**Sheet 1**

**Soil remediation versus soil energy:**
**Conflict or opportunity?**

I would like to tell you something about the traditional clash between the need for soil remediation and the use of aquifer thermal energy storage to produce sustainable energy from soil. I will also show you how recent Dutch developments resolve this clash and create unique new opportunities for both soil remediation and sustainable energy in the Netherlands.

**Sheet 2**
The Netherlands has numerous contaminated sites, especially in our cities. Contaminations are often serious and therefore expensive to clean up, especially when reaching to greater depths in the groundwater. In many cases this leads to excessive costs and a reluctance to tackle this problem. This leads to stagnation in urban development.

**Sheet 3**
The Netherlands also has great ambitions in the field of energy savings and the limitation of greenhouse gas emissions (30% reduction compared to 1990). One of the techniques increasingly used for this in buildings is the ground source heat pump. Especially open loop systems also called aquifer thermal energy storage are popular in the Netherlands. These are highly suitable to heat and cool office buildings and are frequently used in the inner cities. Here however their usage collides with contaminated sites and would lead to unacceptable spreading of this contamination. This usually means no permit can be given and builders have to choose less sustainable systems to heat or cool their building.

**Sheet 4**
Before we examine this further, I shall give you some information on how this technique works. Although this sustainable energy technique has become relatively common, it is still far less well known than solar energy or wind energy for instance.
There are two basic types of ground source heat pumps. Closed loop systems and open loop systems. In this diagram I show you the closed loop system.

Closed loop systems run two or more loops through the soil, through which a coolant fluid is pumped. It uses the natural temperature of the subsoil (approximately eleven degrees centigrade) to cool buildings in summer. In winter it operates with a heat pump to heat the building instead.
Closed loop systems are used all over the world and in many European countries. They are best suited to heating single houses or small buildings.

**Sheet 5**
Open loop systems are less used worldwide, but are especially popular in the Netherlands. We have over a thousand such systems installed and their number is growing by more than ten percent yearly without government funding. This is not surprising since these systems pay back their initial investment in five to fifteen years due to the savings in energy costs.
Our soil is exceptionally well-suited to this technique due to its many sandy layers alternated with clay layers, which provide excellent opportunities for using ground water. Open loop systems pump ground water from a heat well to warm the building in winter and pump the cooler water back to the cold well. In summer the cold water is pumped up to the building and the warmer water goes back to the warm well. This so-called aquifer thermal energy storage freely boosts the amount of sustainable energy available and the energy savings of the system. Open loop systems are best suited for offices, housing property upwards of 30 to 50 houses, greenhouses and so on.

**Sheet 6**
I told you the use of ground source heat pumps grows by more than ten percent yearly. The Dutch government has chosen to further boost this amount by reducing the current procedural difficulties associated with permits. In addition, local and provincial governments are encouraged to actively pursue spatial planning of their subsurface space. This should lead to

a more optimal use of available space. Open loop systems take up a lot of space and in cities this causes a buildup of space claims in relatively small areas. Careful planning frees up room for more of them in the same area.

**Sheet 7**
As I told you in the beginning of my presentation, the use of open loop systems often collides with soil contamination sites, especially in the inner cities where office blocks are built and rebuilt. Until recently, this meant the technique had to be forbidden when this occurred, with a resulting loss in affordable sustainable energy opportunities. Their use would cause an unacceptable spreading of groundwater contamination, which in the Netherlands is forbidden by law.

**Sheet 8**
Until recently I said, because new Dutch developments have turned this situation upside-down. On the former Philips terrain in Eindhoven a new way of using ground source heat pumps is currently being built. What you see on the picture is a groundwater contamination actively being contained by abstracting groundwater along the edges and inserting it back in the middle. At the same time, the system draws its heat and cold from the groundwater and produces sustainable energy.

This is a double win situation. On the one hand it becomes possible to install climate friendly techniques in contaminated areas. On the other hand serious groundwater contaminations become more affordable to treat due to energy savings. You will not be surprised that our government is very excited about this development and that several other projects have already been started.

**Sheet 9**
In fact, there may even be further reaching possibilities. Tests are currently underway to find out if open loop systems can actively add to the soil remediation process. By mixing up the groundwater it may become more easy to promote the natural breakdown of contaminants by micro-organisms. This has been called the bio-washer in our city of Utrecht. In the coming years we will research the effectiveness of this approach and if successful will likely see a lot more of this in years to come.

**Sheet 10**
Resume
The advantage is for the environment:
Heat and cold storage increases and the $CO_2$ emission decreases
Quality is guaranteed
The soil is using sustainable

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