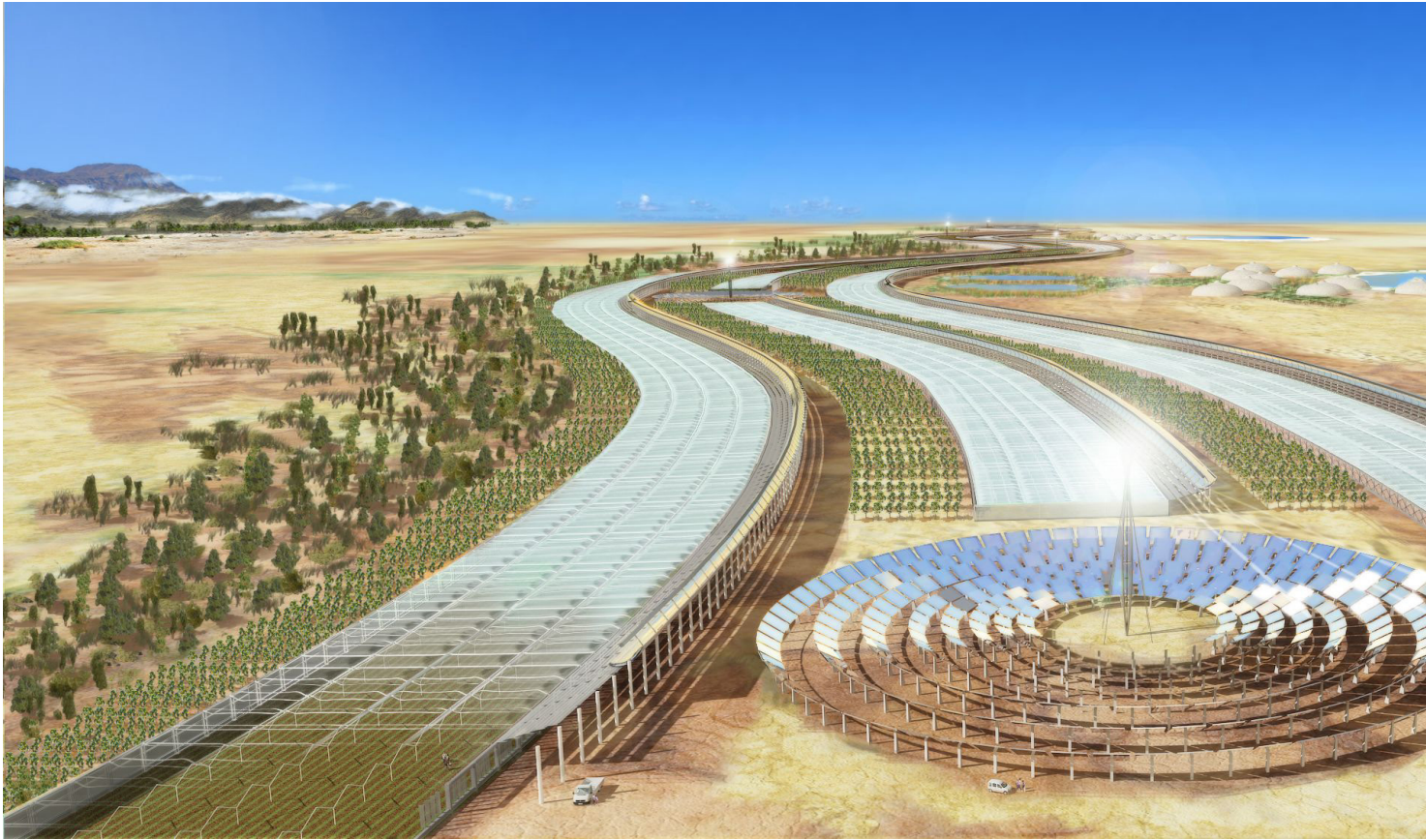


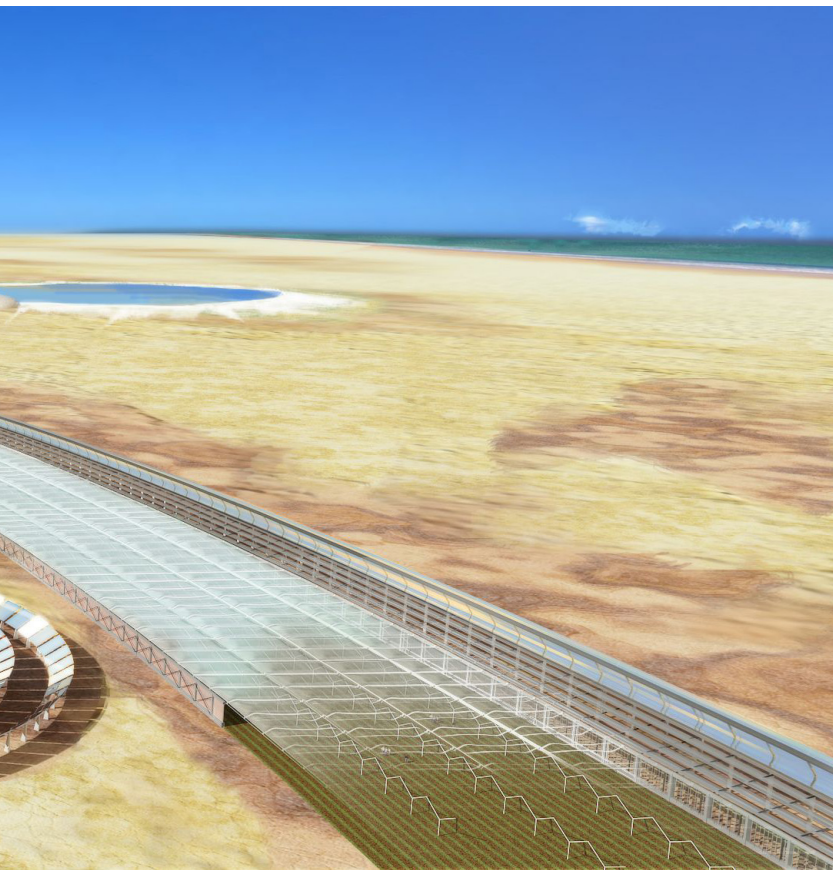
Enabling Restorative Growth





The Sahara Forest Project vision





In 2050 about 9.3 billion people will share our planet. Today the world is facing intertwined challenges of food, water and energy security, coupled with climate change, desertification and shrinking forests.

None of these challenges are without solutions. At the same time it is ever clearer that we cannot afford to pursue responses to one challenge that come at the expense of another.

The greatest challenges of our time are closely interlinked and the same must be true for the answers.

The Sahara Forest Project has been established to realize a vision of

### **Restorative Growth:**

“Revegetation and creation of green jobs through profitable production of food, freshwater, biomass and clean energy”

# SEEING IS BELIEVING IN JORDAN

The Sahara Forest Project is designed to utilize what we have enough of to produce what we need more of, using deserts, saltwater and CO<sub>2</sub> to produce food, freshwater and energy.

The Sahara Forest Project Launch Station contains saltwater-cooled greenhouses utilizing saltwater to provide excellent conditions for production of high-quality vegetables. Photovoltaic panels provide power for electrical installations in the facility. Outdoor growing zones will not only contribute yields from various crops but can also store CO<sub>2</sub> from the atmosphere into vegetation of barren land. A reverse osmosis desalination unit provides the necessary water for the greenhouse and

outdoor vegetation, using saltwater from the Red Sea. The facility further contains salt ponds as well as technical facilities allowing for R&D activities.

The Sahara Forest Project has entered into partnership with Costa Group and Costa Crociere Foundation to supply the Costa and Aida cruise ships calling into the port of Aqaba with fresh vegetables. The products from the Sahara Forest Project are also popular at the local market, and vegetables are being sold to local restaurants and hotels in the booming tourism industry in Aqaba.







The Sahara Forest Project Launch Station is located 12 kilometres north of the city centre of Aqaba and the Red Sea, only a few kilometres from Aqaba international airport

# TWO YEARS OF SUCESSFUL OPERATIONS IN JORDAN

7<sup>th</sup> of September 2017 His Majesty King Abdullah II of Jordan and His Royal Highness Crown Prince Haakon of Norway opened the Sahara Forest Project Launch Station in Jordan. The opening of SFP Launch Station marked the starting point for the realization of large scale SFP operations in Jordan and elsewhere.

The facility is realized with financial support from Norway and the European Union as the two largest donors. The Grieg Foundation, Sundt AS and Yara International are other important project partners. USAID has contributed with funding for shipping and inclusion of materials and equipment from the Pilot facility in Qatar.

The Sahara Forest Project Launch Station is realized to demonstrate the potential for profitably realizing sustainable growth and horticulture production. The Launch Station is established as a regional power house for innovation and green growth in the desert.







## KEY FACTS

- Up to 130,000 kg vegetables produced per year
- Up to 20. 000 litres of fresh water production per day
- 39 KW installed solar power production capacity through PV panels
- 3 hectares (equal to the size of 4 football fields)
- 2 greenhouses – a total of 1350 m<sup>2</sup> of growing area
- 3200 m<sup>2</sup> outdoor planting space
- Salt ponds for salt production

# CONCEPT

The Sahara Forest Project has set out to establish groups of interconnected economic activities in low lying desert areas around the world.

The simple core of the concept is an infrastructure for bringing saltwater inland.

Through establishing this saltwater infrastructure The Sahara Forest Project aims to:

- operate energy- and water-efficient saltwater-cooled greenhouses for growing high value crops in the desert
- produce freshwater for irrigation
- produce solar energy
- grow biomass
- revegetate desert lands

The synergies arising from integrating the technologies improve performance and economics compared to those of the individual components. In addition to its commodity outputs of food, energy and salt, the system also provides global climate benefits by sequestering CO<sub>2</sub> in the facility's plants and soils..

The Sahara Forest Project has been developed through a step-by-step process of concept and feasibility studies, data modelling, field trials, pilot operations, R&D programs and value engineering.



# TRIPLE BOTTOM LINE



A key pillar for The Sahara Forest Project is that the company's activities shall be good for the environment, good for social development and provide long term economic benefits to the investors. This is the company's triple bottom line approach.

The operation of the Jordan Center uses saltwater and solar power only, and hence will not add to the water scarcity, nor the energy supply challenges, of Jordan. The true value added to the society will be more significant than just the financial returns, and as such strengthen the triple bottom line business case compared with traditional horticulture in the region. In addition, the facility will ensure exchange of competence of best practices between Jordan and other countries as a way of supporting the wider agricultural industry.

Added economic activities through packaging, transport and other related industries will continue to build economic value around the Sahara Forest Project production facility in Aqaba.



The Saltwater-cooled greenhouses are highly productive in desert areas.

## SALTWATER-COOLED GREENHOUSES

Saltwater-cooled greenhouses utilize saltwater to provide suitable growing conditions for year-round cultivation of high-value vegetable crops in hot and arid environments. The saltwater is run down honeycombed cardboard pads at one end of the greenhouse, while solarpowered fans draw hot desert air through them and into the greenhouse. As the saltwater evaporates into the hot air, the air becomes cooler and more humid, creating a growing environment inside the greenhouse wellsuited for the cultivation of vegetable crops. By using saltwater to provide evaporative cooling and humidification, the crops' water requirements are minimized and yields maximized with a minimal carbon footprint. TheData from the Sahara Forest Project pilot operations in Qatar and demonstration facility in Jordan confirms:

- The yields obtained in the pilot stage are highly competitive
- The greenhouses are being cooled up to 15 degrees compared with outside temperatures.
- The water usage significantly lower, approximately 1/10, compared to conventional agricultural practices in the region.
- The Saltwater-cooled greenhouses allow for year-round production of high quality crops, even in periods with very high outside temperatures





# SOLAR TECHNOLOGIES

The Sahara Forest Project (SFP) utilizes solar power technologies to provide power for electrical installations in the SFP-facility, while additional power can be exported from the facility. The solar power technologies convert sunlight into electricity, either directly using Photovoltaics (PV), or indirectly using Concentrated Solar Power (CSP) to provide electricity and heat generation. Both PV-systems and CSP-systems benefit from the integration with other SFP-technologies.

Photovoltaic panels in a Sahara Forest Project system allows for efficient production of renewable energy.



More than 50 different kinds of desert plants, vegetables and grain crops have successfully been cultivated outdoors in the desert throughout 365 days of annual operations.

## REVEGETATION

Desert revegetation is catalyzed by a combination of efficient watering regimes and soil reclamation techniques. The eternal cultivation areas host both native desert species and water efficient food and fodder crops. Native species can be utilized as new sources of fodder and bioenergy, or for carbon sequestration and soil conditioning.

Nitrogen-fixing and salt-removing desert plants can be deployed in concert with repurposed waste products from agriculture and saltwater evaporation to improve soil conditions, boost crop yields, and reduce requirements for mineral fertilizers. The Sahara Forest Project has the potential to operate without discharge of brine back to the sea.





The Sahara Forest Project can enable commercial-scale cultivation of algae in new regions of the world.



The Sahara Forest Project produces freshwater for irrigation or drinking from saltwater.

## EXTENSIONS

By establishing a commercially viable way to bring saltwater into the desert, The Sahara Forest Project works as an enabling technology, creating opportunities for a wide range of businesses to develop alongside it. These opportunities include salt extraction, traditional desalination, algae production, halophyte cultivation, mariculture, bioenergy and more. Pilot operations confirmed the feasibility for integrating such technological extensions with the core technologies in Sahara Forest Project facilities.

# LARGE SCALE ROLL OUT

Operations of The Sahara Forest Project Launch Station. The current Launch Station is a platform for international cooperation on food, water and energy production in arid areas. It also serves as a tool for value engineering and cost optimization for the future phases of the project, and provides learning about market characteristics.

The Launch Station is the first step towards the full-scale Sahara Forest Project of 20 hectares.

The Sahara Forest Project and The Aqaba Special Economic Zone Authority (ASEZA) have secured a total of 200 hectares of additional land in Aqaba for this purpose.

The Sahara Forest Project engages in public-private partnerships to develop a 20 hectares facility to produce premium quality vegetables for different markets both in Jordan and abroad. While private investments will be sought for the business opportunities of vegetable production, public investments are sought for the surrounding infrastructure such as the saltwater pipeline. Following the successful operation of the Launch Station, the 20 hectares innovative farm will be constructed gradually over two main phases. The business case provides competitive returns on all three bottom lines – environmental, social and business.







**USAID**  
FROM THE AMERICAN PEOPLE



## JORDAN PARTNERS

The Sahara Forest Project is interacting with a large number of experts, institutions and companies all over the world. This network is very important to us. Our Jordan Partners consist of entities providing both financial resources and know-how to The Sahara Forest Project. They have provided especially important contributions to establishing The Sahara Forest Project in Jordan.





## Sahara Forest Project Foundation

The Sahara Forest Project Foundation raises awareness through action-oriented work on the ground. The foundation facilitates and promotes research, knowledge and the use of proven environmental technologies. Sahara Forest Project is realized to enable revegetation and the creation of new jobs through profitable production of food, water, biomass and clean energy. The Sahara Forest Project Foundation acts as an incubator for launching new initiatives to realize the concept of Restorative Growth. The Foundation manages the Ethical Guidelines and Registered Trademark of The Sahara Forest Project.

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"This is a gold standard in a day and age where we have a hot and crowded planet, and we need to move towards a low-carbon future fast." - **Olav Kjørven**, Assistant Secretary-General of the United Nations Development Program.

"The Sahara Forest Project appears to be a very interesting example of the more integrated and holistic kind of thinking that we will need a lot more of in the future to make our energy, water and industrial systems more sustainable."

- **Andris Piebalgs**, EU Energy Commissioner. "The Sahara Forest Project raises the important point that new renewable technologies and smarter environmental solutions can help both social, environmental as economic challenges."

- **Malek Kabariti**, Minister of Energy and Mineral Resources of Jordan. "This Pilot Project could show how we can grow vegetables with less water or brackish water. I think this will not be important only to Qatar, but to the whole region and elsewhere where they have the same climate as Qatar. So, I have a lot of hope."

- **Sheikh Hamad bin Jassim bin Jaber Al Thani**, Prime Minister of Qatar. "This is an example of the need for new and environmental friendly technologies to contribute to both increase the global production of food, but at the same time reduce the global emissions of greenhouse gasses."

- **Jens Stoltenberg**, Prime Minister of Norway. "Individually, the various technologies are commercially proved, but excitement stems from using them together for the first time."

- **Financial Times**. "A novel combination of technologies that has the potential to turn large areas of desert green, producing commercial quantities of food and energy crops, fresh water, and electricity"

- **Science**. "Agriculture uses more than two-thirds of Earth's fresh water, so the idea of a farming practice that produces more water and energy than it consumes seems too good to be true. But in the desert of Qatar, scientists are showing that saltwater and sunlight can yield food and clean water in a self-sustaining cycle."

- **Nature**. "Sahara Forest Project is an ambitious attempt to use concentrated solar power and Saltwater-cooled greenhouses to produce renewable energy, crops and water. Its success thus far has inspired new feasibility studies in Jordan and Qatar."

- **The Economist**. "SFP is a pioneering project that reflects the kind of holistic vision and solution that we need to explore so that we can address the interconnected challenges of food, water and energy security. It is about optimizing the whole system rather than maximizing one goal."

- **Dr. Dan Kammen**, Chief Technical Specialist for Renewable Energy and Energy Efficiency, The World Bank