

The Svartsengi Resource Park

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ABSTRACT

The combined geothermal heat and power plant in Svartsengi, located on the Reykjanes peninsula, Iceland commenced its commercial operation in 1976. As early as in 1978 people suffering from psoriasis began bathing in the bluish colored geothermal fluid of a small lagoon adjacent to the power plant. The relaxation and relief people got in the lagoon initiated the development of the Blue Lagoon complex of today. Today the Blue Lagoon, one of the most popular tourist spots in Iceland comprises of a spa, psoriasis clinique and a research and a development centre. The spin offs of the power plant, the Blue Lagoon among those led to the definition of the concept Resource Park. The paper describes the development of the Svartsengi Resource Park and defines the concept. It is reasoned how HS Orka hf applies the concept to support the sustainable development of the society. It is highlighted how the concept endeavors to maximize the utilization of every resource, waste as little as possible, generate new ideas and minimizes the environmental impact of the activities.

1. INTRODUCTION

The Reykjanes peninsula, Iceland, a clear manifestation of the slow spreading zone of two tectonic plates, the North American plate and the Eurasian plate is the platform of the geothermal harnessing of the HS Orka hf energy company. For almost 33 years, HS Orka hf, a successor of Hitaveita Suðurnesja hf has today effectively harnessed the ground water and geothermal resources, as well as other valuable resources of the area. The geothermal power plant in Svartsengi was the first geothermal Combined Heat and Power plant (CHP plant) in the world. From the onset our determined focus was on a holistic harnessing of all available resources. The focus set on holistic usage of all available resources and sustainable development of the society resulted in the definition and institution of the concept Resource Park. Today, for almost three decades, the Resource Park Concept has been the major tool of HS Orka hf to endeavor to support sustainable development of the society and by doing so hoping to be a paradigm for entities harnessing geo resources.

2. DEFINITION OF THE RESOURCE PARK

In a way the paradigm of the Resource Park Concept is got from the American Indians and other aborigines honoring the great gifts of nature. The strong message we got from the aborigines is: harness every available resource, do not waste resources and one should do his utmost to harness the resources in harmony with the renewable mechanisms of the earth itself. The Brundtland report: "Our Common Future" was published in 1987, a decade after the Svartsengi power plant complex and the healing effect of the second flash geothermal fluid had been discovered. Our Common Future defining sustainable development as *the development that meets the needs of the present without compromising the*

ability of future generations to meet their own needs did open our eyes for the overall goal to be set for the Svartsengi operation. In 1988 – 1989 The Resource Park Concept was defined and instituted. Ever since the Resource Park Concept has been the guide line of HS Orka hf in harnessing available objective and subjective resources of the area. The Resource Park Concept consists of four main topics.

1. Integrated usages of a variety of subjective and objective resources of different nature.
2. The Resource Park has to equally accentuate ecological balance, economic prosperity and social progress and by doing so it fully supports the sustainable development of the society as defined by the Brundtland commission
3. The Resource Park is to bridge different technical and social cultures
4. The inherent time scale of the Resource Park activities is centuries.

In order to comprehend the concept some definitions are needed. Objective resource: land, geothermal reservoir, ground water reservoir, sea water resource, air, power plant, downstream facilities, integrated infrastructure of the power plant and downstream facilities (roads, workshops, stock buildings, vehicles), road system, airports, harbor and harbor facilities etc. Subjective resource: human resources, geographical and geological settings of the arena, macro and micro history of the arena, climate, cultural traditions, spiritual culture, political system, local and global environmental consciousness, school system, health care system, tourism culture, etc. The bridge: people of different cultures, working together have to respect and honor respective cultures and create a "common" culture, a "common" language both parties understand and accept. The common culture is not to tumble or poison the culture of the area in which the facilities will be built and operated. The common culture is to be looked at as a joint endeavor to further develop the existing culture in a positive and creative way. The time scale: Whereas the goal of the project (geothermal power plant and spin of activities) is to meet the needs of the present and needs of future generations one has to design the project /power plant in a flexible way. Key elements are: research and development, gather experience in a systematic way and transfer know how and experience effectively to the succeeding generation.

3. THE RESOURCE PARK AT SVARTSENGI

The operation at the Resource Park at Svartsengi commenced in 1977 with the startup of the first phase of the CHP complex comprising of two 1 MW back pressure turbine generators an four hot water streams, 12.5 MW_t each. Today the CHP complex comprises of 6 phases with total capacity of 75 MW_e and 150 MW_t. Today the main business units of the Resource Park are:

- The geothermal CHP plant, 75 MW_e and 150 MW_t
- The Waterworks, harnessing the vast ground water reservoir embedded in the lava field
- The Blue Lagoon spa, the most visited tourist spot in Iceland attracting last year 410.000 visitors from all over the world (population of Iceland 310.000).
- The Blue Lagoon Clinic, a dermatology unit treating people with psoriasis and various other kinds of skin disorder. At the clinic multiple research and development activities are undertaken.
- The Blue Lagoon mineral and biotech unit, R&D centre. At the R&D centre, silica and salts specially suited for the skin are precipitated from the geothermal brine and authentic blue green “geothermal” algae are grown. Various skin care products with the active components silica and algae are manufactured at the R&D centre. It has now been scientifically verified how silica in right form and the algae cure the different layers of the skin.
- The Blue Lagoon complex gets geothermal brine-condensate mixture from a special brine supply system at the power plant. The brine mixture flow is measured and sold by HS Orka hf to the Blue Lagoon Ltd.
- Eldborg the conference, education and tourist centre.
- ORF Genetics, manufacturing growth factors and hard-to-produce recombinant proteins, bypassing the use of bacterial or animal cell system. The host organism is barley grown in a green house located a short distance from the power plant.

A conventional power plant has only one revenue stream generated by sales of electricity. The Resource Park has multiple revenue streams which in a way means distributed financial risk. A progressive Resource Park heavily depends on uninterrupted research and development.

4. THE RESOURCE PARK AT REYKJANES

At the tip of the Reykjanes peninsula today, HS Orka hf has for 3 years operated a unique 100 MW (2X50 MW) sea water cooled condensing geothermal power plant (high steam inlet pressure, 18 barg). The power plant is the basic building block of a new “marine” Resource Park different from the one in Svartsengi. The business units already in place are:

- The Power Plant, 2X 50 MW_e.
- Power Plant Earth a tourist and exhibition center which is an integral part of the power plant building.
- Two fish drying facilities.
- Resource stream ~4500 l/s of ~60°C hot seawater mixture is currently released to the open ocean. The concept behind producing such a potential resource stream was to encourage business entrepreneurs to bring it to use, e.g. attempt to combine cultivation of algae for synthetic fuel and a warm water aquaculture that could **nourish** on the bio-waste from the algae.

There are also different and active research and development activities taking place at the premises of the power plant. The main R&D activities are: self cleaning heat exchangers, magnetic treatment of brine at 210°C, corrosion tests of metals, tests on turbine blades, static and dynamic (power generating turbine) brine washing of turbine blades, continuous monitoring of steam quality and scaling build up of the steam path of the turbines and more. The corrosion tests, tests on turbine blades and brine washing of the steam path of the turbines are done in close cooperation and led by Fuji Electric Systems.

5. DISCUSSIONS

One of many benefits of the Resource Park is the number of many well educated and well trained people it employs. At the Resource Park at Svartsengi there are in total around 180 people working and at Reykjanes there are today 25 to 30 employees. One way of looking at the Resource Park is to look at it as a black box with a number of different value streams on one hand going into the box and on the other hand going out of the box. Every in- and outgoing stream is defined as a value stream. This means for example that low grade heat and geothermal gas released to the atmosphere is looked at as valuable resource streams. *The CO₂ is a value stream.* One should never look at these streams as ineluctable waste streams. Today HS Orka hf is working in cooperation with specialized companies on several projects aimed to harness the low grade heat streams and the CO₂ streams from the two power plants. Projects worth mentioning are: sustainable fish feed (Artemia), aquaculture, methanol, growing algae for bio fuel, human and animal consumption, for the cosmetic industry etc. and more. In order to cope with the inherent time scale of the Resource Park Concept, HS Orka hf initiated the inevitable Deep Drilling Project in Iceland (IDDP). The main goals of IDDP area: harness supercritical deep seated reservoirs, heat sweeping by re-injecting geothermal fluid into the supercritical system and evaluation of the volume of the reservoir which can be harnessed. Whereas the reservoir at the tip of the Reykjanes peninsula is fed by sea water through faults and fractures on the ocean floor, IDDP adds valuable information on the geothermal systems/vents on the ocean floor.

6. CONCLUSIONS

Whereas the Resource Park Concept has proved to be successful for treading the bumpy road of sustainable development, HS Orka hf will continue to further develop the concept for the benefit of the company. One of the main learning gained is that it is wrong to look at the geothermal resource as a sole source of energy/enthalpy. Innovative thinking, research and development, interdisciplinary cooperation of different entities and entrepreneurial spirit are all vital components of an active Resource Park which is likely to bloom. Commercially the multiple revenue streams generated in the Park and distributed financial risk is of great importance. Holistic usage of every available subjective and objective resource in a sustainable way is the way HS Orka hf has taken and hopefully can other geothermal companies make advantages of this model.

Do what you can with what you have where you are.

If you can dream it, you can do it.

Nothing ages faster than the future.