Seawater Desalination & Long-Distance Piping powered by renewables

Technology & Economics for SAREP & Mauritania

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Overview

1) **SYNLIFT** – the company
2) **REdesal** – chances & challenges
3) **REdesal** – the optimal system
4) **REpumping (LDP)** – the optimal system
5) **REdesal & REpumping (LDP)** – synergies
6) **SAREP Utility** – project phases
7) **SAREP Utility/Large-Scale Project (Phase 1)** – economics
8) **SAREP Utility** - potential for Mauritania
9) **SAREP Utility** – next steps

SYNLIFT industrial products

1) SYNLIFT Industrial Products – the company

SYNLIFT Industrial Products (SIP) was established in 2015 to develop and implement SYNWATER® and SYNUTILITIES® projects für medium and large capacities.

SYNWATER® stands for smart water technologies (water only) - powered by renewables (RE).

SYNUTILITIES® stands for both energy & water supply - powered by renewables.

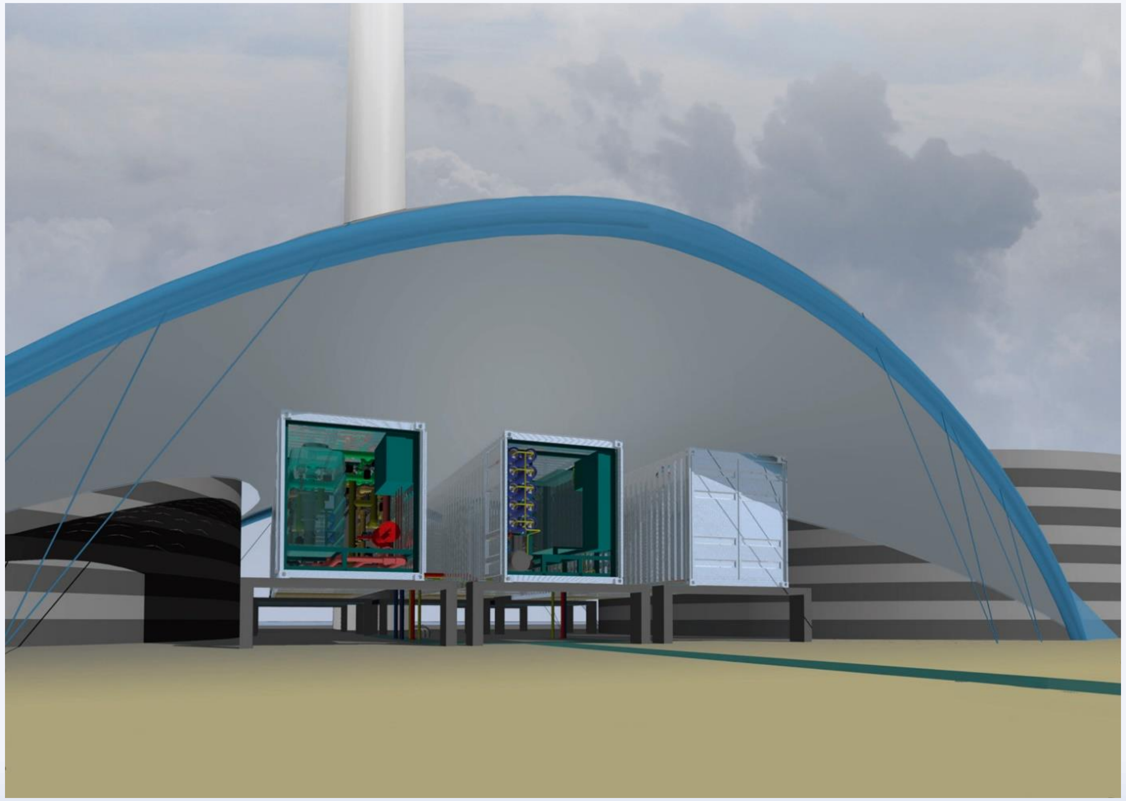
REdesal stands for seawater desalination - powered by renewables and is one focus of SIP business activities. **REpumping** stands for long-distance pumping & piping – powered by renwables too.

SYNWATER® desalination by renewables

SYNUTILITIES® energy & water by renewables

1) SYNLIFT Industrial Products – REdesal technologies (I)

1) SYNLIFT Industrial Products – REdesal technologies (II)



1) SYNLIFT Industrial Products – Floating WINDdesal

Modules	Production Level [1] (m^3/d)		Supply Equivalent [2] (Number of inhabitants)	
	recommended	maximal	recommended	maximal
FWD 10,000/15,000	10,000	15,000	100,000	150,000
FWD 20,000/30,000	20,000	30,000	200,000	300,000
FWD 30,000/50,000	30,000	50,000	300,000	500,000

1) The value *recommended* indicates the operating capacity enabling a high wind penetration level of 90% +/- x%. The value *maximal* indicates the installed or maximum production capacity.

2) Based upon an assumed private water consumption of 100 liter per capita and per day the number of inhabitants is presented, which could be supplied per FWD unit operating on a recommended or maximal production level.

2) REdesal – chances

Using the unlimited resources of seawater as well as solar and wind energy, **REdesal** can enable a reliable, sustainable and cost-effective water supply.

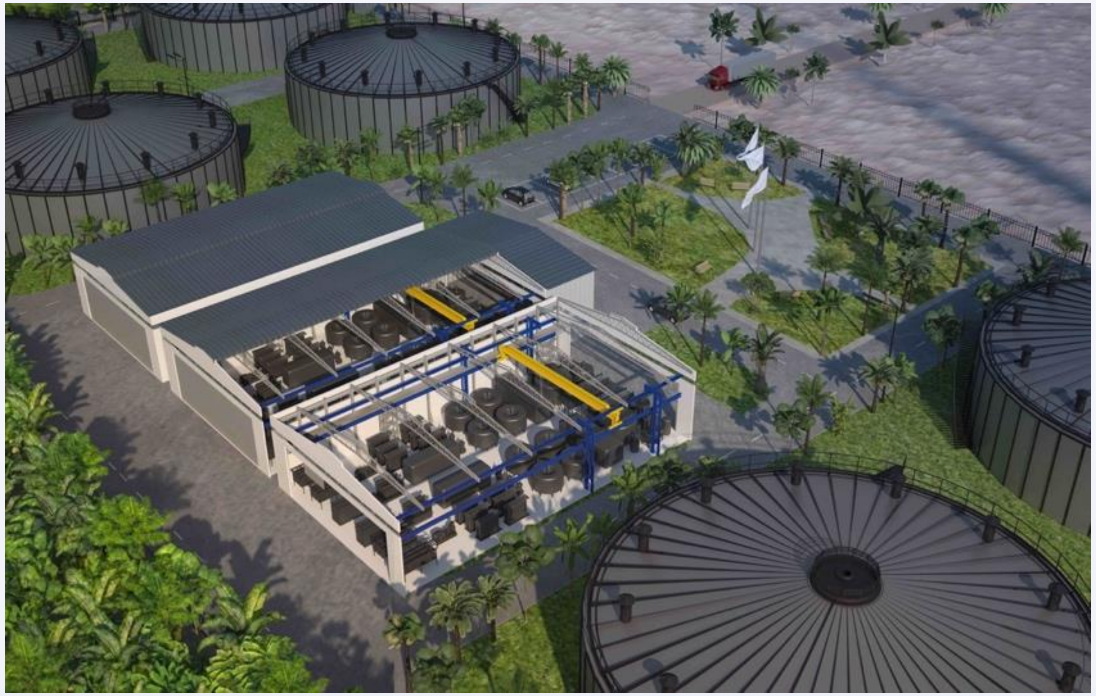
2) REdesal – challenges

Challenge 1:

Wind and/or solar powered seawater desalination
shall be operated at ***maximum RE penetration*** (100% if possible).

Challenge 2:

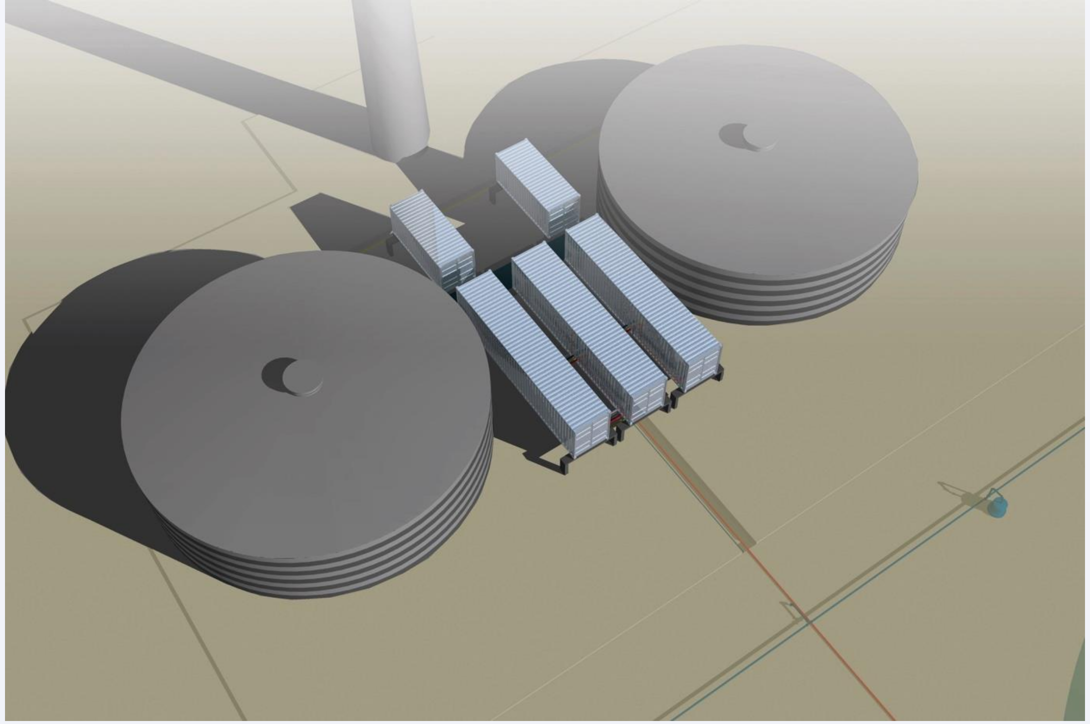
The final product drinking water shall be provided *at **minimum cost***.



3) REdesal – the optimal system (I)

An optimal REdesal system is site-specific and based upon an integrative system approach in which all four technology parts are optimally coordinated with one another:

energy production, energy storage, energy consumption & product storage.



3) REdesal – the optimal system (IIa)

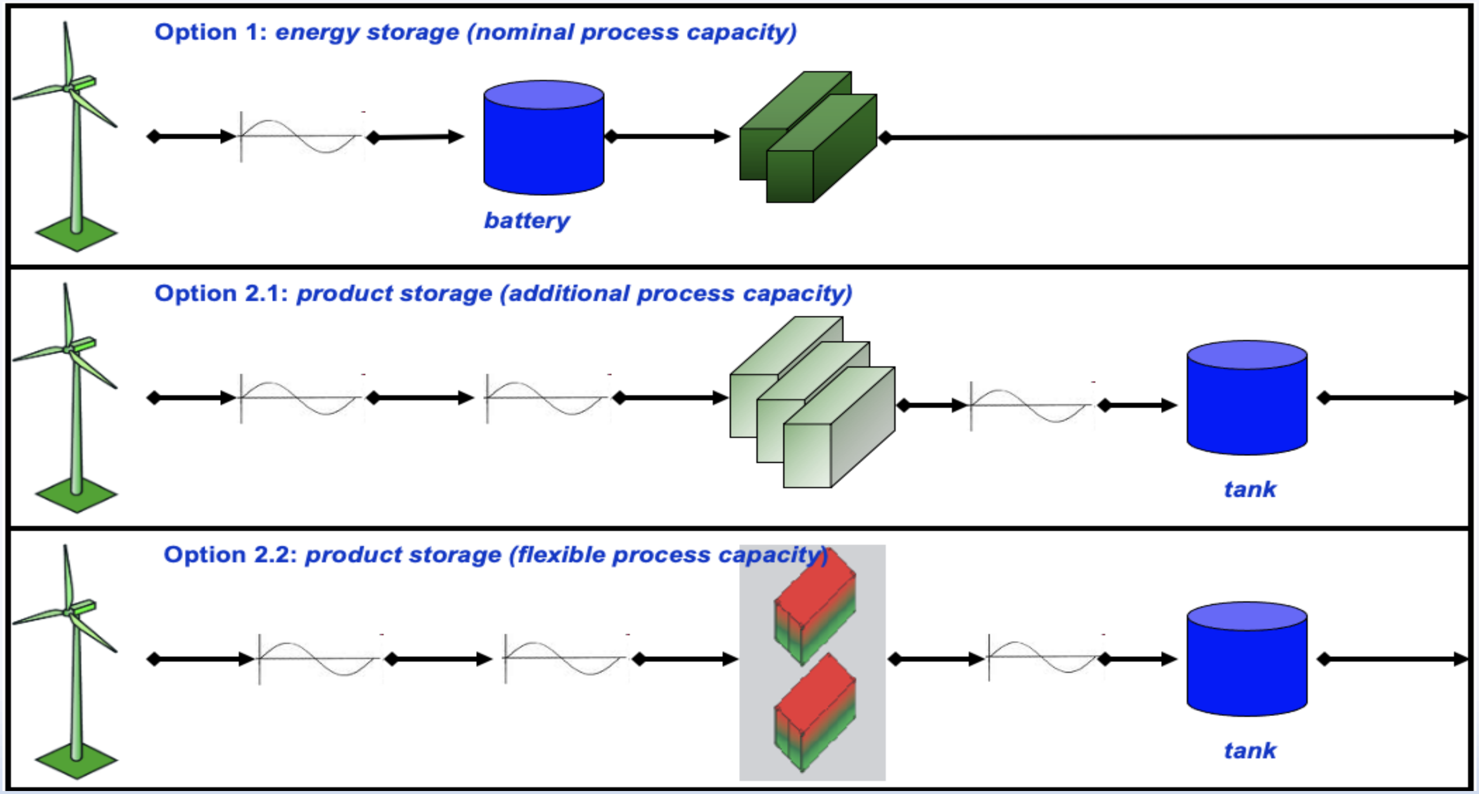
Two options for RE system integration – technically

Option 1:
The *intermediate* product *energy* is stored and thus, the processing is decoupled in time from the RE power supply.

Option 2:
The *final* product *water* is stored and thus, the process control is directly coupled to the RE power supply and requires flexible and extended process capacities (preferred solution).

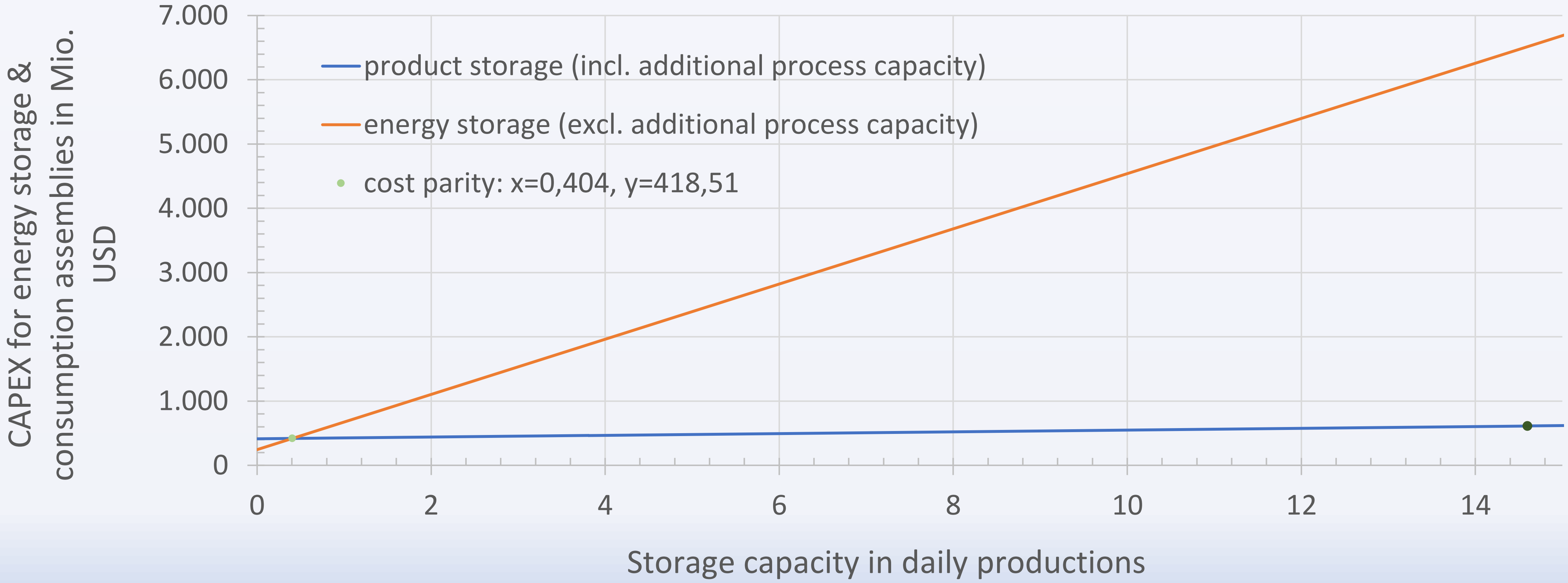
3) REdesal – the optimal system (IIb)

Two options for RE system integration – technically



3) REdesal – the optimal system (IIc)

Two options for RE system integration – economically

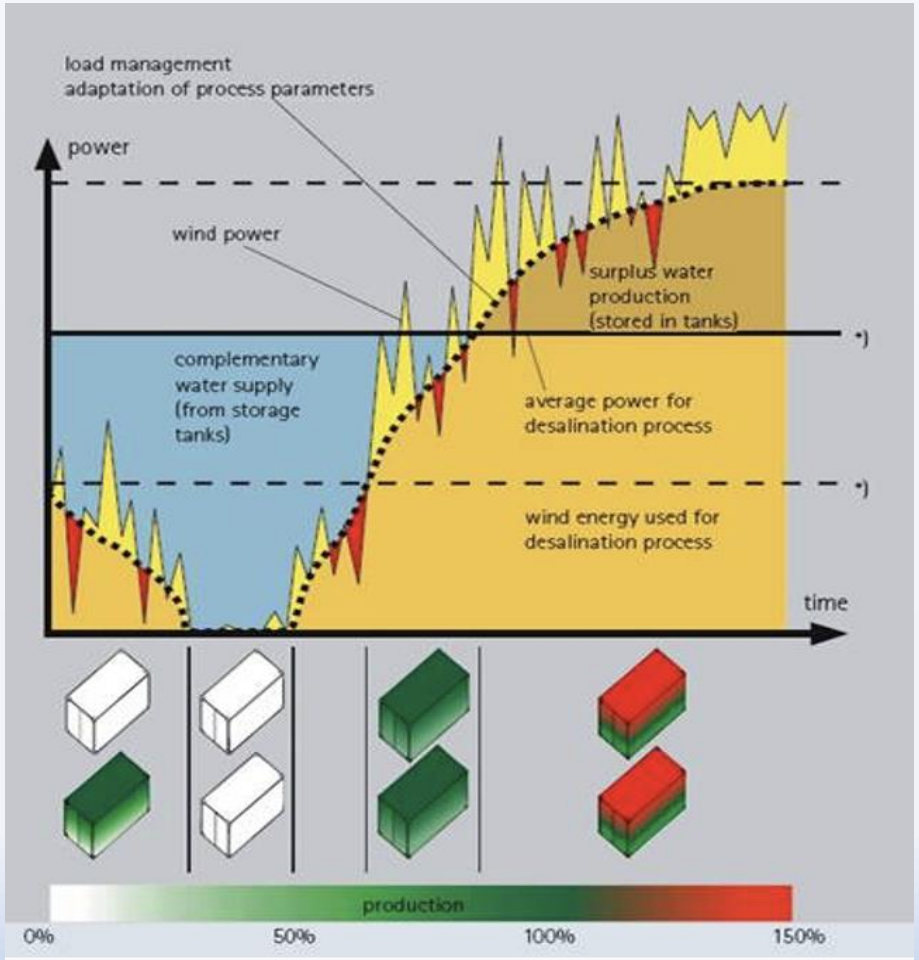


3) REdesal – the optimal system (IId)

The <u>preferred</u>

option for RE

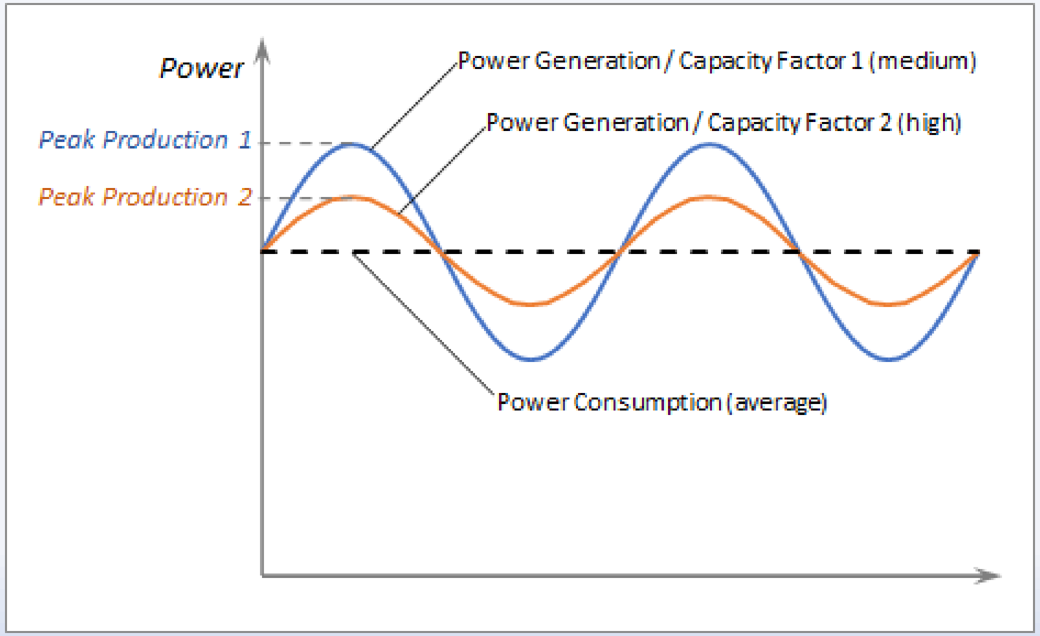
system integration



3) REdesal – the optimal system (III)

Technology Sector 1: *Energy Generation* *(wind and/or solar technologies)*

RE technologies should be used with a maximal capacity factor – if necessary by developing further deveoped standard technologies.



3) REdesal – the optimal system (IV)

Technology Sector 2: ***Energy Storage*** *(seconds & minutes reserve)*

Energy storage capacities must be minimized for cost reasons. Required multi-hour and multi-day reserves can be realized as product storage in combination with flexible and expanded process capacity. The primary task for energy storage is to absorb short-term fluctuations from renewables‘ energy output.

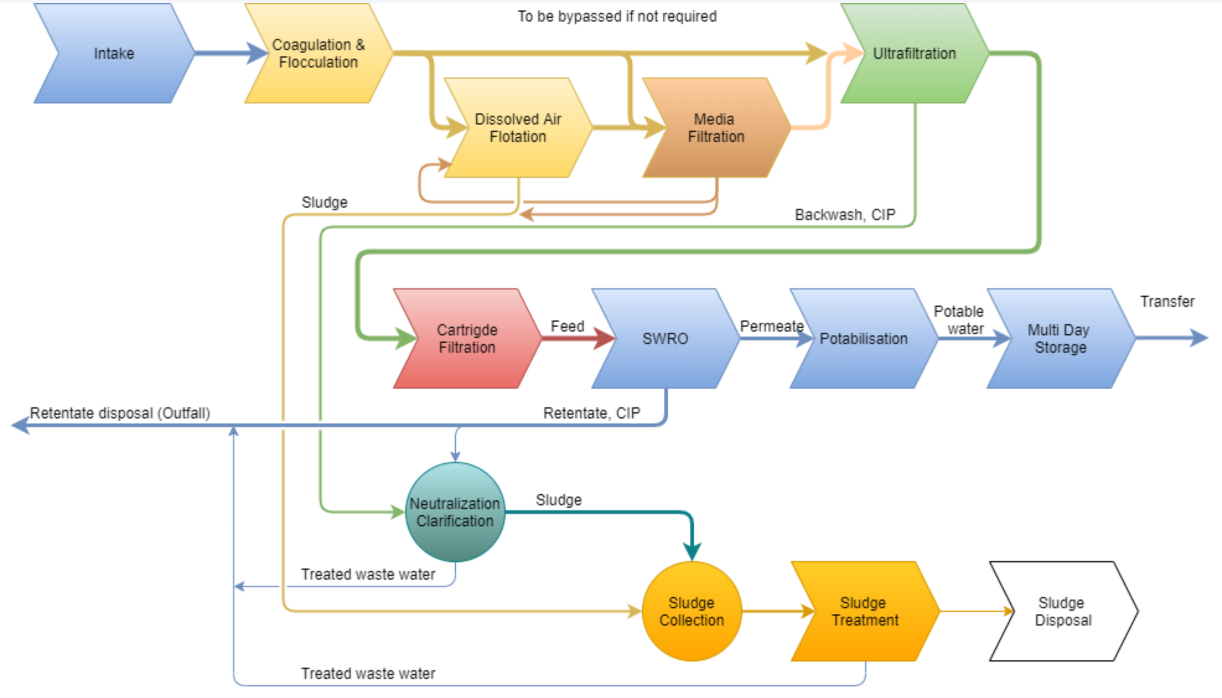
Technology options are e.g.:

- Flywheel as seconds reserve;
- Li-ion batteries as minutes reserve;
- VRF batteries as multi-minutes reserve.

3) REdesal – the optimal system (V)

Technology Sector 3: *Energy Consumption* *(flexible RO processing)*

Consisting of *primary load control* (by frequency-controlled pumps), and *secondary load control* (by adaptation of active RO membrane area).



3) REdesal – the optimal system (VI)

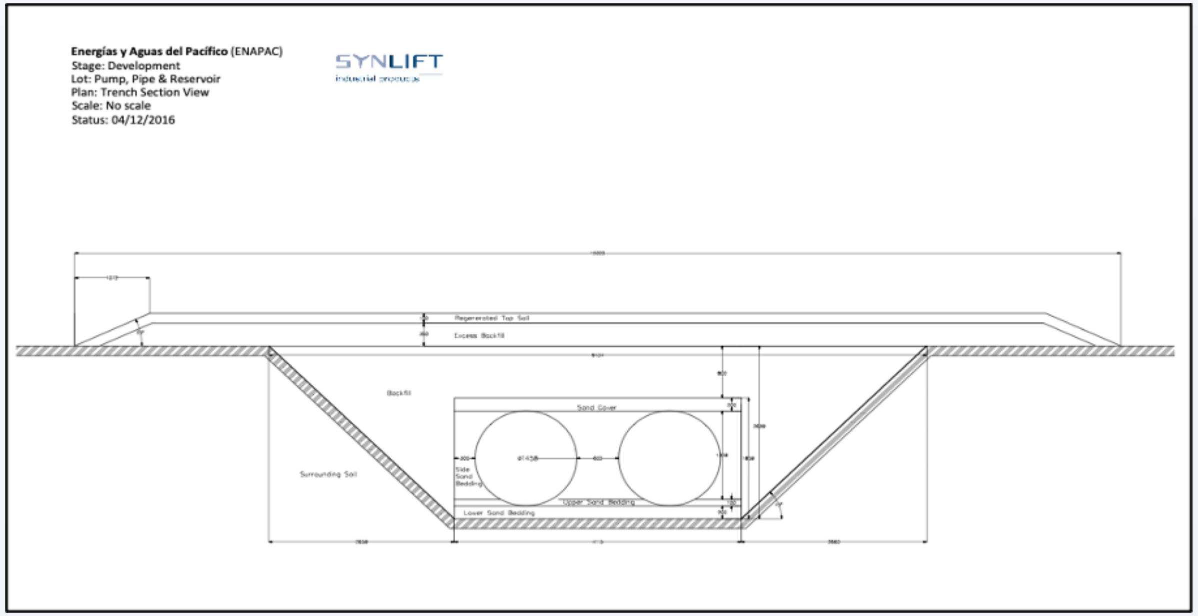
Technology Sector 4: ***Product Storage*** *(reservoirs vs. tanks)*

Longer periods with below-average renewable energy availability usually require multi-day storage. These are much cheaper to implement as reservoirs with (floating) covering than with tanks, especially for large capacities.

Water reservoir with Dynactive covering system (source: Benecke-Kaliko/Continental AG).

4) REpumping (LDP) – the optimal system (I)

Piping: ***GRP – the preferred technology***



- ➢ No corrosion,
- ➢ No induction
- ➢ Simple assembling
- ➢ Flexibility against uneven soil mvmts.
- ➢ Stable pricing

4) REpumping (LDP) – the optimal system (II)

Pumping Stations:

- Downstream the REdesal reservoirs
- Along LDP routing
- Taylor-made

4) REpumping (LDP) – the optimal system (III)

Decentralized Water Tanks:

- Within the afforestation plots
- Taylor-made

4) REpumping (LDP) – the optimal system (IV)

Trenching

Targeted trenching progress:

1 km per day

Hence, the critical path will be the GRP pipe production.

5) REdesal & REpumping (LDP) – synergies

The combination of two processes within the load management makes it possible to concentrate surplus capacities and product storage facilities where it can be realized at the lowest cost – *this might be the REpumping (LDP) side.*

These synergies will open up further potential for cost reduction.

6) SAREP Utility - project phases

- (I) SOLARdesal 1.000 (reference phase 1);
- (II) REdesal 20.000 (reference phase 2);
- (III) REdesal 2.000.000 (large-scale phase 1)

7) SAREP Utility/Large-Scale Phase 1 – economics (I)

REdesal (incl. energy technology):

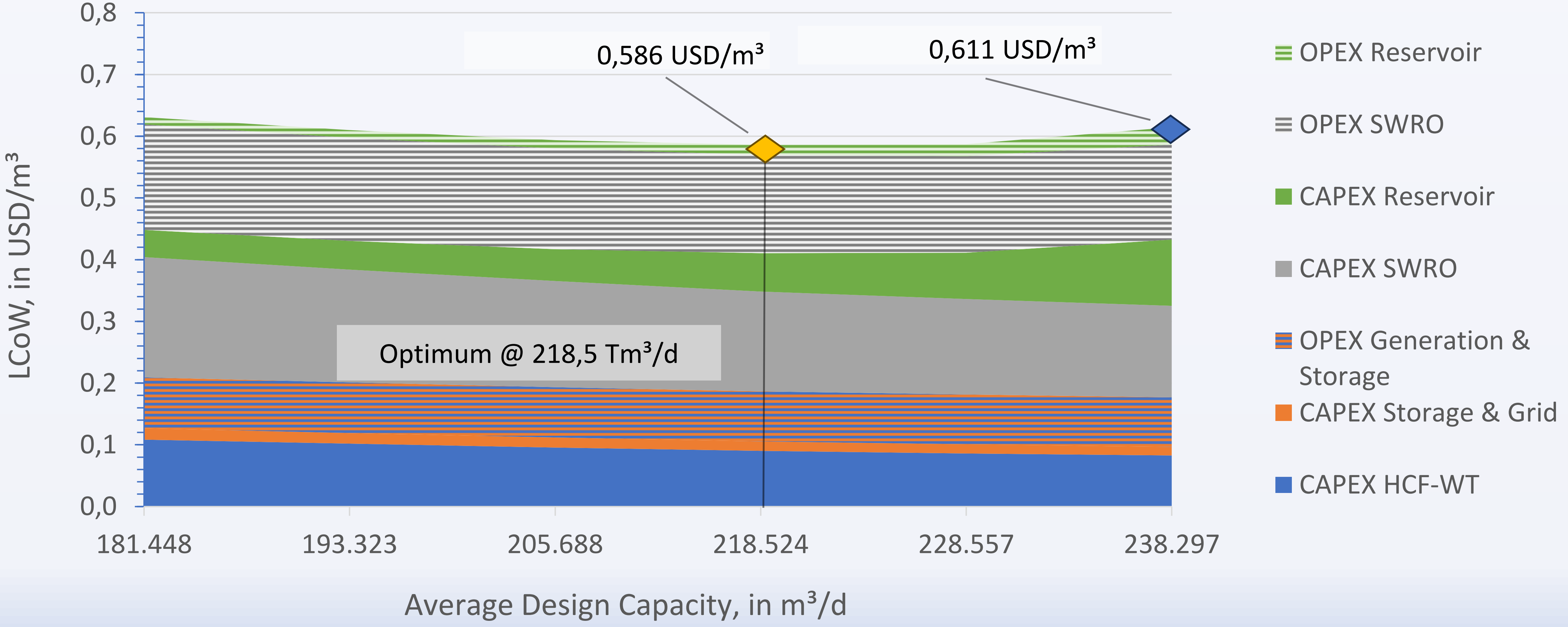
- **CAPEX:** approx. 3,0 Mrd. EUR;
- **OPEX:** approx. 120 Mio. EUR/a;
- **LCoW** (real interest rate : 2,33 %, Betrachtungszeitraum: 30 Jahre): approx. 0,40 EUR/m^3);

REpumping (LDP – approx. 50 km):

- **CAPEX:** approx. 0,7 Mrd. EUR;
- **OPEX:** approx. 13 Mio. EUR/a;
- **LCoW** (real interest rate: 2,33 %, Betrachtungszeitraum: 50 Jahre): approx. 0,05 EUR/m^3;

All information is based on current planning and is without guarantee.

7) SAREP Utility – economics (II)



8) SAREP Utility – Potential for Mauritania

SYNLIFT industrial products

8) SAREP Utility – potential for Mauritania

Based on the currently available data, it is assumed that drinking water in a total volume of approximately **200.000 – 400.000 m^3/d** can be supplied to several locations in Mauritania (incl. Nouakchott) **at a maximum selling price of EUR 0,75/m^3 by 2030**.

9) SAREP Utility – next steps

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SAREP – reference plot

The third & final contract step with the Mauritanian government is intended to be made still in 2024 so that the realization of the reference plot (agroforestry activities on up to 1,000 hectares) can begin at short notice.

Water supply for Nouakchott

The German side has offered to develop and to sign a Joint Development Agreement (JDA) with the Water Ministry/SNDE in 2023 in order to realize a REdesal plant with approx. 200,000 m^3/d.

Thank you for your attention!

Our sincere appreciation to Prof. Peter Heck and his team for preparing this important conference and hosting us at this wonderful place.

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