



## Industrial demonstration project 2 MW PEM fuel cell generator






*2<sup>nd</sup> International Hydrogen Energy and Fuel Cell technology and  
product Expo in Foshan, China*

*November 7, 2018*









Description and results of the DEMCOPeM project

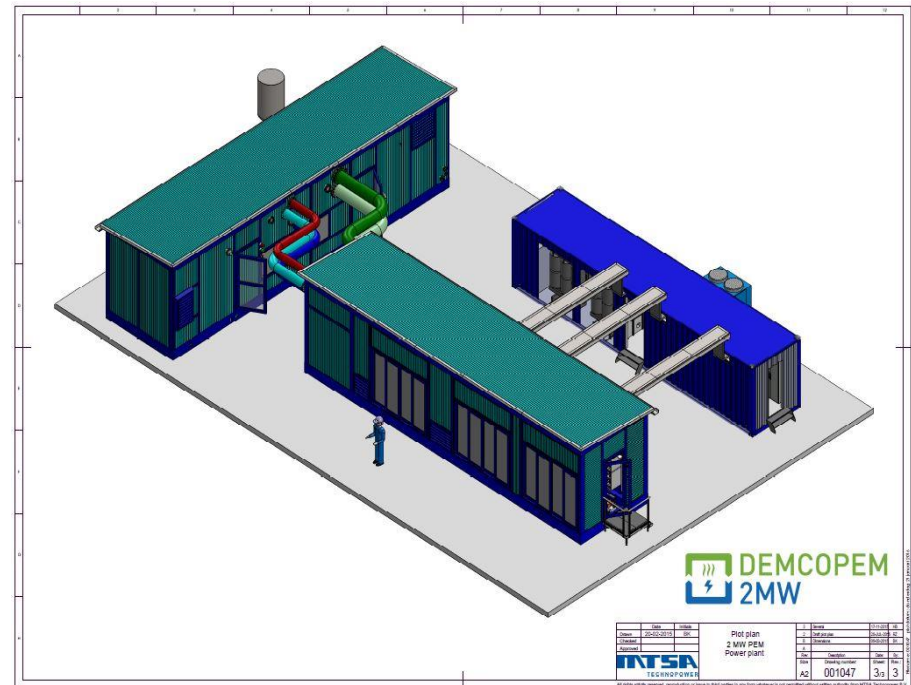


## Introduction/概要

-  Speakers in this presentation:
-  Jan ten Have – MTSA Technopower :
  -  Description of the project
-  Jorg Coolegem – Nedstack Fuel Cell Technology
  -  Results of the project

## Project description/项目描述






-  Demonstration project
-  Production of electricity, 2MWe
-  Use hydrogen as energy source
  -  by-product of CA production
-  Integration in existing industrial production facility
-  Use of produced thermal energy
-  Fully automated operation and control
-  By-product water to be used



## Project partners EU project/项目参与方-欧盟项目

Development project, financially supported by the European Union

Development project partners EU project

-  AkzoNobel (NL) - Project management
-  Nedstack (NL) – Stack development
-  MTSA Technopower - Balance of Plant development
-  Johnson Matthey (UK) – Optimized MEA production development
-  Polimi (I) - Process model development

Project acronym: DEMCOPEM





<http://www.demcopem-2mw.eu/>

This project is co-funded by the 7th FP (Seventh Framework Programme) – Fuel Cells and Hydrogen Joint Undertaking



## Project realization partners/项目实施方

### Realisation project partners

-  Ynnovate (CN) - Principal, utilities, operation and maintenance of the system
-  Nedstack (NL) - Development and realization of the fuel cells (stacks)
-  MTSA (NL) - Design and construction of the installation (excluding fuel cells), project management realization
-  AkzoNobel (NL and China) – contract, project support

## MTSA Technopower

MTSA Technopower designs, builds and maintains customer specific equipment, installations and machines



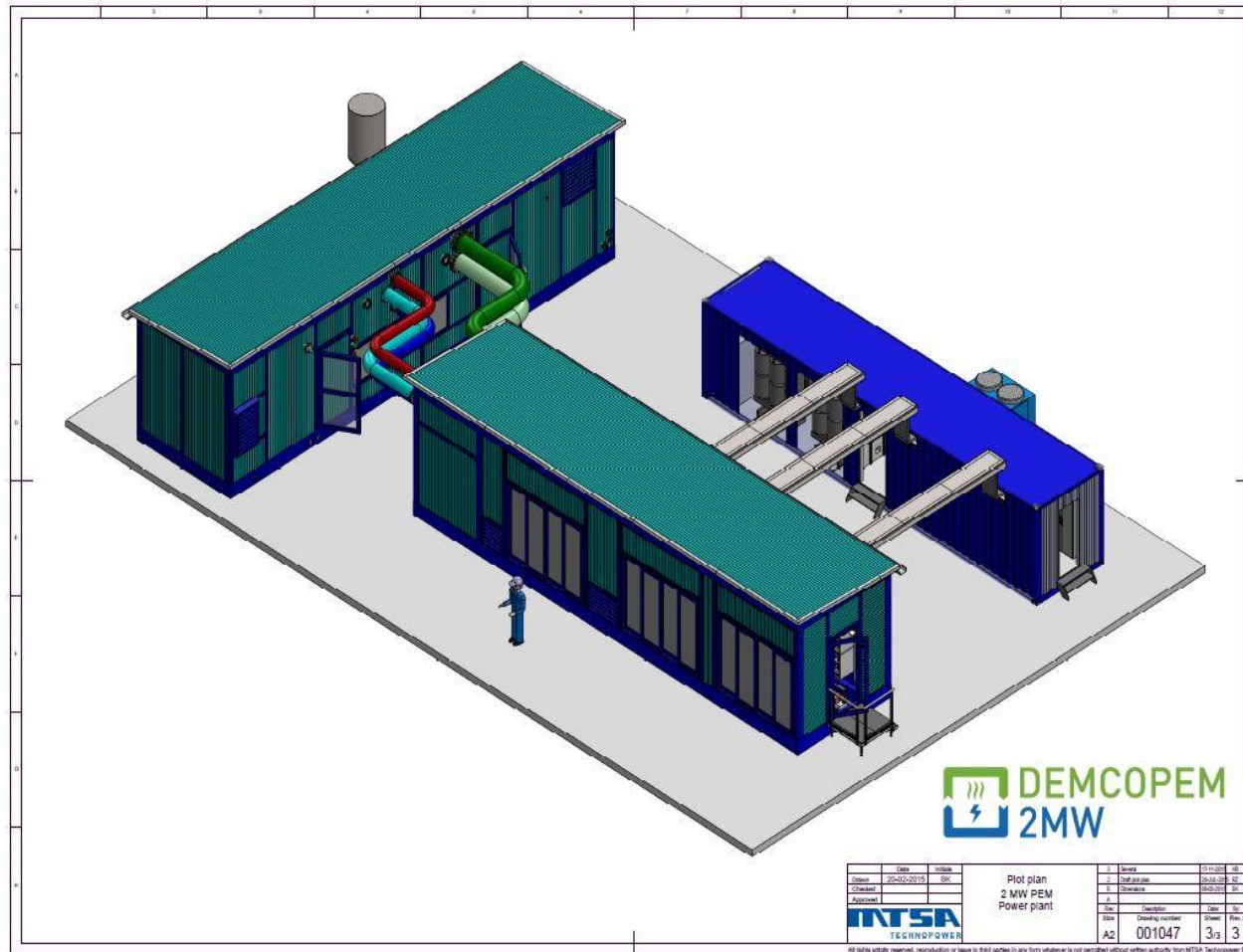
## References hydrogen/氢能源相关项目



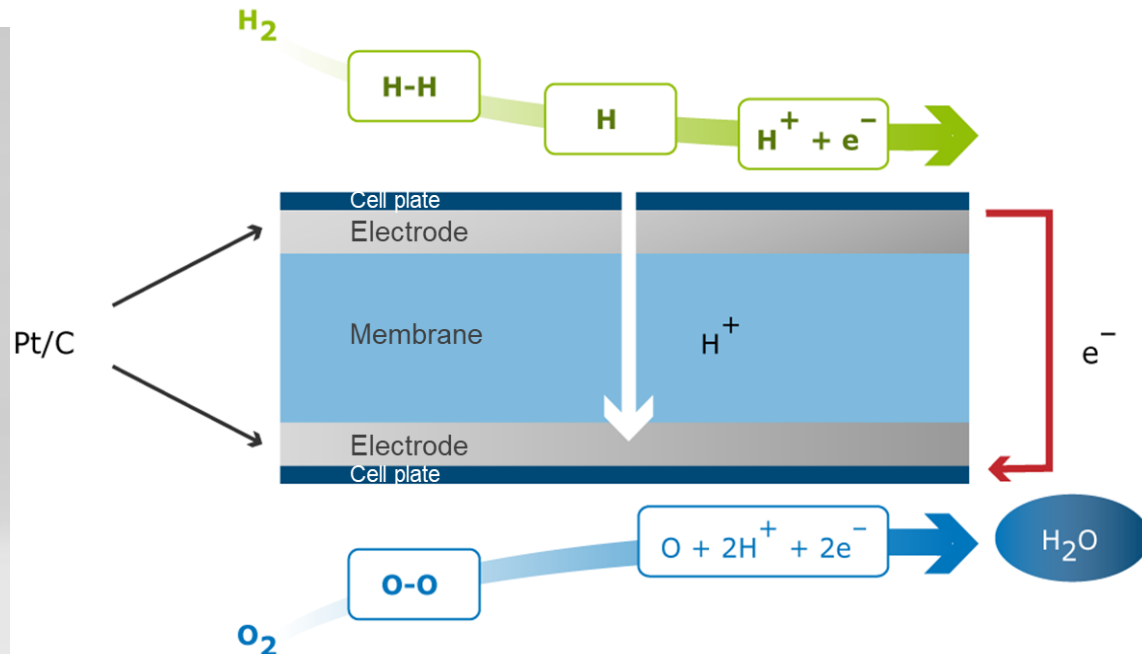
# Ynnovate site in Yingkou (Province Liaoning, China)/中国辽宁营口 营创三征工厂



## Lay-out/设计蓝图



## Fuel cell – basic principle / 燃料电池 – 基本原理



Overall reaction:  
 $2H_2 + O_2 \rightarrow 2H_2O + \text{electricity} + \text{heat}$



## Construction at MTSA/MTSA工厂施工制造



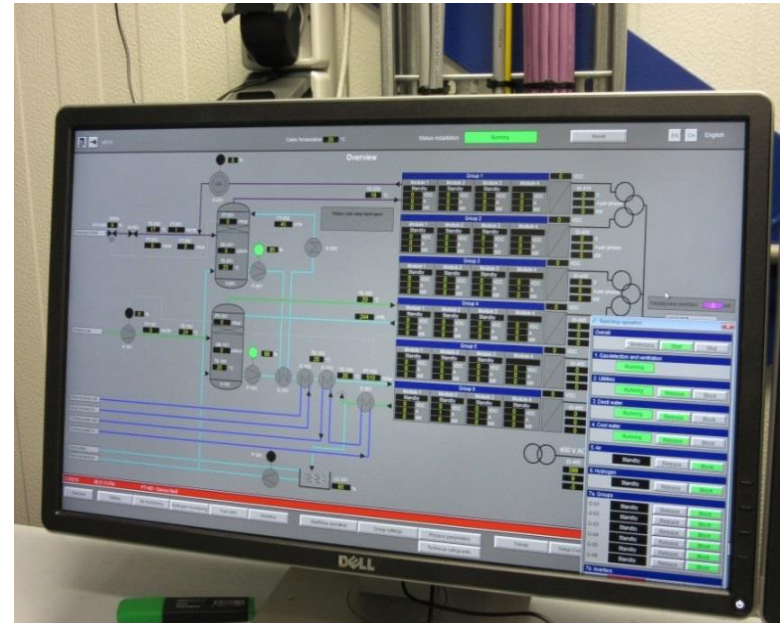
## Instruction and FAT at MTSA/MTSA工厂设备出厂验收测试及培训



## Utilities connection/工艺工程连接






## Commissioning and start-up, SAT/现场调试、开车及验收测试






## Actions – The Product/执行-产品

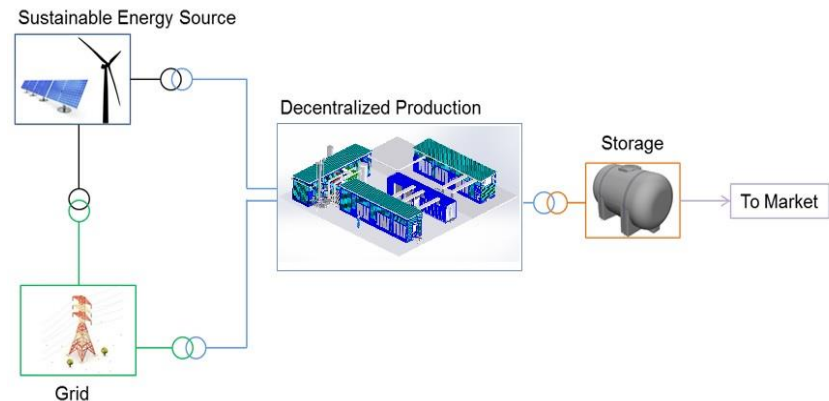
### Product 1: G2P (demonstrated)

-  H<sub>2</sub> gas to Power
-  Modular: 2 – 20 MW
-  H<sub>2</sub> purification, if required



### Product 2: P2P

-  H<sub>2</sub> production
-  H<sub>2</sub> storage
-  H<sub>2</sub> gas to Power



# Nedstack Focus Markets

## 荷兰氢电公司专注的市场

**HuaHe – Sino-Dutch JV**  
**江苏华荷氢电科技有限公司**  
ZhangJiaGang City – Jiangsu  
Province



### Commercial Vehicles

汽车发动机

(maturity status: commercialized)  
(已商业化)

### PEM Power Plants

工厂燃料电站

(maturity status: commercialized)  
(已商业化)

### Marine

船用发动机

(maturity status: Concept Development)  
(技术设计阶段)

# 70 kW Pilot PEM Power Plant

## 70千瓦质子交换膜氢能发电站示范项目

AkzoNobel  Delfzijl chlorine plant

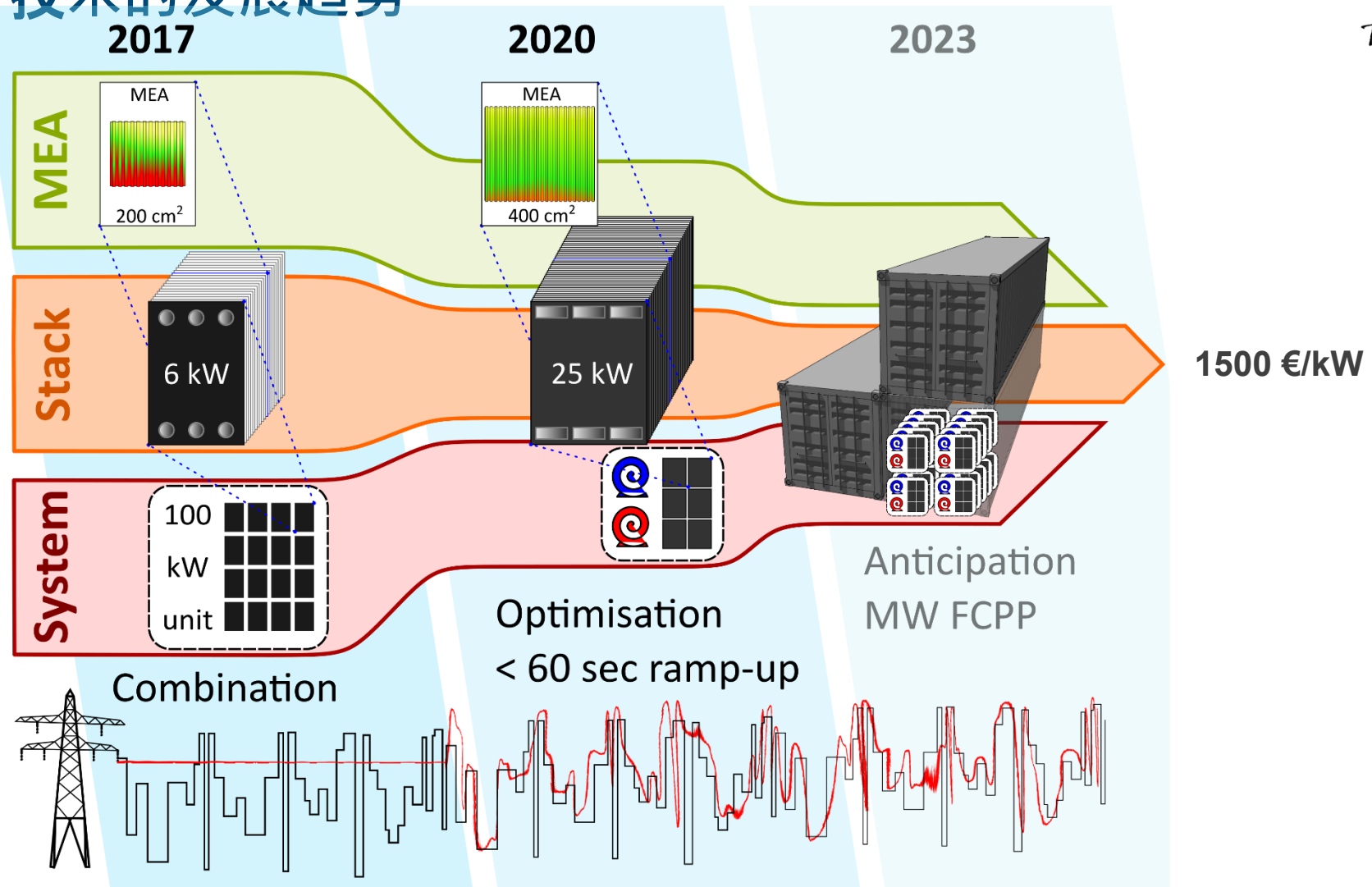


Construction by 

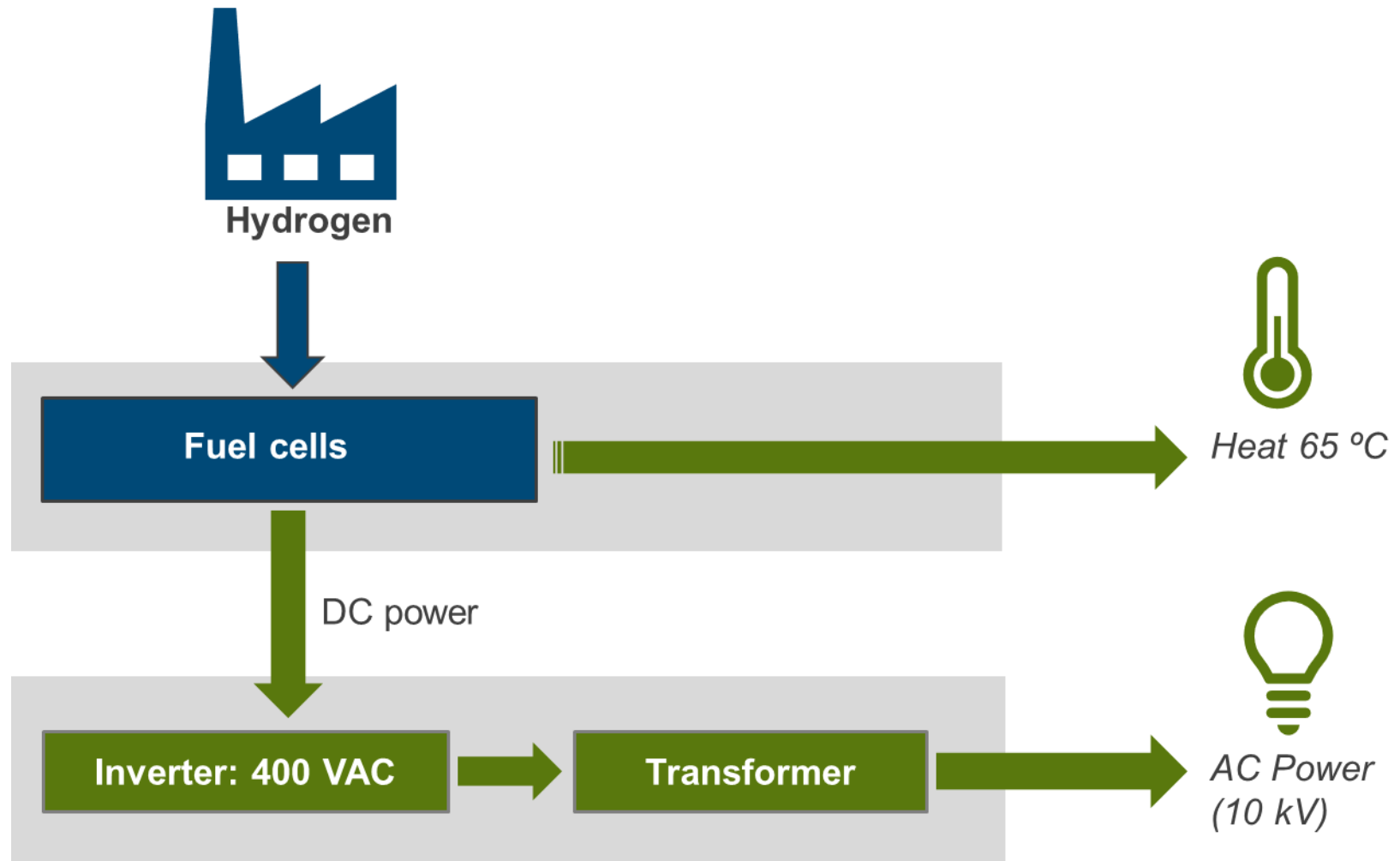
- > 60,000 hours on grid
- Stack life in field conditions over 23,000 hours
- Uptime > 90%
- Reliable operation (10 yrs)  
在网运行大于6万小时，堆栈寿命超过2万3千小时，运行率大于90%。
- Very low maintenance costs
- Fully automated, remote monitoring
- Mobile set-up  
维护费用低，全自动操作，远程监控，移动设计。

# Nedstack's PPP development / Nedstack PPP

## 技术的发展趋势

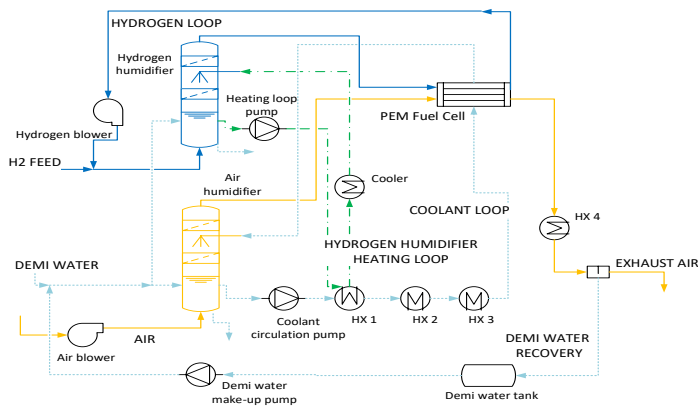


## Cogeneration of AC-power and heat / 交流电与热量伴生

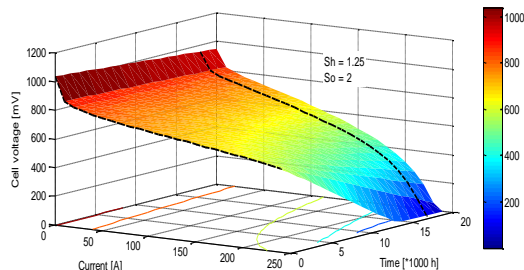


## Results – plant model / 结果-工厂模块

- Setup of a plant model (Aspen Plus®) with custom PEMFC model based on Nedstack stack measurements



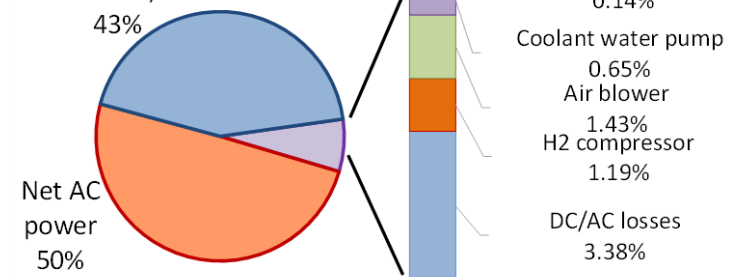
Model of components based on P&ID



Polarization curves as function of current and time at fixed stoichiometry

Property	Model
Date	15 Sep 16
Active groups	5/6
Current [A]	-1.8%
Voltage [V]	+1.8%
Auxiliaries power [kW]	-1.2%
Coolant flowrate [m³/h]	-0.6%
Stack temp. [°C]	-1.3%

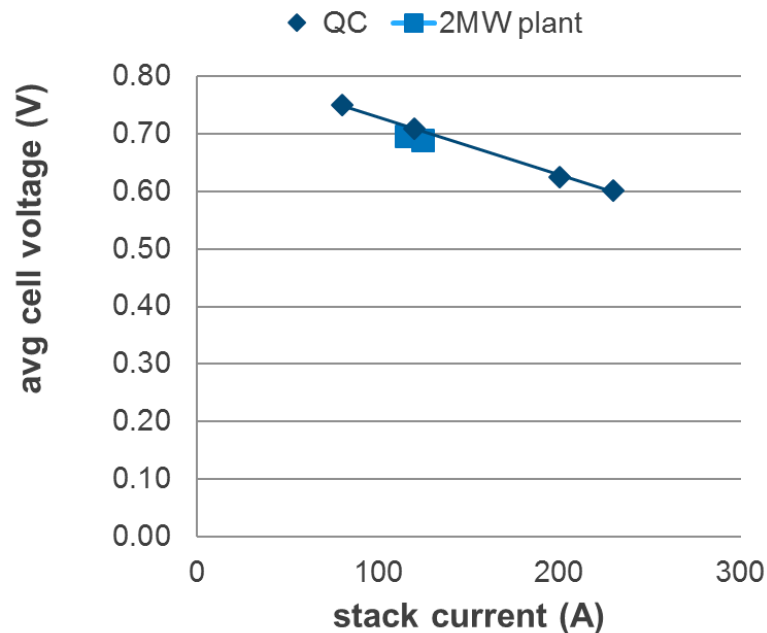
Heat (available + waste)  
43%



Model validation based on field data shows minor deviations only <2%

## Performance data 性能数据

### Stack performance: plant vs. QC test

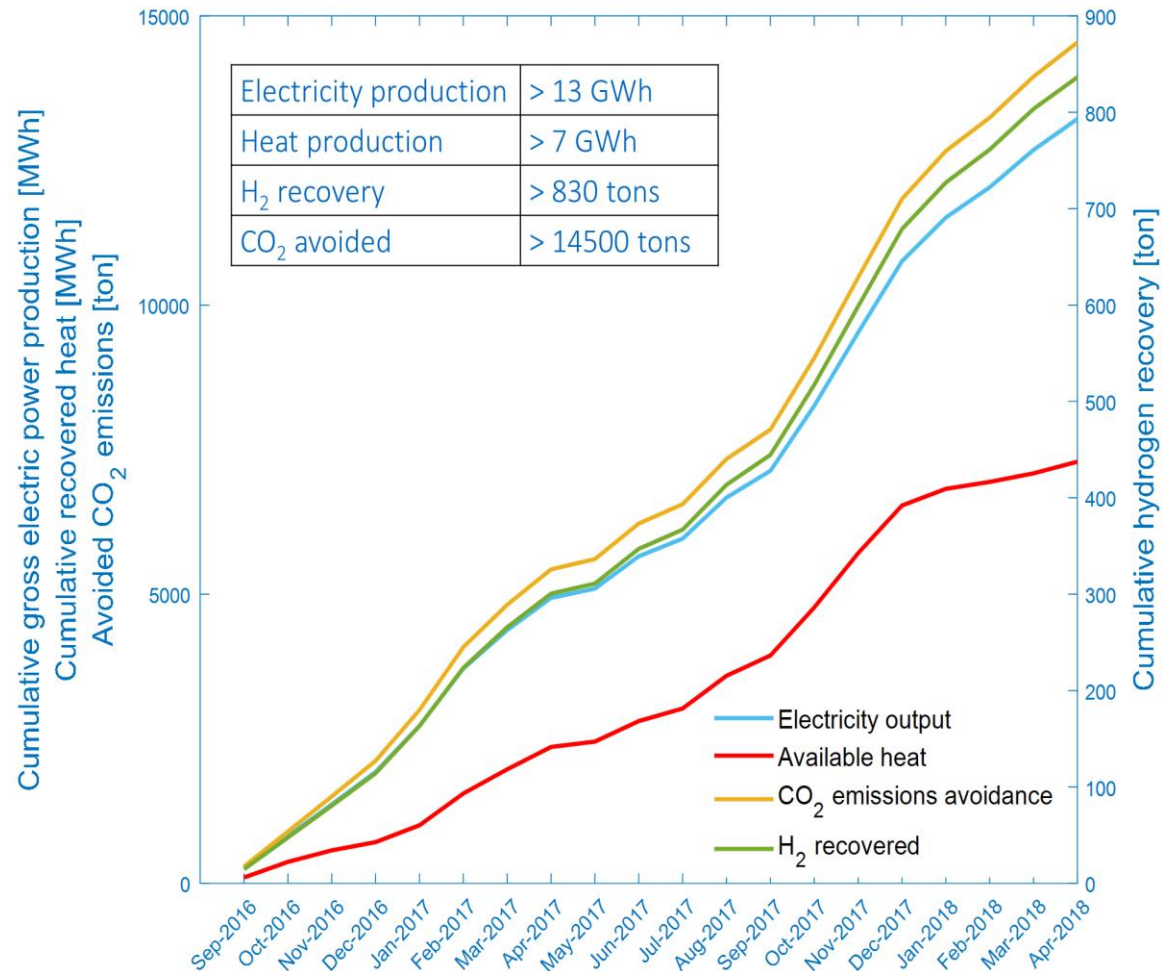


### Plant performance (BoL)












- Nominal fuel cell output: 2000 kW
- Fuel cell efficiency (LHV): 55 %
- Auxiliary consumption: 120 kW
- BoP efficiency: 90 %
- Electrical efficiency: 50 %
- Available heat @ 60°C: >1000 kW
- Total efficiency: 80 %

## Accumulated results/累计结果

- more than 13 GWh<sub>el</sub> and 7 GWh of thermal energy produced
- > 800 ton H<sub>2</sub> recovered, with avg electric efficiency of ~49%<sub>LHV</sub>
- > 14.000 tCO<sub>2</sub> emission avoided
- Uptime largely determined by H<sub>2</sub> and grid capacity availability



## Final remarks /最后备注

-  PEM technology is a proven technology
-  Roll out phase design of PEM power plant is available
-  Aim for further improvement to reduce CAPEX & OPEX
-  Economic viability of PEM power plant depends on:
  -  Availability of surplus hydrogen
  -  Local market conditions e.g. power price
  -  Capacity of the power plant (economy of scale)
  -  Potential value of heat generated
  -  Possible grants from authorities
  -  Regulation e.g. CO2 emission
-  Possible markets: CA, P2P, Maritime, Grid stability

Thank you 謝謝



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