

The background image shows a landscape with solar panels in the foreground, wind turbines on hills in the middle ground, and a large building on the right. Overlaid on the image are glowing orange sine waves and a faint binary code pattern. The Siemens logo is in the top left corner.

SIEMENS

Ingenuity for life

Renewables and the role of Energy Storage & Digitalization in the transition away from Fossil Fuels

Siemens Distributed Energy Systems – Tom Mactier– Pacific Power Conference – Friday 4th August 2017

High Power Prices in the Pacific

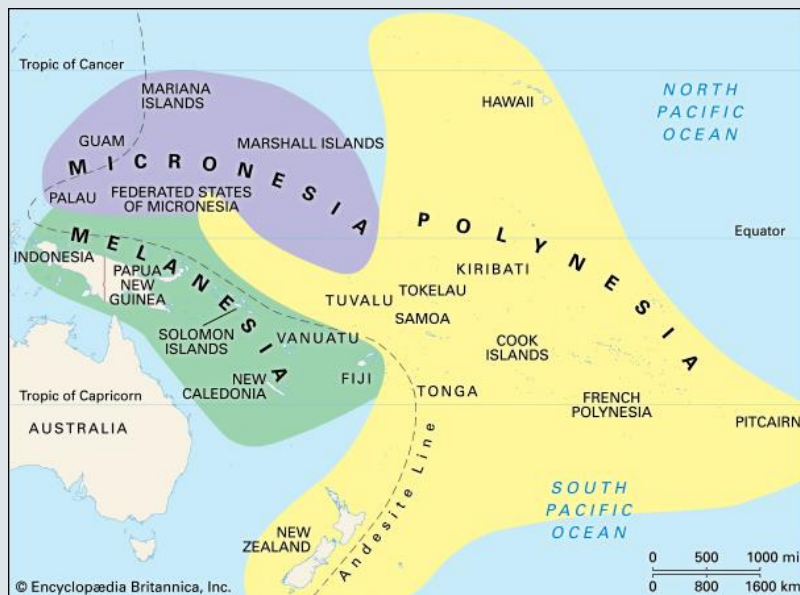
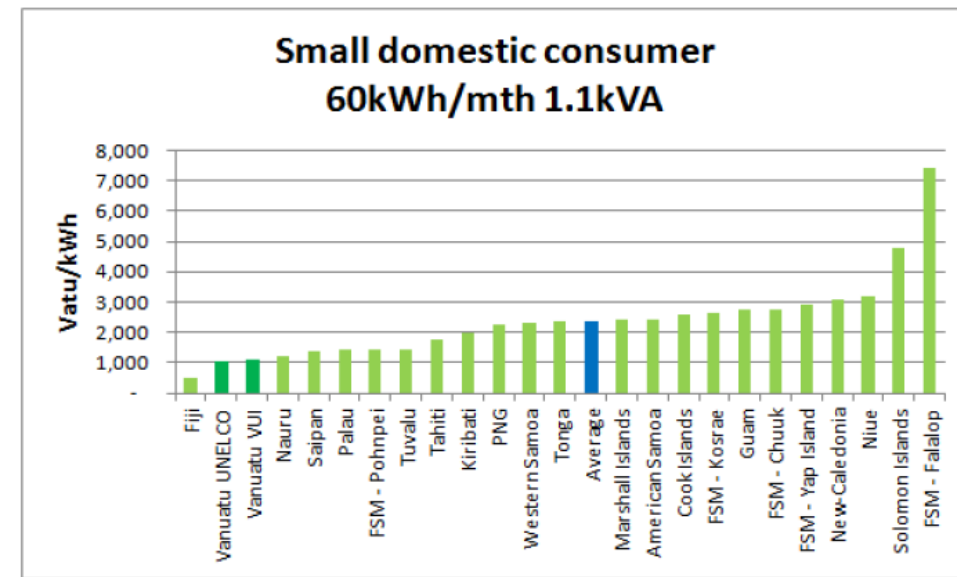


Table 3: Diesel contribution in energy generation mix

Country	Generation capacity in MW	Diesel contribution %
American Samoa	54	98%
Cook Islands	10	100%
Fiji	245	49%
Federated states of Micronesia	28	90%
Guam	552	100%
Kiribati	5	52%
Marshall Islands	17	90%
Nauru	4	100%
New-Caledonia	499	73%
Niue	1	100%
Palau	28	98%
PNG	700	77%
Saipan	105	100%
Solomon Islands	36	45%
Tahiti	186	74%
Tonga	12	98%
Tuvalu	3	100%
Vanuatu UNELCO *	24	71%
Vanuatu VUI *	4	21%
Western Samoa	41	64%

Av=80%

Figure 1: Comparison of bills paid by "Small domestic consumers" across the Pacific region in VUV/kWh

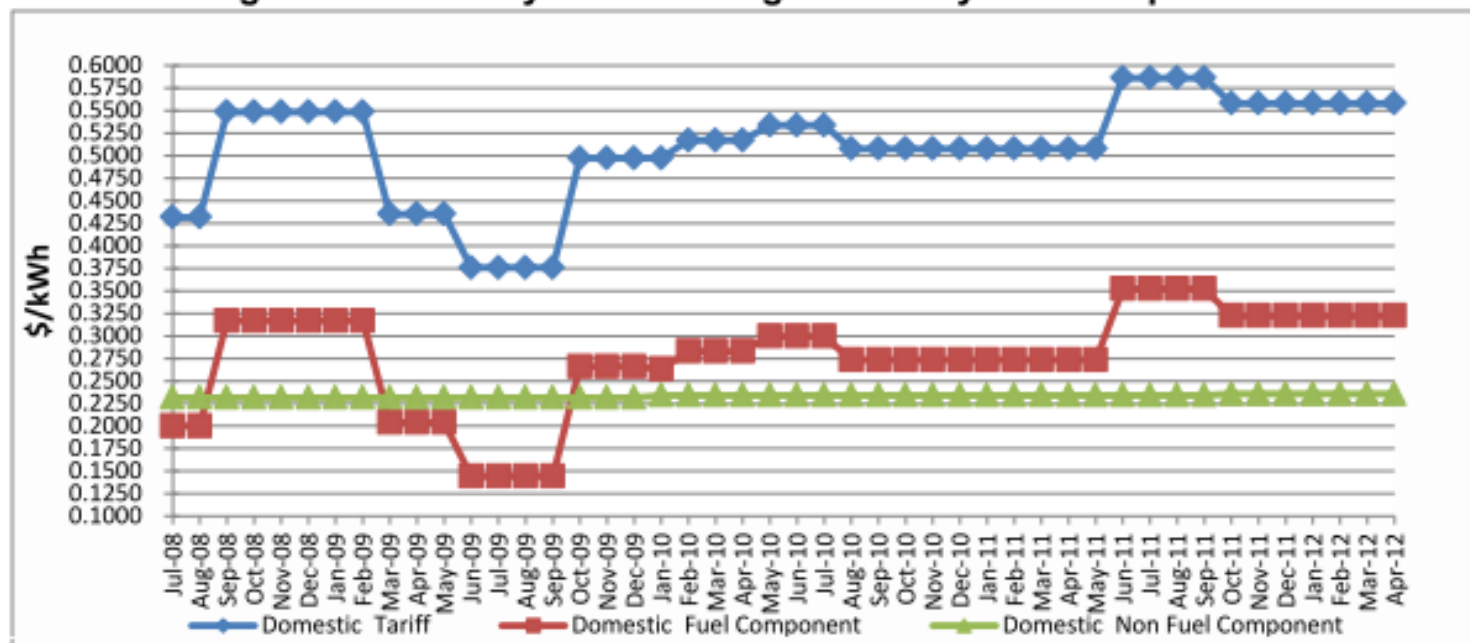


Source: URA

Av=0.32
USD/kWh
Max – USD
0.73/kWh

Power Price Volatility

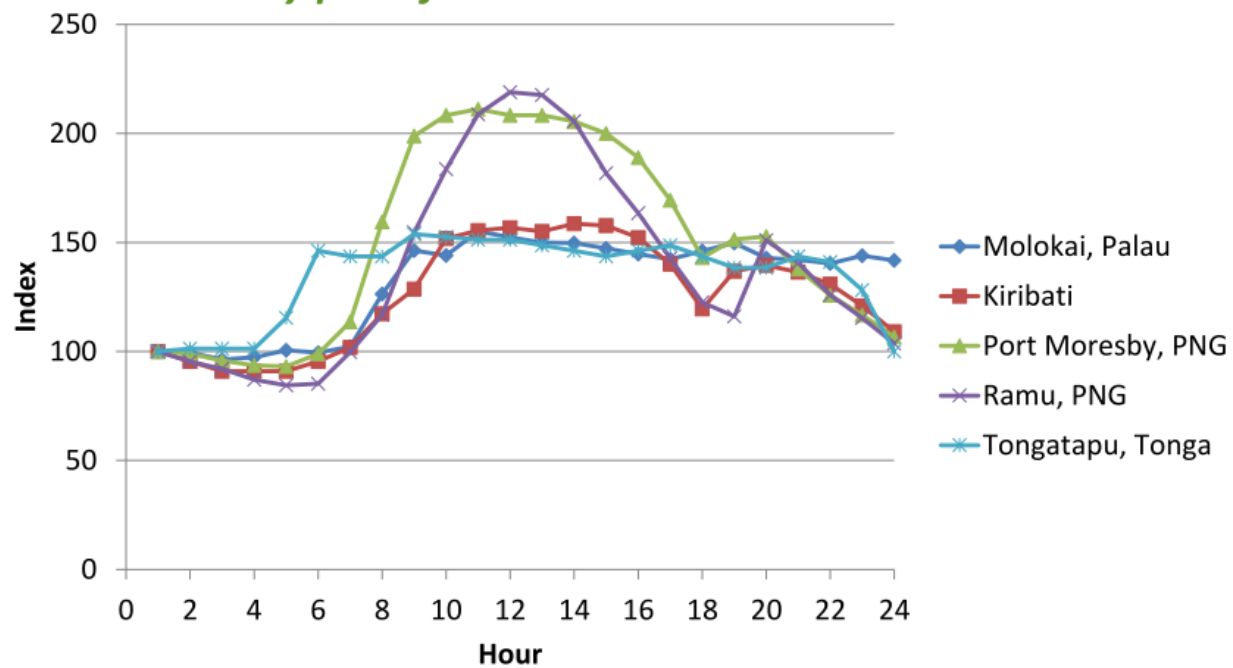
Figure 2: Electricity Tariff in Tonga from July 2008 to April 2012



EIRR = economic internal rate of return, ENPV = economic internal rate of return, kWh = kilowatt hour
Source: Tonga Power Limited and Asian Development Bank estimates.

The response

Pacific load curves
Day peak fits well with PV

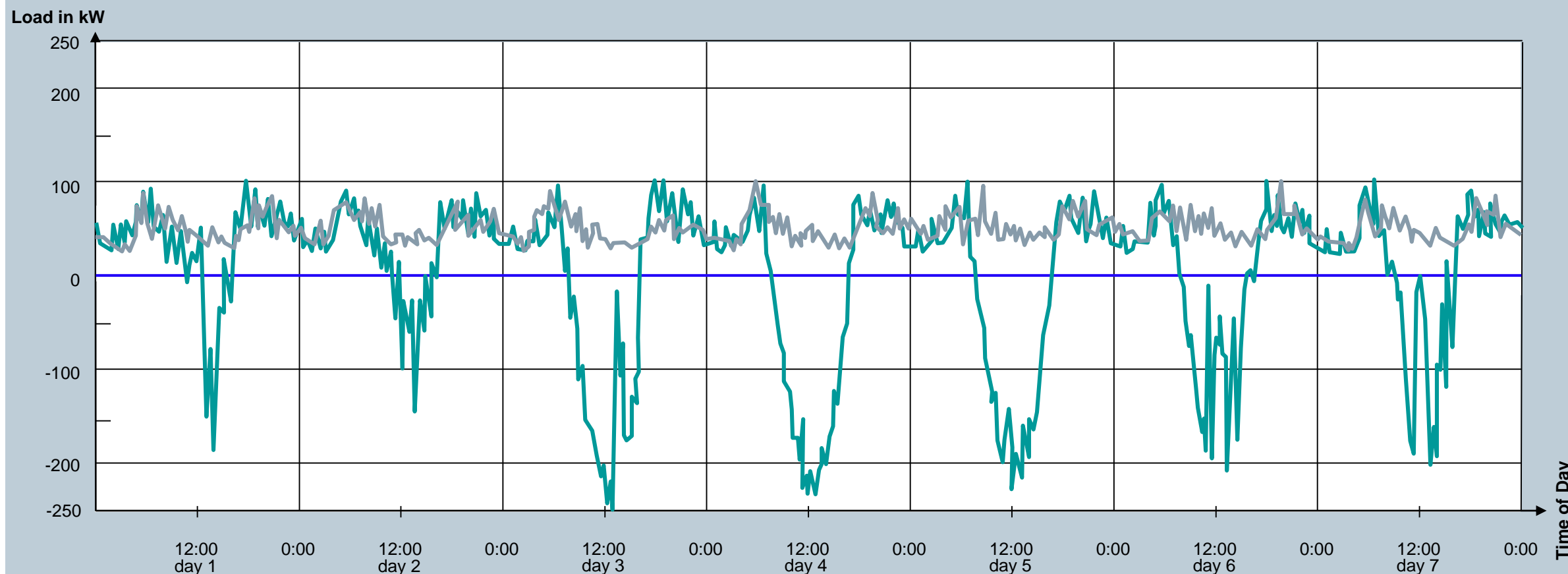


Source: IRENA, 2012



The Challenges

Weekly loading of a Distribution Substation in a rural area of LEW-Verteilnetz GmbH – 2003 and 2011

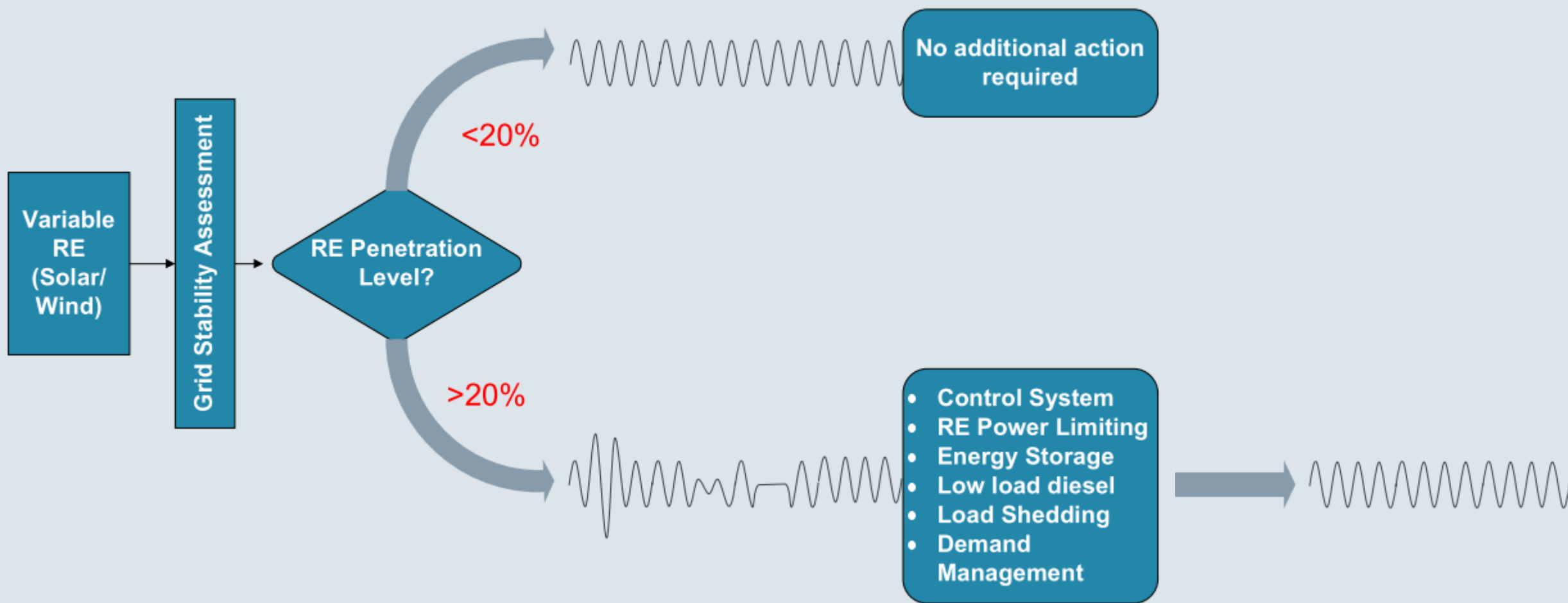


Source: LEW

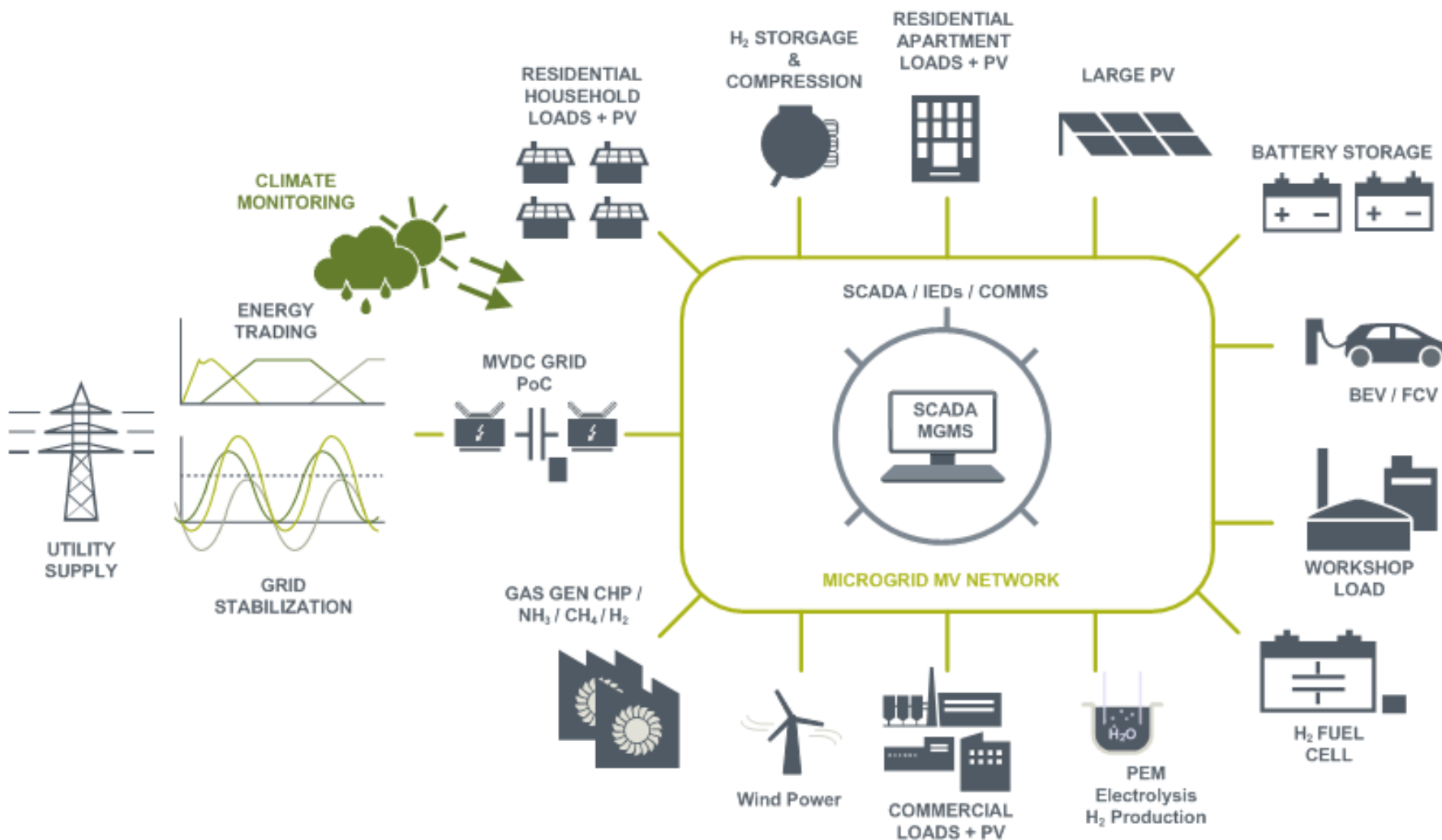
— Load profile 2003 — Load profile 2011

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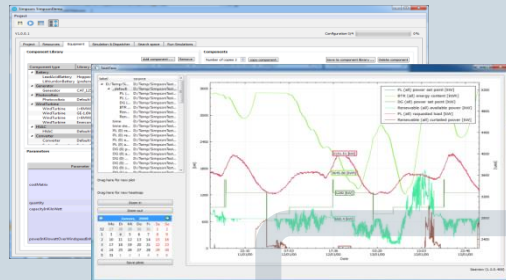
PV Penetration – Low Vs High – The Strategy



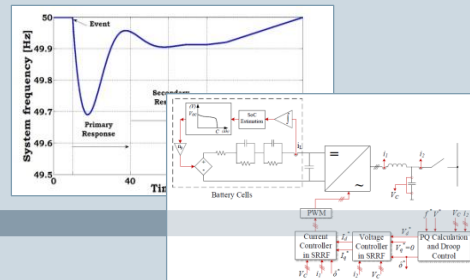
MicroGrid – Energy Storage / Grid Stabilization behind the meter



Microgrid Development



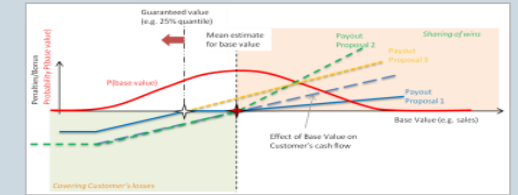
In-house sizing tool: PSS DE



Technical verification: PSS SINICAL



DG control offering: MGC, MGMS



Performance Guarantees

Technical/Economic
Modelling – PSS DE

Partnering &
Procurement

Engineering

Site
implementation

O&M

Financial partners
and optimization

Financing

Performance Guarantee



Financial Evaluation



Engineering and execution



Operation, verification and revenue realization

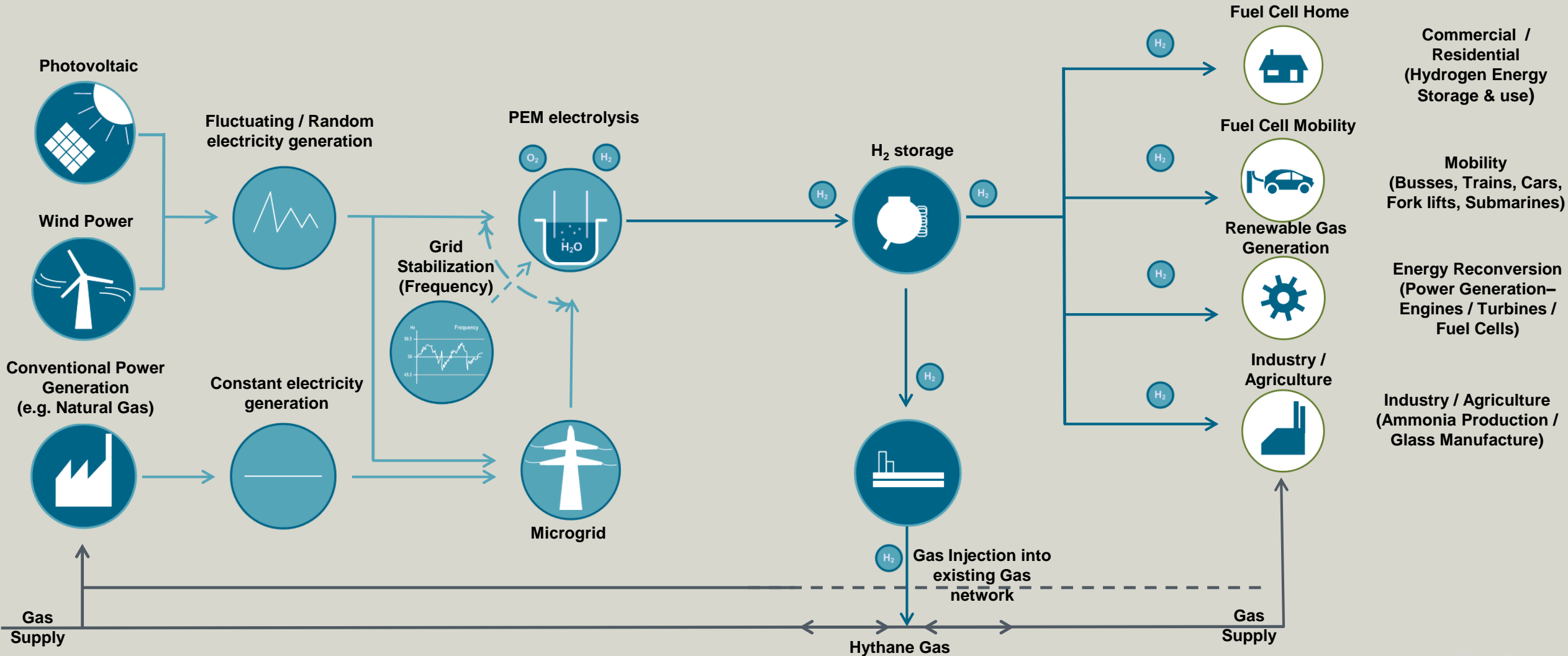
Power to Gas – Possibilities

H₂ Drives the convergence between energy, transport and industry

Generation

Conversion / Storage / Grid Stabilization / Transport

Application



Power to Gas - Energiepark Mainz – Development of a decentralised energy storage plant

- Partners: Municipality of Mainz, Linde, RheinMain University
- 3 X PEM Silyzers - 6 MW peak
- Connected to 10 MW wind-farm
- Ramp Up/Down: 200kW/s
- €3/kg H₂(with €70/MWh surcharges)
- -€1.5/kg H₂(withour surcharges)



Reference: Google



Ein Forschungsprojekt von



Hochschule RheinMain
University of Applied Sciences
Wiesbaden Rüsselsheim



SIEMENS

Gefördert durch



Bundesministerium
für Wirtschaft
und Energie

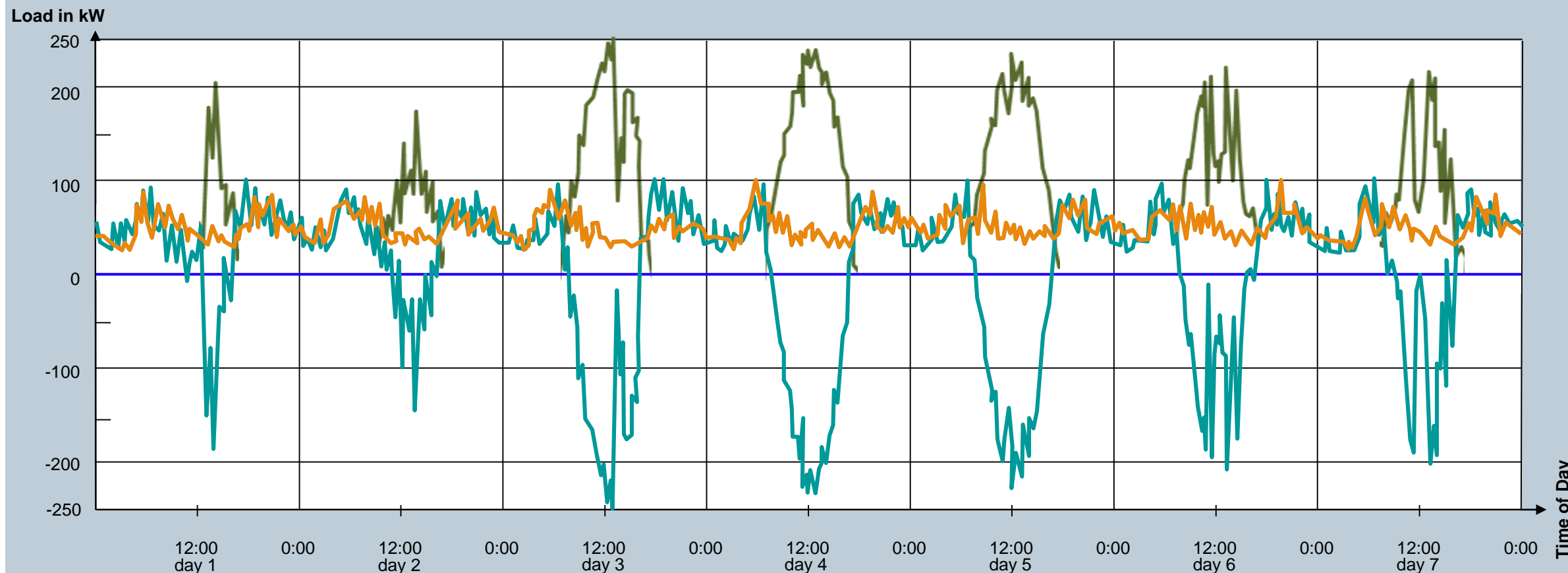
aufgrund eines Beschlusses
des Deutschen Bundestages

ENERGIESPEICHER

Forschungsinitiative der Bundesregierung

Load Curve with Silyzer Implemented

Weekly loading of a Distribution Substation in a rural area
of LEW-Verteilnetz GmbH – 2003 and 2011



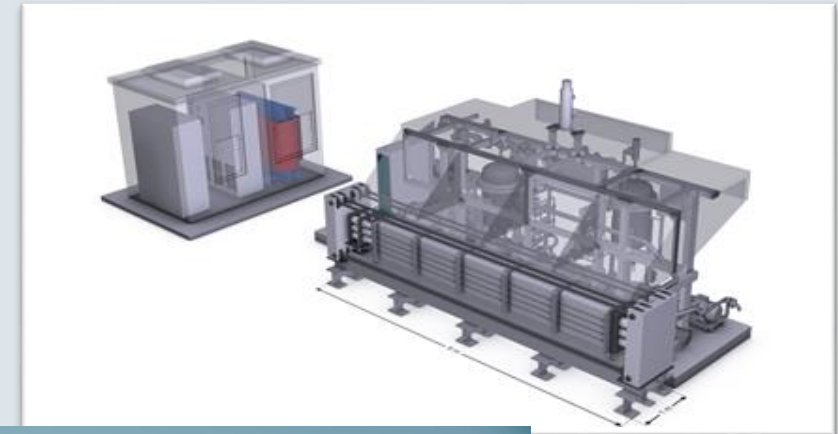
Source: LEW

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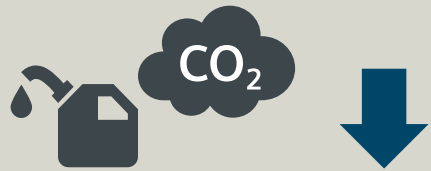
— Load profile 2003 — Load profile 2011 — Electrolyzer Load — Final Load profile

REP2G – Renewable Power to Gas - Silyzer for ACT, Australia

- Silyzer 200 to be supplied as part of 315MW Hornsdale Wind Farm - 'Renewable Transport Fuels Test Birth'
- To supply hydrogen for Hyundai supplied fuel cell cars
- Status: In production. Expected delivery 2018.



Isle of Ventotene, Italy: Enabling electrical independence



10-15%

Reliable

“... Performance and reliability of control is very high...can be considered as business excellence ...”

ENEL, Customer



Challenge:

- Complex control requirements for off-grid stability
- Fuel savings for island grid.
- Enable integration of renewables with existing gen-sets



Project Development Challenges

Galápagos Isabela Island - 100% renewable with Siemens turnkey solution



Solution

Turnkey

**Very high penetration – up to 100%
Renewable Energy**

1.6MW

Reciprocating
Engines on Biofuel

920 kW

PV
Power

620kW

Battery Energy
Storage System

100%

Renewable
Energy

Siemens in the Pacific

- New Zealand - HVDC Inter-Island Link & Converter Stations
- PSS E and PSS SINICAL standardised network modelling and simulation tools for Utilities
- Support Electrical infrastructure development
- Allied member of the Pacific Power Association
- Ongoing engagement with Pacific Island Countries & development agencies



Thank you !



Tom Mactier
Distributed Energy Systems
Siemens Pacific
+61 409 629 976
tom.mactier@siemens.com