wind turbines and reselling it during the peak demand of summer afternoons. Anecdotally, wind farms are said to actually pay grid operators to take their power at night. Wind power specialists, like Green Mountain Energy, sell wind energy at retail for $0.19 / kw-hr during the day. Thus, there exists an opportunity to gross roughly $0.20 / kw-hr with a twelve hour storage system. This could be quite a profitable enterprise if the storage technology is inexpensive enough. The economics of existing technologies make this a marginal proposition at best in an environment of tight capital markets and demand for high internal rates of return.

[0010] In many areas, there is also a shortage of fresh or potable water. One of the prime methods for desalination of water is reverse osmosis. This process requires pressure to overcome the osmotic pressure of salty water and force the water through a semi-permeable membrane. Thus, additional opportunities exist for combining storage technology and desalination technology.

BRIEF SUMMARY OF THE INVENTION

[0011] The present invention uses wells to store fluid at high pressure in hydraulic fractures in the earth. The fluid is used in conventional equipment to produce power as the fluid is produced back from the well. The walls of the fracture may be made less permeable and the propagation pressure of the fracture may be increased by injecting a resin, such as epoxy, into the fracture. The storage capabilities, capital requirements and anticipated rates of return that enable a profitable operation for distributed resources and load management, as well as overnight arbitrage of wind power, are described. If the stored fluid is saline water, such as water produced from strata in the earth, and there is demand for fresh water, a selected fraction of the saline water produced from the storage capacity may be directed to a reverse osmosis unit for desalination. The present invention uses wells to store fluid at high pressure in hydraulic fractures in the earth. The fluid is used in conventional equipment to produce power as the fluid is produced back from the well. The walls of the fracture may be made less permeable and the propagation pressure of the fracture may be increased by injecting a resin, such as epoxy, into the fracture.

[0011a] A first aspect of the present invention provides a method for storing and producing energy and desalinating water. The method includes pumping water containing a dissolved salt down a well at a pressure greater than fracturing pressure and into a hydraulic fracture in a rock formation around the well, before leak-off of the water

containing a dissolved salt from the hydraulic fracture, reducing pressure in the well so as to produce a portion of the water containing a dissolved salt up the well as produced water and using pressure of a first portion of the produced water to generate power and using pressure of a second portion of the produced water to desalinate the second portion of the produced water.

[0011b] A second aspect of the present invention provides a method for operating an electric grid system. The method includes generating electrical power during optimum production periods for the electric grid system, using a portion of the electrical power generated during optimum production periods to pump water containing a dissolved salt at a pressure greater than the fracturing pressure into a hydraulic fracture in the earth, during a non-optimum production period, producing the water containing a dissolved salt from the hydraulic fracture and using the pressure of a first portion of the water containing a dissolved salt to generate electrical power for the electric grid system, and using pressure of a second portion of the water containing a dissolved salt to desalinate the second portion of the water containing a dissolved salt.

[0011c] A third aspect of the present invention provides a method for desalinating water. The method includes pumping water containing a dissolved salt down a well at a pressure greater than fracturing pressure and into a hydraulic fracture in a rock formation around the well, before leak-off of the water containing a dissolved salt from the hydraulic fracture, reducing pressure in the well so as to produce the water containing a dissolved salt up the well as produced water and using pressure of the produced water to desalinate the produced water.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 shows the diurnal wind pattern at Wildorado, Texas

[0013] FIG. 2 shows energy storage technologies costs and efficiencies.

[0014] FIG. 3 shows distributed utility applications and renewables matching.

[0015] FIG. 4 illustrates a hydraulic fracture in the earth and equipment for forming it.

CLAIM(S)

I claim:

1. A method for storing and producing energy and desalinating water, comprising:

pumping water containing a dissolved salt down a well at a pressure greater than fracturing pressure and into a hydraulic fracture in a rock formation around the well;

before leak-off of the water containing a dissolved salt from the hydraulic fracture, reducing pressure in the well so as to produce a portion of the water containing a dissolved salt up the well as produced water and using pressure of a first portion of the produced water to generate power and using pressure of a second portion of the produced water to desalinate the second portion of the produced water.

2. The method of claim 1 wherein the first portion and the second portion of the produced water are varied as produced water is produced up the well.

3. A method for operating an electric grid system, comprising:

generating electrical power during optimum production periods for the electric grid system;

using a portion of the electrical power generated during optimum production periods to pump water containing a dissolved salt at a pressure greater than the fracturing pressure into a hydraulic fracture in the earth;

during a non-optimum production period, producing the water containing a dissolved salt from the hydraulic fracture and using the pressure of a first portion of the water containing a dissolved salt to generate electrical power for the electric grid system; and

using pressure of a second portion of the water containing a dissolved salt to desalinate the second portion of the water containing a dissolved salt.

4. A method for desalinating water, comprising:

pumping water containing a dissolved salt down a well at a pressure greater than fracturing pressure and into a hydraulic fracture in a rock formation around the well;

before leak-off of the water containing a dissolved salt from the hydraulic fracture, reducing pressure in the well so as to produce the water containing a dissolved salt up

the well as produced water and using pressure of the produced water to desalinate the produced water.