The Road Ahead

The Energy Journey: From Flint to Wood, to Fossil, to Renewables, and Now to Evaposynthesis. *How we can combine the best of all our lessons learned.*

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From earliest humans using flint to light a fire, we have been looking for abundant, efficient, affordable and clean energy sources. We burned wood and depleted our forests. We discovered coal and oil and polluted our air. We harnessed rivers and destroyed habitat. We captured the power of the atom and still have not figured out how to manage its waste. Natural gas is a good transition fuel and we can unlock more with fracking, but that may cause earthquakes. We utilize wind turbines and kill birds. We convert sunshine but depend on rare metals. Each of these advances brought great economic growth and enhanced our lives. Each has merit. And each has drawbacks. Natural resources and economics offer restraints. We have enough fossil fuels to burn until we choke ourselves to death. We are threatening our atmosphere and our oceans with what may be humankind's most serious challenge – one that may challenge our very existence.

Our search for abundant, efficient, affordable and clean energy sources has been a reflection of our creativity, innovation, ingenuity, and survival skill. We have used our genius to advance civilization and make people's lives better. Each technological advance has been controversial and left earlier technologies in the dust. The buggy whip manufacturer was perplexed why his fine buggy whips were not in demand as we moved from horses to internal combustion engines. The coal companies are using their abundant wealth and power to perpetuate their industry. We have to break this cycle.

Now we need the next big leap, the next breakthrough. We need to learn from our collective wisdom. My good friend, brilliant scholar and Atmospheric Physicist, Carl Hodges, has built on his 40 years of research and practical applications to develop a concept that combines the best of solar, wind and photosynthesis. He has used his extensive experience with aquaculture and growing robust forms of the halophyte, Salicornia, that can produce food, fuel and fodder. But, the new ingredient he has added, the new *secret sauce* that can transform our energy production, economy and environment, is one that has been hiding before our eyes: evaporation and the energy of stored salt.

Nature does amazing things. Not only does it offer plants, sunshine, wind, rivers and tides – but it has been working for some billion years to store salts. According to a 1980 *Science* article, there are 100 to 1000 times more stored solar and wind energy in salt basins than there is stored solar energy in carbon fossil fuels. That's understandable because nature was collecting solar and wind energy on the earth in salt beds 600 million years before plants arrived to use photosynthesis to collect solar energy.

Nature also created osmosis, which is the magical part of the story, that high school biology students learn in the example of how a plant raises water from the soil to its roots and into the plant. Through the miracle of osmosis, water in a less salty solution can pass through a graphene membrane into a saltier solution. That less salty solution, if given the correct pathway (such as a pipe pointed upward), will flow uphill and out of the pipe. Then, as in a natural river, gravity pulls the elevated fluid down. Install turbine generators in our human-made river and we, nature and humans together, have made electricity. Scientists call this Osmotic Power or Salinity Gradient Power (SGP), with SGP being the more common.

Thus, through the seeming miracle of gravity and osmosis, salt (harnessed from a billion years of evaposynthesis, which has used solar and wind energy to evaporate water away from a solution to increase its salinity), ***can produce electricity***. This may sound like magic, but it is sound science.

"Evaposynthesis?" you correctly ask. Carl has coined and developed the concept of "evaposynthesis." It is a way nature has captured the non-carbon "fuel" stored in the salt basins of the earth. Carl has written that "evaposynthesis is the word we created for the collection of solar and wind energy by the evaporation of fresh water into the air away from an increasingly saline solution."

Here's the point: Photosynthesis provides renewable fuels (non-fossil) in the form of biofuels. Evaposynthesis also provides renewable fuels (non-fossil AND non-carbon) in the form of increased salinity solutions. And both evaposynthesis and photosynthesis occur as part of Carl's new, re-imagined, vision for seawater agriculture.

Carl pioneered the idea of a fully integrated "farm" that grows Salicornia, restores mangroves, and grows fish. An example of this "farm" in Eritria produced food, fuel and fodder. Now Carl combines the stored power from salt in order to produce salt gradient power. Food, fuel, fodder, *and* power. In a fully integrated, self-sustaining process.

Carl calls this fully integrated system ENC Energy, Evaposynthesis Non-Carbon Energy. He proposes that we apply it initially to address the critical water shortage in California, particularly around the Salton Sea (with its high 55,000 parts per million salinity) and the Imperial Irrigation District. Since much of California's fresh water goes to agriculture to produce alfalfa for cattle – and since cattle love fodder from Salicornia – an integrated seawater solution can produce a feed solution that doesn't use precious fresh water. At the same time, we can work to restore the Salton Sea and its surrounding agriculture, and add evaposynthesis and SGP for a fully integrated power generating "farm."

Summary

Let me try to condense a very complicated and technical story into bite-sized pieces. This is the culmination of Carl Hodges' 40+ years of expertise and global experience. It incorporates all the pieces in a way no one else has. His vision, combined with decades of practical field experience, make this a unique and very exciting project. It has the potential to be the game-changer we have long sought. Because this may "sound too good to be true" to some, we have the technical backup that gives it the credibility it deserves.

I think we can start with four basic questions. *What do we want to achieve? What are the benefits? Why are we confident this can work? What's next?*

What do we want to achieve?

- Transform California agriculture to utilize salt water crops.
- Apply ENC Energy systems.
- Develop a new business model for sustainable agriculture and energy.
- Create a model that can be transferred globally.

The benefits are enormous and each could represent a chapter of a book, but I want to offer an initial list that may show the substantial value of a project like this. They fall into three primary areas: Economic, Environmental and Global.

Economic Benefits

- Produce substantial domestic, local jobs, not only in direct agriculture but in the related value propositions of fodder, food production, bio-jet fuel and a new generation of bio-products, and power generation.
- Retain California's agriculture and preserve its cattle industry.
- Free up fresh water for higher value uses without restraining agriculture. Produce crops from seawater. Work with local authorities on revenues from water exchanges and reduced water transfer costs.
- Address the drought with its unpredictable water supplies and stabilize water availability, which also provides greater long-term confidence in California's economic future.
- Produce substantial amounts of electricity as an added value - without adding carbon. Potentially benefit from carbon trading.

Environmental Benefits

- Produce a carbon free energy source.
- Remove carbon from the air and return it to the soil.
- Introduce mangroves and utilize local geothermal resources to avoid freezes.
- Reduce dust and provide related environmental benefits.
- Enhance biodiversity, with flora, fauna, and, particularly around the Salton Sea, birds.

Global Benefits

- Apply lessons globally and transfer them to strategic locations such as developing countries, arid lands, and refugee camps.
- In the long run, with some new, very interesting innovations and “big thinking,” begin to ameliorate seawater rise.
- Allow agriculture to continue to expand around the world and lead the way to a revolution in the way we produce crops that have multiple uses. "Get everything but the oink" out of every plant and every drop of water.
- Create a new business model based on the concept that "everything is a resource and nothing is waste.” Build a new global economy based on integrated, efficient and productive processes.

Why are we confident this can work? Forty years of practical experience with projects from academic research, through laboratory studies, substantial field work, including Eritrea, have provided the unique expertise of the project team. The science is sound. The economics are conservative. The multiple revenue streams are unlike any other project. The timing is right with a world looking for clean energy, revitalized agriculture and robust economic development.

What’s next? In the near term, collaborate with the Imperial Irrigation District, the State of California and other partners on a Salton Sea project. Find funding and additional partners. Build capacity with training. In the medium term, monitor and consider opportunities around the world. In the longer term, apply lessons learned and the business model throughout the world.

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