



THE NEW GENERATION ENERGY STORAGE



9th EU - INDIA Smart Grid Workshop
In Collaboration with Delegation of the European Union to India
and the Directorate General Energy, European Commission”

STARTS UNITED SUN SYSTEMS (NOW TEXEL)

Bought the worlds mos developed Stirling engine

- United Sun Systems (now TEXEL Energy Storage) was formed with the sole mission to combine a solar thermal energy technology (CSP-Dish) with a thermal battery to be able to produce and distribute economically viable electricity 24/7/365.
- One of the two key components, to convert heat to electricity, was incorporated when the V4-Stirling engine was purchased.
- The engine was originally developed by FORD Motors and the Swedish military submarine manufacturing company Kockum's, to be incorporated in a car.
- The V4 engine is by far the most developed "Stirling" engine in the world.
- It is also the most effective, highest power to weight ratio, Stirling engine that has been produced.



STARTS UNITED SUN SYSTEMS (NOW TEXEL)

Maricopa 1.5 MW CSP Dish-Stirling Plant (Phoenix Arizona)



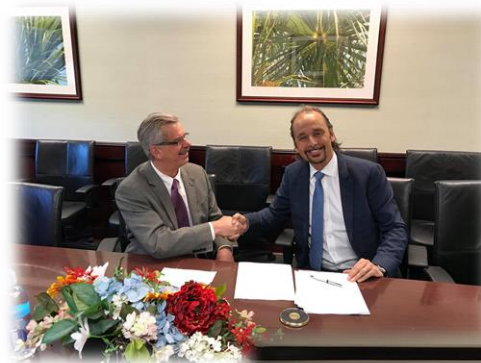
Bought the worlds largest CSP Stirling plant

- \$300 million was invested by Stirling Energy Systems in Phoenix, Arizona to demonstrate the CSP-Dish technology
- Lack of energy storage forced the company into bankruptcy when the market was flooded by cheap Chinese Photo Voltaic, during the PV trade war.
- TEXEL bought the larger part of the bankruptcy to incorporate the test data & know-how from the \$300 million investment into TEXEL's own ambitions.
- A few months later Sandia National Laboratory (SNL) was releasing a report, as an effect of working in the project for five years, pros & cons, how to incorporate a battery technology to the technology.
- The report became a bible for TEXEL during the years to come, in the search for the optimal thermal energy storage solution.

EXCLUSIVE LICENSE AGREEMENT WITH US DOE

After six years of research and negotiations

- In 2015 the negotiations with Savannah River National Laboratory started, with the ambition to sign an exclusive license agreement on the new thermochemical battery solution that was the 100% match with the TEXEL research.
- Savannah River National Laboratory is the laboratory behind the hydrogen bomb.
- In February 2018, two presidency's later, the exclusive license agreement with the US Department of Energy, Savannah River National Laboratory was finally signed.



THE SUCCESS STORY BEYOND LITHIUM BATTERIES



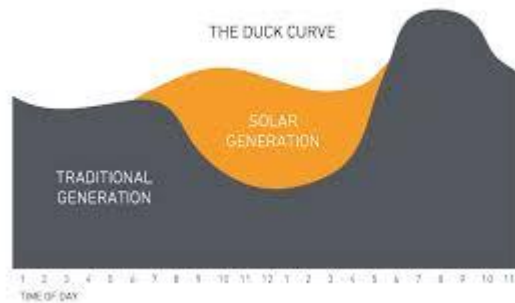
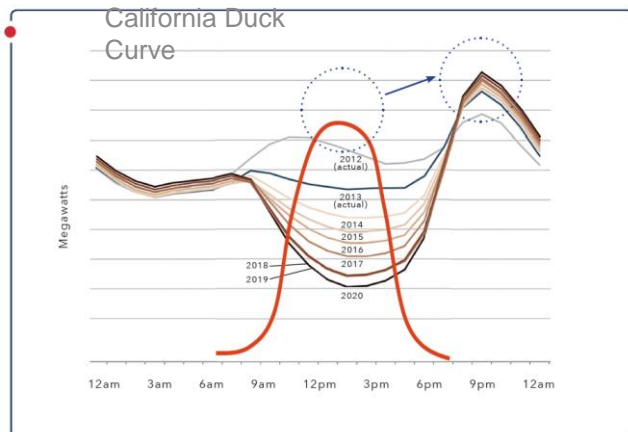
A turning point for TEXEL



Storage summit at Stanford University in Silicon Valley

- In September 2018 TEXEL was appointed the success story beyond lithium batteries at Department of Energy's and X-Labs Energy Storage Summit at SLAC, Stanford University in Silicon Valley.
- The TEXEL battery was now proven to be not only an application for CSP, but also a head to head competitor to Lithium batteries in larger scale energy storage applications - up to 90% more cost effective.
- Focus now goes from CSP to Battery (Energy Storage) for renewables – solar and wind.
- Now TEXEL changes name from United Sun Systems to **TEXEL Energy Storage**.

THE PROBLEM



- The world has decided to transition, away from fossil fuels
- Renewable energy only delivers when the sun shines or when the wind blows
- Renewable energy cannot deliver when the market demands it
- The chart opposite shows how the mismatch of supply & demand for energy
- As more renewable energy comes on tap so the problem is getting worse year on year
- However, direct solar and wind power is cost efficient
- Electricity cannot be stored cost effectively
- The global energy market needs a cost effective energy storage solution
- Until then fossil fuels will never be replaced

US DOE CONFIRMS THE WORLDS CHEAPEST BATTERY



Techno-economic Analysis of Stirling Engine integrated Metal Hydride based Thermal Energy Storage Systems

Economic Feasibility for Grid Storage Applications

Patrick A. Ward, Ragaly Zidan

04/2019

SRNL-STI-20XX-XXXXX (Arial Narrow 14 point plain)

SRNL.DOE.GOV

Techno-Economic Report

US Department of Energy (DOE) and Savannah River National Laboratory (SRNL) released in June 2019, in Washington, a Techno-Economic report to confirm the new super battery, more than 90% more cost effective than Lithium-Ion in some applications.

- LOW COST
- NO CYCLIC DEGRADATION
- LONG STORAGE DURATION + 100 YEARS
- HIGH ENERGY DENSITY
- NO RARE EARTH MATERIALS
- 100% RECYCLABLE
- SCALABLE
- NO RESOURCE CONSUMPTION
- 100% GUARANTEED ENERGY PRODUCTION

THE TEXEL BATTERY IS THE SOLUTION



MAIN COMPONENT (Sub Systems)

THERMOCHEMICAL BATTERY

Metal Hydride technology stores the energy as heat



EFFICIENCY
Electric 40%
Thermal \approx 50%

STIRLING ENGINE (CONVERTER)

Converts thermal energy to kinetic movement

KEY COMPONENT (Sub Systems)

GAS HYBRID

Incorporated to secure 24/7/365 operation.

HEAT TRANSFER SYSTEM

Turns electricity or heat into thermal energy to be stored and to Stirling engine.

GENERATOR

Converts kinetic movement to electricity.

METAL HYDRIDE AND TEXEL PROCESS

The thermochemical battery consists a hot (a) and cold side (b) consisting Metal Hydrides (special metal alloys) and hydrogen.

When the hot side of the battery is “charged”, a chemical reaction is created, and the energy is stored into the metal hydrides on the hot side (a).

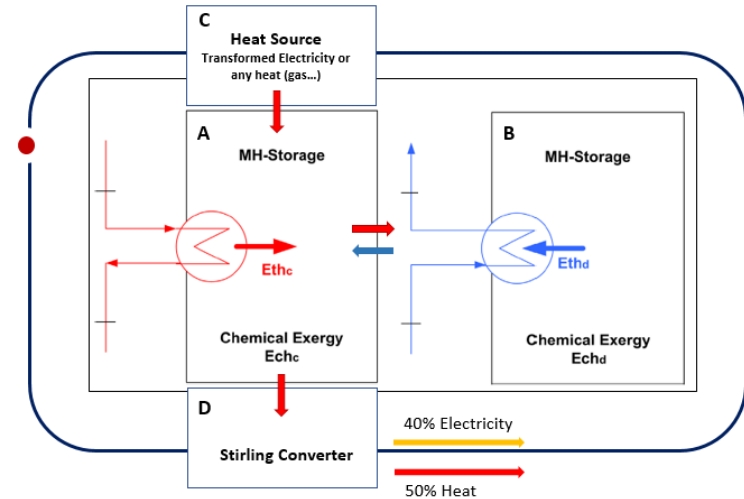
The hydrogen will move from the hot side to the cold side (b) during this reaction to be stored.

The energy is now stored in cool condition and can be stored for 100 years with a minimum amount of energy loss.

When the hydrogen stored in the cold side (b) is forced back to the hot side (a), the thermal energy will be released from the Metal Hydrides and the hot side becomes hot again.

The heat is transferred into the Stirling converter (d) creating kinetic energy that will make a generator produce electricity.

The TEXEL Process



Source: Savannah River National Laboratory, Aiken, SC 29808, USA

ALL YOU NEED IS TEXEL



NO EXTRA POWER NEEDED

The TEXEL battery can not only store electricity produced by Photo Voltaic or Wind. The battery also is able to generate electricity from any heat source like, natural gas, diesel, petrol, wood pellets...etc. This creates an absolutely 100% unique possibility to secure energy production 24/7/365 days per year also when the sun is not shining, or the wind is not blowing.

NO DIESEL GENERATORS.

The only possibilities for other technologies like Lithium batteries in combination with wind and solar, to secure energy production is by adding a traditional Diesel generator as backup.



HUGE MARKET

The market is huge

The market is defined as one of the largest growing ever according to a recent report from Bloomberg

They predict the market for energy storage, excluding batteries for the mobility market are more than \$1.2 trillion USD during the next 20 years.

INITIAL TARGET MARKETS

- Island Storage
- Micro Grids
- Peaker Plants
- Grid Energy Storage



TEXEL IS EXTREMELY COST COMPETITIVE



STORAGE TECHNOLOGY

Technology	USD cent / KWh
Pumped Hydro	10.12 – 12.96
Compressed Air	6.13 – 8.10
Li-Ion	20.4 – 29.8
Solar Thermal incl. Storage	9.8 – 18.1
TEXEL Energy Storage	0.96 – 1.61

ENERGY

Technology	USD cent / KWh
Nuclear	11.2 – 18.9
Coal	6.0 – 14.3
Gas – Combined Cycle	4.1 – 7.4
TEXEL Energy Storage	2.59 – 3.98

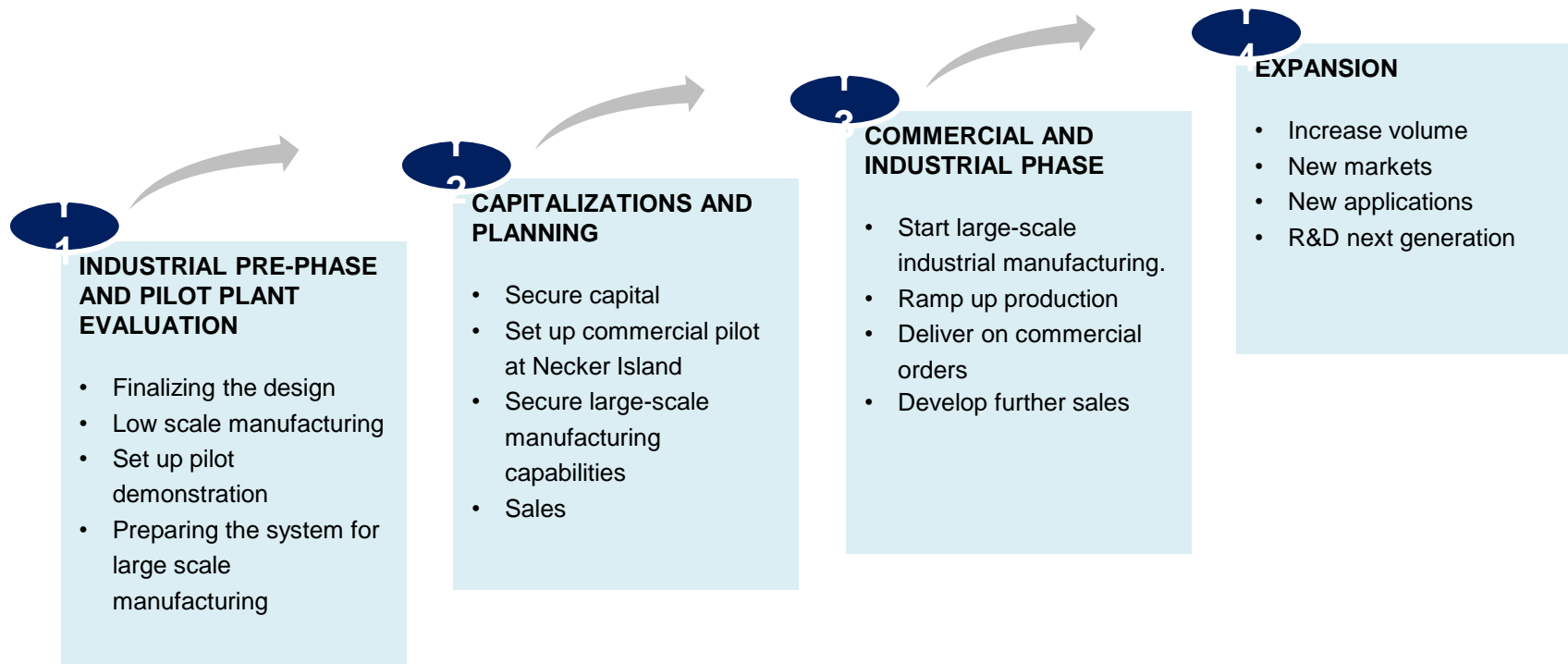
Competitive as Storage and in combination with renewables

- Highly competitive towards other storage technologies
- Scalable both in large- and small-scale installations

TEXEL vs Li-Ion

- Both scalable – therefore the perceived competing technology
- Li-Ion was originally developed for smaller devices, and has now pushed the upper limit in scale to cars
- Are dependent on expensive rare earth materials
- Short life cycle before they need to be replaced

BUSINESS PLAN IMPLEMENTATION



TEXEL INDIA AND WORLD-WIDE



TEXEL Energy Storage

Sweden

- Research and Development
- HQ

TEXEL Energy Storage US Inc

- California office – Palo Alto
- Research and Development
- Initial Sales Activities



TEXEL Australia

- Research and Development co-operation
- Curtin University

TEXEL Energy Storage India

Potential for

- Financial partner
- Technical development
- Pilot plants
- Manufacturing
- Future regional sales incl. Middle East

HUGE MARKET INTEREST – NECKER ISLAND

- Get requests from the market on an almost daily basis
- TEXEL has negotiations with among others the large energy companies in California
- Co-operation with Stanford University is initiated to set up commercial pilot installations
- TEXEL will install the first pilot installation on Sir Richard Branson's, Necker Island in the Caribbean
- To demonstrate this technology it is perfect to use an Island or a Micro Grid
- A very successful and famous entrepreneur just said

“I Understand what you are trying to achieve, and if this will succeed this is the largest opportunity and disruptive technology, I have come across during my whole business career”.



At Necker Island

- Battery will be charged by Photo Voltaic and wind
- During longer periods of no solar or wind the TEXL battery will be charged by burning hydrogen gas – produced using excess production of electricity
- The worlds first cost competitive, 100% renewable and 100% circular micro grid, and has at the same time showcased the possibility for the world to move 100% away from fossil fuels.

NEXT STEPS



In order to carry out the business model, TEXEL is now raising approx. USD 30 million

- Finalize the development
- Set up pilot plant at Richard Branson's Necker Island
- Start Industrial and Commercial phase

An additional USD 80m of funding to (Industrial Phase)

- Equity and/or other form of capital
- Set up Gigafactories
- Industrialise the commercial production of the TEXEL battery in Europe and US
- Hopefully also enter the Indian market with Indian partners!