Harmonisation of Fuel Cell Testing For Automotive Applications

FCH2JU Programme Review Days 2016

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November 2016

OUTLINE

- **Rationale**
- **Scope and Methodology of Harmonisation**
- **Harmonisation of Testing Protocols**
- **Harmonisation of Testing Hardware**

RATIONALE

- **Due to the FCH2 JU Knowledge Management activities "*TEMONAS*" the Need emerged for**
  - **Science based**
  - **industry endorsed**
  - **Common Testing Protocols and Procedures**

To Allow a Fair and Objective Assessment of

- **Achievements and**
- **Progress made with regard to Materials, Systems and Technologies**

PURPOSE…

To enable realistic and objective comparison on *Common Basis*

of results obtained in

the different FCH2JU projects in

the Same Application area for establishing

***Potential Gaps* and**

identifying possible

Future Research Needs

HOWEVER

The Harmonisation Activities do NOT PROPOSE:

- **Substituting *Currently Existing* Testing Protocols/Procedures in different Industries/Research Establishments/Universities**

INSTEAD

it is PROPOSED to:

- **Establishing a COMMON set of testing Protocols/Procedures in ADDITION to the Currently Existing Ones**

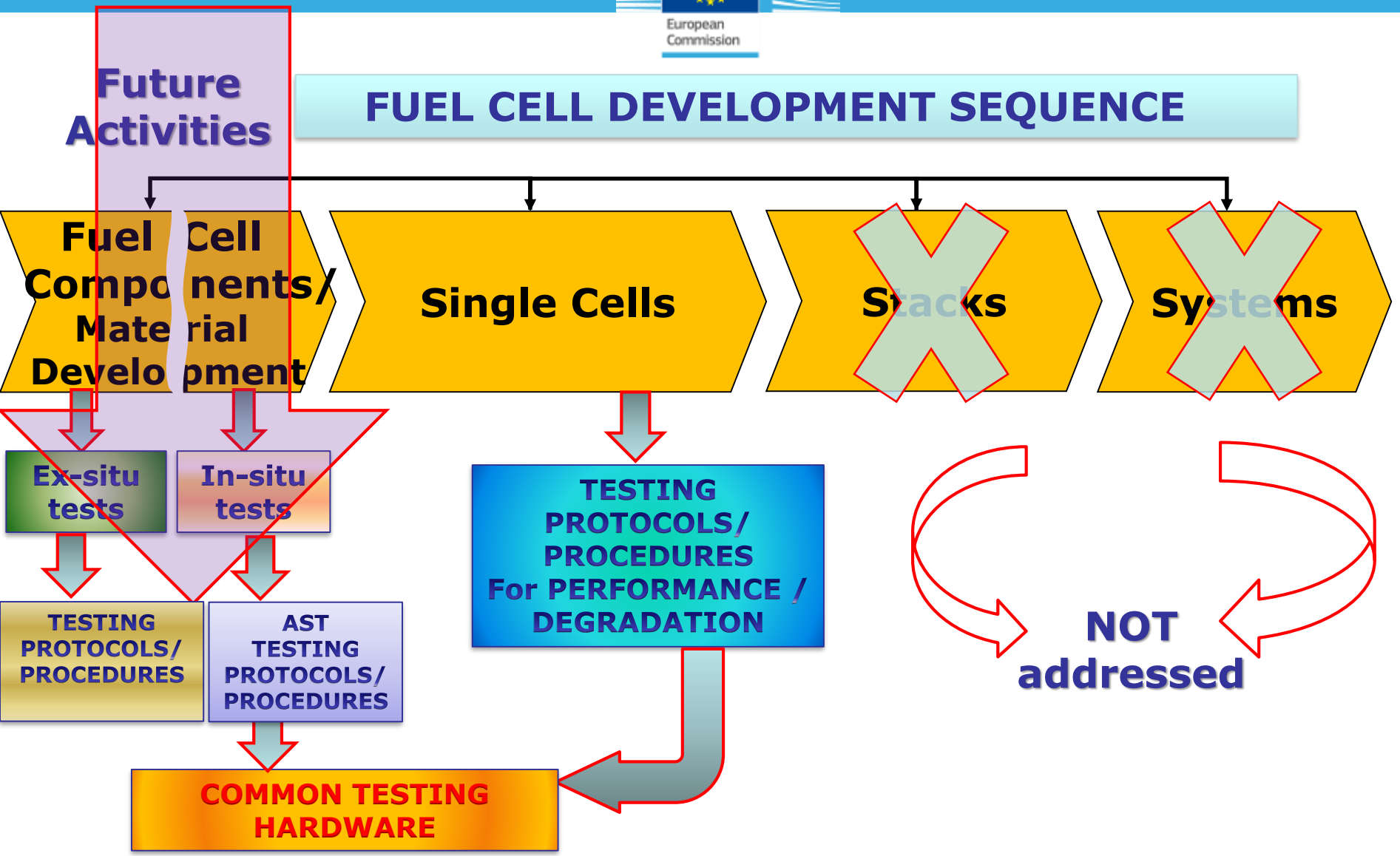
Additional Drivers
Spin-offs

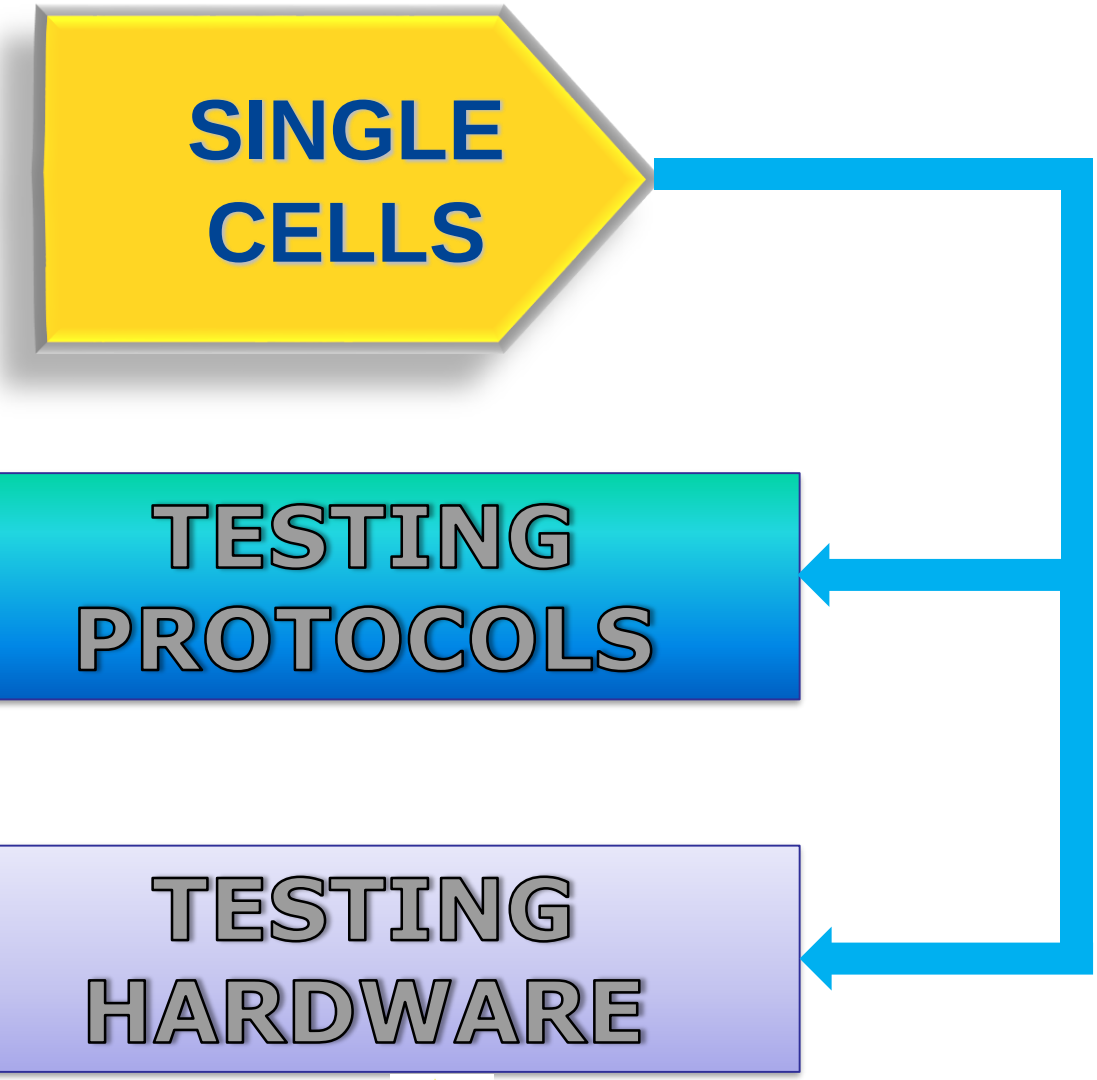
- **To provide to Material Suppliers to OEMs a set of COMMON conditions for evaluating performance/degradation of their MEAs for Quality Assurance**

- **To provide the possibility to OEMs, of establishing their own "*transfer functions*" between "*research results*" and "*real life systems*"**

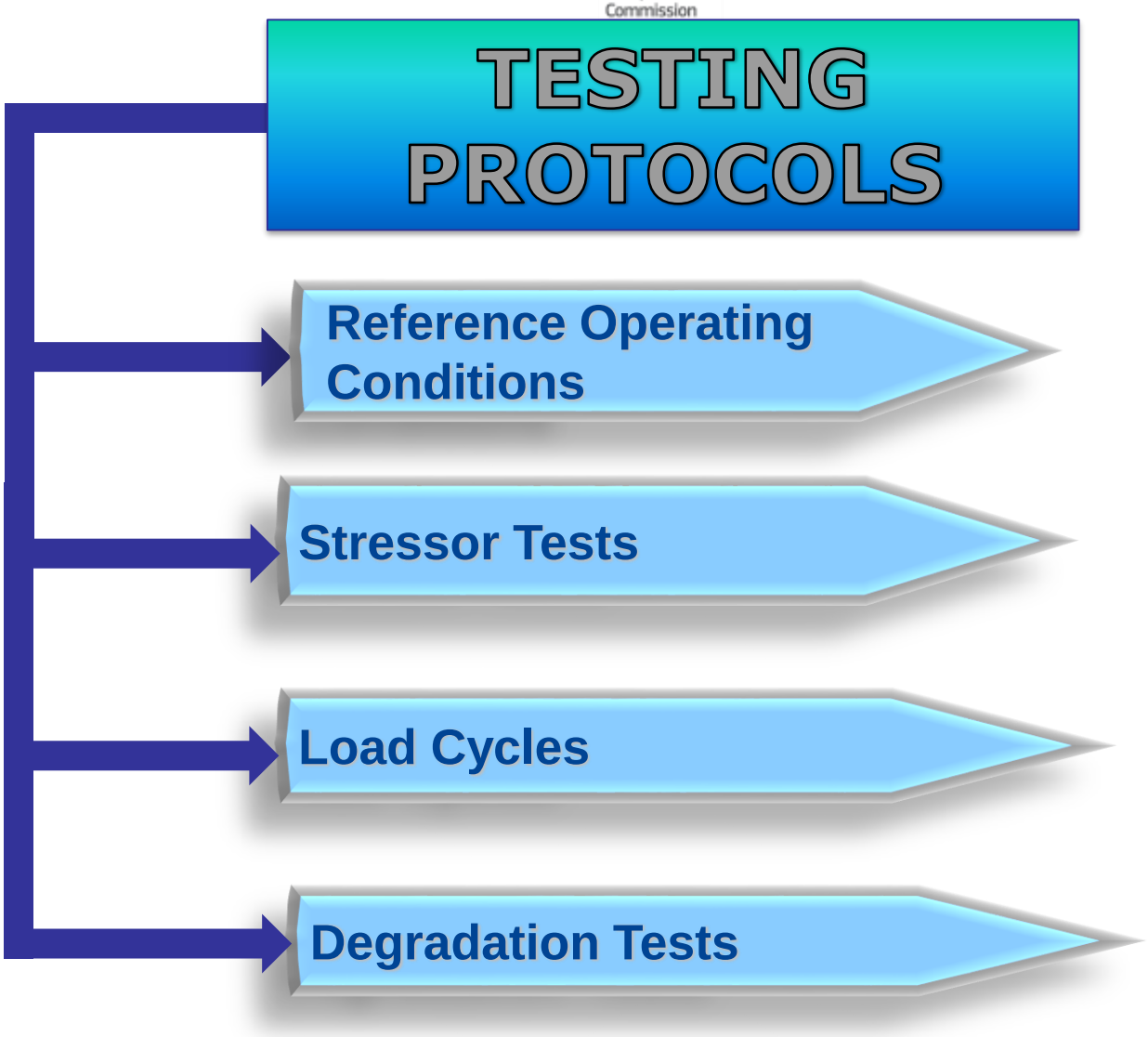
- **To provide to the research community a methodology for easier comparison of results presented in scientific publications, International Conferences Workshops**

SCOPE and METHODOLOGY of HARMONISATION




SINGLE CELLS
TESTING PROTOCOLS
TESTING HARDWARE

Main Features of the Harmonised testing protocols



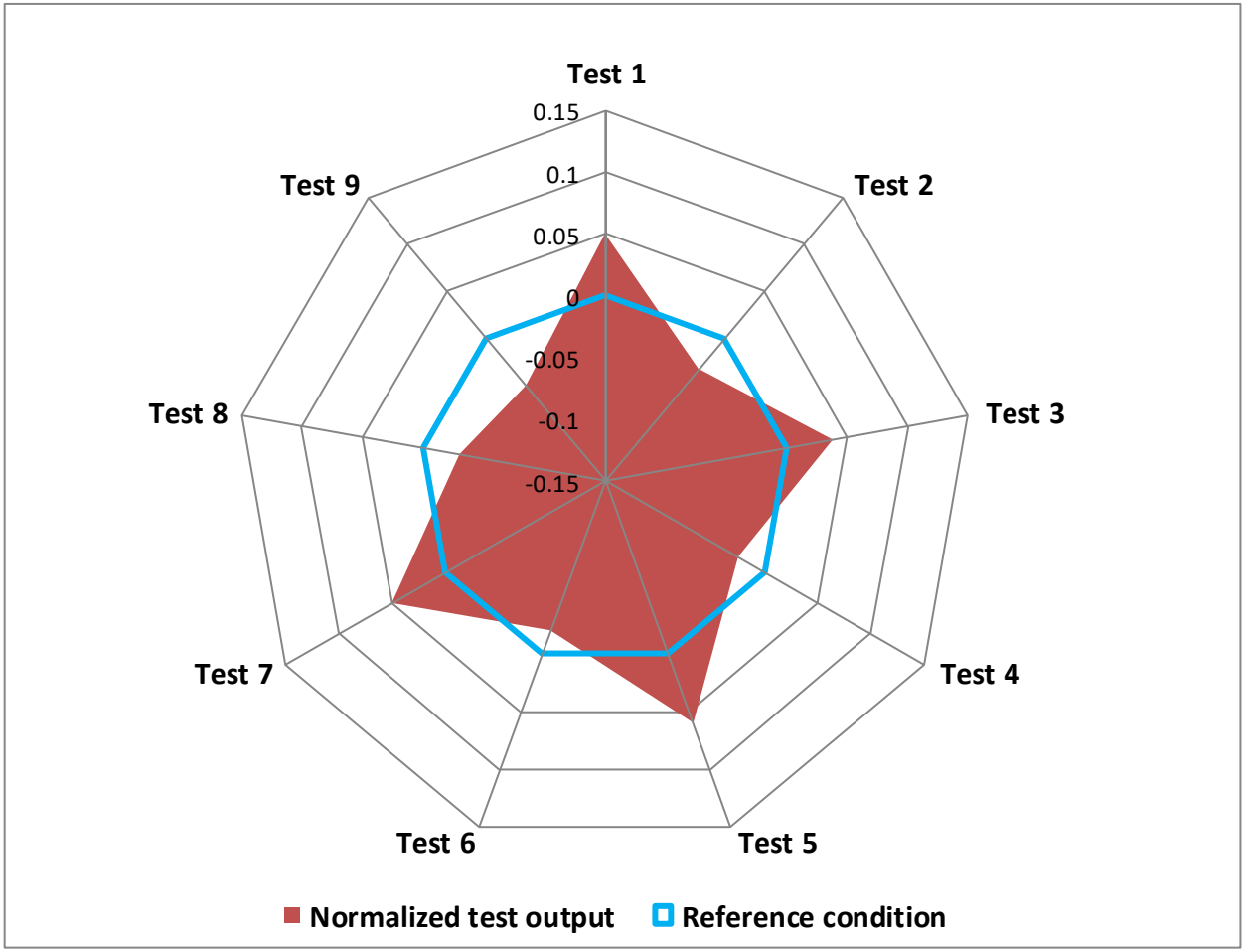
EU REFERENCE OPERATING CONDITIONS

	Parameters	Unit	Values
	Nominal cell operating temperature	°C	80
ANODE	Fuel gas inlet temperature	°C	85
	Fuel gas inlet humidity	% RH	50
	Fuel gas inlet pressure (absolute)	kPa	250
	Fuel gas composition		According to H_2 5.0 quality
	Fuel stoichiometry	-	1.3
CATHODE	Oxidant gas inlet temperature	°C	85
	Oxidant gas inlet humidity	% RH	30
	Oxidant gas inlet pressure (absolute)	kPa	230
	Oxidant	-	According to ISO 8573-1:2010
	Air stoichiometry	-	1.5
	Minimum current density for stoichiometry operation	A/cm^2	0.2

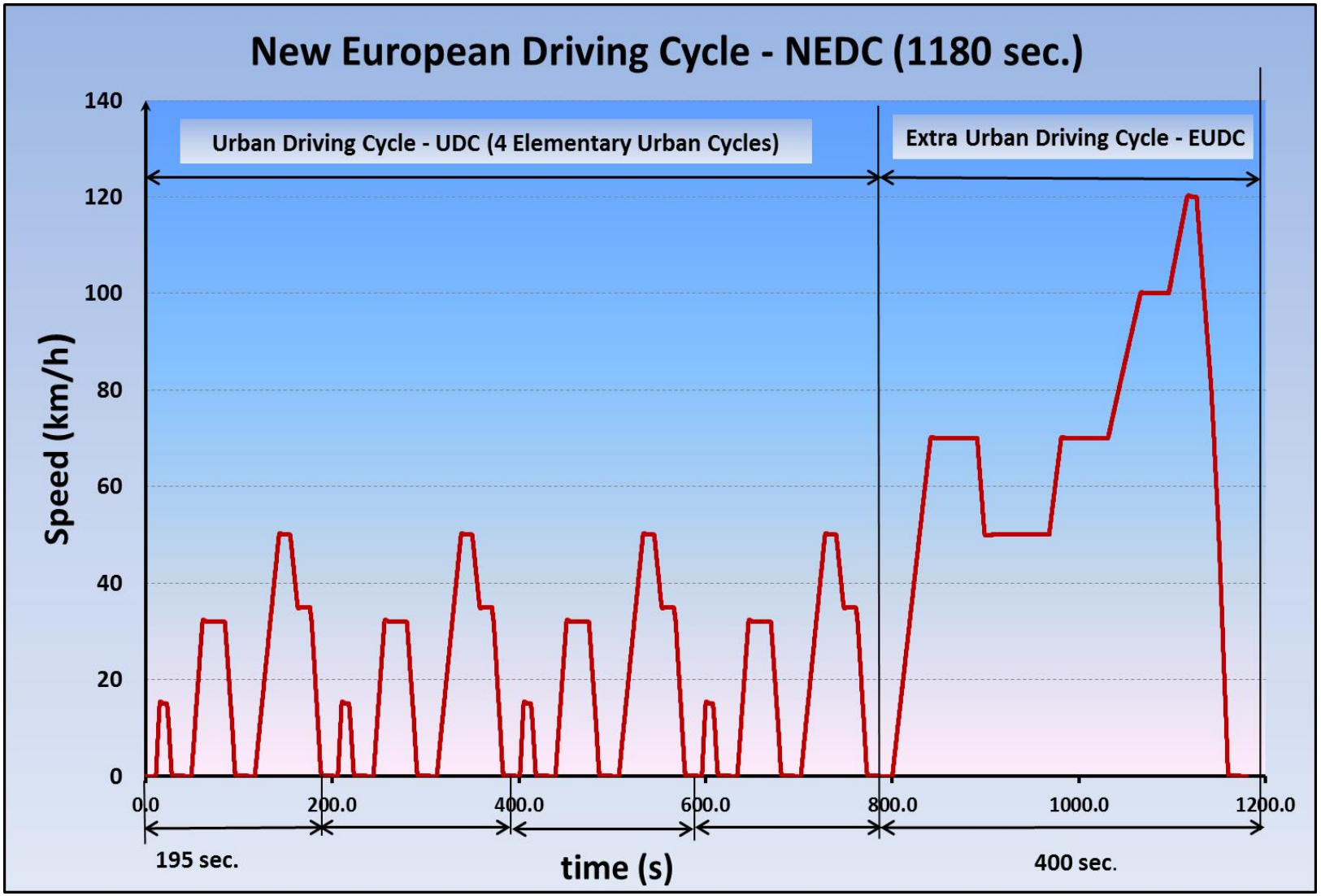
STRESSOR TESTS

	Parameters	Symbol	Unit	EU REFERENCE Automotive Conditions	Cell Temperature Stressor Tests		Reactants Gas Inlet Humidification Stressor Tests			Reactants Gas Inlet Pressure Stressor Tests		Oxidant Stoichiometry Stressor tests	
				VALUES	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9
	Nominal cell operating temperature	T.Si,CL	°C	80	45	95(*)	95(*)	95(*)	95(*)	80	80	80	80
ANODE	Fuel gas inlet temperature	T.Si.A	°C	85	50	100	100	100	100	85	85	85	85
ANODE	Fuel gas inlet humidity	RH.Si.A	% RH	50 DPT64°C	85 DPT42°C	25 DPT61°C	50 DPT77°C	25 DPT61°C	50 DPT77°C	50 DPT64°C	50 DPT64°C	50 DPT64°C	50 DPT64°C
ANODE	Fuel gas inlet pressure (absolute)	p.Si.A	kPa	250	250	250	250	250	250	160	300	250	250
ANODE	Fuel stoichiometry	Stoic.Si.A	-	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
CATHODE	Oxidant gas inlet temperature	T.Si.C	°C	85	50	100	100	100	100	85	85	85	85
CATHODE	Oxidant gas inlet humidity	RH.Si.C	% RH	30 DPT53°C	85 DPT42°C	20 DPT57°C	20 DPT56°C	45 DPT75°C	45 DPT75°C	30 DPT53°C	30 DPT53°C	30 DPT53°C	30 DPT53°C
CATHODE	Oxidant gas inlet pressure (absolute)	p.Si.C	kPa	230	230	230	230	230	230	140	280	230	230
CATHODE	Air stoichiometry	Stoic.Si.C	-	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.3	2
CATHODE	Minimum current density for stoichiometry operation	I.S.MinGasFlow	A/cm²	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

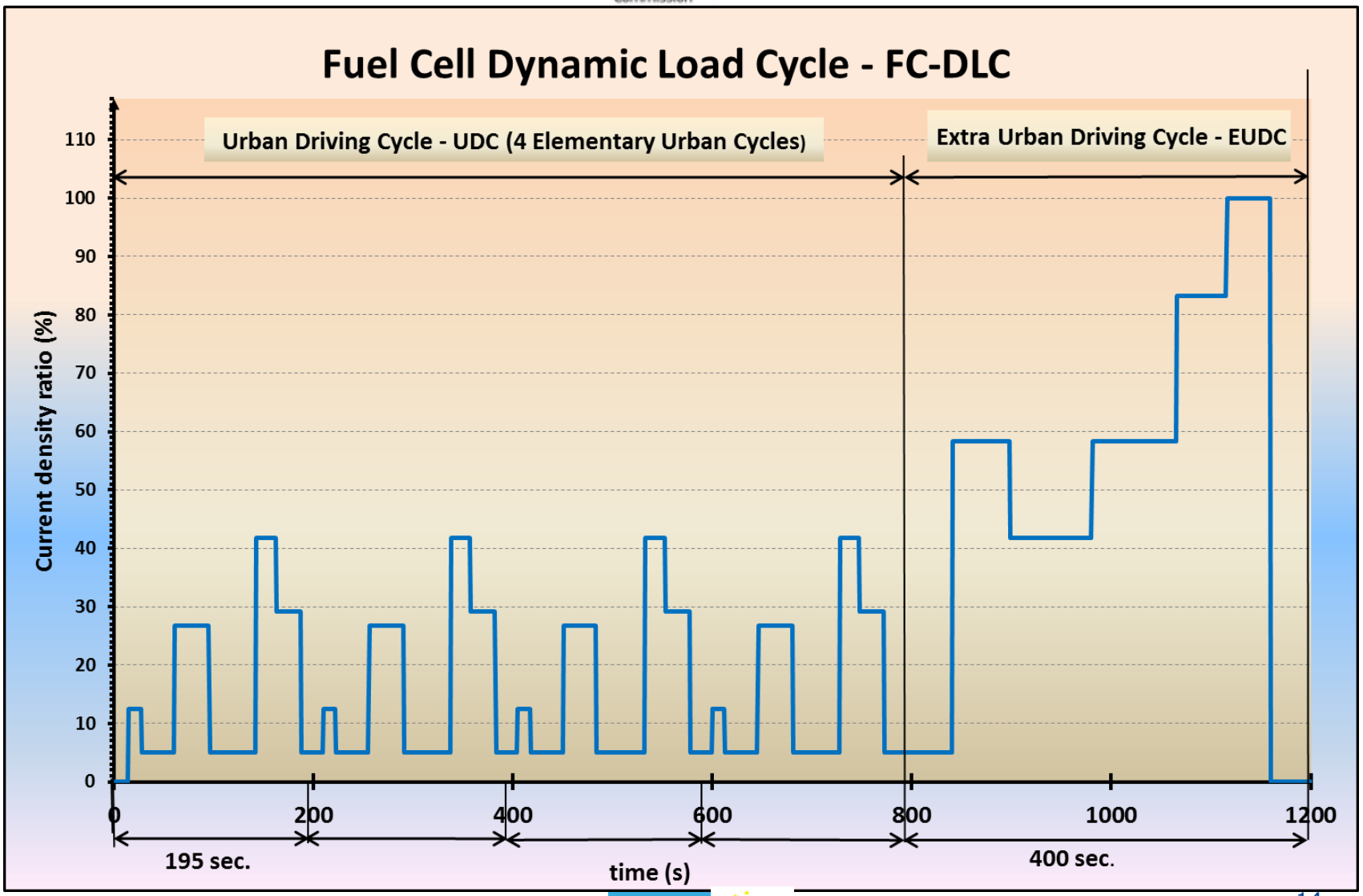
STRESSOR SPIDER



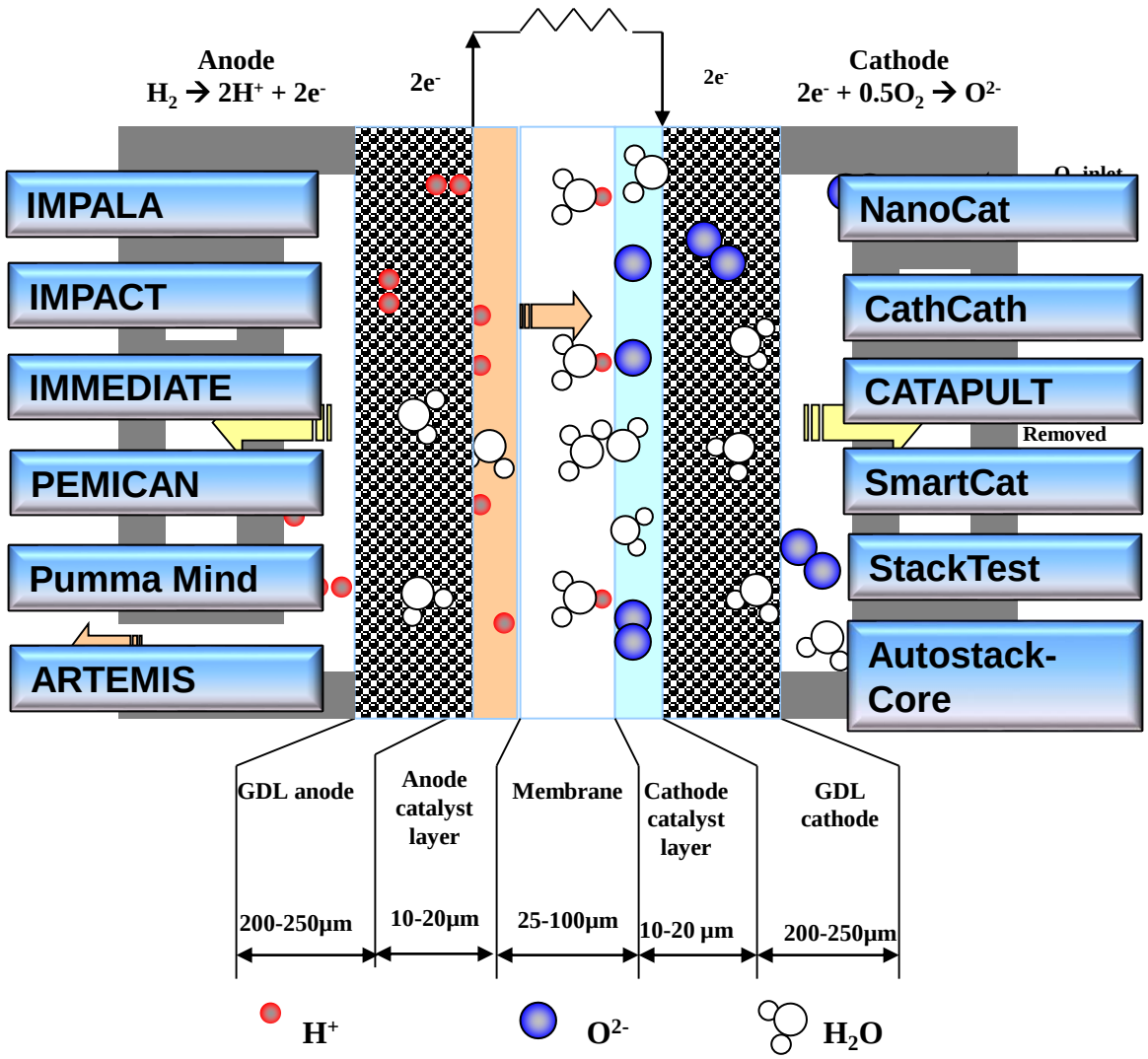
LOAD CYCLE NEDC



LOAD CYCLE FC-DLC



FCH-JU AUTOMOTIVE CONTRIBUTING PROJECTS



AUTOMOTIVE HARMONISATION REPORT

European Commission

JRC SCIENCE FOR POLICY REPORT

EU HARMONISED TEST PROTOCOLS FOR PEMFC MEA TESTING IN SINGLE CELL CONFIGURATION FOR AUTOMOTIVE APPLICATIONS

Georgios Tsotridis, Alberto Pilenga, Giancarlo De Marco, Thomas Malkow

2015

http://bookshop.europa.eu/en/eu-harmonised-test-protocols-for-pemfc-mea-testing-in-single-cell-configuration-for-automotive-applications-pbLDNA27632/

Joint Research Centre

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(in alphabetical order of their organisations)

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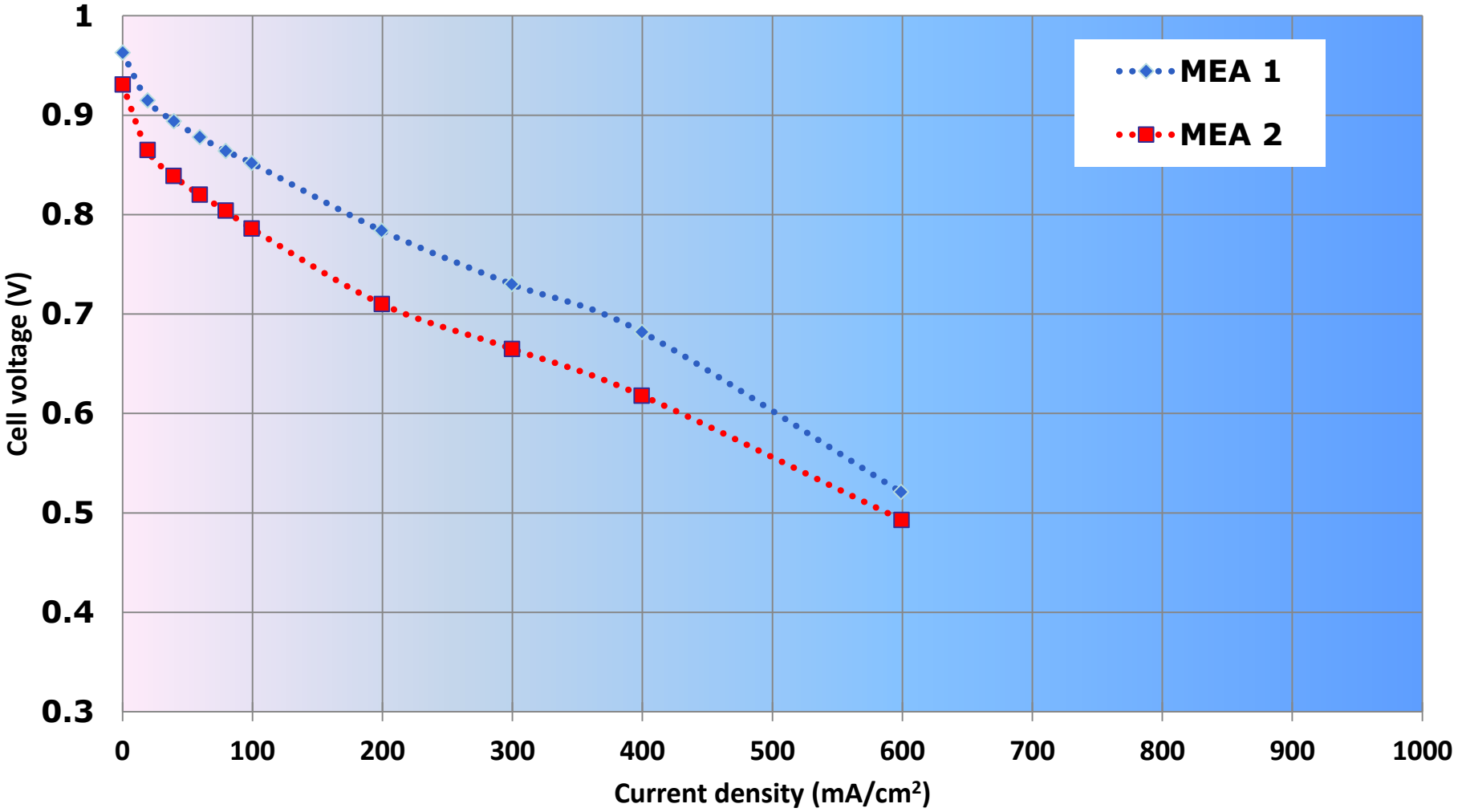
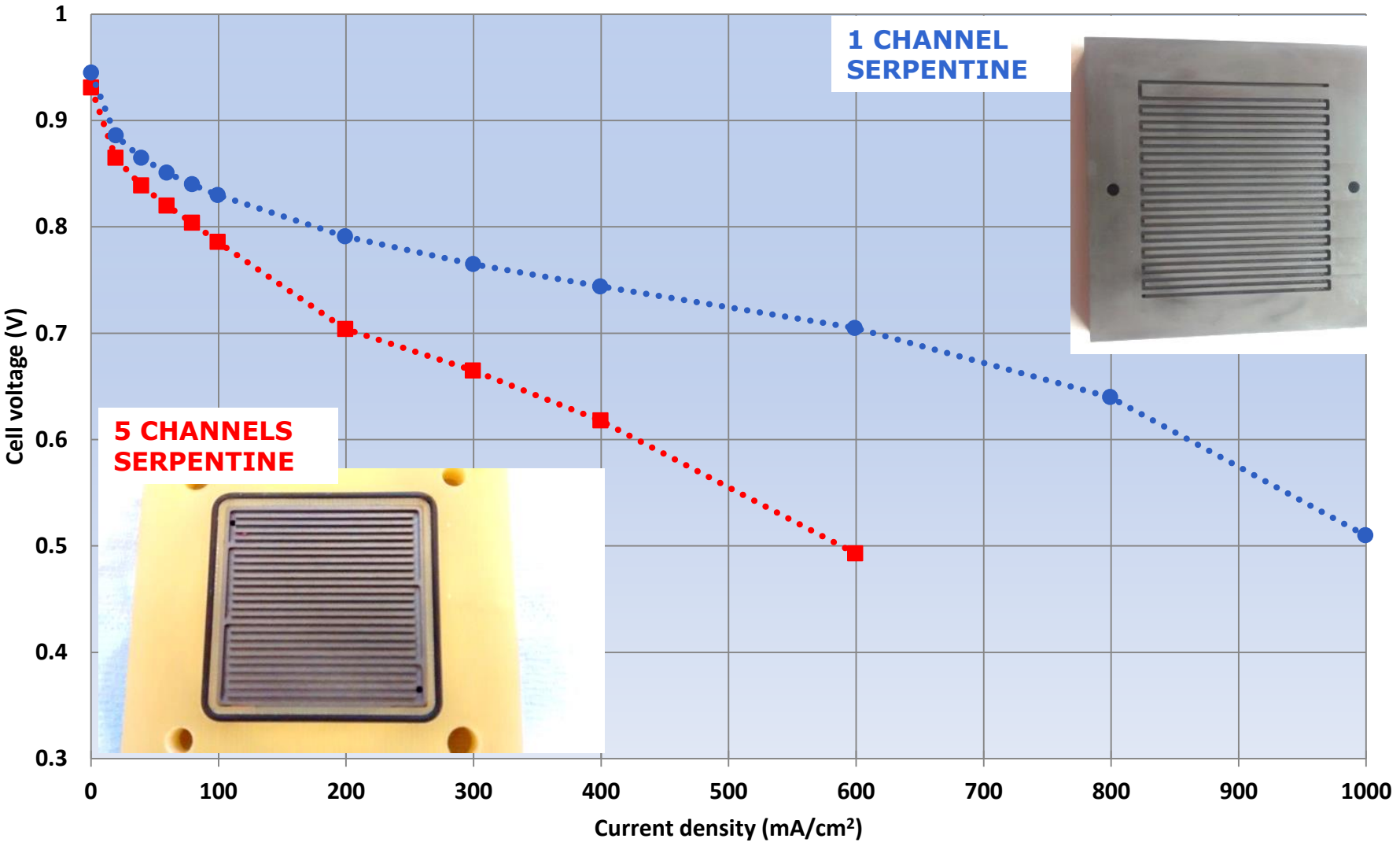
Comparison of Performance (polarisation curves) for TWO different MEAs under Automotive conditions using the same test hardware



Comparison of Performance (polarisation curves) for the same MEA under Automotive conditions using TWO different Test hardware



HARMONISED TESTING HARDWARE

Main Design Features

The purpose of the Harmonised testing hardware is:

- **To assess MEA Performance**

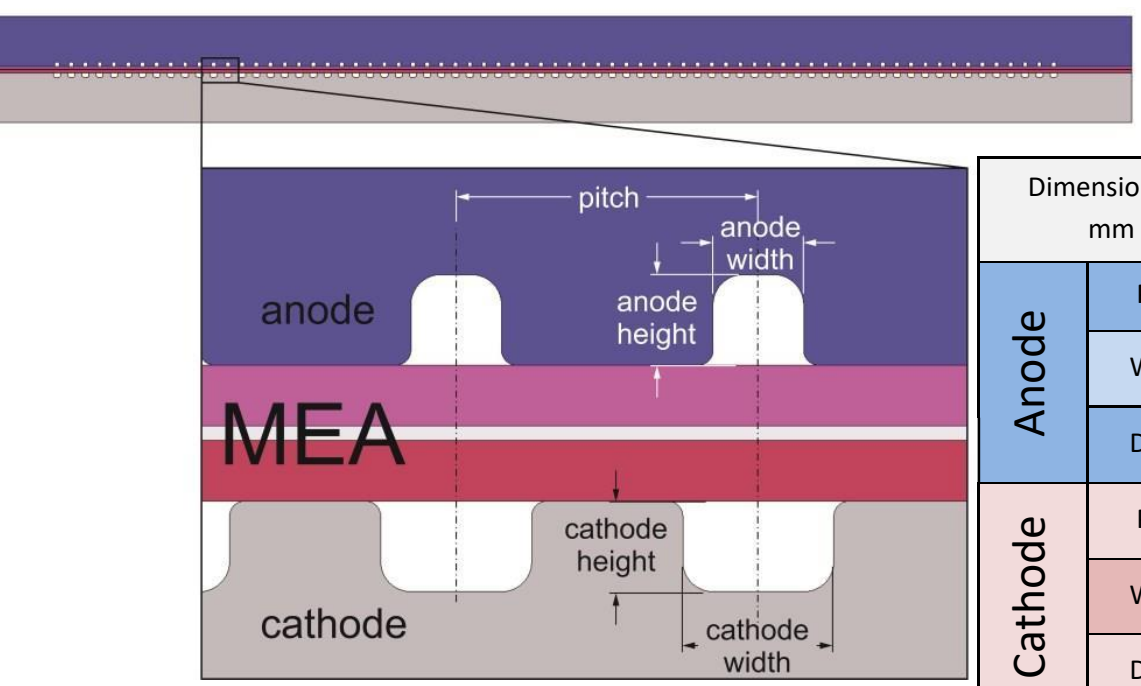
IRRESPECTIVE

of FLOW FIELD configurations.

Main Design Features

ACTIVE AREA FLOW FIELD DESIGN

Active Area:Straight Parallel Flow Channels

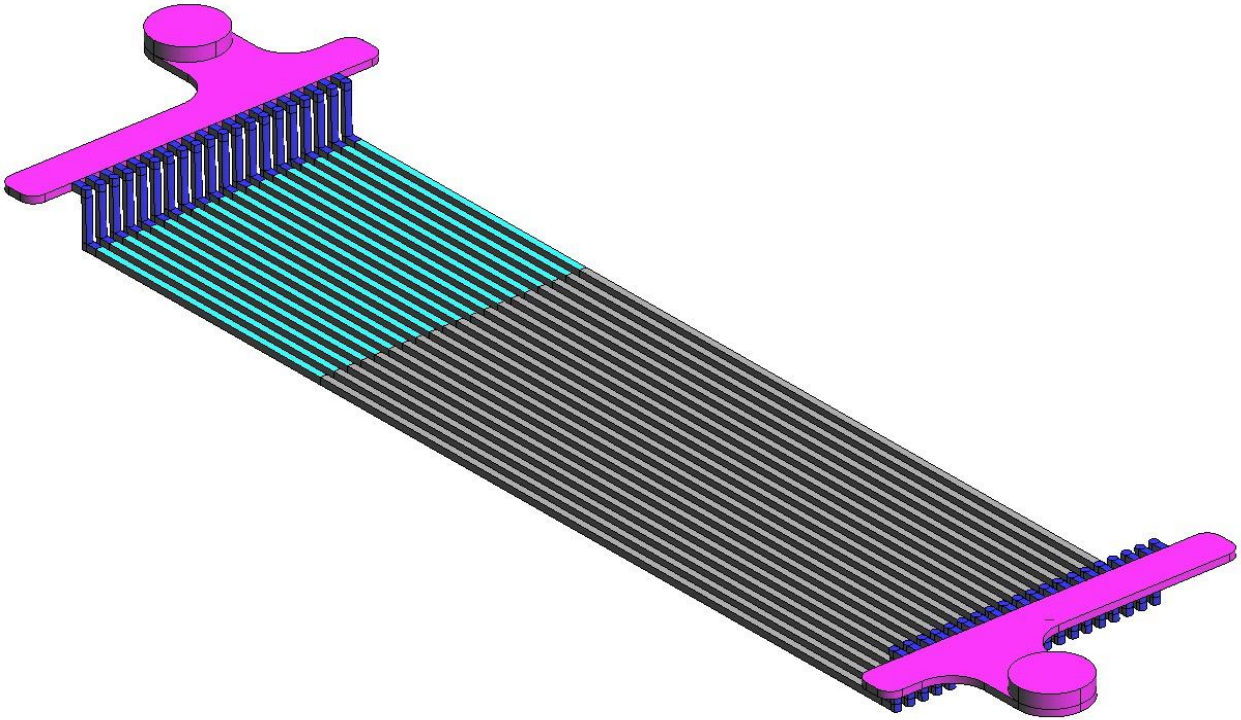


Bipolar plate
Anode/cathode

Dimensions in mm		Option 1	Option 2	Option 3	Option 4
Anode	Pitch	0.90	1.00	1.20	0.84
	Width	0.30	0.40	0.50	0.25
	Depth	0.24	0.40	0.40	0.25
Cathode	Pitch	0.90	1.00	1.20	0.84
	Width	0.55	0.50	0.60	0.6
	Depth	0.30	0.50	0.50	0.4

Design Features Testing Hardware

- **Inlet Manifold**



- **Oulet Manifold**

Further Steps

- ✓ **Finalise the testing hardware design**
- ✓ **Validation of testing hardware**
- ✓ ***"Open Source Test Hardware" provided by JRC***
- ✓ **Option of using the same Testing Hardware for Stationary Applications**

Similar Activities

- ✓ **Harmonisation activities on Electrolysis "ongoing"**
- ✓ **Harmonisation activities for fuel cell for CHP-Stationary Applications "to be started"**

THANK YOU!

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