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**CREATING A FRAMEWORK FOR ASSESSING THE SUSTAINABILITY OF
GEOTHERMAL ENERGY DEVELOPMENTS**

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Overview

Sustainability assessment is a means of showing the progress of development projects towards or away from sustainability. Sustainability assessments are used for many different types of project, including energy developments. Various assessment tools, many of which involve the use of sustainability indicators, exist from the national level, to the local level.

Sustainability indicators are useful tools for informing decision-makers about the progress of certain policies towards sustainable development (Devuyst, Hens, & Lannoy, 2001). The need for the development of sustainability indicators is clearly set out in Agenda 21 and was taken up by the United Nations Commission for Sustainable Development (CSD) (Pinfield, 1996). There have been further calls in the literature for the use of sustainability indicators as a means to measure sustainability.

Indicators must provide a holistic view of sustainability. Furthermore, as well as requiring indicators, sustainability criteria or goals are also important in providing a sustainability measurement. Such criteria and indicators should not be rigid but take account of the local context as well as changes in opinions over time (Lim & Yang, 2009).

Global energy demand is predicted to grow by more than one-third by 2035, with China, India and the Middle East accounting for 60% of the increase (International Energy Agency, 2012). The use of alternatives such as geothermal energy is set to increase, since the world has only a finite supply of fossil fuels. In 2008, geothermal energy represented around 0.1% of the global primary energy supply, but estimates predict that it could fulfill around 3% of global electricity demand, as well as 5% of global heating demand by 2050 (Intergovernmental Panel on Climate Change, 2012).

Given the unique issues associated with geothermal energy projects, a specialized assessment tool is required to ensure that geothermal projects will be properly guided into following best practices.

The aim of this paper is to describe the initial steps in the development of an assessment protocol for geothermal energy projects. The paper will describe the need for such an assessment protocol and the various methods used in creating it through a case study in Iceland. The results of the development process are discussed, along with the advantages of the process as well as potential room for improvement and further work.

Methods

A sustainability assessment framework consists of a set of sustainability goals and indicators that allow monitoring of geothermal projects during their entire life-cycle.

Guiding principles known as the Bellagio STAMP (IISD, 1997) were incorporated into the entire development process. A literature review of the impacts of geothermal energy projects on sustainable development (Shortall, Davidsdottir, & Axelsson, 2014) was carried out in order to determine the boundaries of the system that the assessment framework was intended for. Following the literature review, an initial, small group of stakeholders was gathered to brainstorm a set of possible sustainability goals and indicators. This set of goals and indicators provided a starting point for which further stakeholder input would be sought later in the process.

The goals and indicators in this framework were developed using an iterative process for thematic indicator development (Davidsdottir, 2007), with the intention of carrying out iterations in a number of different locations.

One iteration consists of choosing sustainability goals and indicators guided by stakeholder input; calculating the indicators in a trial assessment of an operational geothermal project and finally evaluating the indicators for suitability. The purpose of the iterative approach is to allow the progressive refinement of the indicators following each iteration.

Stakeholder engagement methods were used to supplement the steps of the first iteration of the development process, from the setting sustainability goals to the choosing of sustainability indicators. The Icelandic stakeholder engagement process consisted of a pre-engagement “World Café” workshop and a Delphi survey.

The Icelandic case study presented in this paper represents the first iteration of the indicator development process. Further iterations are to be carried out in various countries to further refine the indicator set.

Results

Following a pre-engagement World Café workshop, in which an initial set of sustainability goals and indicators was produced, a Delphi survey of three rounds in total was conducted. In Round 1, participants were presented with an initial set of goals and indicators and asked to rate and comment on each one. In this instance, goals and indicators had already been suggested in the pre-engagement workshop as a starting point for the Delphi. In Round 1, participants were also given the opportunity to suggest new goals or indicators.

After each round, the facilitators modified the list based on ratings and synthesized comments. Comments on reference values or perceived relevance of goals and indicators were taken into account. New goals and indicator suggestions were also incorporated into the modified list.

In general, goals and indicators with a mean score below 3 were discarded. Items with a low score but high standard deviation were resubmitted to the next round if there was evidence that more information or a modification could result in a different score.

The sustainability goals and indicators that the stakeholders selected were then implemented in a trial assessment, using data from the Nesjavellir geothermal power project. The indicators were evaluated for suitability to their purpose using a set of suitability criteria.

Conclusions

The first iteration of the indicator development process has been completed in the Icelandic context. Stakeholders have provided input into a set of sustainability goals and indicators for assessing the sustainability of geothermal energy projects. Several ways to improve the indicator development process have been identified as a result of this first iteration. Further iterations will be carried out in New Zealand and Kenya before a final set of goals and indicators is produced.

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