IEA Experts' Group on R&D Priority Setting and Evaluation (EGRD)

Island Energy – Status and Perspectives

5-6 October 2015
Tokyo, Japan

Hosted by the Institute of Applied Energy (IAE)

Research, development, and deployment of innovative technologies are crucial to meeting future energy challenges. The capacity of countries to apply sound tools in developing effective national research and development (R&D) strategies and programs is becoming increasingly important. The Experts' Group on R&D Priority Setting and Evaluation (EGRD) was established by the IEA Committee on Energy Research and Technology (CERT) to promote development and refinement of analytical approaches to energy technology analysis, R&D priority setting, and assessment of benefits from R&D activities.

Senior experts engaged in national and international R&D efforts collaborate on topical issues through international workshops, information exchange, networking, and outreach. Nineteen countries and the European Commission participate in the current program of work. Results provide a global perspective on national R&D efforts that aim to support the CERT and feed into the IEA Secretariat's analysis.

For further information about EGRD activities, see:
http://www.iea.org/aboutus/standinggroupsandcommittees/cert/egrd/

To view the agenda and presentations for this workshop, see: http://www.iea.org/workshops/egrd-island-energy---status-and-perspectives.html.

This Executive Summary reflects key points that emerged from the discussions held at this workshop. The views expressed in this report do not represent those of the IEA or IEA policy nor do they represent consensus among the discussants.

The full workshop report, including detailed information on individual sessions and presentations, has been prepared by the organisers and may be consulted at http://www/ieadsm.org/egrd.

EXECUTIVE SUMMARY

Small island communities and remote, sparsely populated areas are particularly vulnerable to the impacts of climate change. Despite significant renewable energy resource potential, such regions are often highly dependent on imported fossil fuels to meet their energy needs. This reliance often leads to high electricity and energy costs, vulnerability to oil price fluctuations, supply interruptions, and local environmental degradation. In recent years, an increasing number of island and remote communities are seeking to transition to a more sustainable energy system in which improved energy efficiency and renewable energy play important roles.

The *Island Energy – Status and Perspectives* workshop, organised by the Experts' Group on R&D Priority Setting & Evaluation (EGRD) and hosted by the Institute of Applied Energy (IAE) in Tokyo, Japan, on 5–6 October 2015, focused on the energy challenges, strategies, and technological solutions on islands and in remote, sparsely populated areas. The workshop explored the similarities and differences in a variety of cases to summarise lessons learned. Participants also explored which experiences and lessons learned are transferable between densely populated areas, such as compact cities, and islands and other isolated areas.

Some basic factors must be considered when studying an island's energy network.[1] The first is whether the island is part of a continental country, like the Spanish Island El Hierro, or not. Those that are part of a mainland nation often have the disadvantage of national legislation based on mainland market conditions that do not apply locally (e.g., unbundling), which presents legislative barriers for sustainable development. On the other hand, the island may benefit from economic ties to a mainland nation that can afford investments.

The second consideration is market size. Islands range from small, remote territories to large island states with millions of inhabitants. The latter generally have well-developed grids and often interconnection between the major islands. Some of these big island states, such as Japan and the United Kingdom, are developed countries that can invest in an energy transition. However, even these major nations share vulnerabilities with the smaller islands, as showed by the Great East Japan Earthquake and resulting tsunami. Natural disasters can have an enormous impact on island nations' economies.

The third consideration is the presence and prevalence of fossil fuel. If an island had local access to fossil fuels during the industrial revolution, the economy could develop relatively quickly, as could a regional grid. However, domestic fossil fuel resources and industrial development does not guarantee rapid economic development. For example, Indonesia faces an ongoing dilemma: sell fuel to finance the national budget or use the fuel domestically to generate energy and boost the economy.

Energy transition planners must consider these three characteristics and tailor solutions for a location-specific strategy. There are many options available to create a sustainable energy system, the main challenge is determining how to combine them in the most suitable way for a specific territory. Some strategic components are discussed below.

[1] For a much more detailed report on the differences between Island states and territories, see Irena, *Pacific Lighthouses Report,* Abu Dhabi, 2012.

Energy Efficiency

Islands are often exceptions when it comes to mining the first fuel, energy efficiency. In a number of cases, like in major parts of the Southern Pacific, building codes and labelling of appliances are not yet in place and a programme like the Pacific Appliance Labelling and Standards (PALS)helps to implement these codes and thereby helps contribute to limit the dumping of old technology.

Awareness is another element of mining the first fuel. There are several examples of a community approach, which includes all parties on an island and could serve as example elsewhere. These examples include Kumejima (Japan), Bornholm [2] (Denmark), the Faroe Island etc.

Technology

Most sustainable technologies are already available, including solar, wind, biomass, hydro and geothermal. However ocean energy (both tidal and ocean temperature conversion) needs more research to be fully deployed. Nevertheless, it remains a challenge to install the right equipment to achieve sustainable solutions on islands. Furthermore, additional research is needed to create more robust renewable options that can withstand the harsh conditions that occur on numerous islands (e.g., hurricanes, monsoons, and extremely cold winters). Studies that examined climate readiness identified one common strategy: placing energy systems in better-protected areas.[3] However, this is not an option on the majority of islands.

For many islands targeting an energy transition, the first choice is a smart grid with distributed generation. Storage must be a key element in smart grid design. Including demand response and demand-side management can reduce necessary capacity. Smart grids based on direct current (DC) might be more efficient, but appliances are presently almost exclusively available in alternating current (AC). A DC grid would thus necessitate the use of AC/DC converters, which results in energy loss. Examples of successful smart grid island installations include those of the Faroe Islands and Miyako-Jima.

As with other solutions, the ability to implement energy storage is determined by the island's circumstances, i.e., what is both feasible and affordable. Natural storage—such as pumped hydro or heat storage—might be cheaper in the long run, but these solutions require high initial investments. For the most part, the Pacific islands use batteries, which have undergone fast technological development to improve storage capacity and battery lifetime. (As has been presented in previous workshops, including the EGRD storage workshop in 2014). The latest developments in compressed air (CAES)[4] were not discussed during the workshop.

As island-based technological solutions often have to be tailor made, standards to integrate grid components could be of considerable help on the route to sustainability. Regardless of the solutions chosen, electrification is an integral part of island societies becoming self-sufficient.

Financing

[2] Bright Green Island: Bornholm, http://brightgreenisland.com/.

[3] IEA, RD&D Needs for Energy System Climate Preparedness and Resilience Workshop, November 2013, https://www.iea.org/workshops/rdd-needs-for-energy-system-climate-preparedness-and-resilience.html.

[4] http://energystorage.org/compressed-air-energy-storage-caes

There are sound financial reasons to invest in sustainable islands, including high fuel prices, high transport cost, inefficient diesel generators (currently in use), and climate change-induced indirect costs. Investment is more easily attracted when planning and design indicates that solutions will provide multiple benefits, such as sustainability, health, environmental issues, cost-effectiveness, and employment opportunities.

The U.S. Department of Energy developed the "Islands Playbook", a guide to help islands with design and financing.[5] The International Renewable Energy Agency (IRENA) also addresses this topic:

> *An energy development initiative for small island developing states (SIDS), such as SIDS-DOCK,[6] could help to overcome problems, provided funds are managed through the unified programme and not cut into many small projects with different decision makers.*

Despite some successes, financing and business models concerning the EGRD advices that energy transition should be explored in a wider scope than discussed in this workshop. Presenters provided examples from remote, sparsely populated areas, but these few examples alone cannot be the basis for solid conclusions. The challenges are similar to those of off-grid scenarios, so successful island implementation may be used as inspiration.

Crosscutting Issues

Society at large must also be engaged if sustainability efforts are to be effective, as was demonstrated by a number of projects.

Governments have to address regulations that are obstacles to sustainable paths forward. Grid connections, system operations, load management, baseload demand, etc., usually need modifications to be appropriate for an individual island. Long-term planning and political commitment are necessary to secure solutions. There is also a necessity to attract private sector investment in renewable energy deployment.

Islands share some crosscutting issues not only with each other, but also with big cities. For example, some design elements of island projects are translatable into big city sustainability planning. Similar challenges include space limitations, while differences include energy network interconnections and market size. Circumstances differ too much for lessons learned to be largely applicable, although islands' efforts to transition can be inspiring for those who are promoting a more sustainable and efficient society.

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[5] *Energy Transition Initiative: Islands* website http://www.eere.energy.gov/islandsplaybook/

[6] SIDSDOCK (website), http://sidsdock.org/