SCORING EXAMPLE 1

Candidate Technology: Atmospheric Water Generator (AWG)

Technology Description:
Condenses water from humidity in ambient air; combined with ultrafiltration (reverse osmosis), produces high quality emergency potable drinking water on-site.

Key Technology Attributes:

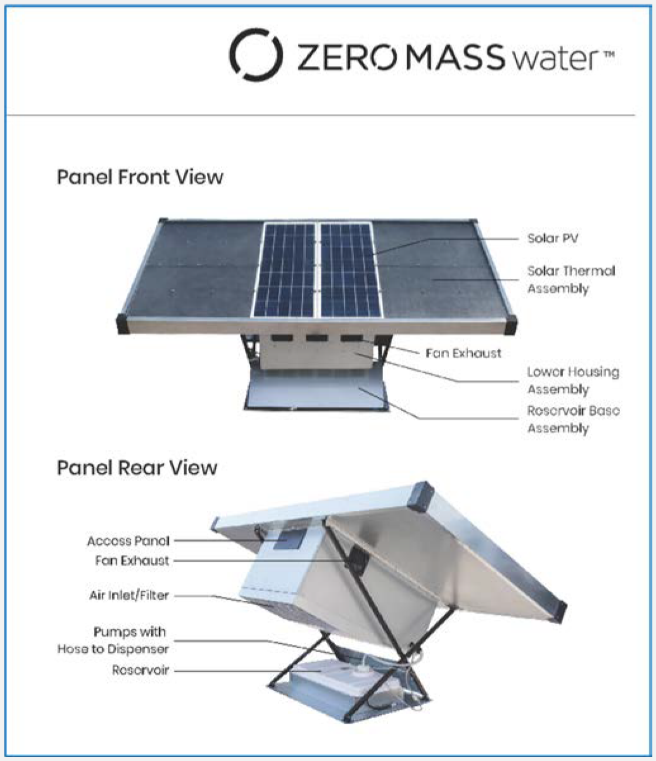
Costs/Risks	Benefits
▪ Uses substantial quantities of energy to produce small quantities of potable water, resulting in a high quality product that is comparable in cost to purchasing bottled water. ▪ Since the technology condenses moisture in air to produce water, local humidity may be reduced (unknown as to whether in enclosed areas, reductions in humidity would be sufficient to cause some discomfort).	▪ Produces potable water at remote sites in quantities sufficient to meet essential human needs for drinking and cooking. ▪ AWGs have been proven effective in providing small quantities of potable water to meet essential human needs in remote locations, especially areas impacted by extreme events that damaged water infrastructure and/or polluted water resources; they are also used by the military when posted in remote locations that do not have ready access to safe drinking water.

Technology Readiness:
AWGs have been proven to work but the high amount of electricity needed to produce potable water is a deterrent to widescale commercialization. It has been demonstrated effective in areas impacted by natural disasters and other extreme events, and is also used by the U.S. military in remote locations.

Research continues into strategies for substantially increasing the efficiency of electric use and also combining AWGs with clean, distributed generation (especially solar PV with battery energy storage).

Zero Mass Water

One innovative product that bears watching is Zero Mass Water's "Source Hydropanels" that draw ambient air via solar powered fans to condense and collect water vapor. The collected water is then mineralized for taste and disinfected with ozone. One system (comprised of 2 solar PV panels in a single array) costs about $2,000. Depending on the amount of solar radiation and humidity, one system can produce between 4-10 liters (1 to 2.6 gallons per day).



Source Hydropanels have been installed and demonstrated effective in 10 countries with highly variable climates, some with humidities as low as 10%.

Zero Mass Water is showing that AWG in combination with solar PV with batteries can produce potable water in small quantities in remote areas that have neither safe drinking water or electric power.

Source: Zero Mass Water's website.

ATMOSPHERIC WATER GENERATOR

Weighted Score	Score	Factor	Basis for Score
		DROUGHT RESILIENCE	
@ 35% = 0.0875	1	↑ Water Supplies	Creates very small quantities of potable water.
	0	↑ Water Quality	N/A
	0	↑ Water Use Efficiency	N/A
	0	↑ Water Recycling/Reuse	N/A
	0.25	**Avg Score**	***~ 2 gpd potable water per single residential unit.***
		ELECTRIC RELIABILITY	
@ 25% = 0.125	0	↓ Electric Consumption (kWh)	Does not reduce electric consumption.
	0	↓ Electric Demand (kW)	Does not reduce electric demand.
	1	↑ Clean/Renewable Distributed Energy Production (kWh/kW)	When combined with Solar PV, increases clean/renewable distributed energy production.
	1	↑ Demand Response (kW)	May have some Demand Response benefit if could be operated only during hours when the grid is experiencing over-generation.
	0.5	**Avg Score**	***This technology is designed to produce emergency potable water, not to provide electric benefits.***
		ENVIRONMENTAL RESPONSIBILITY	
@15% = 0	0	↓ GHG Emissions	Does not reduce GHG emissions.
	0	↑ Carbon Sequestration	Does not increase carbon sequestration.
	0	↑ Biogas Production, Capture & Use	Does not increase biogas production, capture and use.
	0	↓ Adverse Impacts on Ecosystems	Does not reduce adverse impacts on ecosystems.
	0	**Avg Score**	***This technology is not expected to provide environmental benefits.***
		SOCIO-ECONOMIC IMPACTS	
@ 15% = 0.3375	3	↑ Jobs (Local & Statewide)	Could increase jobs if a market is created for this product and at least some of the manufacturing, assembly, installation, and/or maintenance is performed in California.
	0	↓ Water &/or Energy Costs	Would not decrease water &/or energy costs.
	3	↑ Quality of Life for Local Residents	Could increase the quality of life for local residents, especially those that reside in remote local areas where wells are totally dry.
	3	↓ Reduces Risks to Public Health & Safety	Could reduce health and safety risks due to lack of potable water in remote communities where wells are totally dry.
	2.25	**Avg Score**	Could help to provide emergency potable water in sufficient quantities for drinking and cooking; insufficient water production to meet for all sanitation needs (e.g., personal hygeine and flushing toilets).
		OTHER RESOURCE AND ENVIRONMENTAL BENEFITS	
@10% = 0.17	0	↑ Natural Gas Efficiency	Does not increase natural gas efficiency.
	0	↑ Renewable Natural Gas	Does not increase production of renewable natural gas.
	5	↕ Disadvantaged Communities	Could directly benefit residents of Disadvantaged Communities where wells have gone dry and there is no other source of water.
	1.67	**Avg Score**	The primary advantage of this technology is its ability to provide small quantities of potable water in remote areas distant from water resources. It could also be used to supply potable water for essential human purposes (drinking and cooking) in areas where water quality has become contaminated and there is no other reliable source of clean and safe water.
0.72	**Wtd. Average Score: BENEFITS**		

SAMPLE ADOPTION CHALLENGES SCORE SHEET: ATMOSPHERIC WATER GENERATOR

Weighted Score	Score	Factor	Basis for Score
		COSTS	
@ 25% = 0.875	3	% of Annual Budget	The First Cost is typically significant (akin to buying new kitchen appliances). Operating costs, primarily for purchase of electricity, are relatively high.
	5	Est. Payback (# years)	Given that: (a) First and Operating costs are relatively high for units that do not self-produce electricity, and (b) the quantity of water produced is very small, the payback period tends to be long, even when using the price of bottled water as the basis for valuing the product (water).
	3	Funding Availability	The funding level tends to be significant for most residents or small businesses.
	3	Timeline to Secure Funding	The costs to acquire and operate these systems likely exceed the ability of residential customers and small businesses to directly purchase these systems without a loan or other financial assistance.
	3.5	**Avg Score**	***This score varies widely with the type of AWG system and technology, and the individual resident's financial circumstance. The scores shown here are provided solely to illustrate the scoring process and the rationale that was applied to develop these scores.***
		REGULATORY AND ENVIRONMENTAL RISKS	
@ 25% = 0	0	↑ Permit Violations	This technology would not increase permit violations, as long as the water quality is deemed safe. (Note: *In California, residents that self provide their own water are not subject to water quality regulations*[4].)
	0	↑ Threats to Species & Ecosystems	No apparent threat to species or ecosystems (except that taking humidity out of the air could reduce the amount of humidity that may be uncomfortable for some people and/or animals, especially if the unit is operated within an enclosed area).
	0	**Avg Score**	***This technology is not expected to adversely impact regulatory compliance or the environment.***
		OPERATING RISKS	
@20% = 0.15	1	↑ Operating complexity	Operating complexity appears minimal for most systems.
	1	↑ Risk of outages	Risk of outages appears minimal for most systems.
	1	Requires changes to other systems	This technology would not require changes to other systems, but it would require a fair amount of electricity that may require some electric system upgrades.
	0	Requires specialized staff or training	Most residents could probably perform the minimal maintenance needed (e.g., replacing filters).
	0.75	**Avg Score**	***This technology employs mature, well proven technologies in a new way, with the result that operating risks appear minimal.***
		ECONOMIC RISKS	
@ 20% = 0.35	0	↓ Revenues	Does not reduce revenues.
	3	↑ Operating Costs	The additional cost of electricity could be significant for some.
	1	↑ R&R Frequency and Costs	Costs for O&M appear minimal.
	3	Difficulty of obtaining funding	The difficulty of obtaining funding will be specific to the adopter's financial circumstance.
	1.75	**Avg Score**	***Without Solar PV, electric costs may be prohibitive for some adopters.***

[4] "It is the responsibility of the well owner to ensure that their domestic well water is safe, since the State of California does not regulate domestic well water quality." State Water Resources Control Board website: https://www.waterboards.ca.gov/gama/well_owners.shtml (viewed May 6, 2018).

Weighted Score	Score	Factor	Basis for Score
		TECHNOLOGY RISKS	
@10% = 0.3	**3**	Technology Obsolescence	***Ongoing R&D among many market entrants targets increased water production efficiency, reduced electric consumption, and reduced capital costs. Consequently, it seems likely that more economic and efficient units will be available prior to the end of an AWG unit's useful life. However, as long as purchased AWG units continue producing high quality water throughout the projected payback period upon which the investment decision was made, concerns about technology risks need not deter adoption.***
1.675	**Wtd. Average Score: ADOPTION CHALLENGES**		