ESMAP Knowledge Exchange Forum "Sustainable Energy For SIDS" June 17, 2015 Session 5: Traditional and Innovative Approaches for Improving Energy Efficiency in SIDS

Potential Role of Deep Seawater for Cooling and Air Conditioning in Small Island Nations

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What is NEDO?

<u>New Energy and Industrial Technology Development Organization</u>

- NEDO is Japan's largest public R&D management organization
- NEDO has engaged in technology development, demonstration projects and system improvement in order to

address energy and global environmental problems and enhance industrial technology

NEDO's Activities



NEDO's R&D led to the creation **NEDO** of the solar cell market Development of advanced LED NEDO's project leader is a Nobel Prize winner! **Cooperation with World Bank and UNIDO**

World Bank

A memorandum of understanding was signed between NEDO Chairman and World Bank Vice President on October 21, 2010



United Nations Industrial Development Organization

NEDO and United Nations Industrial Development Organization (UNIDO) signed a Memorandum of Understanding on June 4th, 2013







- 1. About Deep Seawater
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What is Deep Seawater?

Seawater deeper than "compensation depth" where respiration and photosynthesis of lives are balanced

Generally, deeper than approx. 200m

Oceanic Circulation





(Reference: Hitachi, Akita university, Japan)

Features of Deep Seawater

1. Stable Low Temperature

• Cooler and stable temperature than surface seawater all year around

2. Cleanliness

Extremely small amount of organic compounds and micro organism

3. Rich Nutrients

• Organic compounds are resolved while they precipitate to the deep sea and changed into inorganic nutrients

4. Sustainability

• Sustainable resource continuously supplied from the polar region

2. Deep Seawater for Air Conditioning (1

Air Conditioning System Using Deep Seawater

- Conventional air conditioning systems creates chilled water using refrigeration systems.
- Instead, by drawing deep seawater and running it through a heat exchanger can create chilled water with

much less energy consumption and

no use of refrigerant such as CFC, HCFC, HFC.



(Reference: Hitachi)

2. Deep Seawater for Air Conditioning (2)

Advantages Using Deep Seawater for Air Conditioning

Reduction of GHG Emission

Mitigation of Climate Change

Suppression of Ocean Temperature Rise

Protection of Marine Resources



3. Points to Consider Using Deep Sea Water 1

Securing Profitability

Evaluation of site, climate and cooling demand is necessary in order to secure profitability of an air conditioning system using deep seawater

Example of Evaluation Points

| Cooling Load | Large constant load is necessary to achieve high energy and economic efficiency |
|-------------------|---|
| Electricity Price | • Higher the electricity price easier to secure profitability |
| Seabed Topography | Intake piping work is the most costly part and geographical features such as steep sea basins are less costly |

3. Points to Consider Using Deep Sea Water 2

How to Design a Feasible Business Model

- An air conditioning system using deep seawater itself should be planned and designed to be profitable
- But to make a more feasible business model, all of the features of deep seawater should be taken into account and use the deep seawater step by step for many different applications
- This can offset the cost of initial pipeline investment which usually is the most costly part



3. Points to Consider Using Deep Sea Water 3

Many Ways to Use Deep Seawater

Stable Low Temperature Sustainability

- Air conditioning
- Cooling
- Ocean thermal energy conversion (OTEC)

Cleanliness Rich Nutrients

- Bottled water
- Foods (salt, liquor, bread...)
- Cosmetics (toner, shampoo...)
- Fishery (aquaculture, washing)
- Leisure (taraso-therapy, spa)
- Medical treatment



4. Multi-stage Deep Seawater Usage (1)



4. Multi-stage Deep Seawater Usage (2)

Advantages of a Multi-stage Utilization System

EDO

| Energy conservation | Electricity saving of air-conditioning system Running cost reduction of desalination Reduction of maintenance for power generator Reduction of CO₂ emission |
|------------------------|---|
| Image advertising | Image improvement by introducing an eco-friendly system |
| New industry | Raw material for new industries such as food, beverages, seasonings, cosmetics and thalassotherapy |

5. Actual Cases in Japan 1 – Nyuzen Toyama

Deep Seawater System in Nyuzen Town, Toyama Prefecture

- A deep seawater cooling system is installed in a rice package factory
- The deep seawater temperature goes up from 5 °C to 18 °C going through the cooling system, which is just the right temperature for abalone culture
- The "Deep Sea Water" trademark was created for various products made using the deep seawater of Toyama



5. Actual Cases in Japan (2) – Kumejima Okinawa

Deep Seawater System in Kumejima Okinawa Prefecture

- The deep seawater pumped for use at an OTEC (Ocean Thermal Energy Conversion) power plant is used for many different applications
- An air conditioning system using the cold post-OTEC sea water is installed at the Deep Sea Water Research Institute
- Also various products are made using the deep sea water



Reference: http://otecokinawa.com/en/OTEC/WaterUse.html

6. Case Studies in SIDS(1) – Mauritius

Image of Studied System in Mauritius



6. Case Studies in SIDS 2 – Maldives 1

Image of Studied System in Maldives



(Reference: Hitachi)

6. Case Studies in SIDS 2 – Maldives 2

District Cooling Service for an International Airport

Floor area : approx. 60,000m2
 Cooling Capacity : 14,000kW

Revised Terminal Plan

Reference EA1 for the Reclamation and Expansion at INIA, Hulhulhe, Kaagu Atoll Figio:proposed new runway



7. Potential Role of Deep Seawater in SIDS 1

Steps for Planning

1. Oceanic survey

• Detail investigation of seabed geography, weather, sea states, temperature, water quality, etc.

2. Basic plan & feasibility study

- Basic plan, cost estimation and energy calculation based on the oceanic survey
- Business feasibility study based on the market research.

3. Design & construction

 Detail design, pricing and construction including testing, commissioning and training.



7. Potential Role of Deep Seawater in SIDS 2

Potential Sites for Air Conditioning Using Deep Seawater

- More than 100 cities in 20 countries are expected as potential sites for deep seawater cooling system
- Up to 1 million t-CO2/year of total GHG emission reduction is expected at those potential sites





7. Potential Role of Deep Seawater in SIDS 3

Potential Role of Deep Seawater for Air Conditioning in SIDS

- There is high possibility of having a profitable business model using deep seawater for air conditioning in SIDS
- The important point is to study in detail and plan an overall business model utilizing deep seawater in multiple ways that is economically feasible, sustainable and friendly to the environment
- Business models using deep seawater has a high potential to contribute to mitigation of climate change, improve the image of local tourism and creation of new industries in SIDS



Thank you!

Contact Point

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