Potential impact of Geothermal Industrial Parks in East Africa

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Introduction







Industrial park

Is an allocated area planned for industrial use where common infrastructure requirements are shared. This shared infrastructure can include access roads, water supply, energy supply, waste management, maintenance etc. Often industrial parks will focus on attracting anchor tenants in a certain trade such as textile, leather, furniture or other production.

Source: Authors



Source: https://semonegna.com/five-industrial-parks-created-40000-jobs/





Industrial Ecology

The concept of Industrial ecology aims to learn from natural ecosystems to reduce the environmental impact of industry by viewing industry as a man-made ecosystem, where the waste or by product of one process is used as an input into another process. In industrial ecology, businesses re-design material and energy flows to move from a linear- to a circular economy.

Source: Authors











Eco Industrial park

"An eco-industrial park is a community of manufacturing and service businesses located together on a common property. Member businesses seek enhanced environmental, economic, and social performance through collaboration in managing environmental and resource issues. By working together, the community of businesses seeks a collective benefit that is greater than the sum of individual benefits each company would realize by only optimizing its individual performance. An eco-industrial park also looks for benefits for neighboring communities to assure that the net impact of its development is positive."



The Kalundborg Eco-Industrial Park , Hond, Frank. (2000).

Source: Lowe 2001



Global spread-out of Eco-Industrial Parks



Non-OECD OECD

Source: World Bank, 2015





Geothermal Eco Industrial park (GEIP)

Area planned and developed based on diverse integrated utilization of geothermal resources with the aim to maximize the sustainability (economic, social and environmental) of the energy use and all subsequent operation within the park. The development of the park is non-stop process during its lifetime and approached with proactive business development and continuous optimization of economic, environmental and social factors.

Source: Authors









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Source: Authors



"Integrated use of the resource is simply evidence of common sense"

Albert Albertsson, Visionary of the Reykjanes Geothermal Resource Park





Why **Geothermal** Eco Industrial Parks?

Geothermal as a sustainability driver

- The future opportunity of geothermal energy is at the heart of our common challenges
 - Decrease atmospheric CO2 release by increasing the use of renewable energy
 - Create infrastructure that promotes sustainable production and increases quality of life
 - Create diverse jobs and support local communities

How can the positive impact of geothermal energy be increased?



THE GLOBAL GOALS





Geothermal vs other renewables









What makes geothermal project a success?























Benefits of the GEIP model

Electricity production only



The story of Bjarnarflag









A Win-Win model

Benefits for power company

- Multiple revenue streams
- Create value out of "waste and pollution"
- Increased social acceptance

Benefits for industrial user

- Access to renewable energy
- Cost benefits
- Connection to other producers
- Shared facilities
- Co-branding

Benefits for society

- More jobs
- Local opportunities for increased value creation





Geothermal EIP

- Geothermal can promote wealth of finical, social & sustainability opportunities exceeding what other renewables can
- GEIP and circular economy approach can lower the environmental impact of geothermal projects – Make them more likely to gain acceptance
- Requires systems thinking from the beginning
 - Planning
 - The business model (revenues, financing, risk, ownership.....)
 - Social license to operate
 - Create win-win case





The Case of Iceland







Primary Energy Use in Iceland 1968-2019





Source: Icelandic Energy Authority



Primary Energy Use in Iceland 1968-2018 in PJ











Development driven by economic reasons

Source: Orkustofnun



GEIP development in Iceland

Icelandic Energy Authority



RG

Orkustofnun Data Repository: OS-2020-T006-01

Geothermal Utilization in Iceland









The cost of heating 4 ha greenhouse

RG





ON Power





ON Power business concept

HS-Orka

HS Orka business concept

Landsvirkjun business concept

"Resource streams from geothermal electricity production

Companies who locate their operations near Landsvirkjun's geothermal power plants can acquire access to multiple energy and material streams as inputs to their production processes. A partnership with Landsvirkjun together with Iceland's friendly and competitive business environment can aid companies in building a competitive advantage. Contact power@landsvirkjun.com to discuss projects and ideas and for any additional information"

www.Landsvirkjun.com

https://www.landsvirkjun.com/productsservices/geothermal-resource-streams

Power to X

The single biggest factor improving quality of life in Iceland?

Power companies and social projects

GEIP – driving more sustainable cities

RG

The Future:

- From geothermal power plants to Eco-Industrial parks
- Improved energy efficiency
- Zero CO2
- Sustainability focus
- Branding
- Bio based industries

The Opportunity in East Africa

Conventional Geothermal Potential in GW_e

Source: Own calculations based on Stefansson, V., 2005: Estimate of the world geothermal potential. Proceedings World Geothermal Congress 2005 and The Global Volcanism Program database of Holocene Volcanos downloaded August 18, 2020.

Conventional Geothermal Installed in GW_e

Source: 2020 Geothermal Power Generation in the World 2015-2020 Update Report - Gerald W. Huttrer

Est. East Africa Geothermal Potential in MW_e

	Volcanoes	Est.	Undiscovered
	voicanoes	Potential	Est. Potential
Djibouti	1	158 MW	790 MW
Eritrea	5	790 MW	3.950 MW
Ethiopia	53	8.374 MW	41.870 MW
Kenya	21	3.318 MW	16.590 MW
Rwanda	1	158 MW	790 MW
Sudan	4	632 MW	3.160 MW
Tanzania	6	948 MW	4.740 MW
Uganda	7	1.106 MW	5.530 MW
Total	98	15.484 MW	77.420 MW

Population growth in Eastern Africa by 2100

Continent	Population (in millions of inhabitants)			Evolution	Evolution
	2019	2050	2100	2019-2050	2050-2100
Ethiopia	112.083	205.411	294.393	83.27%	43.32%
Tanzania	58.007	129.387	285.652	123.05%	120.77%
Uganda	44.271	89.447	136.785	102.04%	52.92%
Kenya	52,575	91.575	125.424	74.18%	36.96%
Mozambique	30.367	65.313	123.647	115.08%	89.31%
Burundi	13,126	28.668	62.661	118.41%	118.57%
Somalia	12,423	27.03	58.311	117.58%	115.73%
Rwanda	12.997	21.187	25.692	63.01%	21.26%
Eritrea	5.754	10.421	15.616	81.11%	49.85%
Djibouti	0.947	1,186	1,126	25.24%	-5.06%
Total population of Sub-Saharan Africa	342.55	669.625	1129.307	95.48%	68.65%
Total population of Africa	1 308.06	2 489.28	4 280.13	90.30%	71.94%

Source: FAO Global Perspectives Studies, using 2011 food balance sheets from FAO, 2016a.

Comments received during SEP

- Farmer male age 49. "We hope our locality could be tourist destination, farther widening off farming business opportunities to our women"
- Elder male age 67. "Our key problem is that the youth who have graduated from universities and college are now jobless" ... "industry that will contribute for the development in one or the other way."
- Farmer male age 55. "We are deprived of road, water supply, electricity, health service and almost everything." ... "Teachers are leaving schools because there is no drinking water"
- Farmer (former Soldier)— male age 40. "If you are telling that we will get light for our households that is ok, but everyone will get that light. I mean what will be a special benefit to this community due to this project?
- Farmer Female age 28. " As you have seen we have no potable water. We are using running water, which is dirty and causing a lot of disease to our children".... "I hope your project will assist us improving our road so that we will bet better transportation services. In that way we can easily move our products to the market and can sale for better price than we do here for local merchants."

Food Security Food Storage Water supply Space Cooling **Energy stability** Job creation Housing Health care **Higher Education Increased earnings** Increased tax revenue Increased value creation

Potential Impacts

SWOT

Strengths	Weaknesses	Threats
 Resource Manpower Agriculture East Africa Zone Large market 	 Legislation Infrastructure Red tape 	 Environmental Impacts Social impacts

Opportunities

- Leapfrog
- employment creation
- Innovation
- improving productivity
- Increased industrial output

Final thoughts

Sustainability will be the main driving force of change over the next decades

Geothermal energy can impact greatly on a local level

It requires the right approach:

- Shift of focus from individual power project to geothermal as the backbone of an industrial ecosystems

- Strong focus on local innovation, engagement with stakeholders and community
- Cooperation with research institutions, universities and entrepreneurs
- Legal environment that promotes systems thinking and encourages circular thinking

