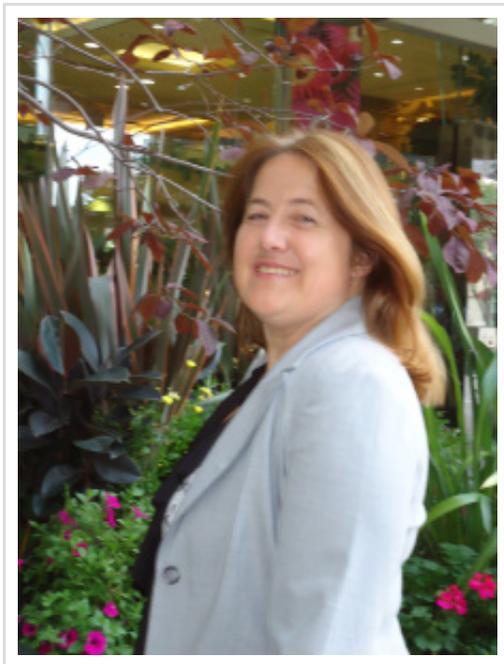


Role of academic and private partnerships to address energy and water nexus in arid regions, including islands and peninsulas

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Renewable Energy and the Role of Academic and Private Partnerships for Energy and Water Nexus in Arid Regions

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Energy and Water Nexus for Arid regions

Sustainable energy development and water linkages were recognised at the UN Conference on Sustainable Development, Rio+20, with recognition continuing across a broad variety of UN and international initiatives. For example, the United Nations Department of Economic and Social Affairs is very engaged in explore energy and water nexus, particularly in the context of

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alleviate water scarcity and poverty both in the Middle East.

northern Africa

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energy and water

Renewable energy help address water scarcity. Energy systems, and combining renewable energy with water developments are also underway, such as in Qatar at the 66th Session of UN General Assembly. The Global Dry Land Alliance aims to increase research and the adoption of energy an

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More generally, renewable energy, combined with desalination and aquifer management, could address water security, quality and quantity, through innovative integrations of energy and water systems, and integration of renewable energy with desalination and aquifer replenishment and management. Arid regions including coasts, islands and peninsulas have common needs to integrate energy and water systems, energy and water uses and efficiencies in order to achieve sustainable energy development and poverty alleviation, and to assist in adapting to climate change. Arid regions may have extensive geothermal, ocean, solar, and wind resources, but despite that often rely on imported hydrocarbons to generate electricity.

Reliance on imported hydrocarbons in arid regions results in environmental and oil spill risks to land and seas from the transport of hydrocarbons from ships to the generation facilities, as well as issues with water quality and water scarcity that renewable energy, desalination, ground water and aquifer management and replenishment, and innovative approaches to water treatment can address. The intermittent nature of renewable energy can be addressed by energy and water storage options (including hydrogen storage and aquifer re-injection and management) or by retaining hydrocarbon generation as backup, emergency or peak energy source. Transmission lines between islands can integrate renewable resources and markets for adjacent islands.

It is generally recognized that arid regions are at the forefront of impacts to climate change and adapting to these impacts including higher temperatures, changing seasonal and annual precipitation, depletion of aquifers and groundwater, saline intrusion of coastal and island aquifers, and increased water quality issues and incidences of waterborne illnesses. However, these regions have rich sources of customary, local and traditional knowledge and technologies in managing energy and water resources and needs (i.e., water harvesting, storage and irrigation; traditional architecture and buildings), which can augment and complement renewable energy knowledge and technology, and the integration of energy and water systems.

Private and public partnerships can support energy and water projects in arid regions. There are parallel issues of external investment, and technology transfer and capacity development for renewable energy and water technologies and projects. As knowledge, technologies and projects evolve, knowledge and technology transfer and capacity development can occur

between arid regions globally. Additionally, there could be opportunities for building synergies (including knowledge and technology exchanges and capacity development) between those arid regions which are currently leading in the use of renewable energy technologies and projects to address water security and scarcity. Last, renewable energy projects that are not integrated in electricity grids may also be eligible for carbon credit as small scale renewable energy projects under the Clean Development Mechanism.

Energy and Water Nexus and Coasts, Small Islands and Peninsulas in the Mediterranean, Northern Africa and Baja Region of Mexico

The Small Island Developing States (SIDS) – as well as coastal arid regions such as northern Africa and the Middle East – need to incorporate energy with water for sustainable energy development, economic development and poverty alleviation in order to mitigate and adapt to climate change. For example, although SIDS have geothermal, ocean, solar, and wind resources, they mainly rely on hydrocarbons to generate electricity. Both SIDS and arid regions share similar issues relating to energy and water security, which renewable energy, desalination, and aquifer management can address.

The Renewable Energy-Desalination-Water Treatment Pilot Project for Small Islands and Coasts in the Americas is currently being implemented with the support of a Fulbright Scholarship and in partnership with municipalities, academic institutions, civil society, and international agencies. For example, this project explores an island and coastal locations, identifies commercial or government client, and develop a project plan for approvals and finance to construct a renewable energy, desalination and water treatment facility. Integrated facilities such as this will displace the imported hydrocarbons, provide energy and address water scarcity, and allow local mitigation and adaptation to climate change.^[2]

For example, the arid Baja coasts and peninsula of Mexico shares numerous characteristics with islands, the Mediterranean and northern Africa, being all beset by high seasonal temperatures, limited precipitation and declining aquifers. Though solar and wind resources are available, municipalities and national governments may use diesel generators to provide electricity. If water scarcity and high energy costs are not addressed they could limit economic sectors, such as agriculture and tourism, which supports the local economy and populations. Additionally, renewable energy and desalination could improve sustainability and thus attract more residents and tourists to the peninsula.

There has been significant knowledge in the Baja region of Mexico on existing water resources including aquifers, and regional and municipal water needs now and into the future. Research and analysis has been conducted by Mexico's Centro Mario Molina in partnership with municipal governments and water departments including water scenario planning, economic analysis and modelling. This includes economic and public policy analysis for aquifer management, and impact of electricity rates for agriculture on aquifer depletion. Municipal entities such as IMPLAN Los Cabos' Municipal Planning Institute (IMPLAN Los

Cabos) have information and knowledge of energy and water at the local level.

Technologies and facilities design and any required operational and technical equipment, renewable energy-desalination projects, aquifer management approaches could meet the intertwined energy and water objectives and needs of the Baja region. Innovative financing, public/private partnerships for projects for renewable energy, desalination and aquifer management and replenishment would be very useful. The Centro Mario Molina has water data and information and a water gap methodology that consider sectors in the Baja region with significant water uses, being the agriculture, household and tourism sectors. Economic, energy and technical implications of changes to water include population growth and climate change scenarios.

In Mexico, government typically own and operate desalination plants in Ensenada and other regions of the Baja, though this is gradually changing. For example, private parties built a large desalination plant in Los Cabos, with water being supplied under a concession arrangement with the municipality. Desalination plants that may be owned by government or the private sector have been proposed in Playas de Rosarito (along with water exports to US), La Paz, San Quentin, near Loreto to support a resort and for the three fishing villages of Puerticitos, Bahia de Los Angeles, and El Barril. One of the proposed desalination plant in Rosarito and another proposed plant in the Gulf of California (Sea of Cortez) are bi-national initiatives where some of the treated water may be exported to the United States. Aquifers and existing and proposed desalination plants in the Baja region in Mexico – along with best practices, technologies and municipal water systems, are important to meet regional, municipal and sectorial water needs.

Additional Consideration of Aquifers and Aquifer Management

The aquifers that are the main water sources in many arid regions are being depleted, and also contaminated by saline intrusions. These aquifers are affected by changing mean and seasonal precipitation and temperatures and sea level rise, but can assist in buffering and mitigating the risk of these changes. Many of these aquifers will be transboundary engaging two or more countries.

Aquifers have increased dramatically in importance in recent years. Aquifers are essential to human life and agriculture, providing vital sources of water for drinking and agriculture. Some transboundary aquifers, such as the Nubian Sandstone Aquifer System, contain non-renewable fossil water. Aquifers sustain streams, wetlands, and ecosystems; and resist land subsidence and salt water intrusion.

Aquifers in arid and semi-arid regions, such as the Mediterranean, Middle East and northern Africa, and Baja region of Mexico are affected by high temperatures, low precipitation and water scarcity, as well as water uses. Links between groundwater depletion and sea level need to also be considered here. Considering the Baja region of Mexico, aquifers are managed at the state level, while municipalities provide local water services. These

municipalities do not have access to sufficient water to meet current or future needs. Water efficiency and pricing approaches have been proposed to address water shortfalls at a municipal level. However, it is also useful to examine the role of renewable energy and desalination to create additional safe clean drinking and replenish depleted aquifers.

Climate change may increase aquifer uses and rates of depletion, thus increasing complexity and challenges of aquifers and their management. Key climate impacts for aquifers are changes in recharge and discharge zones and volumes, contamination and saline infiltration. Changes in seasonal and annual precipitation, flooding, temperature and extreme weather events could modify the recharge and discharge of renewable aquifers. Flooding and extreme weather events could contaminate all types of aquifers. Coastal aquifers will increasingly be vulnerable to saline intrusion as sea levels rise and aquifers are depleted.

Aquifers in arid and semi-arid regions, such as the Mediterranean, Middle East and northern Africa, and Baja region of Mexico are likely to be affected by higher temperatures, decreased precipitation and increasing water scarcity, as well as greater water uses. Links between groundwater depletion and sea level rise need to also be considered here. Considering the Baja region of Mexico, aquifers are managed at the state level, while municipalities provide local water services. These municipalities do not have access to sufficient water to meet current or future needs. Water efficiency and pricing approaches have been proposed to address water shortfalls at a municipal level. However, it is also useful to examine the role of renewable energy and desalination to create additional safe clean drinking and replenish depleted aquifers.

Appropriate management of aquifers can minimize adverse implications of climate change, and assist in adaptation to that change. Aquifer management could alleviate surface water scarcity and contamination, reduce seasonal, annual and inter-jurisdictional flood risks, and sustain the aquatic and terrestrial ecosystems dependent on the aquifers. For example, water could be abstracted from aquifers, and re-injected when beneficial, so the aquifer functions as a managed water storage system for all aquifer states. Linkages between aquifers and surface, coastal and marine waters necessitate integrated approaches. Aquifers could also have a beneficial role for climate mitigation. Countries could sequester greenhouse gases in deep saline aquifers, which provide the greatest global potential for the storage of greenhouse gases. Further, aquifers could facilitate hydrocarbon development, whether traditional or non-conventional sources such as natural gas or shale gas, where, if appropriately done, this development may not adversely affect freshwater aquifers, and could result in the development of lower carbon energy.

References and Weblinks

Sustainable Energy Development project at www.eucc.net/en/climate_change/index.htm and http://www.arctic.ucalgary.ca/research/sustainable_energy_development.

Global Dry Land Alliance, <http://www.qnfsp.gov.qa/home>

Mexico's Centro Mario Molina, <http://centromariomolina.org/>

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[2] The Fulbright Scholarship research occurs under the Sustainable Energy Development project and is implemented under the Arctic Institute at the University of Calgary; and as a visiting scholar with Columbia University and the University of Delaware. Institutions such as the Department of Sustainable Development of the Organization of American States, United Nations Department of Economic and Social Affairs, the Coastal and Marine Union (EUCC), and the Sustainable Cities International Energy Lab are involved in the Fulbright Scholarship and will contribute to the scholarship research.

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