AutoStack-CORE
Automotive Fuel Cell Cluster for Europe II

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Brussels, 22-23 November

PROJECT OVERVIEW

Project Information	
Call topic	SP1-JTI-FCH.2012.1.2
Grant agreement number	325335
Application area (FP7) or Pillar (Horizon 2020)	Transport and Refuelling Infrastructure
Start date	01/05/2013
End date	31/08/2017
Total budget (€)	14 673 625
FCH JU contribution (€)	7 757 273
Other contribution (€, source)	-
Stage of implementation	100% project months elapsed vs total project duration, at date of November 1, 2016
Partners	ZSW, BMW, CEA, DANA, Fraunhofer, JRC-IET, Freudenberg, PSI, Powercell, Greenerity, VW, Volvo, Swiss Hydrogen

PROJECT SUMMARY

AutoStack Core Consortium

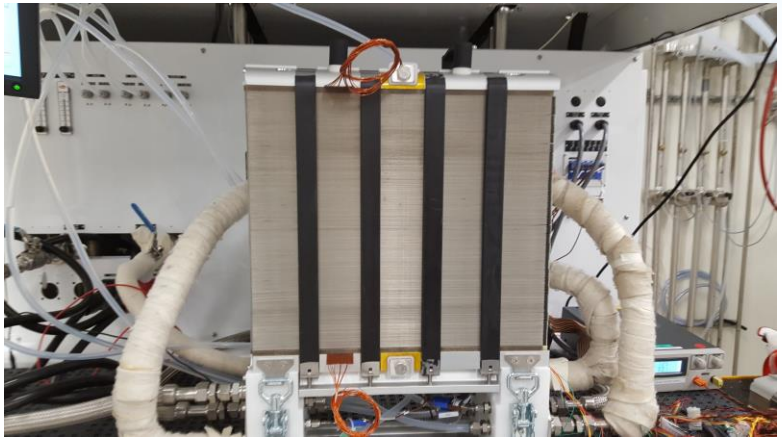
Automotive OEMs	Component and System Suppliers	Research Institutes
BMW	SWISS HYDROGEN	CEA
VOLVO	DANA	Fraunhofer ISE
VOLKSWAGEN AKTIENGESELLSCHAFT	FREUDENBERG INNOVATING TOGETHER	European Commission
	POWERCELL	PAUL SCHERRER INSTITUT PSI
	Greenerity	ZSW

Evo1

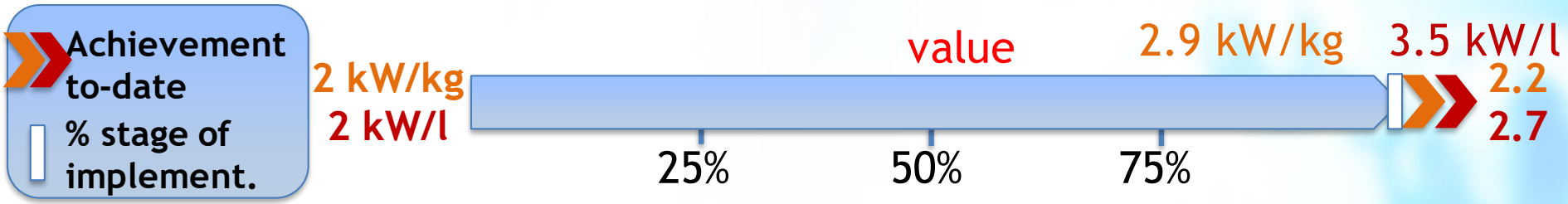
Evo2

Objectives

- Develop best of its class automotive stack technology
- Utilize industrial components and materials
- Establish platform concept to enable additional vehicle and stationary applications
- Ensure scalability to address various power levels
- Achieve highest power density to address packaging and cost
- Reduce Pt-use while maintaining performance



PROJECT PROGRESS/ACTIONS - Volume, Weight Related to Nominal Power



Aspect addressed	Parameter (KPI)	Unit	SoA 2017	FCH JU Targets		
				Call topic	2017	2020
Weight	Specific power@ 1.5 A/cm^2	kW/kg	2.9 (3.0 @ peak)	> 2	-	-
Volume	Power Density @ 1.5 A/cm^2	kW/l	3.5 (4.0 @ peak)	> 2	-	-

Future steps:

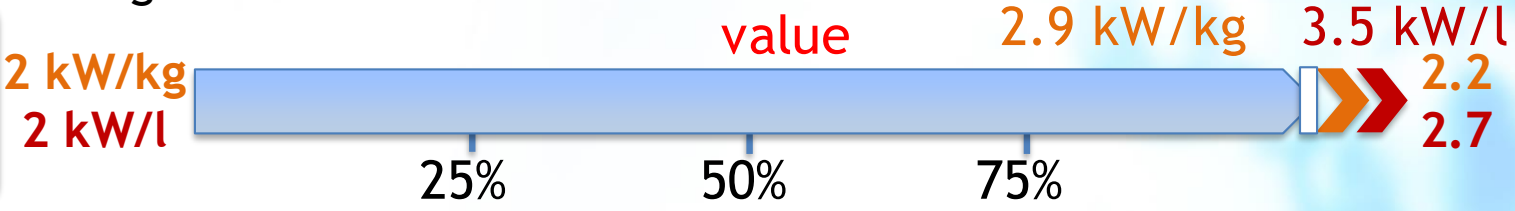
Goal achieved,
further design optimizations are targeted to improve manufacturing and make use of improved peak power capabilities

PROJECT PROGRESS/ACTIONS -Weight, Volume Related to Nominal Power

Achievement to-date

% stage of implement.

Data given at rated load 1.5 A·cm^{-2}

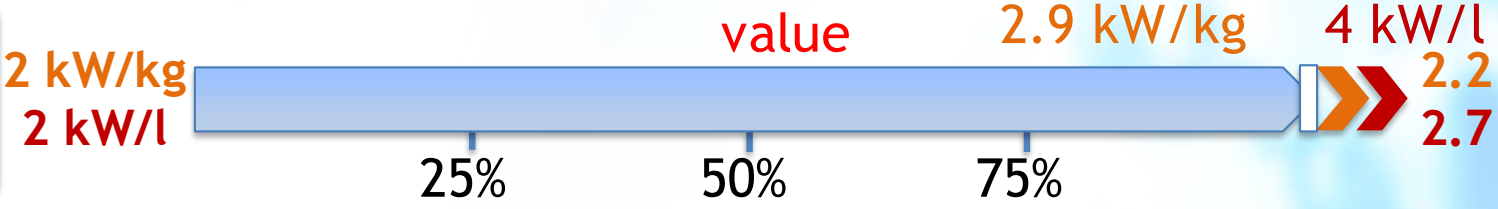


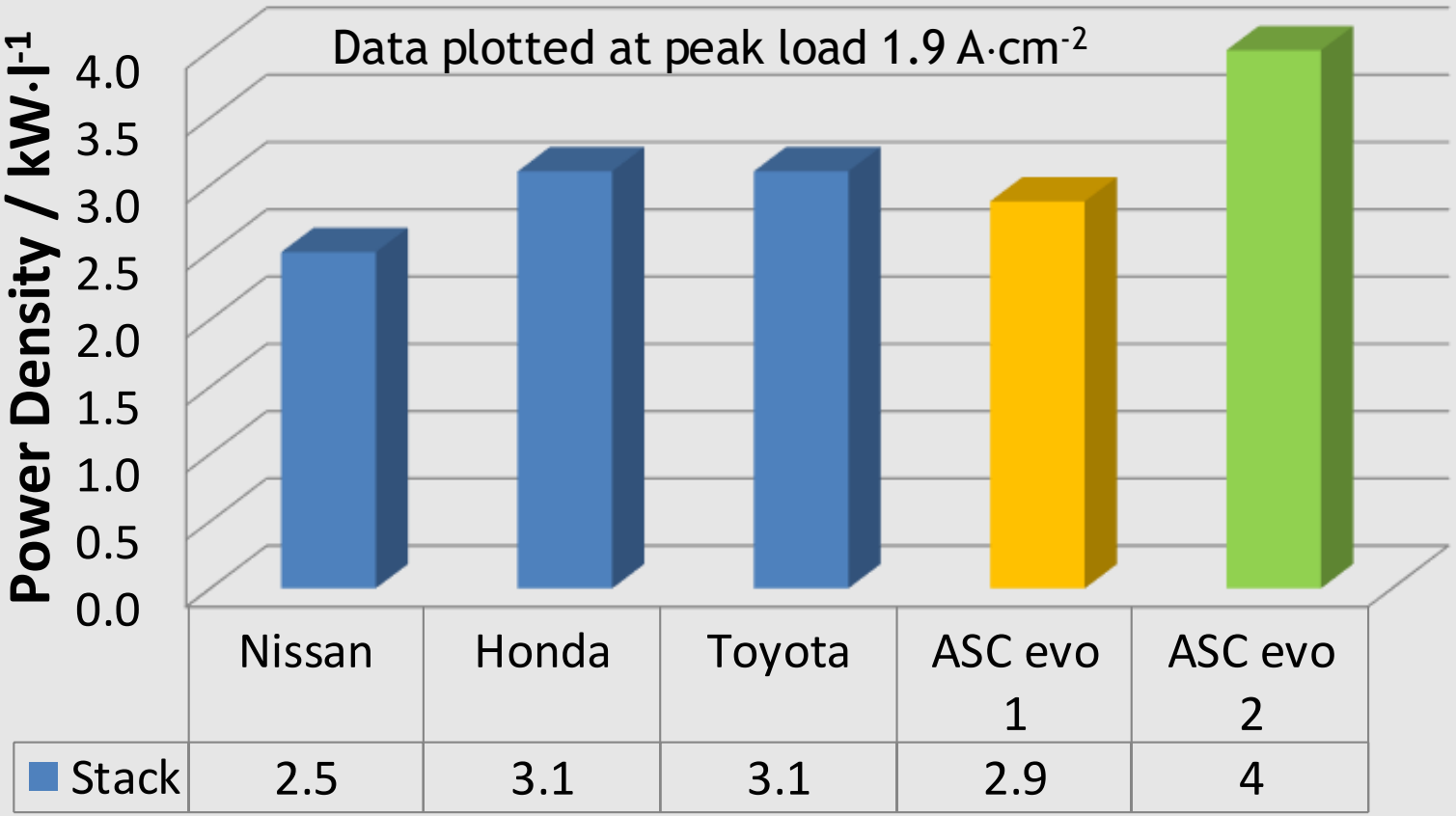
Specifications	Unit	Target	EVO1 Outcome	EVO2-A Outcome	
Volume of the stack exterior	dm^3	<55	34.3	~27.7	
Weight without fluids an fully humidified membranes (net weight)	kg	<44	46.3	33.1	
Power density at nominal load	kW/ dm3		2.7	~3.55	
Power density at peak load	kW/ dm3		2.8	~4.05	

PROJECT PROGRESS/ACTIONS -Weight, Volume Related to Peak Power

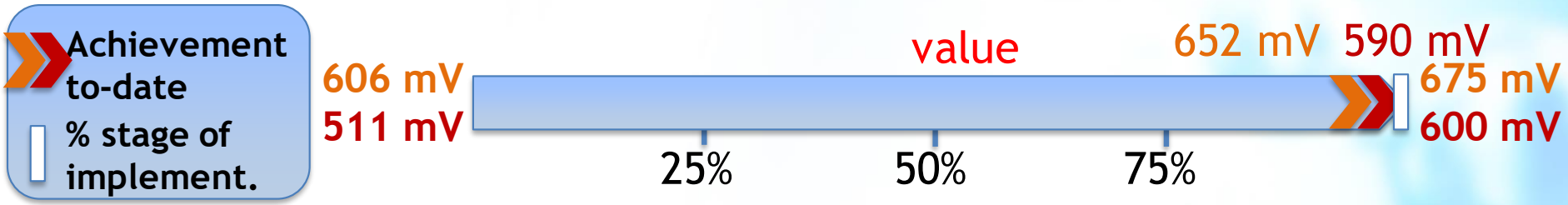
Achievement to-date

% stage of implement.





PROJECT PROGRESS/ACTIONS - Performance



Aspect addressed	Parameter (KPI)	Unit	SoA 2017	FCH JU Targets		
				Call topic	2017	2020
Avg. Cell-Performance	Average single cell voltage @	mV				
Rated load	1.5 A·cm^{-2}		652	675	-	-
Peak load	1.9 A·cm^{-2}		590	-	-	-

Future steps:

Improve operating conditions

Improve activation procedure

Optimize material combination: CCM, GDL

PROJECT PROGRESS/ACTIONS - Performance AutoStack-CORE Reference Conditions

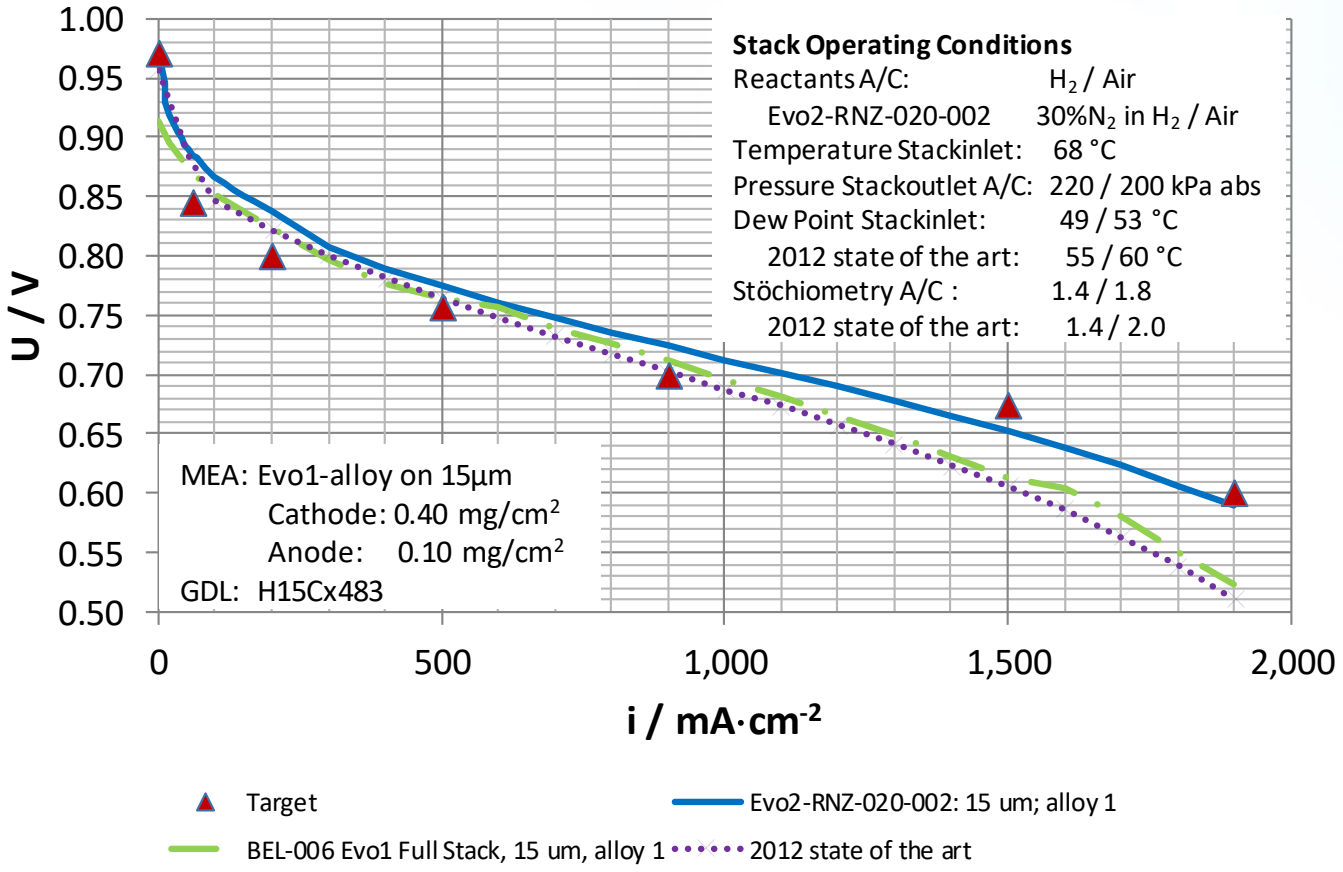
Achievement to-date

% stage of implement.

606 mV
511 mV

652 mV 590 mV
675 mV
600 mV

25% 50% 75%



PROJECT PROGRESS/ACTIONS - Performance Optimized Operating Conditions

Achievement to-date

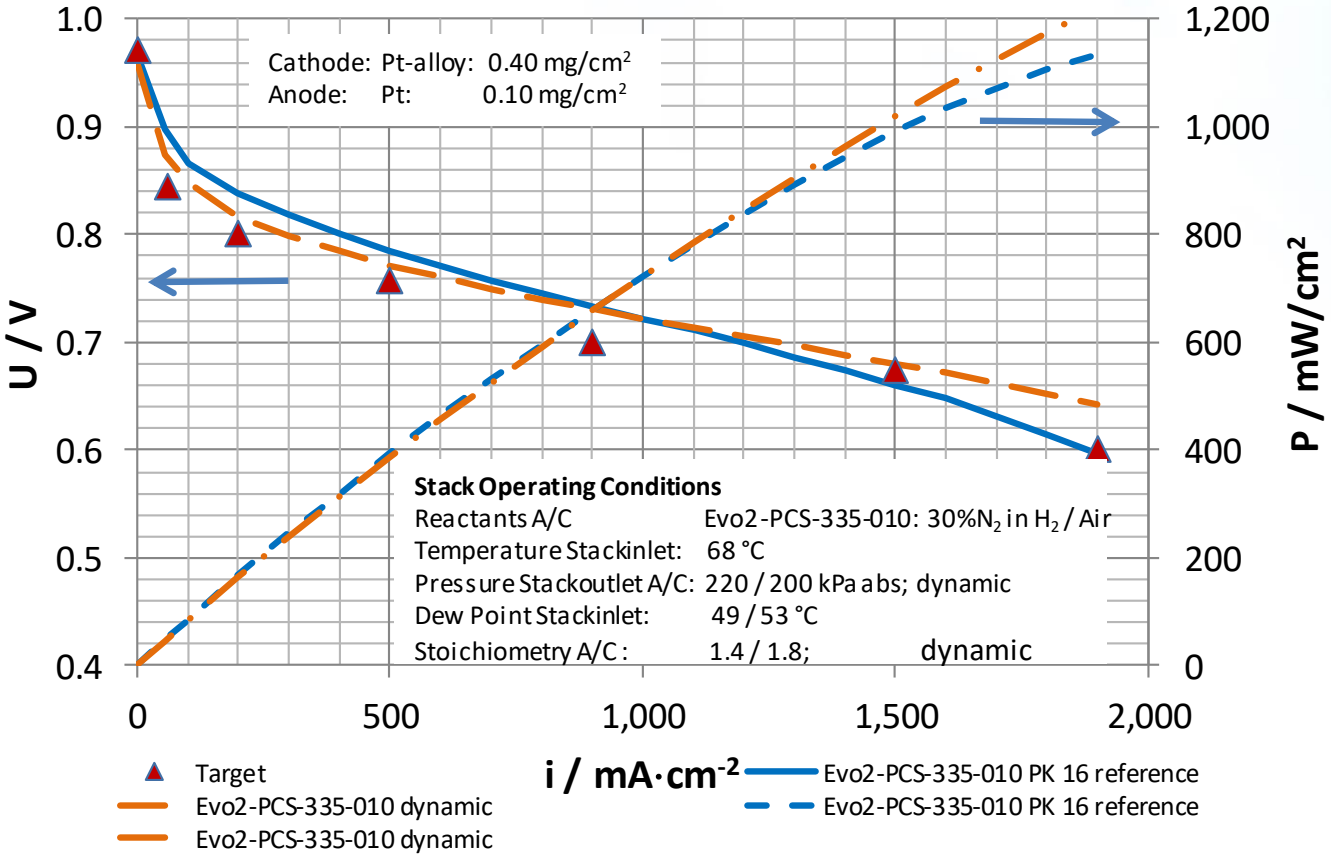
% stage of implement.

606 mV
511 mV

680 mV 643 mV

25% 50% 75%

675 mV
600 mV



PROJECT PROGRESS/ACTIONS - Performance Reduced Platinum Loading

autostack core

Achievement to-date

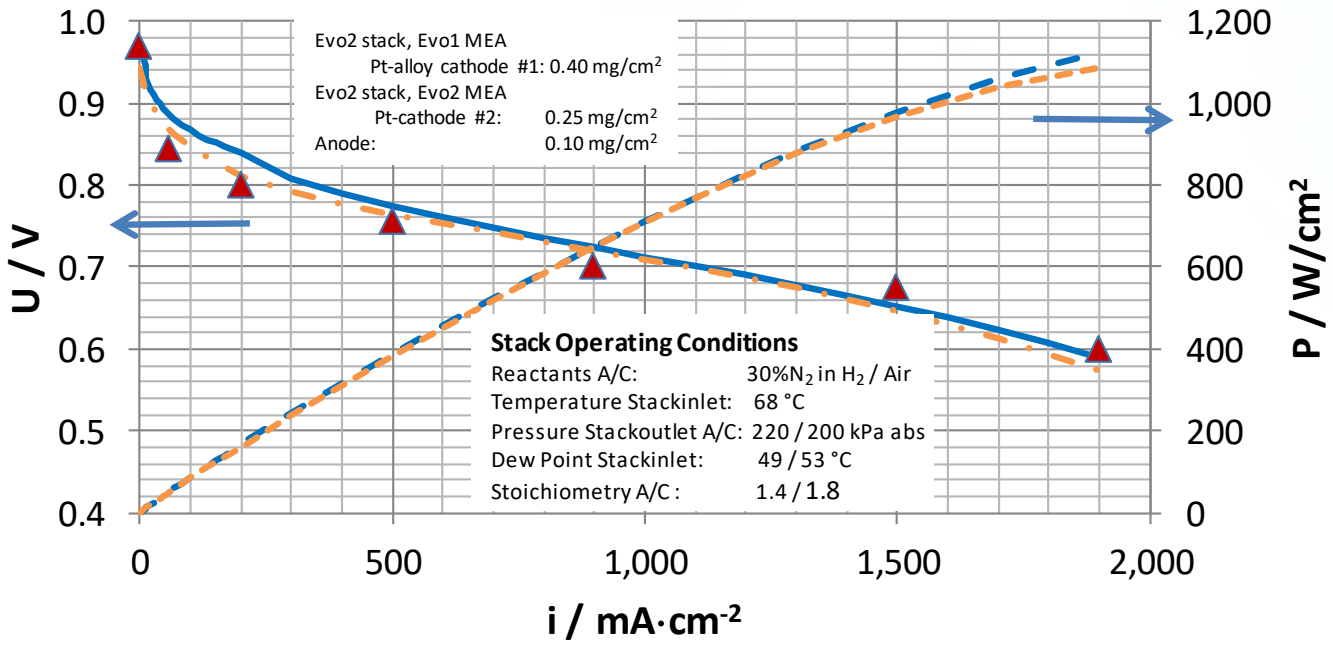
% stage of implement.

606 mV
511 mV

646 mV 573 mV

675 mV
600 mV

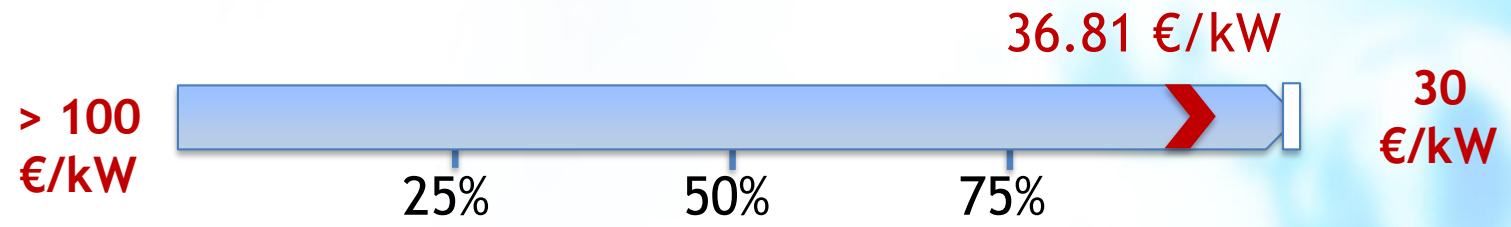
25% 50% 75%



PROJECT PROGRESS/ACTIONS - Cost

Achievement to-date

% stage of implement.



Aspect addressed	Parameter (KPI)	Unit	SoA 2017	FCH JU Targets		
				Call topic	2017	2020
Cost	Specific cost comparable to DoE studies	€/kW	36,81 @ 30 000 p.a.	-	~48.1 *	~24.1 *

* Based on 48.1% system cost described in MAIP 2008-2013
ratio taken from B.D. James et al.: Mass Production Cost estimation of direct H_2 PEM Fuel Cell Systems for transport applications

Future steps:

Improve BPP-design

Improve manufacturing processes

PROJECT PROGRESS/ACTIONS - Cost

Achievement to-date

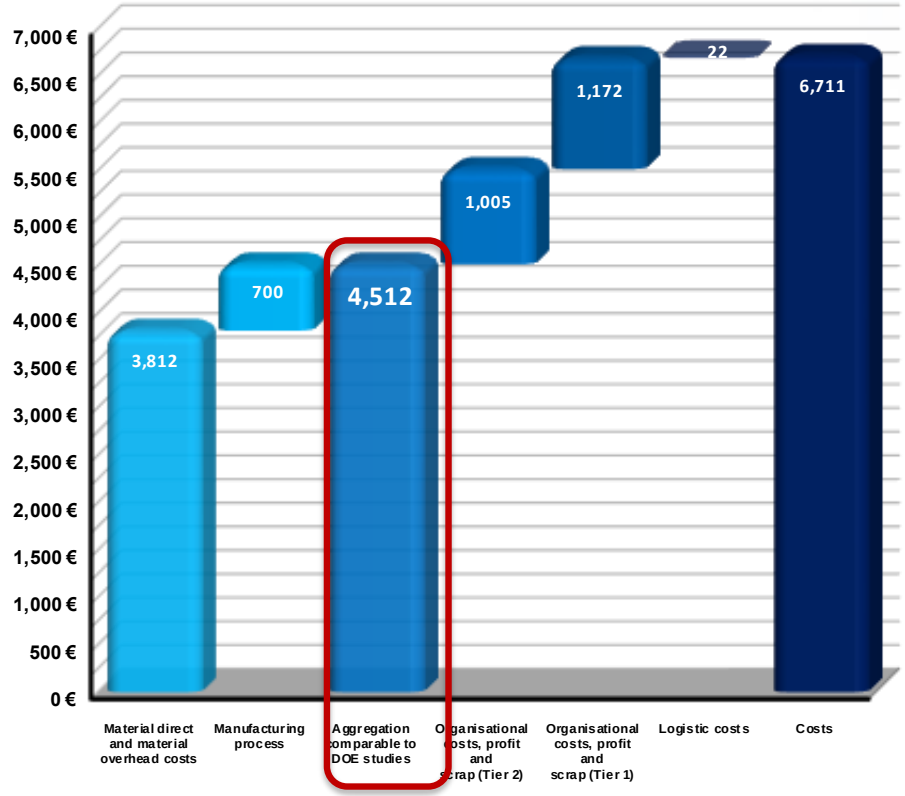
% stage of implement.

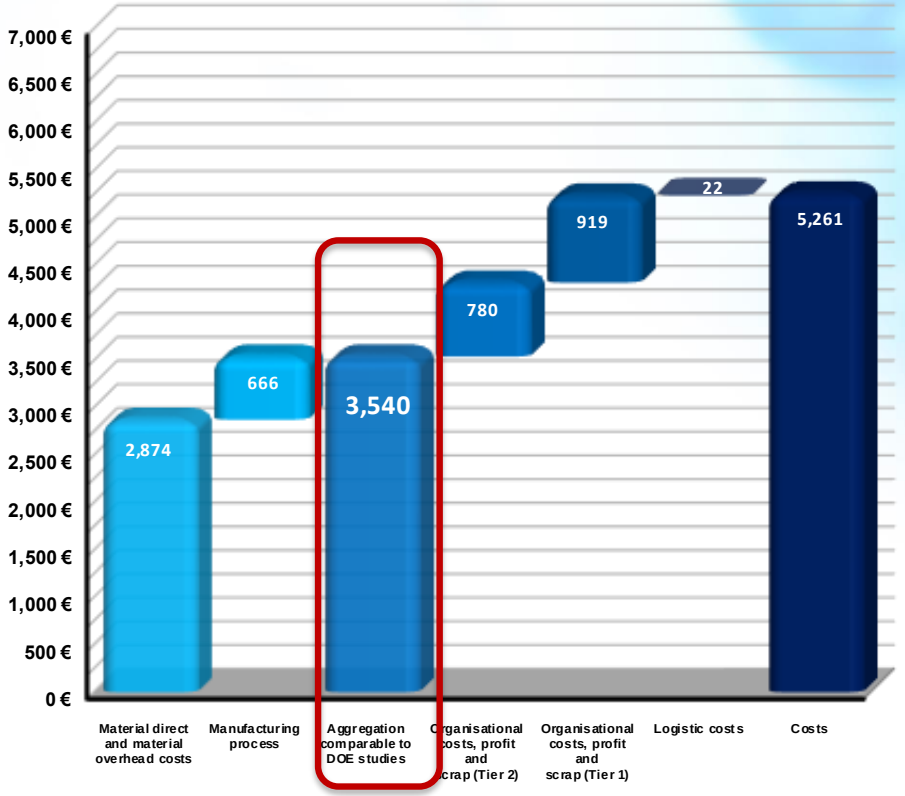
> 100 €/kW

36.81 €/kW

30 €/kW

25% 50% 75%





[1] Pt content: 0,50 mg/cm² (EVO1) and 0.35 mg/cm² (EVO2) [Pt price = 1.500 $/tr.oz, similar to DOE study, 2014]{Exchange rate from 20.11.2014: 1 US Dollar (USD) = 0,798 Euro (EUR)}

[2] Incl. SG&A and R&D

[3] Incl. Logistic costs for components and stack (Tier1 and Tier2)

SYNERGIES WITH OTHER PROJECTS AND PROGRAMMES

Interactions with projects funded under EU programmes	
Stack-Test	Use of project results (test modules and test programs)
IMPACT	Exchange of information
Interactions with national and international-level projects and initiatives	

DISSEMINATION ACTIVITIES

Public deliverables

- 1 « Stakeholder Workshop Documentation «
- 2 « Stakeholder Workshop Documentation »

Conferences/Workshops

- 2 organised by the project
- 2 in which the project has participated

Social media

http:autostack.zsw-bw.de

Publications: 2

- A. Martin, L. Jörissen, ECS Transactions 42 (1) 31-38 (2014)
- A. Martin, L. Jörissen, Hypothesis 2016 Proceedings Volume

Patents: 1 application

EXPLOITATION PLAN/EXPECTED IMPACT

Exploitation

Several specific business discussions with OEMs.

Test sample sold to third party OEM.

One full size stack sold to a vehicle demo project.

Stacks used in 2 new and provided to 5 additional FCH-JU projects

German national project proposal filed with 4 OEMs.

Impact

Low stack numbers supplied for demo and testing.

Development is recognized in the community.

Successful demonstration, feedback on stack robustness in real world operation.

Limited production for demo market launch in the next 12 to 24 months.

Volume production intended in 2020.

Thank You!

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RISKS AND MITIGATION

Project LOGO

Voltage of 675 mV at 1.5 A not reached under the operating conditions defined in the project.

- Improve matching of CCM, GDL and flow field.
- Reconsider system requirements to operating conditions, pressure, humidity and flow.

Risk 2

- Mitigation 2

Risk 3

- Mitigation 3