Building a SEED Park: Part V – Water

A Sustainable Environmental and Economic Development Park, SEED Park, will require water to operate. Water will be required for primary production (plants), for secondary production (animals, including fish), for processing of products, for heating and cooling, and for domestic use. The San Luis Valley is blessed with an abundance of ground water, including geothermal water, but is extremely short of rainfall with only 7 inches/year. A SEED Park could recycle wastewater, the nutrient-rich discharge from wastewater treatment plants, runoff from animal feeding operations, and discharges from on-site processing operations. Additionally, many industrial processes such as the production of electrical energy from fossil fuels and the processing of corn into ethanol, exhaust heat into the atmosphere by evaporation of water. Condensation of water vapor yields distilled water. Also, internal-combustion engines fueled by hydrogen produce water vapor as the only exhaust emission. Condensation of this water vapor could be another source of distilled water.

If we compare the intrinsic value of water to that of petroleum fuels, water is much more valuable. Today, the world uses about 1.3 trillion gallons of oil per year, but we use 3.9 trillion gallons of water each day. In the US, each person uses an average of 176 gallons of water per day. Compare that to water availability in Africa where the average is only 5 gallons per family per day. There is no substitute for water. There are many substitutes for energy and, especially, fossil fuels.

Most of the ground water withdrawn annually in the United States is used to support irrigated crops and is the life-blood of rural America today. The growing urban population, and the political power therein, is diverting water from rural American to urban areas. Rural America must find ways to use water more efficiently. For example, Peter Doyle of New Zealand has calculated that every $100 worth of rice produced requires 196,263 gallons of water. One hundred dollars worth of cotton requires 42,105 gallons of water; for beef cattle, the figure is 21,368 gallons. However, hydroponic production of fruits and vegetables requires only 158 gallons of water to produce $100 worth of produce. Water requirements for producing $100 worth of crops in the San Luis Valley, and perhaps much of the US, are probably similar to those of New Zealand.

Jim Bordovsky, Texas Agricultural Experiment Station-Plainview, TX, has conducted research trials documenting yield of corn, sorghum, picker cotton and stripper cotton as influence by the amount of water applied to the cropland. Within the range tested, yields typically increased with increasing amounts of water. A yield of corn at 10,000 lb/A required about 27 inches of water, but increasing water to about 38 inches increased yield to about 12,500 lb/A. Water applied at to sorghum at about 25 inches annually produced a yield of about 7500 lb/A. Twenty-five inches of water produced a yield of picker cotton lint of about 1,700 lb/A whereas, with stripper cotton, the yield was only about 1,200 lb/A.

Water Requirements for Crops
Southern High Plains of TX

	H_2O (gal)/$100
Cotton (stripper)	106,396
Corn	102,390
Sorghum	81,004
Cotton (picker)	76,085

*Based on data from Jim Bordovsky, TX Ag. Exp. Station-Plainview, TX

Ethanol plants, dairies, and confined animal feeding operations, such as cattle feedlots, swine production facilities and large poultry operations are visible components of big-time corporate farms. Many small, rural towns seek to attract these operations to secure jobs and increase the local tax base. The operations are dependent upon an adequate supply of dependable water. How much water is required to support these operations?

Water into Energy

1.8 gal ETOH = 1 gal gasoline
2,398 gal H2O = 1.8 gal ETOH

therefore
2,398 gal H2O = 1 gal Gasoline

It requires nearly 2,400 gallons of water to produce ethanol with the energy equivalent of 1 gallon of gasoline.

Consider milk – every gallon of milk requires about 38,684 gallons of water for the production process. That includes water for the cows to drink, water to clean equipment, cool the milk, and to flush out the manure and urine from the barns. That figure

does not include the water required to produce the feed crops supplied to the cows.

At this time, ethanol appears to be the economic engine of focus to produce renewable fuels. How much water does it take to produce ethanol with the energy equivalent of one gallon of gas? It takes about 1.8 gallons of ethanol to yield the energy equivalent of one gallon of gasoline. A bushel of corn will produce about 2.3 gallons of ethanol, but takes about 3,000 gallons of water to produce 1 bushel of corn. Once the corn is in the ethanol plant, another 13 gallons of water are required to convert a bushel of corn to 2.3 gallons of ethanol. On a per-gallon basis, 1.8 gallons of ethanol requires 2,398 gallons of water to produce the energy equivalent to 1 gallon of gasoline.

The San Luis Valley does not overlay the Ogallala aquifer, but parts of Eastern Colorado and seven other states do. Pumping of irrigation water from the Ogallala aquifer began around 1940. Water in the Ogallala represents an accumulation of over 100,000 years. In 67 years, the water in some areas has been drawn down to one half of the 1940 level. In some other areas, irrigation from the Ogallala is economically unfeasible today due to the depletion of the ground-water. Water pumpage from the Ogallala Aquifer (about 12 billion m^3/yr) is equal to the flow of 18 Colorado Rivers. As water levels in the Ogallala are drawn down, as the population grows, and with global warming there will be increasing pressures to move water from the San Luis Valley to outside the Valley. How much longer can we pump ground water at the present rate without jeopardizing adequate supplies for the future? Water use throughout the world has increased as the population has increased. Today nearly 25% of the world's population does not have a dependable water supply. Nearly 3 billion people in the world, or almost half of the people in the world, do not have a latrine and certainly not a toilet.

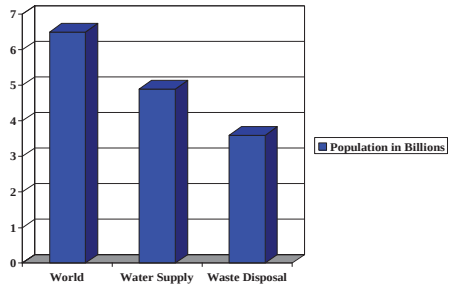
Ogallala Aquifer

Depleted at 12 billion m^3/yr = the flow of

18 Colorado Rivers

Water withdrawal from the Ogallala Aquifer is at a rate far greater than that of the annual recharge.

Population

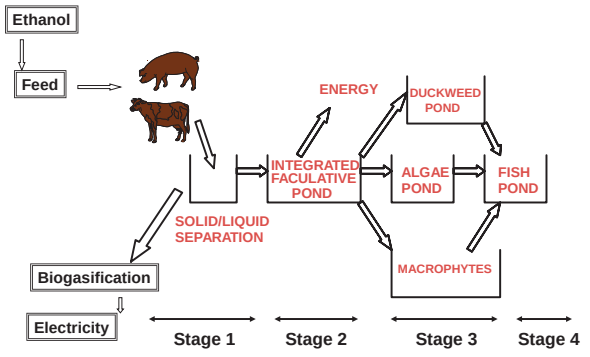


Over 1 billion people in the world do not have a dependable supply of water and 2.9 billion do not even have latrines or toilets for waste disposal.

Residents of the San Luis Valley are blessed with water and have fought diligently to keep water in the valley. As the supply of water decreases and its value increases, some may be inclined to sell water for transport out of the Valley. As water is pumped out of the Valley along with it goes the social fabric of the Valley. Water within the Valley is essential for jobs, for agriculture, industry, domestic use, population stability and potential growth. These commercial activities are essential to support the social fabric of communities, including schools, hospitals, government, merchants, parks, and highways. A SEED Park is one way to derive local value from the water resources and retain the social fabric of the Valley.

Making the most of water resources is both environmentally and economically the right thing to do. In a SEED Park, the waste stream, including nutrient-rich water, is discharged from one operation to become a major input in the next downstream operation. For example, water discharged from a dairy, a feedlot, or a city is rich in nitrogen and other nutrients. This stream of water containing waste materials including ammonia, or other forms of nitrogen, phosphorus and potassium is liquid fertilizer available to support plant growth. Runoff from the plants can be used to support production of fish, alligators, snails, or other

POTENTIAL INTEGRATED DESIGN



aquatic-based organisms. Discharge from these cold-blooded animals contain no coliform bacteria and, therefore, can be used to support food crops such as herbs, vegetables, and other produce.

A SEED Park can have a series of natural resource-based businesses recycling one of our most precious resources – water. I'm sure that you can think of many other opportunities for water conservation and recycling.