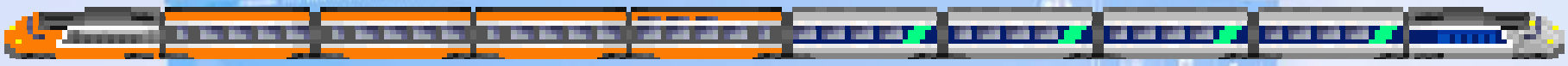
Nedstack

fuel cell technology



Drive Train solutions based on NedStack PEM fuel cells

Drs Jan Piet van der Meer

Nedstack fuel cell technology BV

Core competence

- Production of PEM FC Stack
- Power pack production
- R&D on PEM + key components

- Cost driven

Mission

NedStack's mission is to proof that
PEM fuel cells are a
technical reality NOW
-
Cost reduction
by technology improvement and volume
-
PEM fuel cells will be a
commercial reality SOON

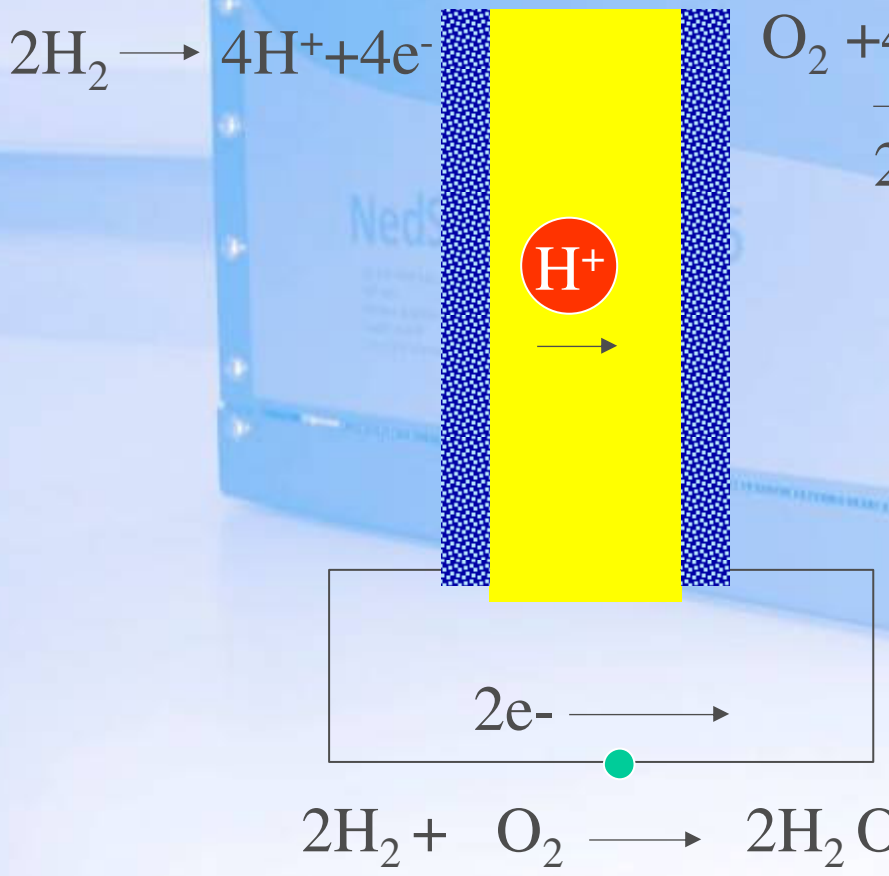
Background

- Continuation of AkzoNobel's fuel cell activities that started in 1989
- At AkzoNobel R&D originally focused on fuel cell materials like plates, catalysts, GDL and membranes
- In 1998 AkzoNobel decides to stop its corporate R&D programme and its FC activities with it.
- Founding of NedStack Q4 1998
- NedStack took over all AkzoNobels FC related IPR and the key people (7) that worked on fuel cells

Status quo

- Venture Capital investor is aboard since 2003
- Employees own 55%
- 43 employees, 6 vacancies
- NedStack is one of the largest European FC makers
- Among relations are:
  - car manufacturers
  - marines
  - micro cogeneration manufacturers
  - fork lift truck manufacturers
  - boat builders
  - city busses
  - TRAIN builders
- Production is on stream

Basics of the FC

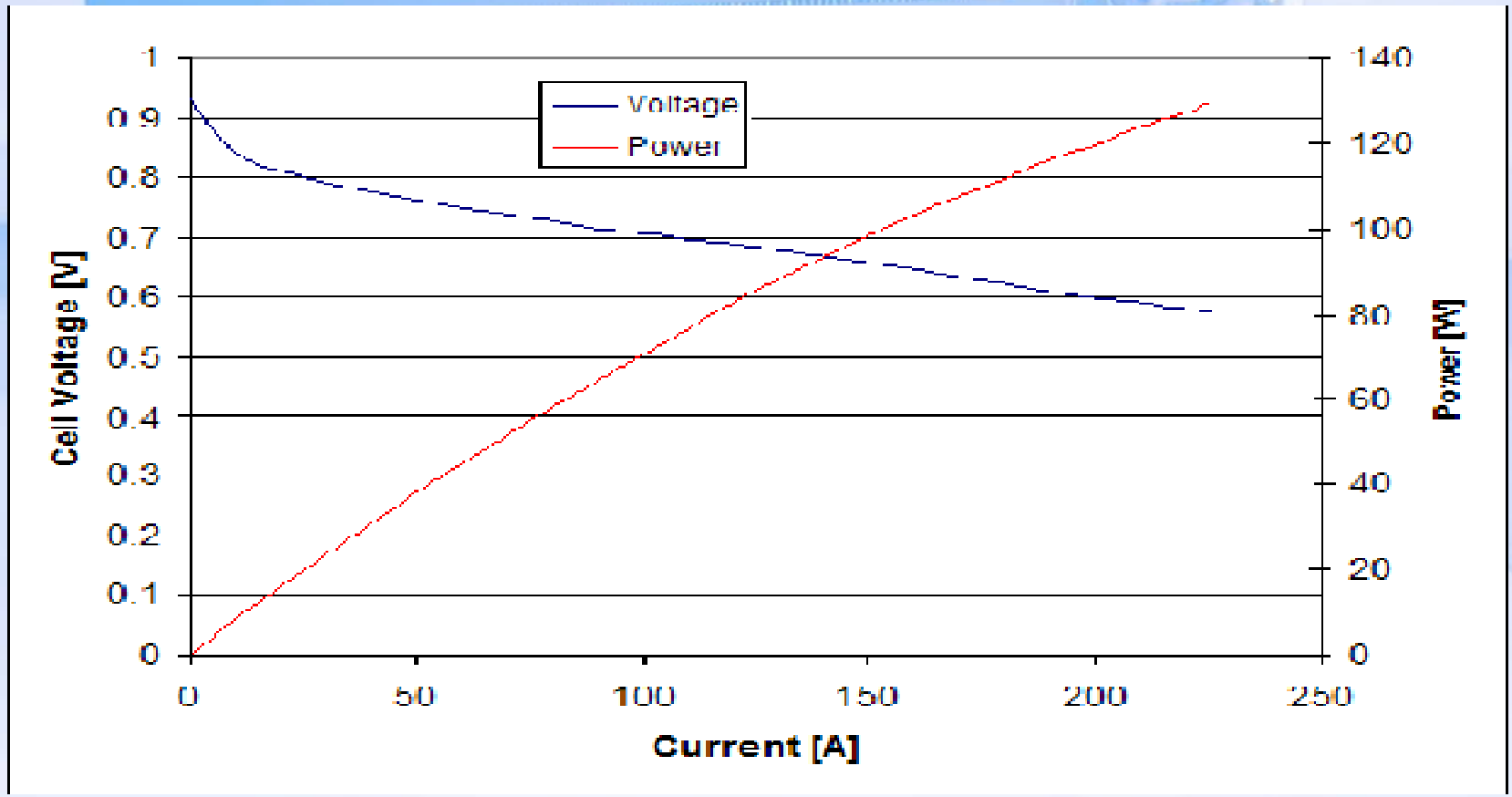


$2H_2 + O_2 \rightarrow 2H_2O$

Fuel Cell "plusses"

- High efficiencies
- zero-emission
- High power density
- *Recyclable*

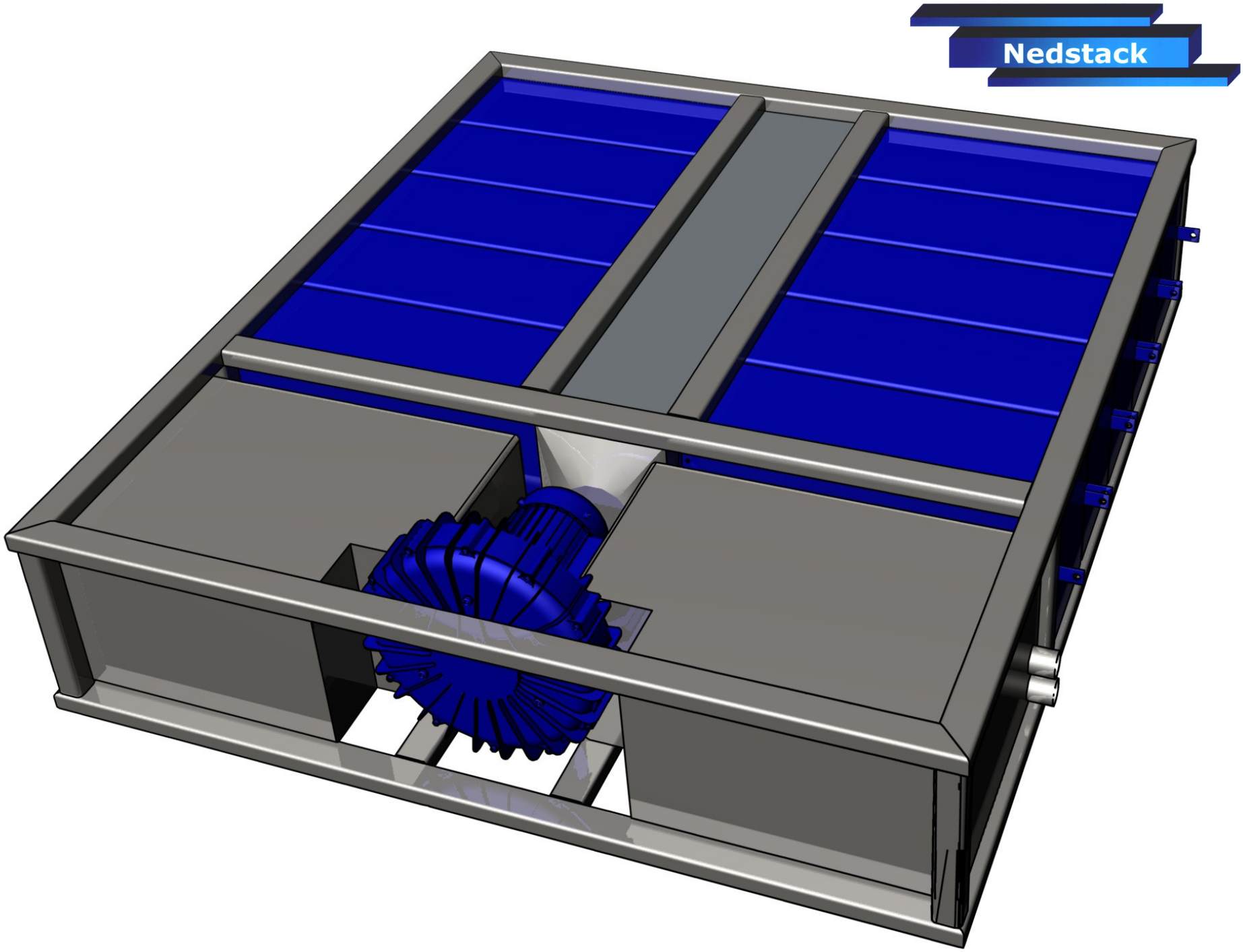
IV curve at atmospheric pressure



H2NE

Nedstack

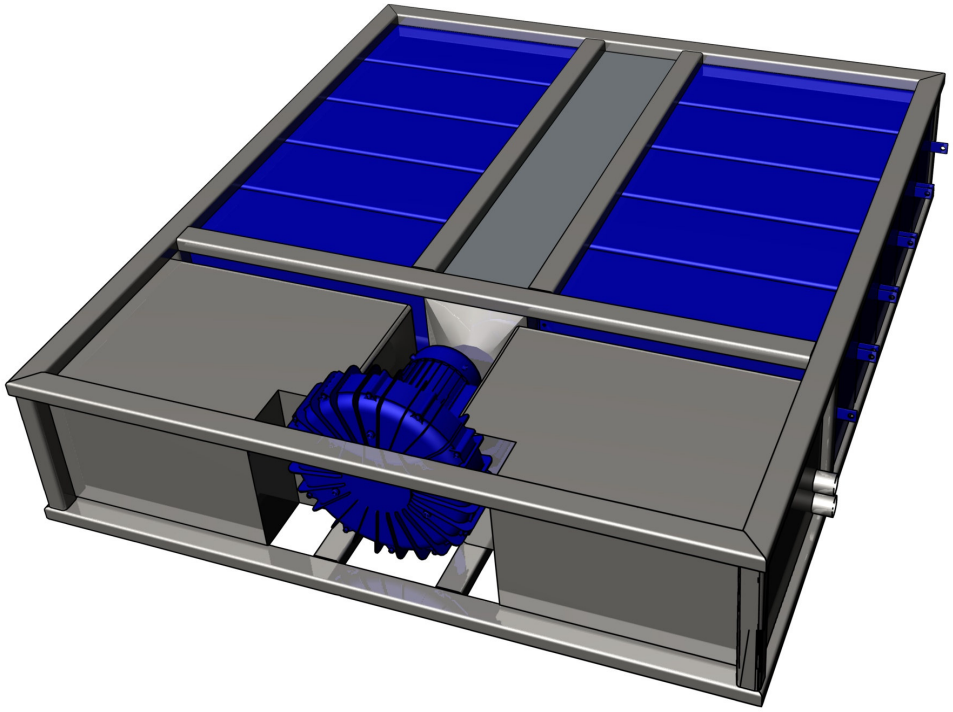
CLEAN CITY TRANPORT 1950:
Arnhem TROLLEYBUS
Wireless trolley planned for 2007

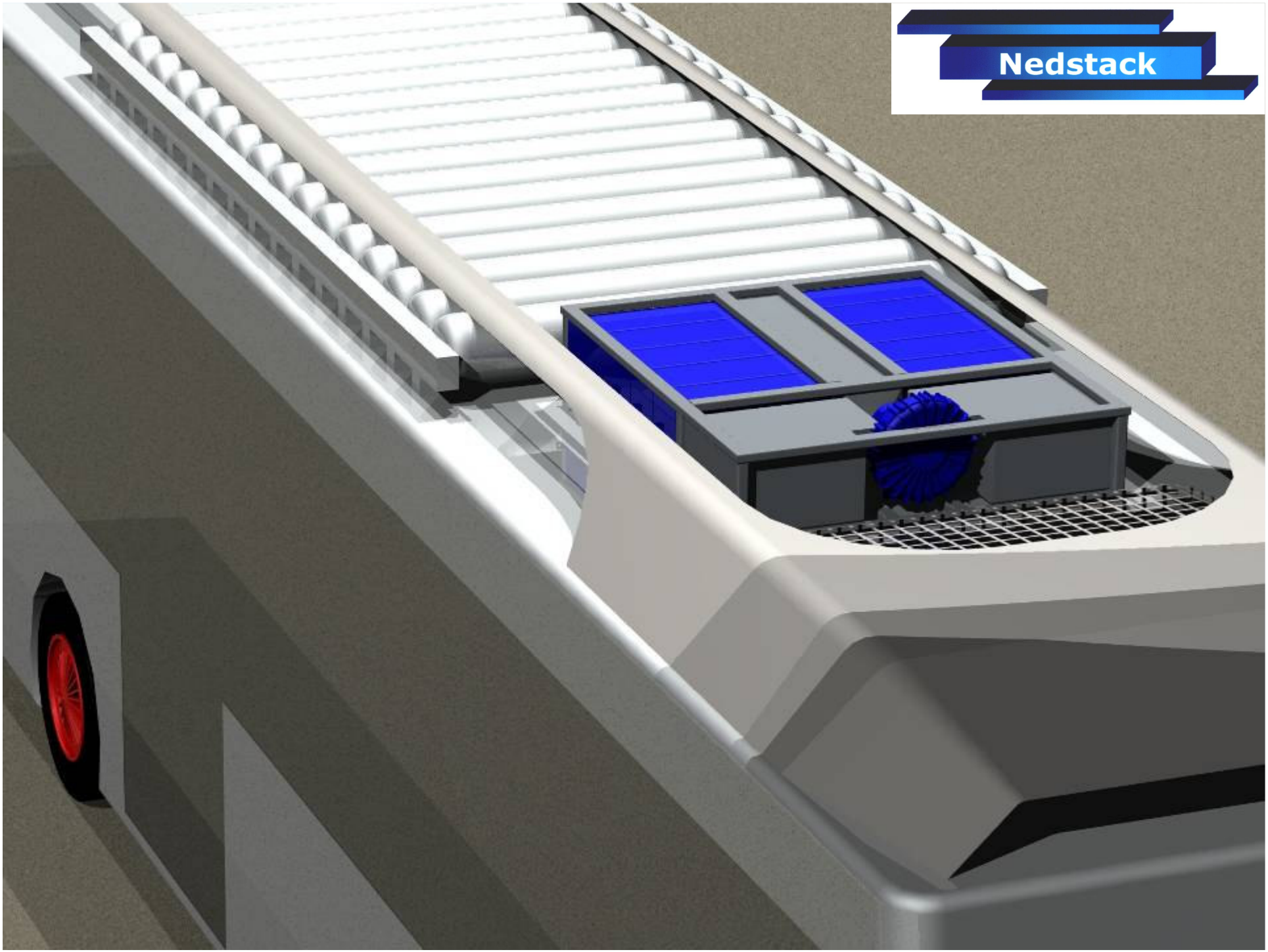

Nedstack

Specifications

- 10x 10kW$_{peak}$ stacks
- Air pump
- Air Filter
- Humidification
- Anode recirculation
- Primary cooling loop
- CVM
- System control
- CAN interface

- 72 kW$_{nom}$
- 200A
- 360V
- 45% e-efficientcy

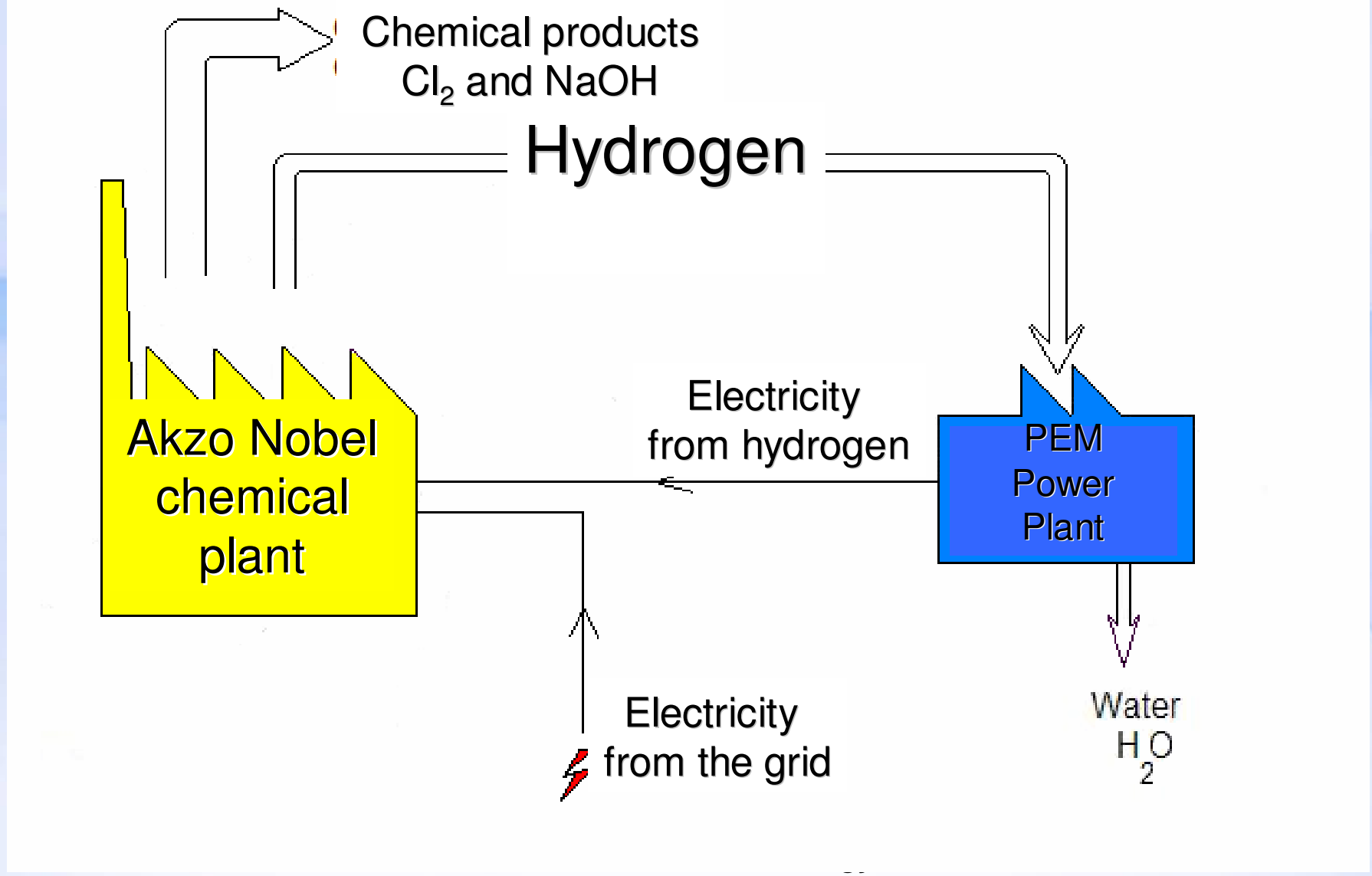



Nedstack

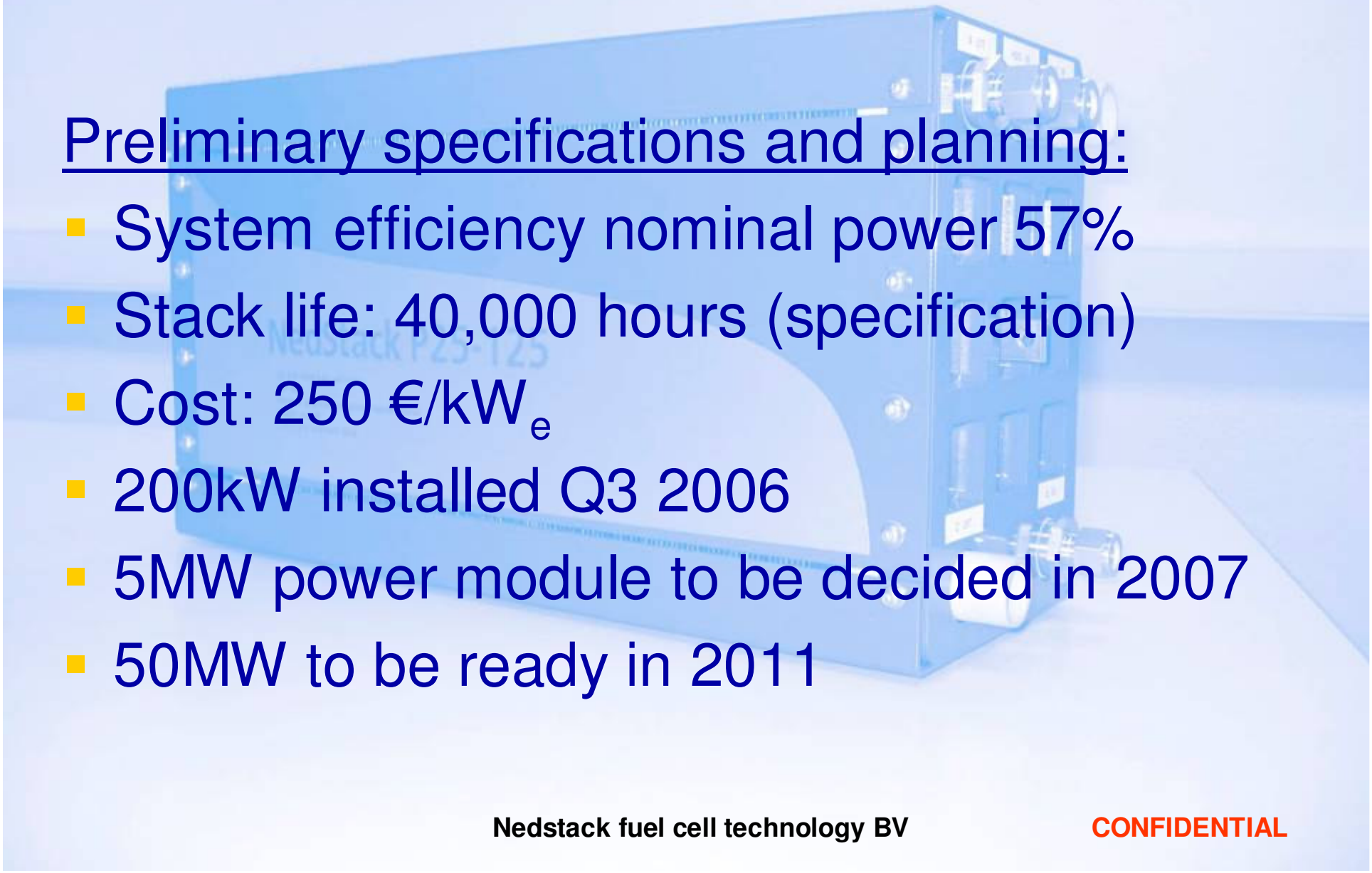
“Olympics Torino” 2006

Nedstack

PEM Power Plant



PEMPOWERPLANT



Preliminary specifications and planning:

- System efficiency nominal power 57%
- Stack life: 40,000 hours (specification)
- Cost: 250 €/kW_e
- 200kW installed Q3 2006
- 5MW power module to be decided in 2007
- 50MW to be ready in 2011

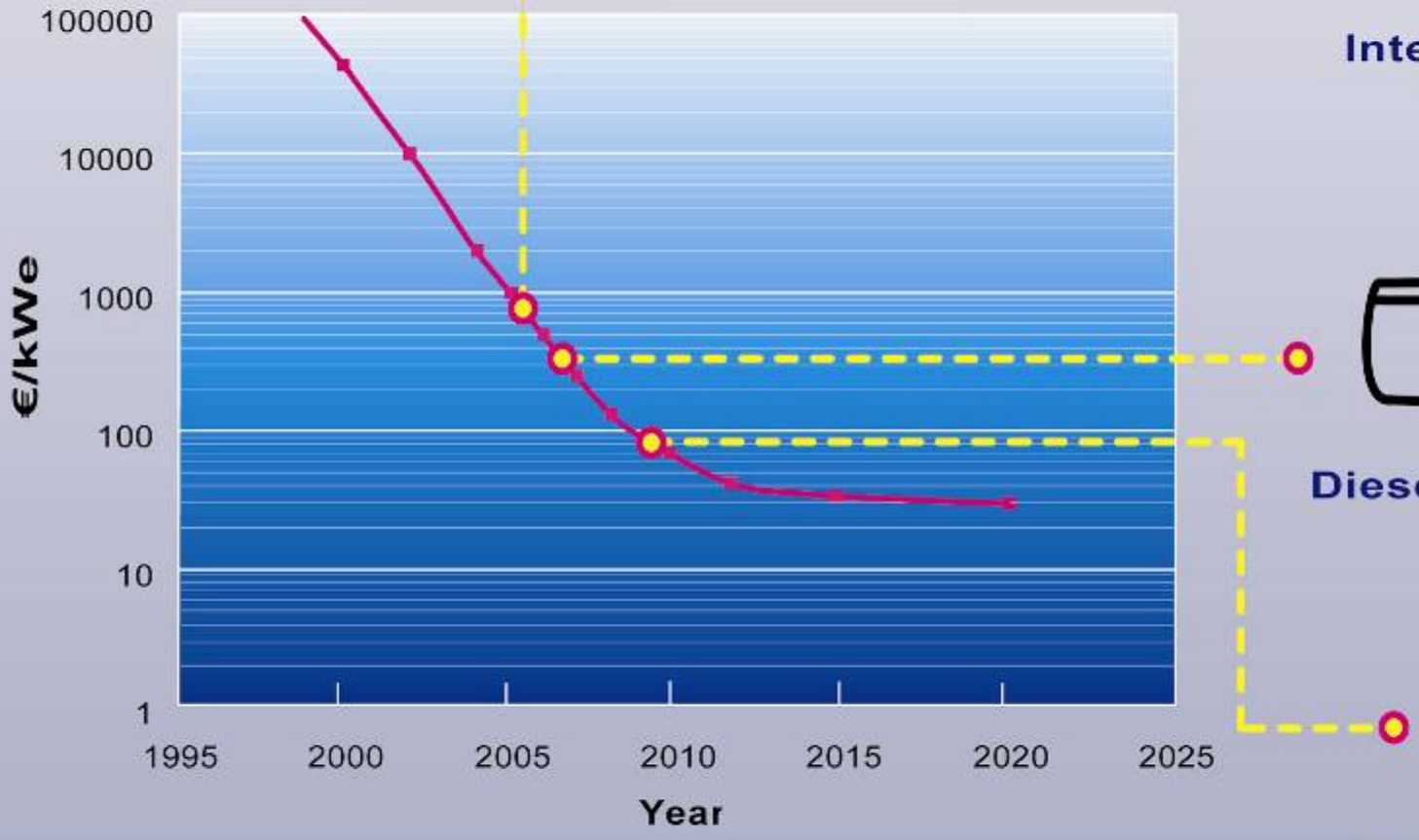
Main problems to be solved 1

Cost

- Cost of raw materials
  - Inomer, catalyst
- Cost of intermediate products
  - Membrane, GDL
- Cost of components
  - Bipolar plates, MEA's
- Cost of stacks
  - Cost /kW power installed
  - Cost /kWh power generated (durability & efficiency)
- Cost of balance of plant components
  - Humidifiers, circulation pumps, blowers, cell voltage monitoring, hydrogen storage tanks, special valves.....
- Cost of fuel cell systems

NedStack

PEM FC PRICE DEVELOPMENT

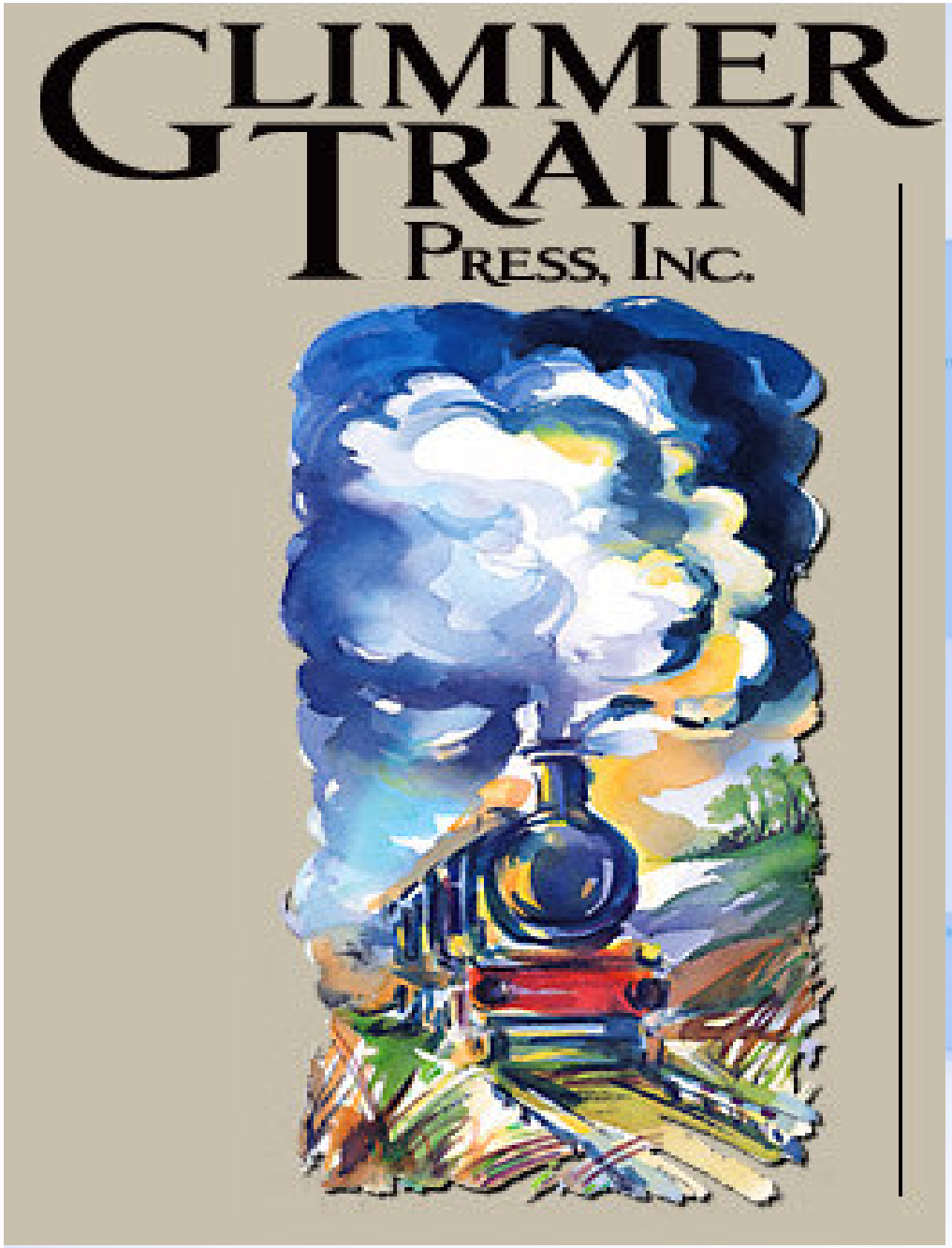


Internal transport
€ 800/kWe

Diesel engine buses
€ 250/kWe

Turbo diesel cars
€ 80/kWe

1 Volume production
2 Cost reduction raw materials
3 Improving power density



Nedstack

Thank you for your attention

Questions?