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In my talk today I want to attempt to convince you that India needs to take full advantage of its geothermal resources that exist within the country.

Geothermal, as an energy resource is admittedly very little harnessed in global terms, however, in some countries, like mine, Iceland it has been an important energy resource for decades. In terms of its share in the global energy mix, it is absolutely minuscule.

The reason is quite simple and well documented and I will share with you today what I believe to be the solution to addressing this.

First, let me share with you Iceland's experience in harnessing its geothermal resources for the benefit of its people. Coming from the cold climate region of the North, Icelanders have used low temperature thermal water to heat houses since the early 1930's. By 1980's Icelanders began in a systematic way to harness high temperature resources, producing electricity, to a point where today 27% of all electricity in the country comes from geothermal and 73% from hydropower. I am thus very proud to say that 100% of electricity and house heating come from clean, sustainable energy resources setting my country apart from the rest of the world.

So why is geothermal such a miniscule energy resource in the global energy mix? The answer to that is the high up-front resource assessment risk, which requires public support, which for the longest time was nowhere forthcoming to neither developing nor emerging economies like India. The reason for that is because the geothermal risk profile is substantially more significant than the other renewable options. It is only very recently that multilateral institutions have begun to address this issue by creating specific Risk Mitigation Facilities, giving way forward for geothermal developers to create new projects.

This is somewhat puzzling in light of the fact that electrical production from geothermal resources is a mature technology, dating back to 1903 when Italy began electrical generation from the source. And because it is a mature technology, geothermal provides competitive energy prices where high-quality resources are well-defined. In a study conducted by The International Renewable Energy Agency, -IRENA in 2014, comparing renewable energy costs, it was found that the levelised cost of energy -LCOE of conventional geothermal power varies from USD 0.05 to USD 0.10/kWh for recent projects. However, the LCOE can be as low as USD 0.04/kWh for the most competitive projects, such as those, which utilize excellent well-documented resources or brownfield developments.

However, cost factors vary between the technologies, as cost structures are different and differ across regions, depending on overall framework conditions. This cost can also vary through time as technology changes. Additional items like, projected utilization rate, resources mix and capacity value, have also impact on decision making in each region. According to the U.S. Energy Information Administration on LCOE between different technologies it states that the geothermal sector is being the most price competitive in comparison to other energy sectors as the levelised cost is only 48 $/MWh and the next one being natural gas-fired conventional combined cycle with 66 $/MWh, or 38% higher. Wind is estimated as 80 $/MWh or 67% higher, hydro is estimated on 85 or 77% higher and other options beyond. (NEMS, US National Energy Modelling System, 2014). In my own country levelised cost of geothermal is slightly higher that hydro and significantly lower than other alternative sources, like wind or solar.

Keeping our focus on India there is nothing that indicates that key elements of geothermal development should not apply to the country. Mature technology and cost effective power generation. However, for a successful geothermal development to

take place there are other key components that need to be in place and may be lacking in India. Those would be factors like; effective and dedicated institutions that need to be in place, supportive policies and regulation schemes, which are often lacking. The third factor relates to access to risk mitigation facilities and access to suitable financing for developers. Lastly, there is a dire need for increased capacity in geothermal and that has to be a joint effort by the international community. Iceland has supported capacity building in geothermal for over 32 years, including in India, through the United Nations Geothermal Training Programme.

On risk mitigation and financing I want to say that over the past 5-6 years major efforts have been made through the multilateral system to address the problem of resource assessment risk. Iceland has undertaken a lead role in working with the World Bank on the creation of a risk facility for geothermal development. In 2012 the Ministry for Foreign Affairs of Iceland signed an Open Compact with WB specifically aimed at increasing geothermal deployment globally. Our own efforts are focused on East Africa where it is believed that hundreds of millions of people stand to benefit from geothermal electrification. Parallel the WB has created the Global Geothermal Development Plan –GGDP a multi-donor initiative, formally launched in Reykjavik on March 6th, 2013. These efforts have, to date capped or surpassed an allocation of $235 million for test drilling projects through the new Dedicated Private Sector Program window of the Clean Technology Fund, and the initiation of a pipeline of geothermal energy investments. This is a significant achievement, considering that historically, the vast majority of donor support for geothermal development was focused on above-the-ground infrastructure such as power plants and transmission lines. Funding for exploratory drilling was far below actual needs. The new CTF funding will facilitate private sector engagement in the earlier, costlier, and riskier stages of geothermal development, and will go a long way to getting geothermal off the ground in a number of countries. I believe that India needs to explore this option to a much, much greater extent.

Similarly, the German Government in cooperation with the EU and the German Development Bank –KfW has created the Geothermal Risk Mitigation Facility-GRMF for East Africa and is developing a second facility for Latin America. The objective of the Facility is to encourage public and private investors as well as public private partnerships to develop geothermal prospects for power generation in Eastern Africa by providing grants for two types of activity. Surface studies to determine the optimal location of reservoir confirmation wells at the most promising geothermal prospects. And drilling and testing of reservoir confirmation wells at the most promising geothermal prospects to assist Developers secure financing for subsequent reservoir confirmation and/or well field development wells.

It is significant that the multi-donor community is now supporting the upfront resource risk assessment of geothermal projects as is evident by the increasing number of projects that have been initiated around the globe. Secondly, this has also had important spill over to regular investment institutions that seek opportunities in the energy sector, as the know-how on financing of geothermal projects is rapidly expanding with very positive indications for private and public project developers.

On the two geothermal projects in India that have been under consideration one is the Puga Geothermal Project, in the Ladakh region of Jammu and Kashmir.

This project, which projects to first install a Pilot Plant of 5MW, eventually leading to a 30-50MW power plant serving an area of 56.000 km² that covers 70% of the State. Reviewing the planned project, it's apparent that it bears all the characteristics of a typical geothermal Greenfield project. There is a need for

necessary resource evaluation studies, including pre-feasibility, identifying the potential of the system through exploratory drilling of up to 2km depth. In addition and what makes this project somewhat different are the difficulties encountered by the fact that the area lies all the way up to 4,5km altitude in a harsh and hostile terrain permitting work for at the most 6 months in a year, with additional costs encountered by the need for a new transmission line.

A 30-50MW geothermal power generation from the Puga Geothermal project could give the population of Jammu and Kashmir access to a base-load (24/7), clean energy offering heating, electricity and eventually new economic opportunities for a population that, today has restricted access to power and heat. Last but not least, this project has the potential to replace the diesel generation in Leh Disctric, which is expensive and environmentally unacceptable.

India stands to benefit from using its geothermal resources where applicable. The technology is available, it is mature, the resource is a proven base-load, clean and sustainable and very cost effective thus calling for a consorted efforts by the Indian Government for securing risk mitigation and reconnaissance support from the Multilateral system like the World Bank and Asian Development Bank.