



Molten Salt Reactors and the Water Problem

How High Temperature Nuclear Reactors Can Drive the Water/Energy Nexus

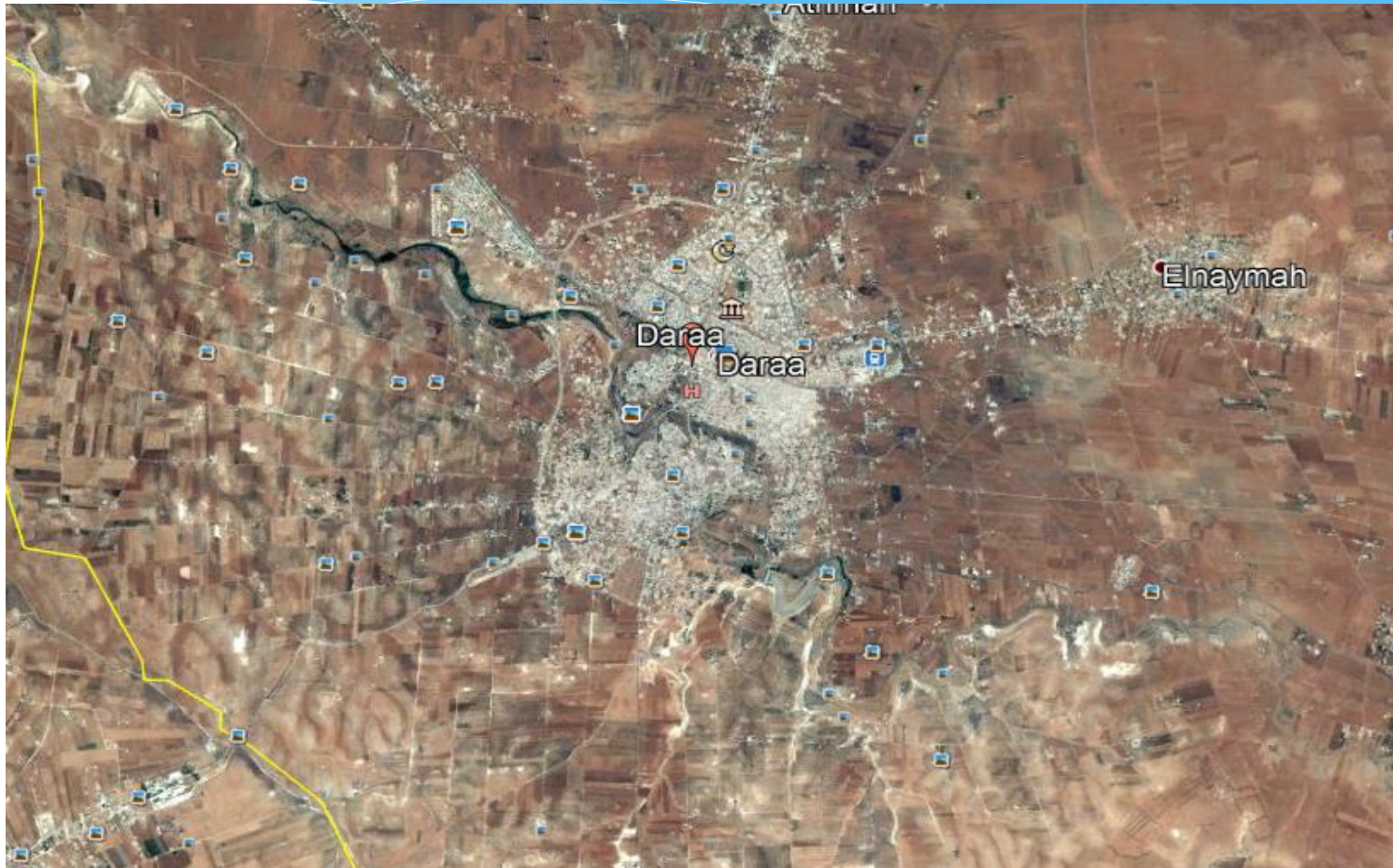
The Water Problem

- * During the 1960's the idea of using nuclear energy to cogenerate electricity and fresh water was seriously considered based on current cost estimates for nuclear power.
- * These plans foundered because of a lack of support for nuclear power, and increased costs for conventional reactor design.
- * Now, things might be different.

Welcome to the age of eco-refugees

- * In places like the Middle East wars and revolutions are tied directly to water shortages.
- * Daraa Syria, the birthplace of the Syrian revolt was drought stricken (see next slide)
- * Families driven from their farms by loss of irrigation rights, became impoverished and started graffiti campaign.
- * This was the start of the revolt
- * Syria has no fossil fuels and not enough energy to desalinate water conventionally.

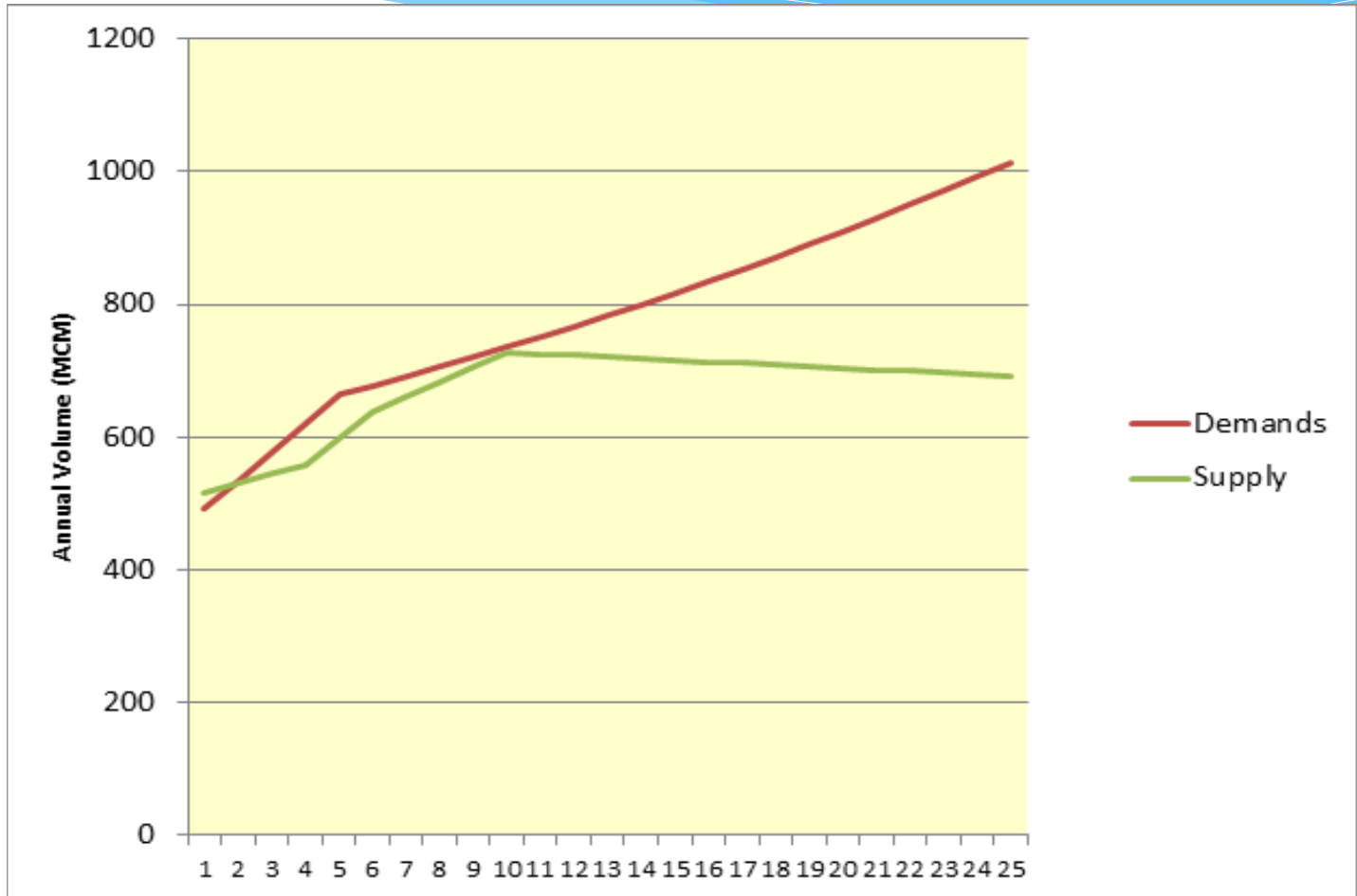
Daraa, Syria



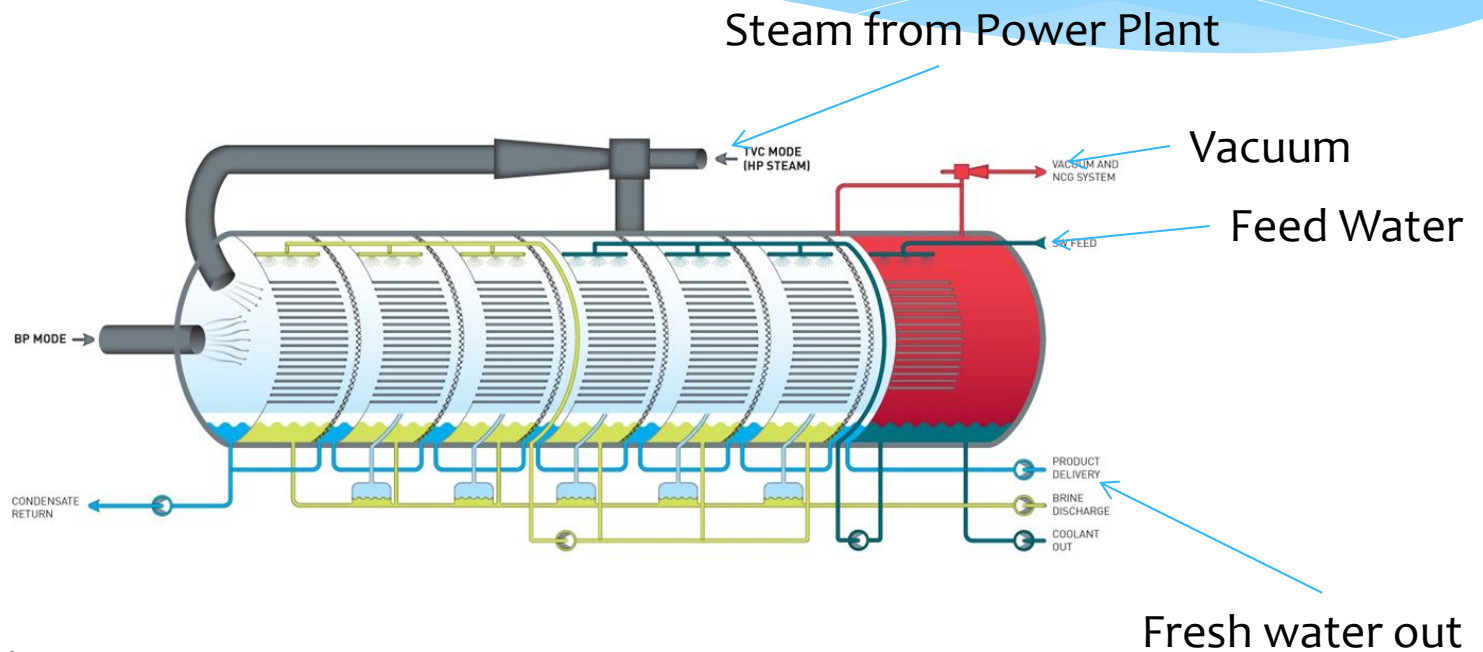
Or Consider Jordan

- * Last refuge in the Middle East
- * Has absorbed refugees from Palestine, Iraq, and Syria
- * Population is over twice the planned size
- * Water supplies can not keep up
- * Power supplies are inadequate as well
- * Jordan has no oil or gas and must import all of their fuels
- * They don't have enough water for conventional pressurized water reactors

Water Demands and Supplies in Jordan

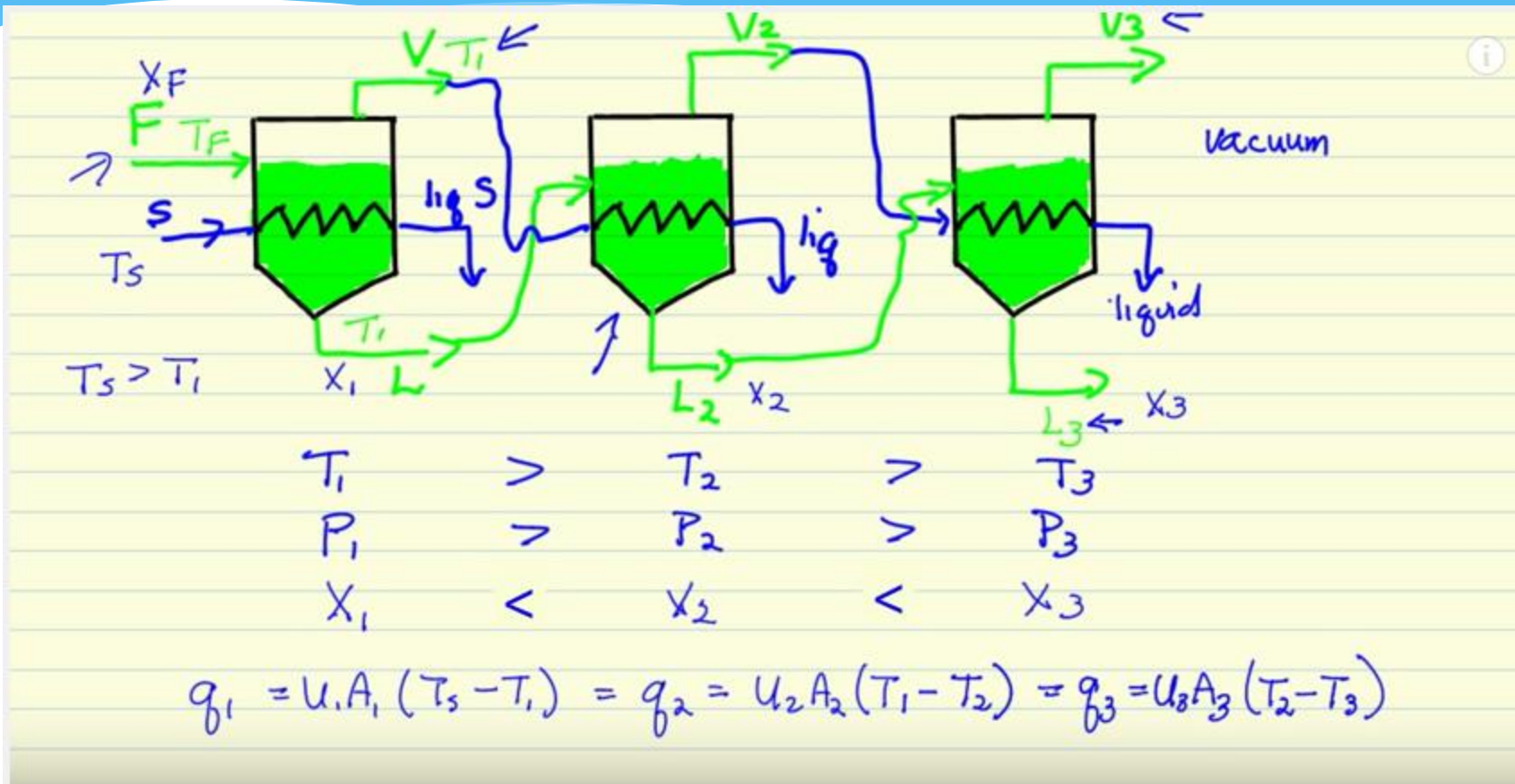


MED Thermal Desalination



Source: IDE, Inc.

Simplified diagram of MED

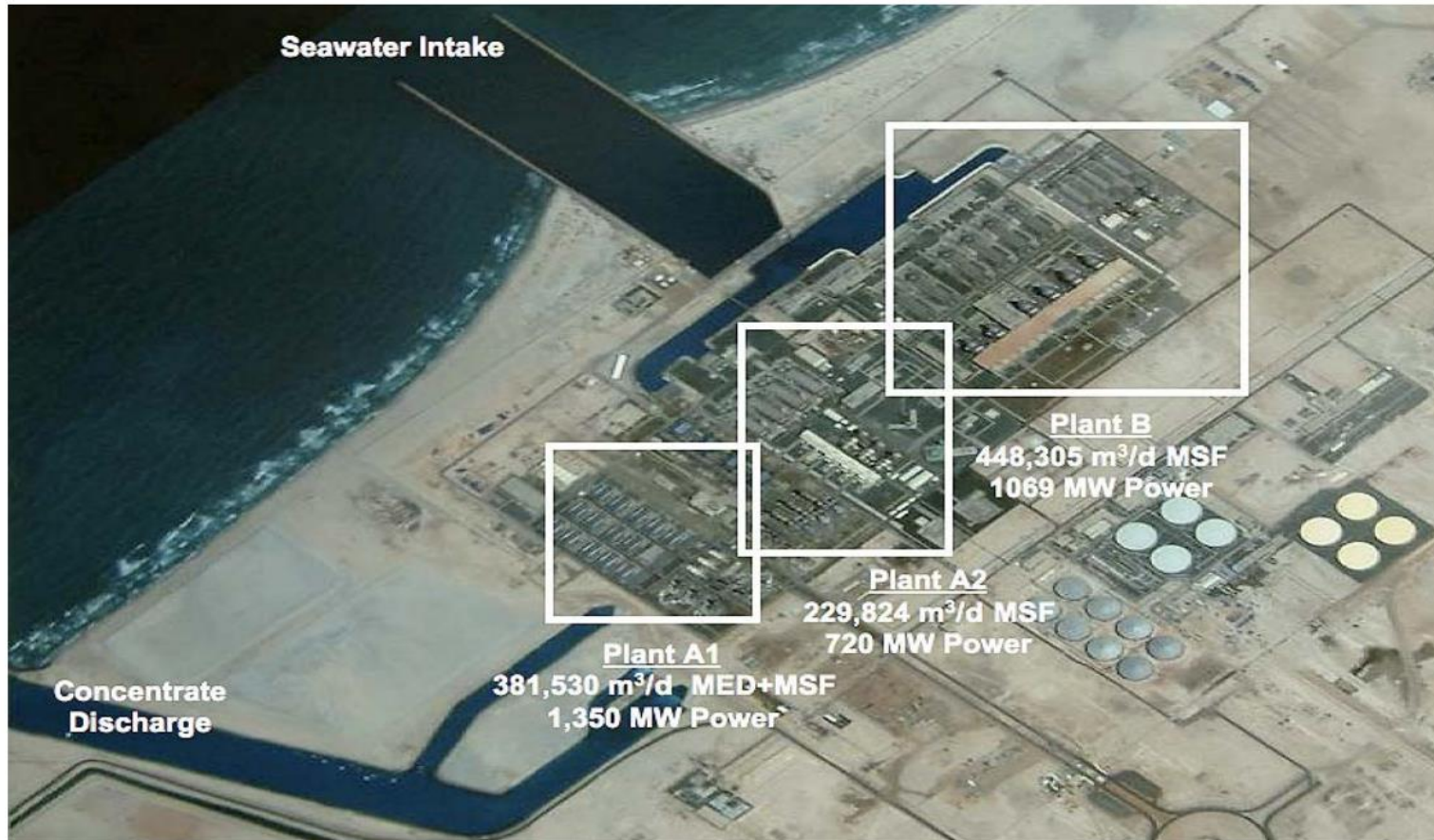


Source: U. of Colorado, mechanical engineering dept.
<https://www.youtube.com/watch?v=brxp3Su01UY&t=17s>

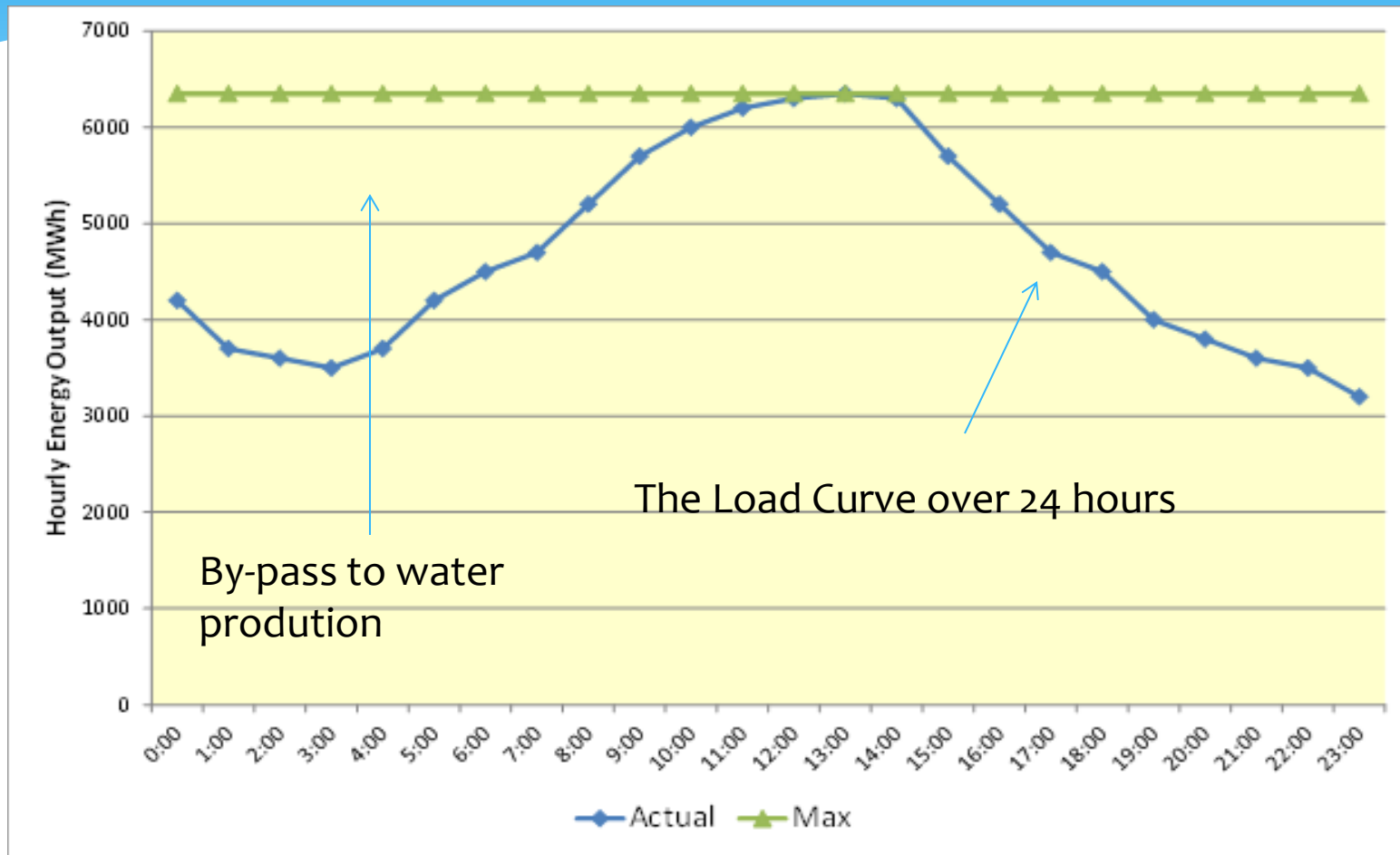
Advantages of Linking

- * Thermal Desal units can use heat that would otherwise be wasted and generate fresh water
- * For every 100 MWe output from power plant one can produce ~10 MGD of fresh water.
- * This plant, in combination with a sister plant at Shuwei hat, produces 400 MGD of water with power output of 4600 MW a ratio of 9%. (see next slide)

Al-Taweelah Plant in Abu Dhabi



Thermal Desal Can Optimize Power Plant Operation



MSRs Are Ideally Suited

- * Operate at high temperatures
- * Do not require water for cooling
- * Are passively safe
- * Heat from the reactor goes to a secondary heat exchanger and generates steam for power and water
- * Only water required is make up for boiler
- * This comes from desal product water

The Economics Work

- * A 1000 MW power plant would generate up to 6.3 million MWh of electricity
- * 112,000 acre feet of fresh water (137 MCM)
- * Capital costs would be ~ \$4.5 billion.
- * Annual costs ~\$465 million
- * Income from power and water would be ~\$850 million
- * B/C ratio of 1.8

What's the hold up

- * There are no MSR's on the market
- * Work being done by private companies is slow and poorly funded
- * The U.S. DOE is not actively promoting development
- * Most work is being done in other countries: Canada, China, India
- * Water production is a compelling reason for MSR development. The only question is whether the U.S. will be a player in this field, or have we given up.