

Small Tropical Island Solutions (STIS)

SMART with OTEC: Kumejima - a model island in Japan

Mission report by Ronald Osinga (Wageningen UR)

Mission date: May 13-15 2014

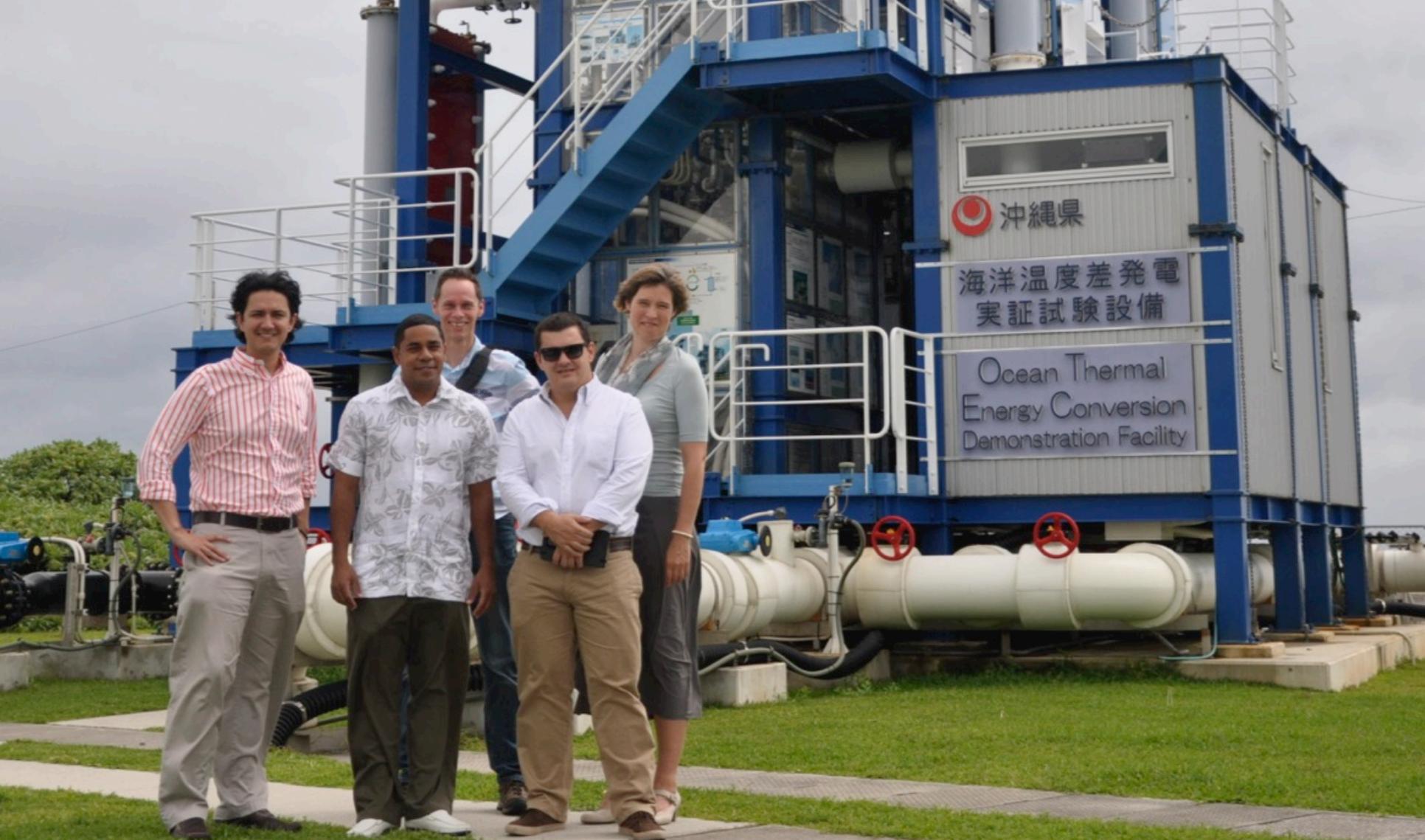
Organized by Diego Acevedo (Bluerise)



On 13, 14 and 15 May 2014, a Dutch/Colombian delegation travelled to Kumejima to visit the deep sea water research and industry park at the island. The delegates were accompanied by Mrs Merei Wagenaar from the Dutch embassy in Tokio.

Goal of the mission was to evaluate whether the Kumejima approach could serve as a model for the island of San Andres, Columbia. San Andres considers to develop a similar deep seawater program in collaboration with Dutch company Bluerise and Wageningen UR.





The delegation, from left to right:

Diego Acevedo (Bluerise BV), Albron Hebron (San Andres government), Ronald Osinga (Wageningen UR), Santiago Aramburo (National University of Columbia), Merei Wagenaar (Dutch embassy in Tokio)

Welcome to Kume Island

ようこそ久米島へ

환영 구메지마 섬 欢迎来到久米岛 歡迎來到久米島



久米島の歴史

① 宇江城城跡(国指定史跡)

Uegusuku Castle Site(National government-designated Historic Site)

宇城ヶすき 跡(国指定史跡) 宇江城城跡(國家指定古蹟) 宇江城城跡



沖縄で最も高い位置にある城跡であり、海上には望楼、石名残等、いい日には沖縄本島が眺めます。

This is the highest castle site in all the prefecture sites of the islands of Japan, and on a clear day the main island of Okinawa can be seen from here.

② 久米島博物館

Kumejima Museum

구메지마 박물관 久米島博物館 久米島博物館



「久米島の自然と文化」をテーマに企画展・特別展などが開催され、観覧がたくさんです。Designed by the Nature and Culture Museum Team. A changing exhibition, and offers a wealth of information.

久米島の動植物

⑤ クメジマボタル

(町の動物) <久米島ボタル会>



Kumejima Firefly Society
1993年に新種として発表。グンツボタルと近縁の水生ボタルです。4月中旬まで、久米島ボタル館で観覧。
The Kumejima Firefly is a new species, discovered in 1993. It is closely related to the species known as Guntsu Firefly. Specimens of this firefly are housed in the collection of the Okinawa Prefecture Museum.

久米島で体験・遊ぶ

⑦ パーデハウス久米島

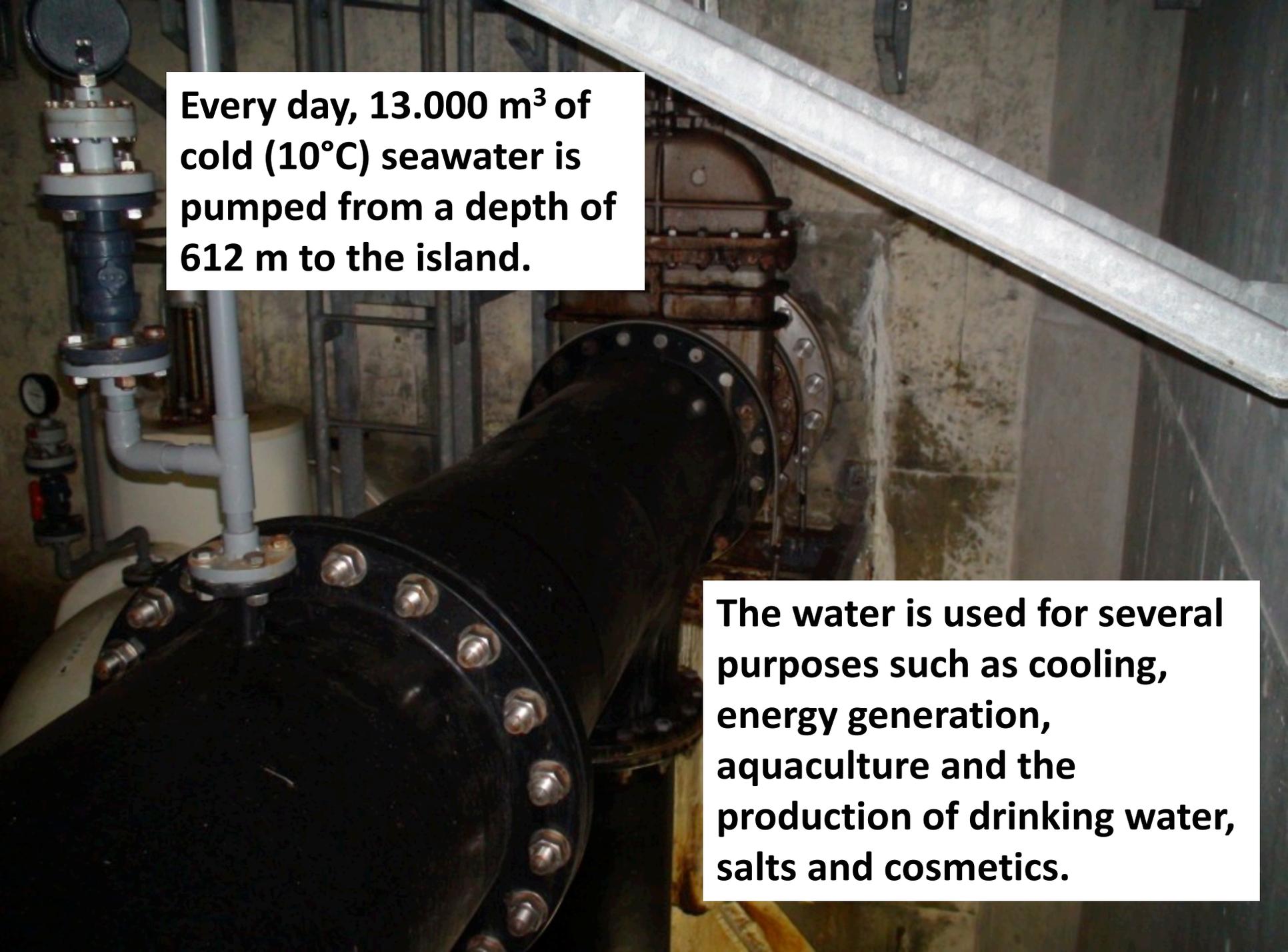
(海洋探検船) <久米島ボタル会>

Badu Haus Kumejima
パデハウス 久米島 (海洋探検船) <久米島ボタル会>

Kumejima is a small (46 km²) tropical island in Japan. It is part of the Okinawa prefecture and has 8300 inhabitants.

The prefecture of Okinawa wants Kume Island to be 100% sustainable in the year 2020. This was the incentive to install a deep seawater pipeline in 2003.



The image shows a complex industrial environment with various pipes, valves, and large cylindrical components. A prominent feature is a large, dark, cylindrical vessel in the foreground, secured with numerous bolts. To the left, there are smaller pipes and a pressure gauge. The background consists of concrete walls and structural beams, suggesting a subterranean or industrial setting. The lighting is somewhat dim, highlighting the metallic and concrete surfaces.

Every day, 13.000 m³ of cold (10°C) seawater is pumped from a depth of 612 m to the island.

The water is used for several purposes such as cooling, energy generation, aquaculture and the production of drinking water, salts and cosmetics.

The deep water facility includes a research station and a deep water tower, from where the water is further distributed.

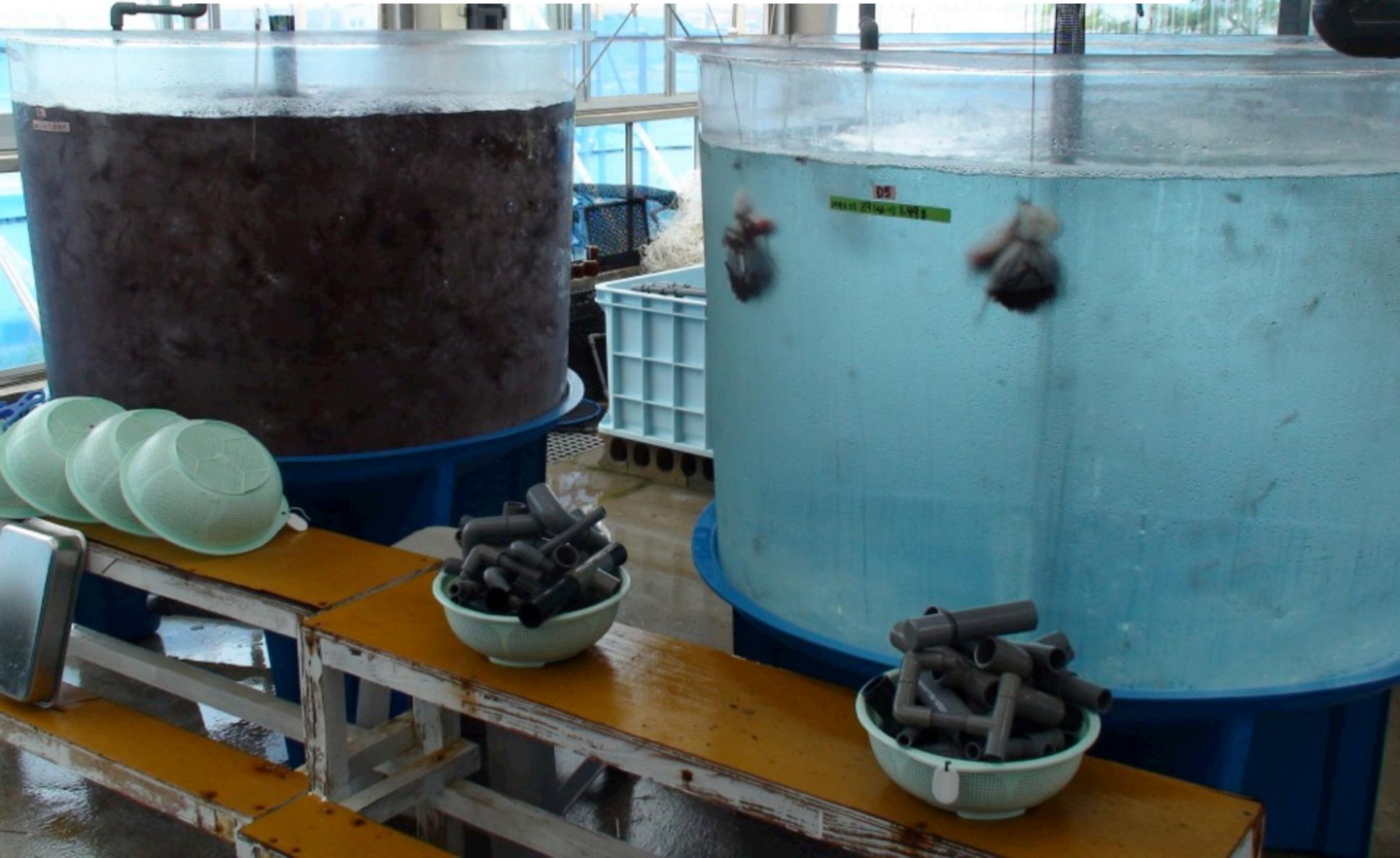


Around the institute is a 10 ha industrial park. Companies located here are directly connected to the deep water supply.



Companies located at a further distance can obtain deep seawater at the “fuel” station for tank wagons.

The research station has good indoor and outdoor research facilities to support the industries.





This greenhouse farm uses the deep water to cool the soil, so that it is suitable for the production of “winter” vegetables...

...such as spinach!





In addition to direct cooling, the deep water is also used to generate electricity through the process of Ocean Thermal Energy Conversion (OTEC).

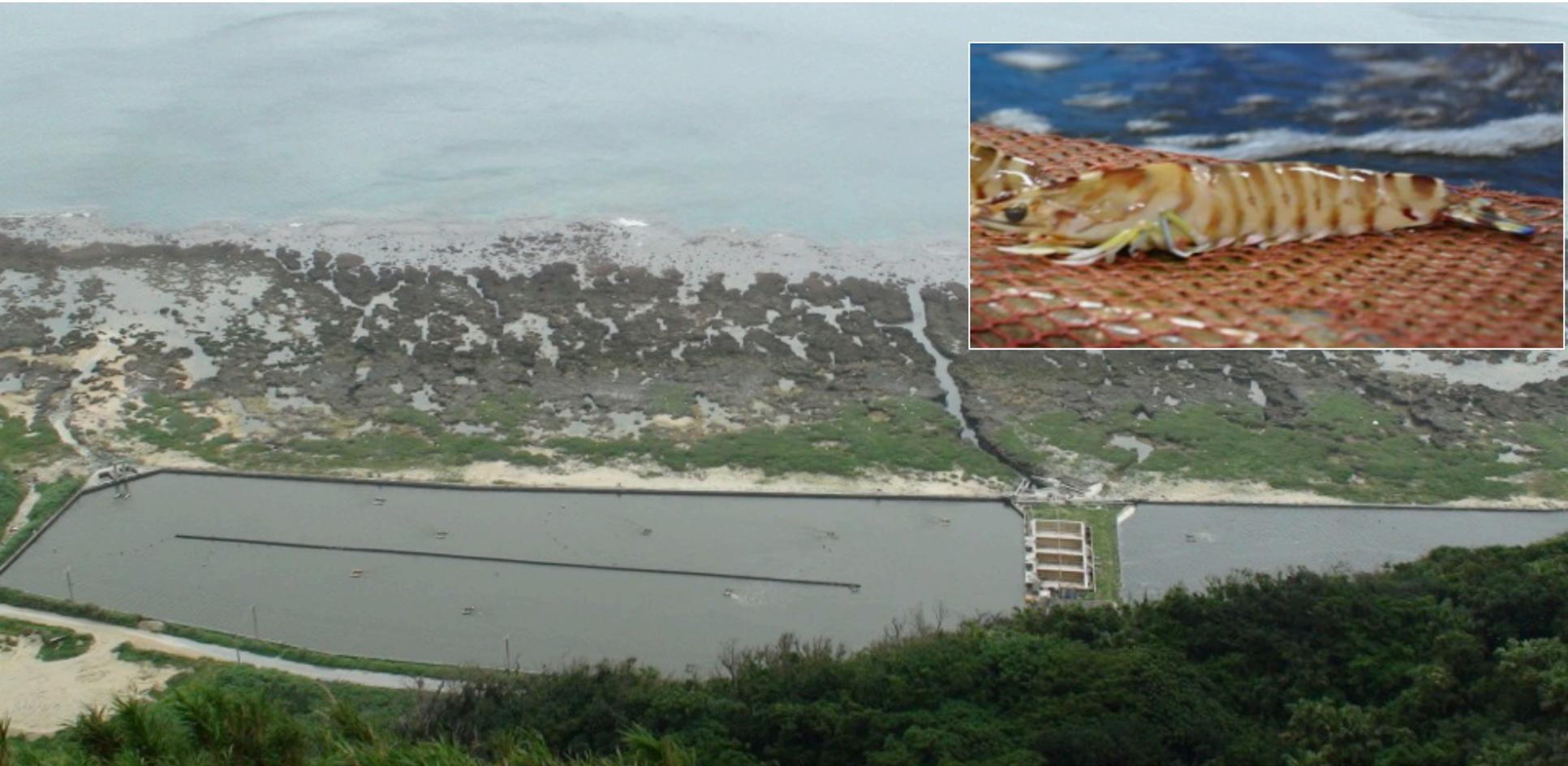
Kumejima currently has the world's only operating OTEC installation, a 50 KW demonstration plant

OTEC takes advantage of the difference in temperature between surface water and deep sea water. Warm surface water is used to evaporate a low-boiling point liquid such as ammonia to create steam. The steam drives a turbine that generates electricity. The steam is condensed back to liquid using cold deep seawater.



OTEC is particularly suited for tropical areas, where temperature differences between sea surface water and deep water are largest (the red area on the map).

Deep seawater that has been used for OTEC or cooling can be further used for other purposes such as aquaculture. This 6 ha shrimp farm uses the clean, virus-free deep seawater for its hatchery.



The farm produces 250 tonnes of tiger prawn per year and is currently the largest deep water based industry on the island.

Deep seawater is rich in inorganic nutrients and as such very suitable for the aquaculture of seaweeds. This farm produces 180 tonnes per year of seagrapes, a local variety of Caulerpa.



Deep seawater can also be used for human consumption. In this water factory, deep seawater is converted into drinking water (1) and salt (2) through reversed osmosis (3).



1



2



3

Benjamin Martin, OTEC operator and deep water park promotion officer explains the principles of OTEC.



概要
「海洋深層水の利用」
事業の位置づけ
沖縄21世紀ビジョン
洋エネルギー（再生エネルギー）の地産地消
事業の主な内容
・ 天候、海況に依存しない
・ 安定した発電
・ 海洋深層水及び表層水のより高度な複合的利用についての検討
・ 沖縄における洋上型海洋温度差発電設備の設置の可能性の検討
など
■ 実施方法
IHIプラント建設株式会社・株式会社ゼネシス・横河ソリューションサービス株式会社の3社共同企業体に委託して実施しています。



実証・検討・調査内容

- 1) 発電利用実証試験
天候、気温、海水温の変化に伴う発電量を計測するとともに、安定した出力が得られる海洋温度差発電技術に関する実証試験を行います。
- 2) 海洋温度差発電システムの確立
将来の海洋温度差発電設備の実用化に向けて、発電に係る諸条件の検証、洋上型海洋温度差発電設備の設置の可能性の検討を行います。
- 3) 海洋深層水の複合的利用システムの確立
海洋温度差発電に利用した後の海洋深層水の利便性及び3次利用を調査・検討します。



Meeting with the major of Kumejima at the town hall



Exhibition of deep seawater-based cosmetics





Watching and tasting seagrapes

The delegation meets the director of the water factory



Merei Wagenaar eating a raw prawn at the shrimp farm



The Dutch delegates conclude the following:

- **Kumejima's deep water park is an inspiring Small Tropical Island Solution, generating energy, enabling seafood production, creating employment and increasing sustainability.**
- **Currently, the deep water-based industries at Kumejima generate an annual turnover of 20 million USD, which is 25% of the islands Gross National Product.**
- **Deepwater pipelines at tropical islands should first serve energy generating devices such as OTEC and SWAC. The "waste" water can then be applied for aquaculture and other industries, providing solutions for tropical challenges related to energy, food security and water.**
- **Bluerise and Wageningen UR should cooperate in advocating and developing and designing deep water solutions for other tropical islands around the world such as San Andres.**

This presentation was prepared for Wageningen IMARES by
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