The Central Arizona Project (CAP) versus Groundwater: A Comprehensive Look at Arizona’s Water-Energy Nexus Between the Two Systems

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Abstract:
- The arid region of southern Arizona gets its water from two main sources; the Central Arizona Project (CAP) and pumping groundwater.
- The C.A.P. requires 688,000 MWh per year to pump 215,000 acre feet of water.
- Pumping 135,000 acre feet of groundwater requires 162,000 MWh per year.
- Pumping groundwater is about 50% more efficient than using water from the C.A.P., the C.A.P. isn’t as economically sustainable as pumping groundwater. However, it is more environmentally sustainable especially for Arizona’s water needs.

Introduction: The CAP side
- Water is a scarcity in Arizona. Due to the depleting amounts of water being fed from the Colorado River and a growing population, water’s importance to the Tucson community is more prevalent than ever.
- The Central Arizona Project (C.A.P.) provides 55% of the state’s water. It diverts water from the Colorado River and runs it through 14 pumping plants, 39 radial gates, 50 turnouts, and 1 generating plant (May).
- Since Tucson is located in southern Arizona and relies mostly on water from the C.A.P. The water must travel over 336 miles and be elevated over 2900 feet over that course to finally get to Tucson from Parker (Dwyer).

Introduction(continued): the Groundwater side
- The remaining 45% of Arizona’s water comes from groundwater as stated in the Arroyo article produced by the Water Resources Research Center at the University of Arizona. And 39% of water in Tucson comes from groundwater.
- Although the groundwater is already in the southern Arizona region, factors such as pumping, collection, distribution, and treatment must be taken into account.
- With no immediate renewable water sources near the southern Arizona region, it takes a lot of energy to extract and treat that water.
- Because all of these processes use energy, the water-energy nexus in Arizona is becoming increasing important.

Materials and Methods:
- The assignment was split into sections between group members; in pairs of two the assignment was split between CAP and groundwater to effectively research both.
- For groundwater research, the materials were found primarily using the University of Arizona’s Library, The Science and Engineering library, Main library, and the database WorldCat all proved useful in the researching process.
- Two interlibrary loans were completed throughout the ILL office at the U of A library to obtain two books, one of which was borrowed from the University of Arkansas.
- The information for C.A.P. was gathered using the Internet, C.A.P. videos, C.A.P. pamphlets, and the online U of A library and cited by www.refworks.com. Dr. Riley, an awesome professor assisted by providing C.A.P. videos and pamphlets, which can also be found at the nearest C.A.P. site in west Tucson.

Results: CAP
- The only pump generating plant for the CAP lies at the border between Arizona and California at Parker Dam. There, four generators produce 30,000 kwh each amassing to a 120,000 kW energy output. The C.A.P. also gets power from the Navajo Generating Station, which it owns a 24% share of the station’s 2250 MW energy output (Lamberton).
- To get water from Parker to Tucson takes 9.8 kWh of energy per 1,000 gallons of water. There are 32,585 gallons of water in an acre foot, which means that it takes about 320 kWh to transport an acre foot of water to Tucson. The average amount of energy it takes to transport water from the C.A.P. is 5.5 kWh per 1000 gallons, or 3792 kWh per acre foot. The reason Tucson’s energy requirement is so much higher is due to its elevation.

As the figure above shows, the route that the C.A.P. takes begins with a slight incline, and then moves to an exponential incline. This has a direct correlation with the amount of energy it takes to transport the water.
Results: CAP (continued)

- The C.A.P. distributes 215,000 acre feet of C.A.P. water to Tucson every year, with 38,300 acre feet of that water going to the Native American Reservations. This means that it takes 688,000 MWh to transport all of Tucson’s C.A.P. water to Tucson annually.

Results (continued): the conclusion?

According to our results, it takes the C.A.P. 688,000 MWh to transport 215,000 acre feet of water annually while pumping groundwater takes 162,000 MWh to transport 135,000 acre feet of water annually. This means that in Tucson, pumping groundwater is 52% more efficient than using the C.A.P. for fresh water.

Conclusion:

- Pumping groundwater is a more energy-efficient and economical source of water for Tucson. The long distance and difference of elevation between the start of the C.A.P. in Parker and Tucson is too much of an obstacle to be an efficient form of obtaining water for southern Arizona residents. This is not to say that the C.A.P. should be abandoned, however. The C.A.P. offers hundreds of jobs to many Arizona residents, thus stimulating Arizona’s economy while providing a necessary resource to southern Arizona.

- Despite the economical disadvantages of transporting water using the C.A.P., it is vital that Arizona utilizes both of these resources in order to supply its ever-growing population with clean, pure water.

Discussion:

- The C.A.P. allows millions of people the chance to have clean water, without having to pump it from a local well, it comes straight from the Colorado River. The energy used for ground water however is more efficient because the only energy required is to pump, clean, and transport.

- The amount of energy it takes to pump and transport that water from an elevation of 423 ft. in Parker to 2.389 ft. in Tucson using C.A.P. is massive.

- Groundwater is mainly used for agriculture and irrigation and the uses of groundwater are not limited to just that; they may equally overlap the uses of water that are utilized from the C.A.P. as well. Groundwater is relied on as a long-term source to fill in any shortcomings by the C.A.P.

References/works Cited: