SAREP

SAHARA RENAISSANCE PROJECT

SAREP // West // Coast

THE FIRST STEP IN MAKING A VISION A REALITY

SAHARA RENAISSANCE PROJECT

THE VISION

THE CHALLENGES

Global climate change requires at short-term and urgently effective measures to reduce the emission of CO_2 resp. greenhouse gases. The NetZero target for 2050 sets out the ambitious path for continuing and intensifying these measures.

The replacement of fossil fuels with the consistent use of renewable energies for power generation and the transition to alternative fuels such as green hydrogen and biofuels – especially among consumers in industry and transport – is a key contribution to the targeted reduction in emissions. This will require the provision of green fuels on a large scale timely and reliably.

However, it is foreseeable already today, that the reduction of emissions alone will not be sufficient for NetZero 2050. Strategies must be developed and implemented in parallel to enable carbon removal, i.e. large-scale capture and safe storage of atmospheric CO_2.

Climate change mitigation measures must be consistent with responses to the challenges of global population growth and international wealth disparities, which will also intensify in this century.

SAHARA - THE PATHWAY TO SOLUTION

The Sahara Renaissance Project focuses on an approximately 8,000 km long and 30 - 100 km wide Saharan desert belt along the northern edge of the Sahel, extending from Mauritania to Sudan.

Afforestation on the particularly low-carbon soil of the Sahara allows biomass production, provided that, there is sufficient irrigation, successive soil improvement and the selection of suitable tree and plant species, which, with special management and utilization technology, enables a very high specific potential for safe carbon removal. In relation to the entire area, this results in the potential for a global impact of this project.

The coast of Mauritania forms the starting point of the project and offers excellent conditions for wind and solar power generation for the sustainable and cost-effective operation of seawater desalination plants including water distribution systems as pre-condition of irrigation required for afforestation.

The particularly cost-effective wind and solar energy generation at site as well as efficient water treatment and conveying technologies powered by renewables both are also essential pre-conditions for green hydrogen production. Mauritania also has the potential to use green hydrogen on an industrial scale for processing domestic iron ore and subsequent export.

The economic and civic development impetus unleashed by SAREP favors a region where this is particularly needed.


SAREP // West // Coast

THE PREMISES

SAREP is divided into three main project areas: **SAREP West (Mauritania & Mali)**, SAREP Central (Algeria, Niger & Chad) and **SAREP East (Sudan)** and is a partnership between the aforementioned countries and international stakeholders with the aim of initially satisfying the basic needs of the people of these countries. SAREP is an essential contribution to a resilient development and addresses the majority of the 17 Sustainable Development Goals of the United Nations (SDGs). The project has direct effects on food security, peacekeeping, climate protection, value creation, education, cleaner drinking water, poverty reduction, sustainable economic and urban development.

Sustainability is a basic SAREP principle. All processes including agricultural and forestry, technical, structural and other components are consistently based upon sustainable principles and regenerative technologies.

THE VISION

SAREP as a holistic approach uses the unique geophysical benefits of the Saharan belt region and therefore will significantly contribute to achieve the global climate change mitigation goals and to support the economic and civil society development of the region.

SAREP // WEST

THE PROJECT

The western part of the SAREP project consists of two sub-projects:

SAREP // West // Coast: Mauritanian coast
SAREP // West // Inland: Mauritanian hinterland and the north of Mali

The content of this brochure focuses on the sub-project *SAREP // West // Coast* only.

SAREP // WEST // COAST

The coast of Mauritania, as the westernmost part of the SAREP belt, offers ideal pre-conditions for the project's starting phase with its excellent wind and solar resources and the direct seawater access.

The core of this sub-project is the implementation of an agroforestry as well as an industrial complex in order to do both, opening up a large-scale carbon removal potential and developing a basic materials industry based upon green hydrogen.

National and international requirements and development goals serve as guidelines for the project set up.

SYNERGIES BY DUAL USE

The two project components agroforestry & industry form self-sufficient and independent structures and business models but use the same project area and can therefore be implemented individually or together.

The agroforestry complex encompasses the entire project area, which is subdivided by a network of paths. The latter includes the access roads, the media lines for the water and energy supply, as well as the wind turbine locations. The sub-areas resulting from path pattern primarily accommodate the areas used for agriculture and forestry, but also open spaces for solar energy use.

The industrial complex encompasses project areas near the coastline only but is subdivided in the same way by the road network. Due to the higher energy requirements, the area required for wind and solar systems is significantly larger, but the local arrangement follows the same basic pattern as in the agroforestry complex. The extensive planting only serves to protect the infrastructure and settlement from wind and erosion.

The simultaneous realization of both the agroforestry and the industrial complex enables a variety of synergy effects through the dual use of areas, supply facilities and central infrastructure components (settlement/city, port, connection to the national road network, etc.), which further improve the economic attractiveness of the individual complexes.

SAREP // WEST // COAST

WATER & ENERGY

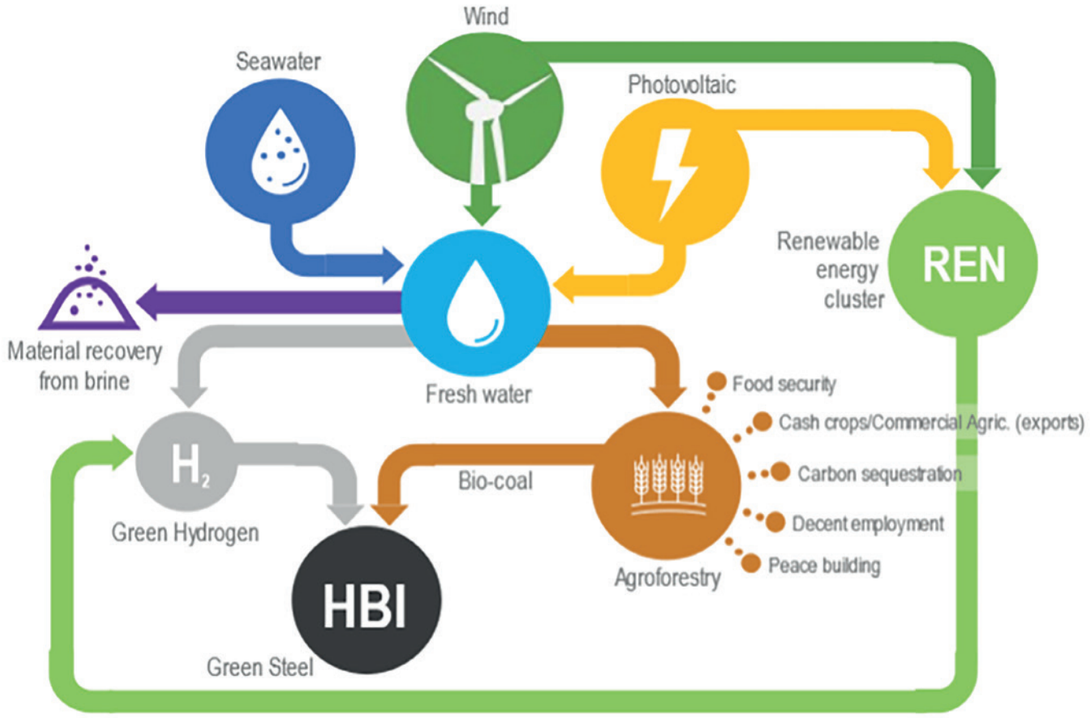
The cost-effective provision of both water & energy is the central prerequisite and basis for the realization of the project parts agroforestry & industry.

The water & energy requirements of both project parts complement each other very well and thus enable synergies in their simultaneous realization:

Agroforestry:
Water demand: high, Energy demand: moderate.

Industry:
Water demand: moderate, Energy demand: high.

The water and energy supply for the project will be designed in consultation with the national demand development so that energy, drinking water and green hydrogen can also be provided for the development goals of Mauritania.



WATER

SECURE DRINKING WATER SUPPLY BY SEA-WATER DESALINATION

SAREP relies on seawater desalination for water supply independent of groundwater and precipitation.

Reverse osmosis is an energy-efficient and cost-effective seawater desalination technology that is integrated as a flexible component in the overarching energy and load management system, enabling extensive direct use of wind and solar energy.

ENERGY

ISOLATED GRID CONFIGURATION

The project provides its own independent electrical grid in which wind and solar power is self-generated and self-consumed.

The stability of the project's internal grid is cost-efficiently ensured by a customized combination of wind, solar and storage technology, flexible loads and an integrated energy and load management.

In addition, gas powered generators, which can also be operated with green hydrogen, ensure security of supply.

TAILOR-MADE WIND & SOLAR TECHNOLOGY

Wind turbines with extra-long rotor blades are used, which were specially developed for the self-consumption of wind energy, especially to power industrial processes directly. They enable a particularly balanced power output and thus significantly more cost-effective measures for grid stabilisation.

For a complementary energy supply, photovoltaics is an ideal partner due to its regular and foreseeable availability.

AT A GLANCE

AGROFORESTRY COMPLEX

ELEMENTS OF THE AGROFORESTRY COMPLEX

The Agroforestry Complex of the project consists of 10,000 ha plots to be developed in a modular way in the area of today pure desert soils of the Sahara in Mauritania along the border with the Sahel. The following agricultural and forestry uses are planned on the 10,000 ha plots to be developed based upon irrigation to be provided:

AFFORESTATION FOR CO_2 SEQUESTRATION

The central element of the forestry land use is the afforestation of the "virgin" desert soil with suitable woody plants (jatropha and shelter-belt plantations), which - using appropriate management and utilization techniques - primarily offer a high and at the same time long-term and safe CO_2 sequestration potential.

AFFORESTATION FOR FORESTRY PRODUCTION

A complementary element of forestry land use is the cultivation of woody plants to generate classic forestry yields from the utilization of jatropha nuts in particular and, to a limited extent, the extraction of timber (e.g. eucalyptus, Aleppo pine) for further regional processing and value adding.

PRODUCTION OF AGRICULTURAL PRODUCTS

An integral element of the agroforestry complex, albeit with a comparatively small share of land, is the production of agricultural products primarily for regional supply and further processing. For this purpose, the cultivation of crops that are suitable and marketable for regional supply is planned.

ESTABLISHMENT OF AN AGROFORESTRY RESEARCH AND EDUCATION CLUSTER

A complementary element of the agroforestry complex is the bundling and further development of know-how and techniques for reforestation and agricultural and forestry production in desert areas in a research and education cluster within the immediate vicinity of the project area.

Agroforestry in the Sahara offers a high CO_2 sequestration potential compared to already certified carbon removal projects with an expansion potential of global impact.

The carbon removal potential of reforestation is a key factor for the successful implementation of the overall project with its multiple positive impacts in terms of Strategic Development Goals of the UN (SDG). With regard to the SDGs, it is important to emphasize that the development of agricultural production is made possible where it is particularly urgent for food security.

IMPLEMENTATION

Based on a standard plot or a series of simultaneously developed standard plots, a ratio of land uses of 30% shelter belt, 60% tree species for forestry production (primarily: Jatropha, secondarily: other timber) 10% agriculture shall be maintained to safeguard economic feasibility.

However, the land uses can be varied according to the requirements of potential purchasers of such plots. Depending on the location of the plots, shelter belt plantings are assumed to be essential in this regard as protection for all of the agroforestry land to be operated. High percentage of shelter belt plantings as well as Jatropha plantings are necessary due to their high CO_2 sequestration potential and thus for the economic operation of the plots.

The implementation of all agroforestry uses on the intended project areas is only possible with the help of irrigation on a considerable scale and represents a decisive cost component for the project implementation. In connection with the intended sale of CO_2 certificates, energy supply for project-internal water treatment (seawater desalination) and water supply (pump-operated water distribution) must be based on renewable energies.

AGROFORESTRY COMPLEX

AGRICULTURE

AGRICULTURAL CULTIVATION IN THE DESERT

Through initial soil improvement measures, irrigation and selection of suitable plant species, even desert soils can gradually be developed into agricultural land. Progressive biomass production and the supplementary introduction of biomass material from the reforestation taking place at the same time successively improve the soil quality and thus the conditions for agricultural use.

Tree planting and growth as a protective belt around the cultivated areas help to prevent wind-induced soil erosion.

CULTIVATION TYPES

Based on scientifically evaluated comparative projects in similarly arid areas, the following agricultural crops are prioritised for cultivation under SAREP:

- Foxtail millet,
- Sorghum,
- Legumes (especially chickpeas),
- Groundnuts.

Legumes with higher water requirements (e.g. cowpea) or selected cash crops can generally be cultivated with advanced soil improvement and with significantly higher irrigation capacity.

The water requirement of the initially prioritised crops is between 2,000 and 10,000 m^3/ha/a (also varying for the same crops depending on age, soil and climatic conditions). Cash crops require up to 20,000 m^3/ha/yr.

Under desert climate conditions, continuous irrigation of all crops is mandatory. Irrigation techniques and intensity depend on the selected species.

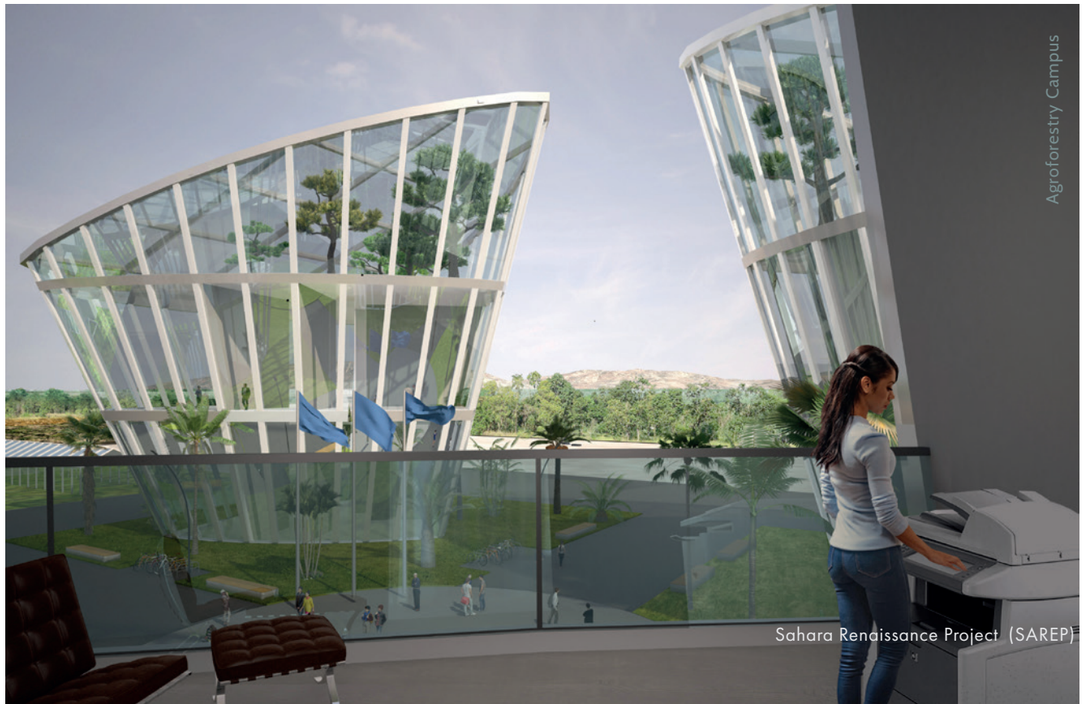
FOOD SUPPLY AND EMPLOYMENT

The main benefit of the agricultural production within the agroforestry complex is the sustainable food supply to the regional population with a special focus on the supply of the employees to be settled by wages in kind - mainly by small parcels of land and water for staff-own subsistence cropping - in the direct vicinity of the project. Agricultural production, including downstream processing, offers significant additional employment and income opportunities within the project structure.

The initially prioritised annual plants for agriculture do not offer CO_2 sequestration potential. However, the CO_2 emission from soil treatment or movement during cultivation is comparatively low due to the low carbon content of the initial soil.

AGROFORESTRY CAMPUS

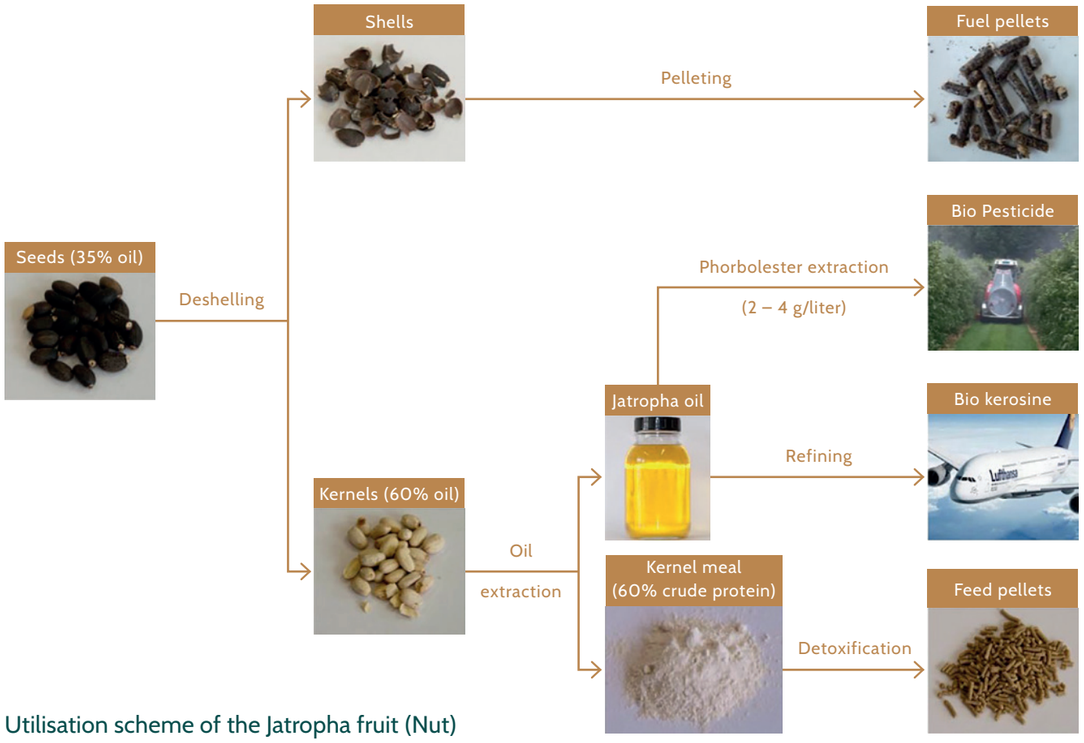
The efficient cultivation and management of desert soils in the Sahara requires on-site experimental and research facilities where the results and findings obtained from cultivation activities on the SAREP plots are documented, scientifically processed, evaluated and further investigation requirements from cultivation activities quickly operationalised and implemented. In addition to the R&D facilities, qualified project staff must be retained at the site and specially trained for this purpose. The establishment of an agricultural service and science location directly adjacent to the SAREP project area represents a high-quality impulse for employment in the tertiary sector of the target country.



Sahara Renaissance Project (SAREP)

AGROFORESTRY COMPLEX

AFFORESTATION



Utilisation scheme of the Jatropha fruit (Nut)

AFFORESTATION ON DESERT SOIL

The development of suitable tree species on soils with very low organic carbon content succeeds by means of sufficient irrigation and biomass accumulation – already tested and proven at various desert sites (e.g. SEKEM, Egypt).

TREE SPECIES

For the required shelter belt planting, tamarisk, prosopis, acacia, casuarina and eucalyptus are preferred, whereas Aleppo pine, date palm and argan nut may also be considered.

The central crop plant in the afforestation concept is jatropha. In addition to its potential as a fast-growing biomass producer, it offers attractive yields from its fruit, the jatropha nut too.

CO_2 SEQUESTRATION POTENTIAL

Jatropha as well as the tree and plant species of the shelter belt extract CO_2 from the atmosphere by means of photosynthesis, stored in their roots (below ground) and in their trunk and branches (above ground).

Tree pruning (Jatropha) in particular, but also selective felling, can also permanently extract renewable biomass, which is processed into biochar by means of a biological pyrolysis process.

This biochar is applied to the SAREP plot for soil enrichment and improvement, where it represents a permanent and safe storage of CO_2 as a material compound of inert carbon compounds.

ECONOMIC SIGNIFICANCE

The CO_2 sequestration volume of the respective SAREP plot can be individually certified according to procedures already established today (gold standard, etc.).

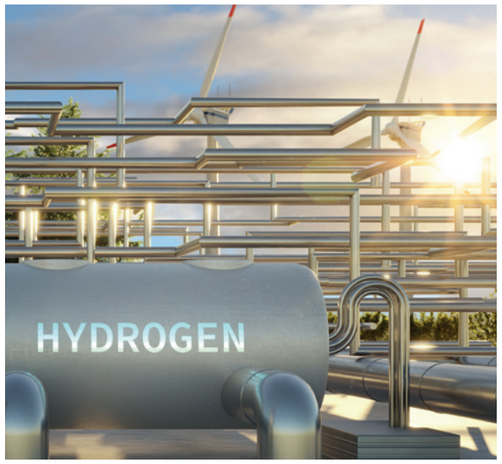
A market for these certificates already exists today (voluntary certificate trading). It can be assumed that the demand for voluntary certificates will increase strongly in the medium term, as under the global target NetZero 2050 both, private companies and states will increasingly have to invest in carbon removal measures to compensate for emissions that cannot be reduced in the short and medium term.

With a certificate price of 100 €/(t CO_2e), which has already been reached on relevant commodity trading platforms in 2022, a positive business case for a large-scale SAREP project can be assumed.

AT A GLANCE

INDUSTRIAL COMPLEX

The industrial complex of the project SAREP // West // Coast consists of three main areas:



GREEN HYDROGEN:

production, conditioning, storage and supply

METALLURGY:

processing of iron ore based on green hydrogen

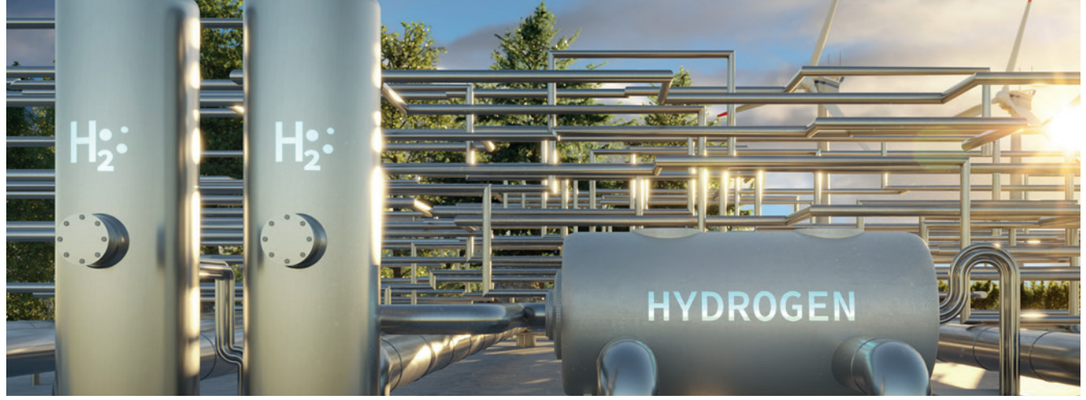
FOOD/BUILDING MATERIALS:

processing of locally produced agricultural and forestry products

INDUSTRIAL COMPLEX

GREEN HYDROGEN

With its excellent wind and solar conditions as well as its central geographical location, SAREP // West // Coast offers ideal conditions for the cost-effective production and supply of green hydrogen for the European and African markets.



In addition, green hydrogen is used as fuel for the project's internal needs on site: For the processing of iron ore from national and international sources to iron ore pellets as well as for the backup system of the energy grid.

INDUSTRIAL COMPLEX

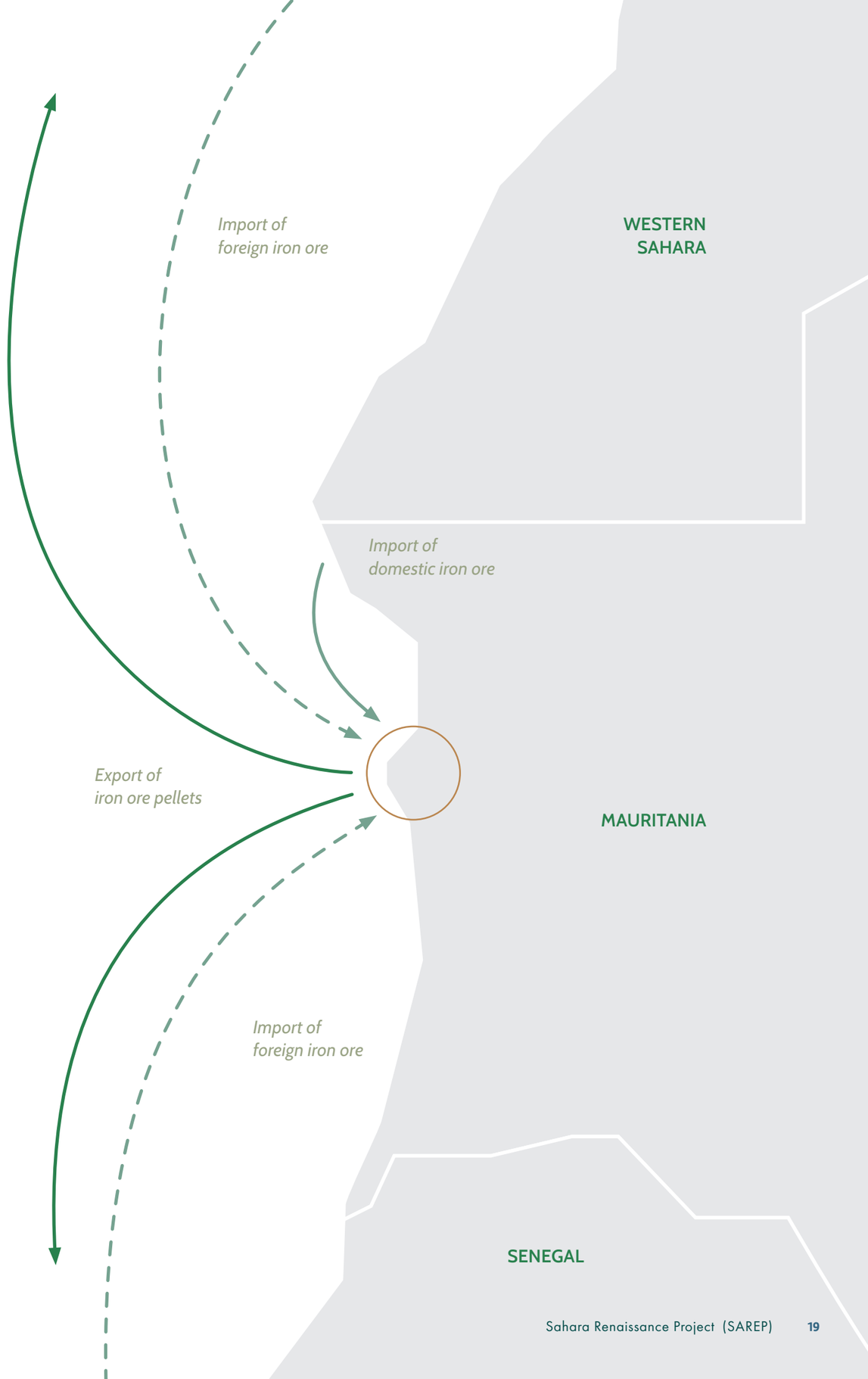
IRON ORE PELLETS PRODUCTION

MINING & METALLURGY

Green hydrogen produced at site is not only exported, but also forms the basis for expanded locally added value. In addition to iron ore extraction, further processing into iron ore pellets will also take place at the Mauritanian coast in the future.

A HUB FOR IRON ORE REFINING

The project site will be developed into a supra-regional and international hub for iron ore pellet production, which will be able to receive and process iron ore rock not only from Mauritania but also from other mining sites resp. companies on the African northwest and southwest coast via the project's own industrial port. The processed iron ore pellets are to be transported to global customers via the same industrial port after then.



INFRASTRUCTURE

SETTLEMENT & PORT

THE SETTLEMENT

The community structure is developed for a minimum size of 3 - 5 thousand inhabitants in order for essential municipal, social and self-supporting commercial functions to be staffed by residents of the community.

A self-sufficient and sustainable energy and water supply is based on wind and solar energy as well as seawater desalination.

Agriculture and forestry with associated research and educational institutions, processing industry and municipal functions are established to allow for working and living within the community structure.

The agricultural facilities on site enable the supply of regional products to a large extent.

A compact community structure enables short distances within the entire settlement. The local and regional traffic concept is CO_2-free.

THE INDUSTRIAL PORT

The industrial port is considered an integral part of the industrial complex.

For the export of hydrogen, whether as a derivative or in gaseous or liquid form, special tankers and associated berthing and filling facilities are required in the area of the industrial port.

Likewise, special bulk freighters and associated mooring, loading and unloading facilities will be implemented in the area of the industrial port for the import of ore-bearing rock, the export of iron ore pellets and the removal of rock that can no longer be used.

SAREP // WEST // COAST

NEXT STEPS

THE PROJECT COMPANY

The development of the SAREP // West // Coast project part is the responsibility of the SAREP project company (Special Purpose Vehicle (SPV)).

SAREP project company comprises the development and realization of standard plots, each with an area of 10,000 ha, including the associated water and energy supply as well as other infrastructure facilities. The distribution and sale of the standard plots - and, if desired by the respective investor, their management and operation - is also carried out by the project company.

Parallel to the development of the first three to five standard plots, the implementation and operation of the reference project (100 ha) takes place.

The project company also stands for site development for the industrial complex in the areas of hydrogen, metallurgy and processing industry.

THE REFERENCE PROJECT

The reference project is intended to generate site-specific empirical data on the cultivation and yield of agricultural and forestry crops, the associated energy and water supply, etc. on a sub-plot of at least 100 ha in order to minimize risks for stakeholders and potential investors. Based upon these empirical data, adjustments can be made to the concept for the scaling up to a standard plot of 10,000 ha.

The energy supply is to be primarily provided by wind energy and designed in such a way that, in addition to seawater desalination, hydrogen production can also be realized on a small scale to provide fuel for the backup supply of the off-grid package.

For a temporary energy, water and hydrogen production to secure the time-limited reference plot operation, a mobile design as FWD technology (Floating WINDdesal) is suitable, which is additionally equipped with technical facilities for the production and storage of hydrogen.

The reference plot is arranged in such a way, that it can be integrated into the surrounding standard plot in the future.

TIME SCHEDULE

The project development for the reference plot and the first standard plots will start in 2023.

The reference plot will be built and commissioned in 2023/2024.

INSTITUTE FOR APPLIED MATERIAL FLOW MANAGEMENT (IFAS)

IfaS has set out as their overall goal to promote the sustainable optimisation of regional and company material flows in concrete, practical projects. Intelligent, resource-efficient handling of materials and material flows forms the backbone of a sustainable society.

IfaS is located at the Environmental Campus in Birkenfeld and is part of the University of Trier.

IfaS Institut für angewandtes Stoffstrommanagement

SYNLIFT INDUSTRIAL PRODUCTS GMBH & CO. KG (SIP)

SIP is a technology and project developer of wind and/or solar powered supply systems for water (SYNWATER®) and for energy & water (SYNUTILITIES®).

SYNLIFT industrial products

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