Seawater Desalination (RO) as a Wind Powered Industrial Process - Technical and Economic Specifics -

International Conference on Renewable Energy Desalination
Tunis, 11-12/06/2012
Content

- Who we are
- Power generation costs
- Wind power process integration
- SYNWATER® - technical & economic specifics
SYNLIFT Systems: Who We Are

- project developer for turnkey renewable energy (RE) power plants and RE applications worldwide

- full range of services - from early stage investigation to final operation management

- technology provider for wind & solar powered seawater desalination (RO)
### Why Wind & Solar Power?

<table>
<thead>
<tr>
<th>Power Generation Costs in EURcent/kWh</th>
<th>Price Increase in % p.a.</th>
<th>Volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil fueled PG (&gt; 5 MW)</td>
<td>3-10</td>
<td>3-5</td>
</tr>
<tr>
<td>Wind PG (&gt; 1 MW)</td>
<td>3-10</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>PV PG (10 ... &gt; 100 kW)</td>
<td>8-20</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>Solar thermal PG (&gt; 50 MW)</td>
<td>19-24</td>
<td>&lt; 1</td>
</tr>
</tbody>
</table>

Economic prognosis for a power plant installed in 2012

*Wind and Solar (PV) power at many (coastal) sites are about to become competitive with large-scale fossil fueled power generation ... already today ... tendency increasing.*

*Wind and Solar power are mainly independent of price trends and volatility.*
What is RE powered desalination?

A wide range of solar thermal, solar (PV), wind, geothermal and wave energy applications for desalination are known and patented – mainly being still on a conceptual and/or pilot stage level.

• **Direct RE integration:**
  Using the RE source directly for desalination (not via electrical energy)

• **Indirect RE integration:**
  Using the RE source via electrical energy for desalination...mainly for solar and/or wind powered applications with small to very large capacities...see the 3 options beside.
RE combination vs. RE integration

energy costs =

power generation + grid use + fees & taxes

An optimal RE integration allows a maximum RE use directly for the desalination process.
RE integration (I): Key parameters

**RE Penetration (REP)** = \[
\text{RE used directly for the process} \\
\text{overall energy demand of the process}
\]

Most influential REP parameters are:

- **RE power** capacity;
- **Storage** capacity (on energy and/or product side);
- **Process** load management;
- **Process** capacity;
RE integration (II):

**Installed Capacity**

1. **Process with RE power** (feed-in tariff level: *low*)

2. **RE Powered Process** (feed-in tariff level: *medium*)

3. **RE Power with process** (feed-in tariff level: *high*)

Surplus energy -- RE

Process energy -- RE

Process energy - grid
RE integration (III): Storage Options

Project integrated storage facilities increase the RE share directly used for the process (RE penetration) and decrease the energy exchange with the main grid respectively.

3 options of large-scale/multi-hour storage integration:

- **Option 1**: energy storage (nominal process capacity)
  - Battery

- **Option 2.1**: product storage (additional process capacity)
  - Tank

- **Option 2.2**: product storage (flexible process capacity)
  - Tank
RE integration (IV): Process Load Management

The flexible SYNWATER® modules are designed to be temporarily driven with an increased capacity of up to 150% within strong wind periods what allows a high wind energy share for the process.

*) nominal power of 1 or 2 RO trains
**RE integration (V): Process Capacity**

**Wind Powered Processes**

*WP capacity factor:* 25 – 50%

*Process peak capacity:* 200 – 400%  
(required for 100% Penetration)

**Solar (PV) Powered Processes**

*PV capacity factor:* 15 – 20%

*Process peak capacity:* 500 – 700%  
(required for 100% Penetration)

**Challenge for Process units:**

*Wide and flexible operational window,* what allows a continuous process adaptation to the full range of power output without excessive modularisation.
SYNWATER®

the components

SYNWATER® Pre-Processing

SYNWATER® Kernel System

SYNWATER® Load Management

SYNWATER® Wind/Solar Power

Putable Water Distribution

National/Regional Grid

AC Substation (medium voltage)

Power Exchange Meter

Transformer

CONTROL ROOM

SYNWATER ON

SCADA System

process power
Recently, strong developments in overall energy production, reliability and power output continuity for MW-class wind turbines.

PV on the threshold to become further competitor to large-scale conventional power.
<table>
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<tr>
<th>Modules:</th>
<th>50/100/200/400 m³/d (continuous production)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100/200/400/800 m³/d (maximal production)</td>
</tr>
<tr>
<td>type:</td>
<td>containerised</td>
</tr>
<tr>
<td>Plant capacity:</td>
<td>100 – 2,000 m³/d</td>
</tr>
<tr>
<td>Wind turbine capacity:</td>
<td>80 – 1,500 kW</td>
</tr>
<tr>
<td>Multi-day storage tank:</td>
<td>1- 3 daily productions (optional)</td>
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</table>

Compact plant arrangement with one wind turbine located directly adjacent the site.
SYNWATER®

large plant capacities

Modules: 1,000 / 2,000 / 4,000 m³/d (continuous production)
          1,500 / 3,000 / 6,000 m³/d (maximal production)

Plant capacity: 2,000 – 20,000 m³/d

Wind turbine capacity: 1.5 – 15 MW

Multi-day storage tank: 1-3 daily productions (optional)

Distributed plant arrangement with one or more wind turbines (wind farm) located in the project area.
SYNWATER® application fields (Wind)
SYNWATER®

application fields (PV)

- Conventional SWRO
- PV Powered SWRO (1300 Full Load Hours)
- PV Powered SWRO (1600 Full Load Hours)
- PV Powered SWRO (1800 Full Load Hours)

Water Production Costs (€/m³) vs. Grid Tariff (€/kWh)
Wind & Solar Powered Desalination

profitable & sustainable
already today!

Thank you for your attention