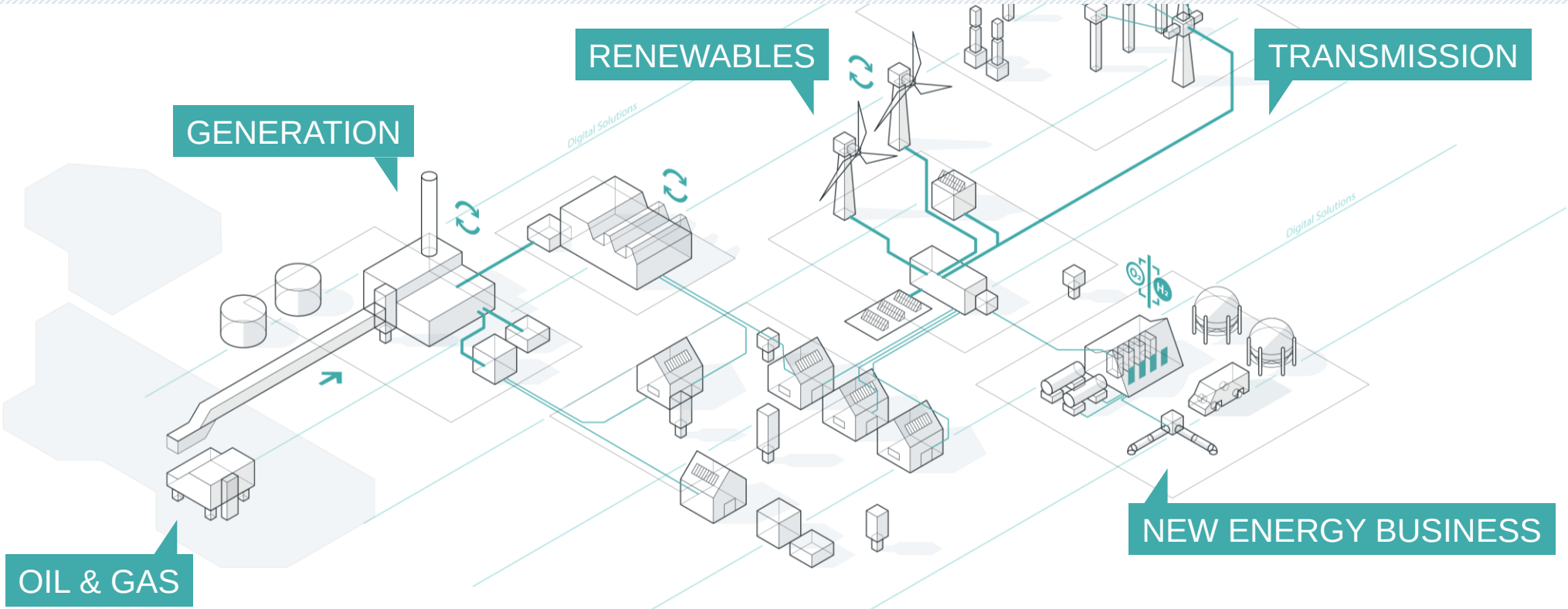
Scaling up green Hydrogen

June 25th, 2020

Siemens Energy will be an independent pure play energy company

REVENUE	ORDER BACKLOG	ORDERS	EMPLOYEES
~€27 bn	~€70 bn	~€30 bn	~88,000



Figures FY18 pro forma, the portfolio additions announced in the Q42019 are not reflected

Silyzer portfolio scales up by factor 10 every 4-5 years driven by market demand and co-developed with our customers

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Silyzer portfolio roadmap

0,1 MW → 1 MW → 10 MW → 100 MW → 1000 MW

2011

Silyzer 100
Lab-scale demo
~4.500 OH[1],
~150k Nm³ of H_2

2015

Silyzer 200
~86.500 OH[1]
~7.3 mio Nm³ of H_2

World's largest Power-to-Gas plants with PEM electrolyzers in 2015 and 2017 built by Siemens!

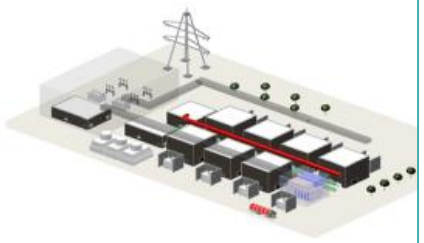
2020

Silyzer 300

Biggest PEM cell in the world built by Siemens!

2023+

Next generation
Under development



2030+

First investigations in cooperation with chemical industry

[1] Operating Hours; Data OH & Nm³ as of Dec 2019

Silyzer 300 –
the next paradigm in PEM electrolysis

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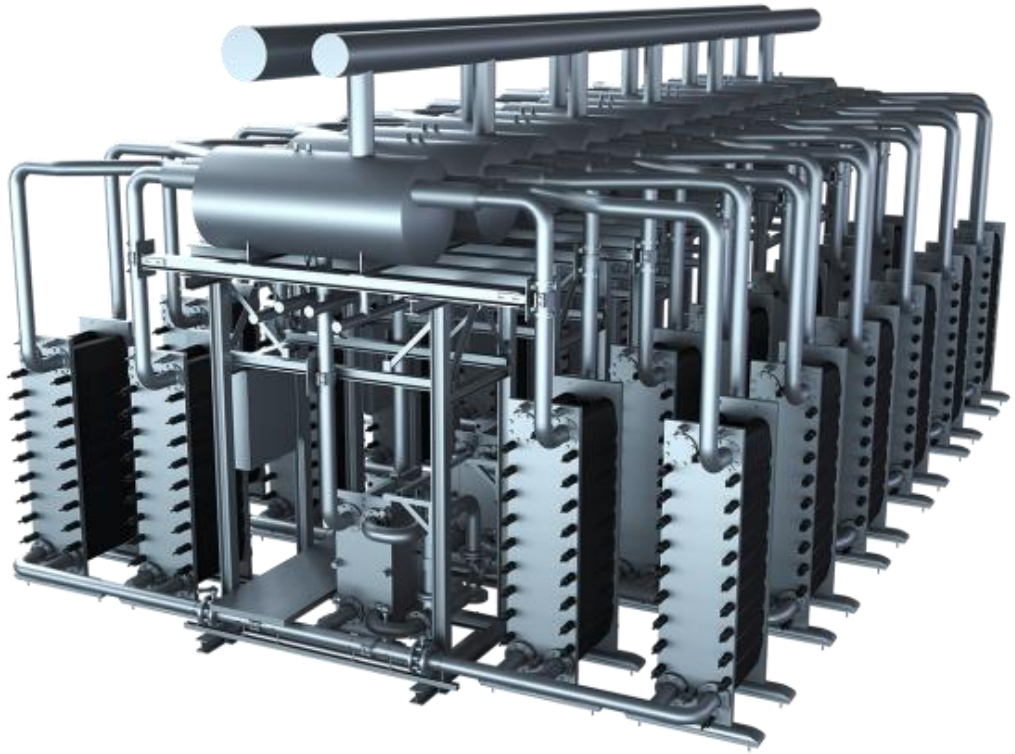
17.5 MW	Power demand per full Module Array (24 modules)
75 %	System efficiency (higher heating value)
24 modules	to build a full Module Array
330 kg	hydrogen per hour per full Module Array (24 modules)



Silyzer 300 – Module Array (24 modules)

The modular design of Silyzer 300 can be easily scaled

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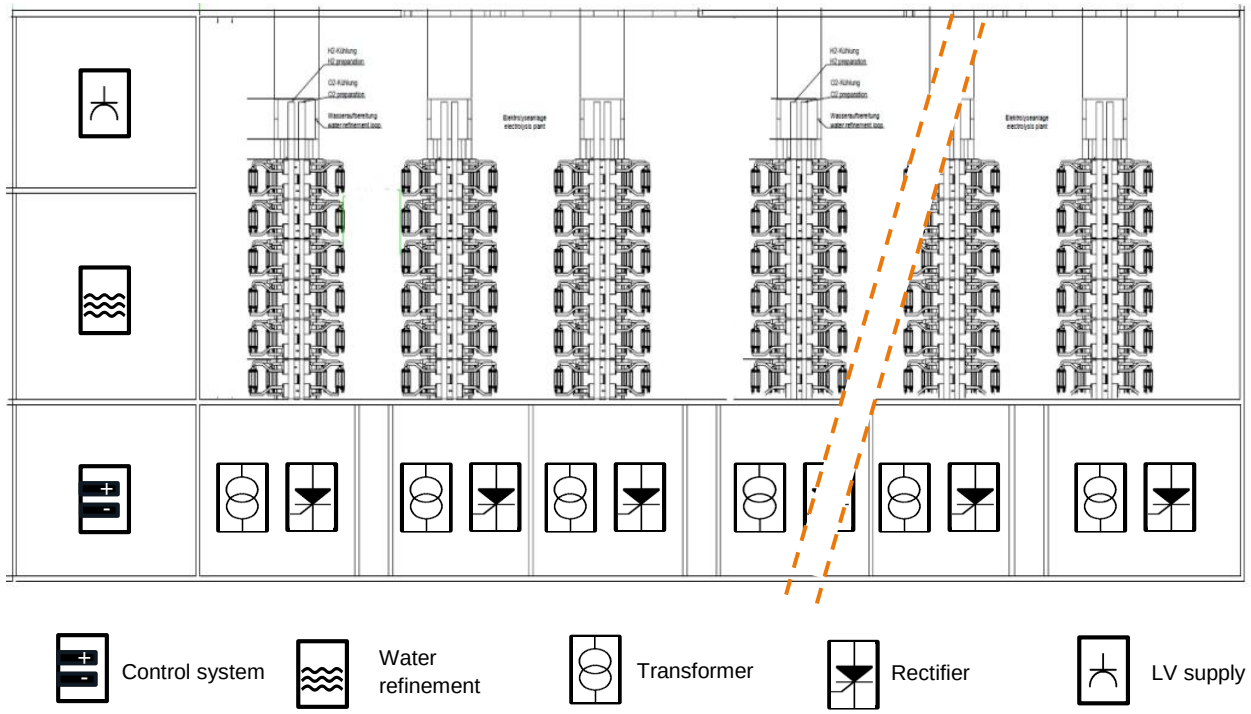
Module | Module array | n+1 | Customized solution | Plant

Between 12 and 24 modules

Scale up to the necessary demand



! **Modular concept to cover wide production rate**

Hydrogen generation: more than just an electrolyzer

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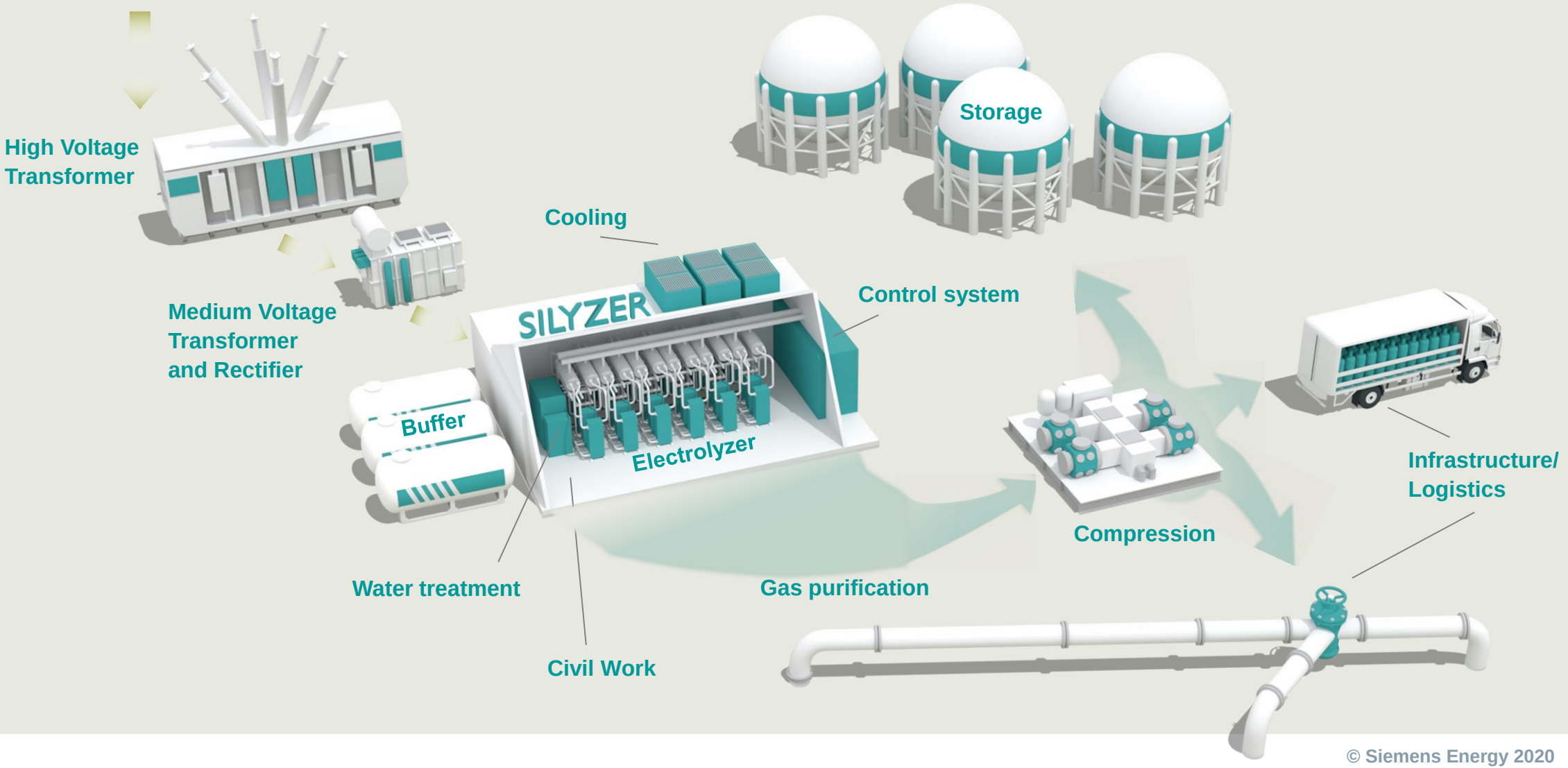

Basic H2 production cost modelling at a MENA location

Exemplary top-down calculation for discussion purpose only

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Assumptions:

- 100 MW generation capacity
- 75% efficiency (Silyzer 300)
- Capex 650 EUR/kW (H2 production system only)
- 8% WACC
- 10 years depreciation
- 3% Maintenance
- Water ~2 EUR/cubic meter

Expected generation cost for 1kg H2, uncompressed, civil and downstream infrastructure not considered

Electricity cost: ct/kWh	Electricity costs €/kgH2	Water costs ct/kgH2	1000	2000	3000	4000	5000	6000	7000	8760
1	0.53	0.02	6.82	3.76	2.74	2.23	1.93	1.72	1.58	1.40
2	1.05	0.02	7.35	4.29	3.27	2.76	2.45	2.25	2.10	1.93
3	1.58	0.02	7.87	4.81	3.79	3.29	2.98	2.78	2.63	2.45
4	2.10	0.02	8.40	5.34	4.32	3.81	3.50	3.30	3.16	2.98
5	2.63	0.02	8.92	5.86	4.85	4.34	4.03	3.83	3.68	3.51
6	3.15	0.02	9.45	6.39	5.37	4.86	4.56	4.35	4.21	4.03
7	3.68	0.02	9.97	6.92	5.90	5.39	5.08	4.88	4.73	4.56
8	4.20	0.02	10.50	7.44	6.42	5.91	5.61	5.40	5.26	5.08

On-grid curtailed

Dedicated Solar

Dedicated Wind or Hybrid

On-grid constant operation

How to scale up (green) Power-to-X

A few considerations …

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Power supply

- (Green) electricity tariff
- Intermittency of electricity supply
- Co-location vs. grid connection
- Blending with grid-power

Electrolysis

- (Green) water requirements and availability
- Operating hours
- Space requirements

Compression and Storage

- Buffer storage requirements
- Continuous supply requirements
- Compression cost, redundancy and scale effects

Synthesis

- CO2 / N2 supply
- TRL and scalability of synthesis technology
- Acceptable CO2 source

Offtake

- Local (distribution) vs. (long distance) export
- Offtake-prices and premium for green products
- Seasonality of offtake

EPC

Operations, Maintenance, Replacement, Recycling, Digitalization, Optimization

Guarantees and Bankability

THANK YOU

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