

## Ecological Restoration of Construction Sites of Geothermal Power Plants

Magnea Magnúsdóttir

Orka náttúrunnar (ON), Bæjarháls 1, 110 Reykjavík

magneam@on.is

**Keywords:** Restoration, constructions, carbon emission, vegetation, sustainability

### ABSTRACT

Vegetation and soil in the Hengill area of Iceland were disturbed at the construction sites at Hellisheidi and Nesjavellir geothermal power plants. The disturbance was related to the establishment of buildings, drilling platforms, ditches, roads, etc. Restoration interventions have been implemented with the goal of minimizing disturbance to the land caused by constructions. Furthermore, the goal was to restore the disturbed sites with vegetation and soil like the local one prior to disturbance, thereby reducing the negative environmental impacts and to increase sustainability of the power production. In addition, by doing this, helping mitigate carbon emission due to construction, which puts its weight on reducing climate change. Methods such as turf relocation, hay and moss fragments dispersal have been used with promising results.

### 1. INTRODUCTION

Human standards of living today cause huge changes in Earth's ecosystems and there is less and less of wild nature to be found. The changes can cause loss of biological diversity, land degradation and loss of important ecosystem services (Millennium Ecosystem Assessment, 2005).

Construction of geothermal power plants causes several disturbances on the vegetation cover. Establishment of buildings, roads, drilling platforms, pipes, ditches, roads and storage areas are few examples of geothermal power plant infrastructure that can damage the environment and in some cases the disturbance can even be found far outside of construction areas.

Seriously damaged wildlands have lost control over their resources (i.e., soil, water, nutrients and organic materials) and the capacity for self-repair. They are less resilient to additional damage and are unable to prevent additional degradation (Whisenant, 1999). Ecological restoration is the process of assisting the recovery of an ecosystem that has been damaged, degraded or destroyed. It is an important tool to restore damaged vegetation cover and reduce loss of biological diversity (Aradóttir et al. 2011a.). Restoration methods that have been proven to be useful in Hengill area Iceland area: turf transplants, seed containing hay transfer and moss transfer (Aradóttir et al. 2011b; Magnúsdóttir, 2013). These are mainly the methods that are being used in restoration projects at Orka náttúrunnar (ON) Power Plants today. The methods and the results of the restoration projects will be described in this paper.

### 2. RESTORATION PROJECTS AT HENGILL AREA

The geothermal power plants in Hengill volcano are two: Hellisheidi Power Plant and Nesjavellir Power Plant. They are about 30 km east of Reykjavík. Both plants are in approx. 260 m elevation and the mean annual temperature is 2.9°C (Icelandic Meteorological Office, Reykjavík Iceland, unpublished data). Extensive moss heaths cover much of the area, but dwarf shrubs, heathlands, grassland and small wetlands are also found.

Construction of Nesjavellir Power Plant started in 1987 and Hellisheidi in 2001. Constructions are still going on as it is necessary to react on changes in geothermal activity and development of the power plants.

Ecological restoration is a normal procedure today during and after constructions at ON's Geothermal Power Plants in Hengill area Iceland. In the Hengill area, 152 ha have been restored with ecological restoration (Orka náttúrunnar, unpublished data).

#### 2.1 Native Turf transplants:

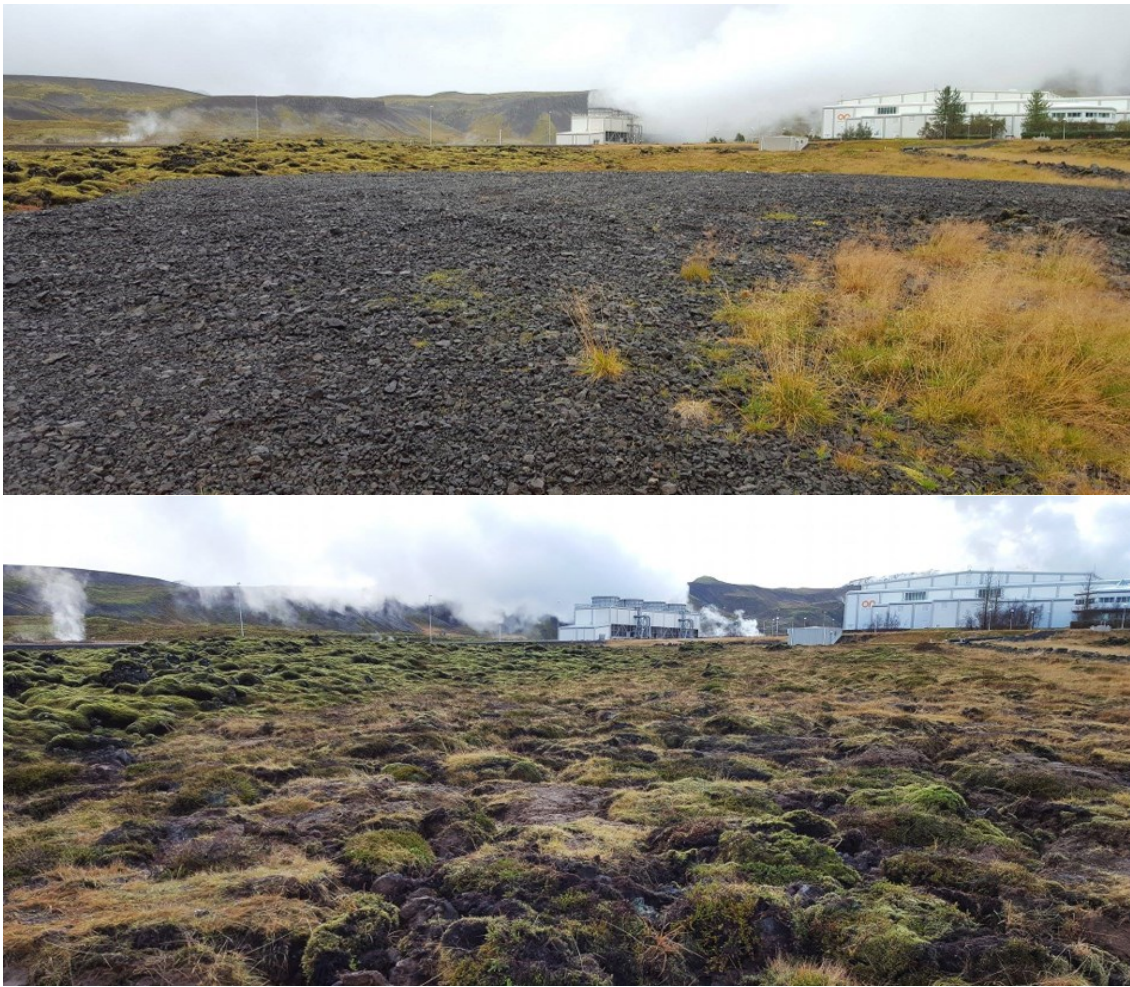
At ON's power plants in the Hengill area, vegetation cover has been removed during all constructions since 2013 and the vegetation turfs retained. The vegetation turfs are then either used at the same construction site for example on top of ditches (Figure 1) or road edges or relocated to an older disturbed area for example a drilling platform (Figure 2 and Figure 3) to restore heathlands or grasslands with good results as Figures 1, 2 and 3 show.



**Figure 1: Left: Vegetation cover is removed during constructions at Hellisheiði Power Plant and retained on the edge of a pipe ditch. Right: Native turfs one year after transplant on top of the same pipe ditch as in the picture on left. Photos: Magnea Magnusdottir**



**Figure 2: Vegetation cover removed during road constructions at Hellisheiði Power plant, transferred on a truck and transplanted on the edge of a drilling platform. Photos: Magnea Magnusdottir**



**Figure 3. A disturbed area at Nesjavellir Power Plant. Bottom: The same area one month after turfs were transplanted at the site relocated from a construction site nearby. Photos: Magnea Magnusdottir**

## 2.2 Seed containing hey transfer

Native grassland is cut during early in the fall, when the plants have developed seeds. In the hey there are seeds of the native plants, moss fragments and plant parts (Aradottir et al. 2011). The seed containing hay is then distributed over a disturbed area (Figure 4) to restore grasslands. The results are fast, and the native plants grow there quite well as Figure 4 shows.



**Figure 4. Left: A damaged site at Hellisheiði Geothermal Power Plant. Right: Same area as picture on left, two years after hay transfer distribution. Photos: Magnea Magnusdottir**

### 2.3 Moss transfer

Moss cover is removed during constructions, both as moss turfs and loose moss branches. The turfs are then transplanted, and the moss branches distributed over disturbed areas preferably on lava surface to restore moss heaths (Figure 5). The moss starts to grow on the lava fragments as soon as it was planted and distributed at the drilling platform (Figure 5).



**Figure 5. Left: A damaged site at a drilling platform at Hellisheiði Geothermal Power Plant. Right: Same area as picture on left, one month after moss turfs were planted and moss branches distributed. Prior to moss transfer, lava fragments were set on the restoration area. Photos: Magnea Magnusdottir**

### 4. DISCUSSION

The restoration methods used at Hellisheiði and Nesjavellir Geothermal Power Plants have been successful, and the native plants of the Hengill area have been restored at the construction sites where they have been applied as shown in Figure 1, 2, 3, 4 and 5.

The good results of the restoration projects at Hellisheiði and Nesjavellir Power Plants show that turf transplants, seed containing hey transfer and moss transfer are good methods to restore native plants at construction sites of Geothermal Power Plants. These methods can be used to minimize disturbance to the land caused by constructions. By restoring native plants and ecosystems, negative environmental impacts of the geothermal power production can be reduced, and the sustainability increased. By restoring native ecosystems, carbon emission due to construction are mitigated and restored areas start binding CO<sub>2</sub>. This puts its weight on reducing climate change.

### 5. REFERENCES

- Millennium Ecosystem Assessment: Ecosystems and Human Well-being - Desertification Synthesis. Prepared by World Resources Institute, Washington (2005).
- Whisenant, S.G.: Repairing Damaged Wildlands. Cambridge University Press. Cambridge (1999).
- Aradottir, Á.L., Halldorsson G.H.: Vistheimt á Íslandi. Landbúnaðarháskóli Íslands og Landgræðsla ríkisins. Reykjavík (2011a).
- Aradottir, Á.L., Grétarsdóttir, J.: Endurheimt staðargróðurs á röskuðum hálendisvæðum. Landbúnaðarháskóli Íslands (2011b).
- Magnusdottir, M.: Mosþembur: Áhrif rasks og leiðir til endurheimtar (M.Sc. thesis). Landbúnaðarháskóli Íslands (2013).