expenditure

Tax incentives and exemptions on geothermal equipment

Letter of support issued to investors to cover political risks and ease financing

Partial risk guarantee to protect investors from political risk

Kenya

Institutions:

Geothermal Development Company

Kenya Electricity Generating Company

Renewable Energy Resource Advisory Committee (RERAC)

Energy and Petroleum Regulatory Authority

Constitution of Kenya (2010)

Energy Act (2019) and regulations

Environmental Mgt and Coordination Act and Regulations

International conventions and treaties

PPP act and regulations

Energy Act 2019

Recognizes the role of Direct use of geothermal energy

Allows for the participation of IPP in geothermal

Licensing for geothermal projects

Policy and Regulatory Frameworks

Tanzania

Tanzania Geothermal Development Company

Geothermal resource development and derisking

Energy act (2015)

Private sector participation through concession or PPP

Mining Act (licensing law)

Government is considering to develop a geothermal Act

Uganda

Renewable Energy policy 2007

Increase renewable electricity to 61% by 2025

Geothermal feed-in Tariff (USD 0.077/kWh)

Draft geothermal policy to streamline development of geothermal projects

Geothermal Development Department established under the Ministry of Energy and Mineral Development

Uganda Energy Credit Capitalisation Company (UECCC) establish to support financing efforts for geothermal and other RE projects

Mining Act (2003) – Licensing for geothermal

Electricity Act (1999) – licensing of IPPs

Zambia

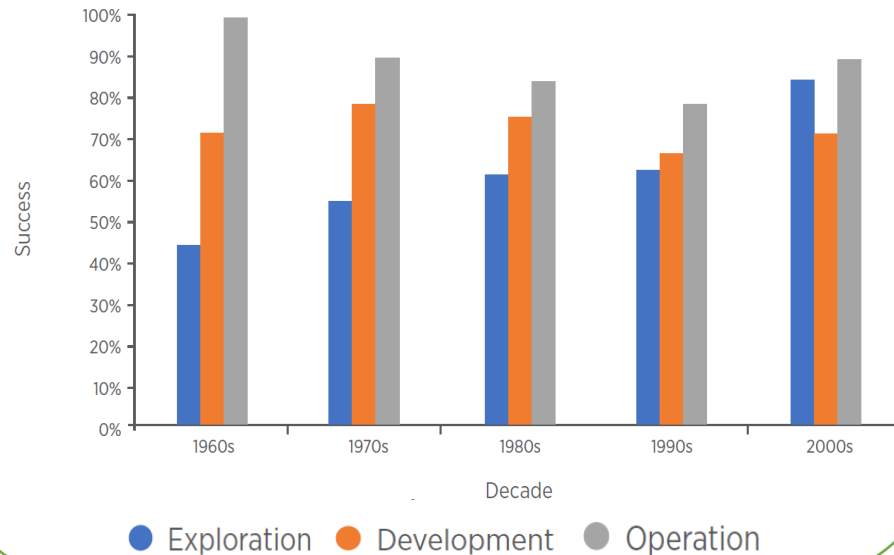
Energy policy of 2008 focuses on grid-hydropower

Energy regulation Act 2009 provides for licensing of RE projects including by IPPs

Financing

Perceived high risk profile

- ❑ Over the years, the actual risk of geothermal development has decreased significantly
- ❑ Improved exploration and modelling techniques



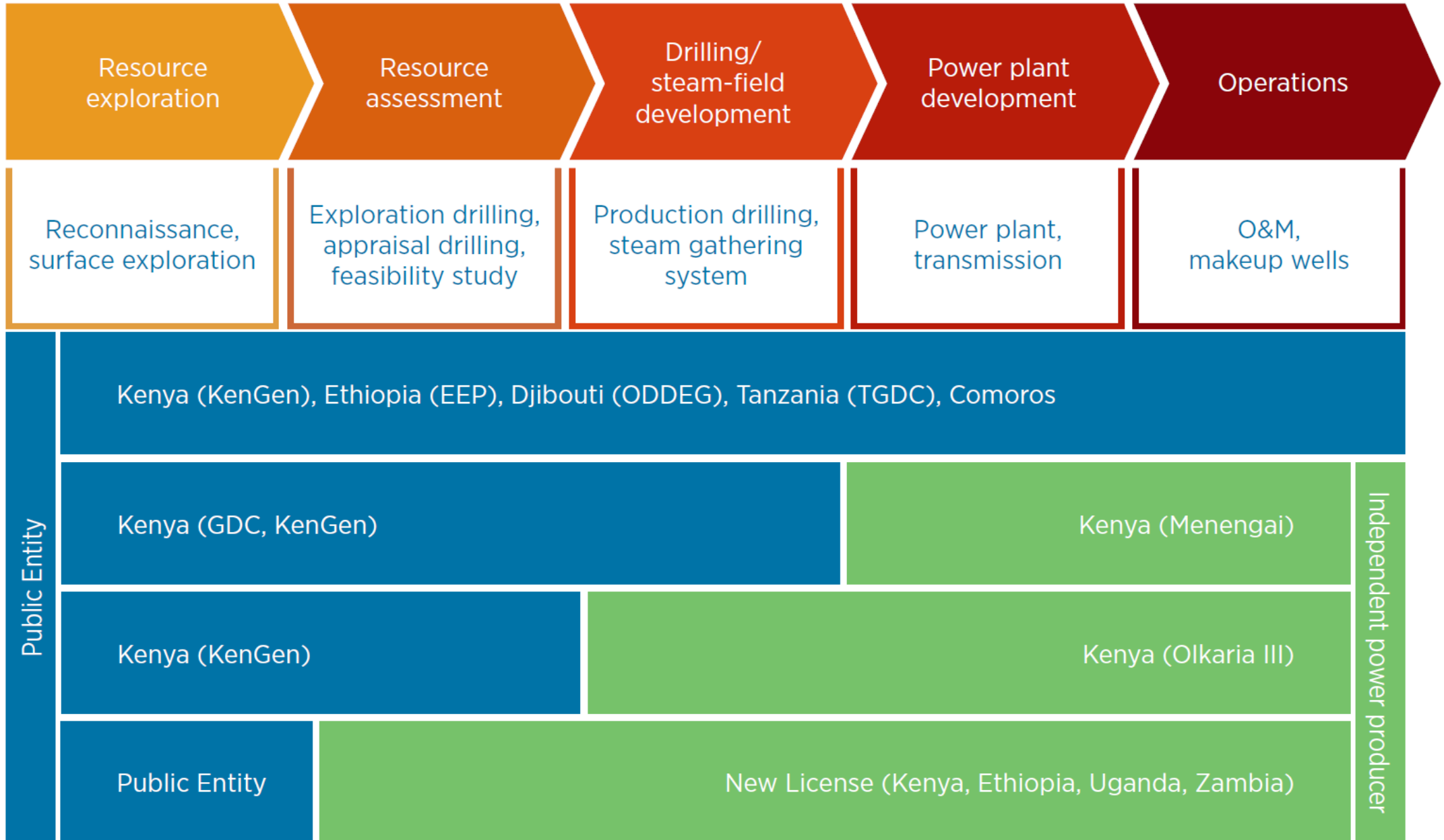
Financing options

- ❑ Public finance
- ❑ Private finance [equity, PIBO, Green Bonds Market]
- ❑ Concession loans [loans guaranteed by govt, early-stage development]
- ❑ Blended finance [partial risk guarantee]
- ❑ Grants for TA and risk mitigation [surface studies, regulatory frameworks, GRMF]

Unlocking financing for geothermal projects

- ❑ Co-location of electricity and direct use projects
- ❑ Early generation of electricity using well-head technology
- ❑ Phased development of a geothermal field

Development models



Enabling direct use



Use	Installed capacity (MWt)	Annual energy use (TJ/yr = 10 ¹² J/yr)
Greenhouse heating	5.3	185
Agricultural drying	0.3	9.9
Fish farming	0.2	6.5
Bathing and swimming	8.7	275.5
Other uses (laundry operations and milk pasteurisation)	4	125
Total	18.5	602.4

Increased interest in DU in EAR

- ❑ Kigali Statement of ARGEO-C7 called for the mainstreaming of DU
- ❑ Technical workshop on the Geologic Development and Geophysics of the Western Branch of the Greater East African Region – most resources are low and medium temp. suitable for DU
- ❑ Several social, economic and environmental benefits of DU



Enabling direct use

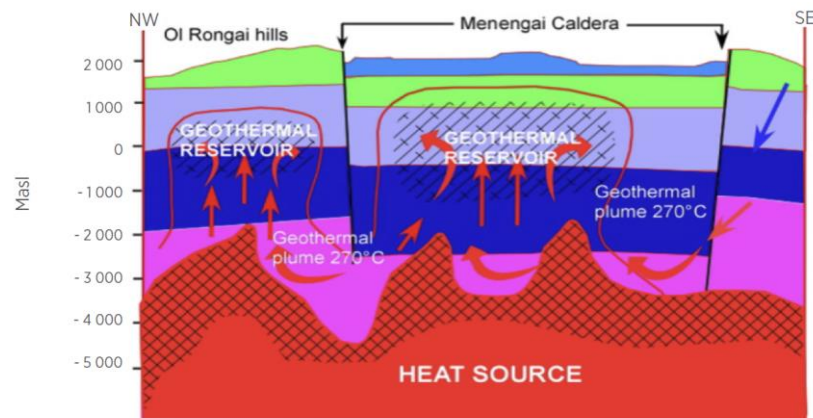


Selection of suitable exploration methods

Different **Geological settings** require **selection of appropriate methods of exploration** to max. chances of resource recovery

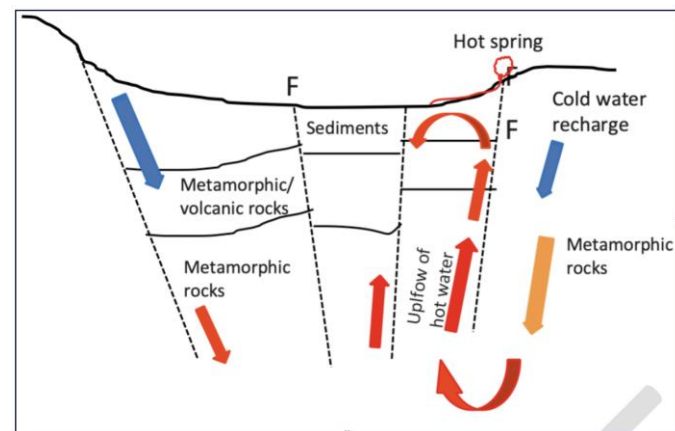
Volcano-hosted geothermal systems

- Convective reservoir driven by hot rock or magma under a volcano with upflow under the mountain and outflow on sides
- Techniques identify reservoir above a heat source



Fault/fracture-controlled systems

- Conduction-dominated reservoir with minimal convection in areas with not recent tectonism or volcanism
- Techniques identify reservoir along fault planes



Shallow resources

- Reservoirs at <500m due to buried faults or steam leaking to shallow ground above high-temperature systems
- Techniques identify reservoir along fault planes

Skills and capacity development

Limited awareness and lack of sufficient numbers of skilled workforce in the region are the main capacity challenges

International capacity building Initiatives

- Training
 - GRO GTP (formerly UNU GTP)
 - 3 week geothermal exploration short course in Kenya
 - 6 month specialized training in Iceland
 - University of Auckland – Geothermal Institute
 - Oregon Institute of Technology – GeoHeat Centre
- Technical Assistance
 - New Zealand Africa Geothermal Facility
 - JICA
 - BGR

Local capacity building initiatives

- Local Universities – limited geothermal related courses
- Africa Geothermal Centre of Excellence
- GDC Geothermal Centre of Excellence
- KenGen Geothermal Training Centre



Proposed tailor-made capacity building for various stakeholders

- Geothermal policy, legal and regulatory frameworks
- Geothermal financing and risk mitigation
- DU opportunities, benefits and development
- Geothermal transactions – procurement, PPA
- Support for decision making thru' coaching and mentoring
- Community and stakeholder engagement

Status of Geothermal Development – Direct Use

- ❑ Integration of electricity markets in the framework of the power pools
- ❑ Enable the development of direct use, including in combination with electricity generation
- ❑ Improve the policy, institutional and regulatory frameworks to attract private capital
- ❑ Support the development of all types of geothermal resources through the use of appropriate exploration techniques
 - High-temp, volcano hosted
 - Low-medium temp. fault/fracture-controlled
 - Shallow resources
- ❑ Capacity building to focus on all aspects of geothermal energy
 - Technical skills
 - Commercial
 - Decision making
 - Direct use
 - Community and stakeholder engagement



Thank you!

