



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

***ENERGY - Next
generation
products***

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PRD 2018
15 November 2018

Agenda

PROGRAMME REVIEW DAYS 2018
FUEL CELLS AND HYDROGEN JOINT UNDERTAKING
 14 - 15 NOVEMBER, BRUSSELS



| | TRIALS AND DEPLOYMENT OF FUEL CELL APPLICATION - TRANSPORT | NEXT GENERATION OF PRODUCTS - TRANSPORT | TRIALS AND DEPLOYMENT OF FUEL CELL APPLICATION - ENERGY | NEXT GENERATION OF PRODUCTS - ENERGY | HYDROGEN FOR SECTORIAL INTEGRATION | SUPPORT FOR MARKET UPTAKE |
|---------------|--|---|--|--|---|--|
| 11:30 - 11:50 | H2ME HAWL HYFIVE HYLIFT-EUROPE HYTRANSIT | AUTO-STACK CORE COBRA COSMHYC DIGIMAN Fit-4-AMandA | ALKAMMONIA AUTORE CH2P CLEARGEN DEMO D2SERVICE DEMCOPEM-2MW DEMOSOFC ENE.FIELD ONSITE PACE PEMBEYOND POWER-UP STAGE-SOFC | Cell3Ditor DIAMOND ENDURANCE FLUIDCELL HEALTH-CODE HEATSTACK INSIGHT MATISSE NELLHI PROSOFC qSOFC SCORED 2:0 SECOND ACT SOSLeM INNO-SOFC | BIONICO BIOROBURplus Demo4Grid DON QUICHOTE Eco ELECTRA ELY4OFF ELYntegration GrInHy H2Future HELMETH HPEM2GAS HyBalance HYDROSOL-PLANT HyGrid INSIDE MEGASTACK PECDEMO PECSYS QualyGridS SElySOs SOPHIA BIG HIT MEMPHYS | HYACINTH HYCORA HyLAW HYPACTOR HySEA HYTECHCYCLING KNOWHY NET-Tools SOCTESQA |
| 11:50 - 12:10 | JIVE SWARM H2ME 2 | H2REF HYCARUS INLINE INN-BALANCE INSPIRE MARANDA NANO-CAT SMARTCAT VOLUMETRIQ COMPASS Giantleap | | | | |
| 12:10 - 12:30 | | | | | | |
| 12:30 - 12:50 | | | | | | |
| 12:50 - 13:10 | | | | | | |
| 13:10 - 13:30 | | | | | | |

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Next generation products- ENERGY

Fuel cells for combined heat and power



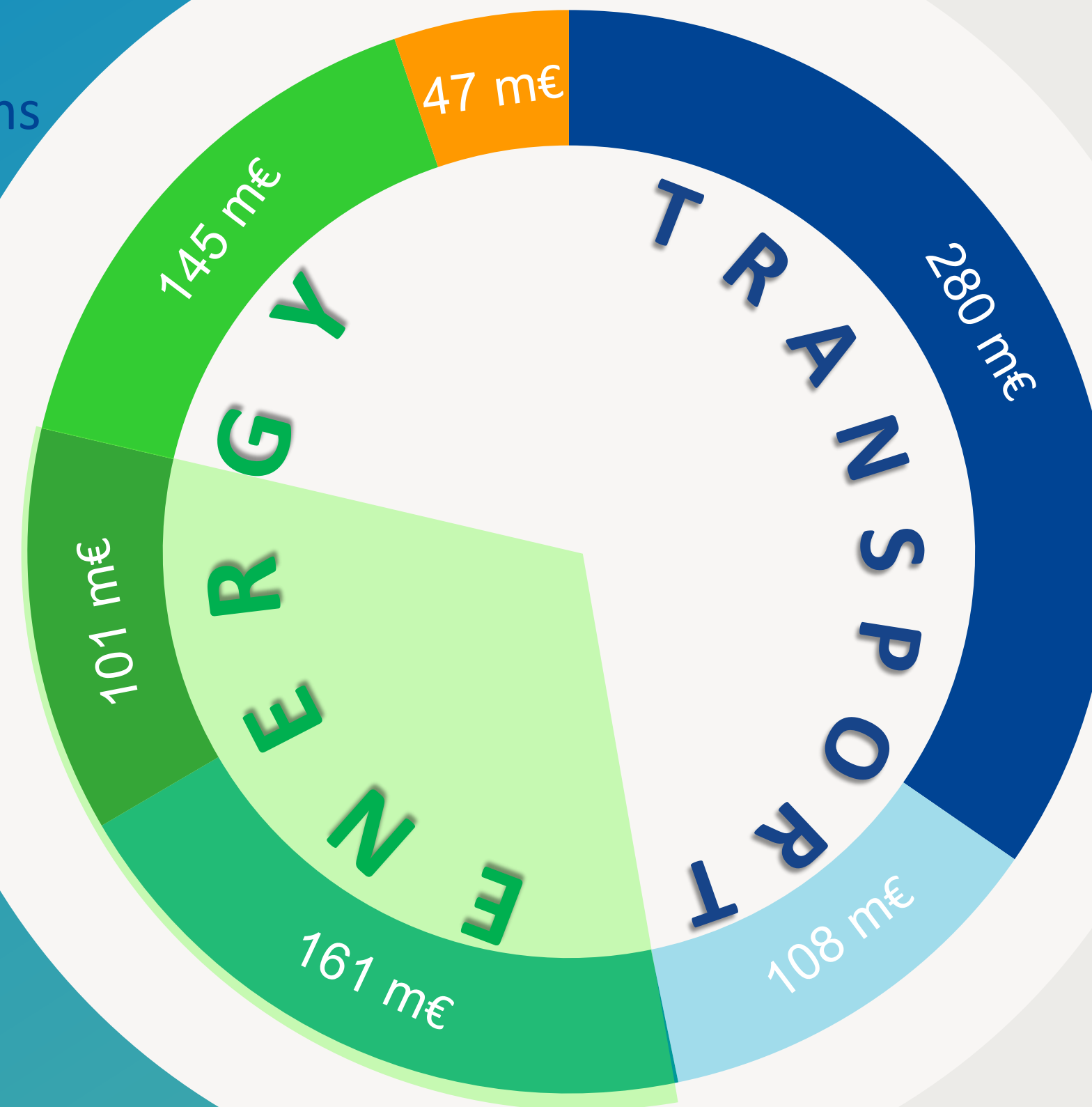
Related FCH JU objectives



Increase the efficiency and the durability of fuel cells for power production, while reducing costs

Reduce use of critical raw materials

Applications



Stationary - Total

31 %



262 M€

76 Projects

Next Generation



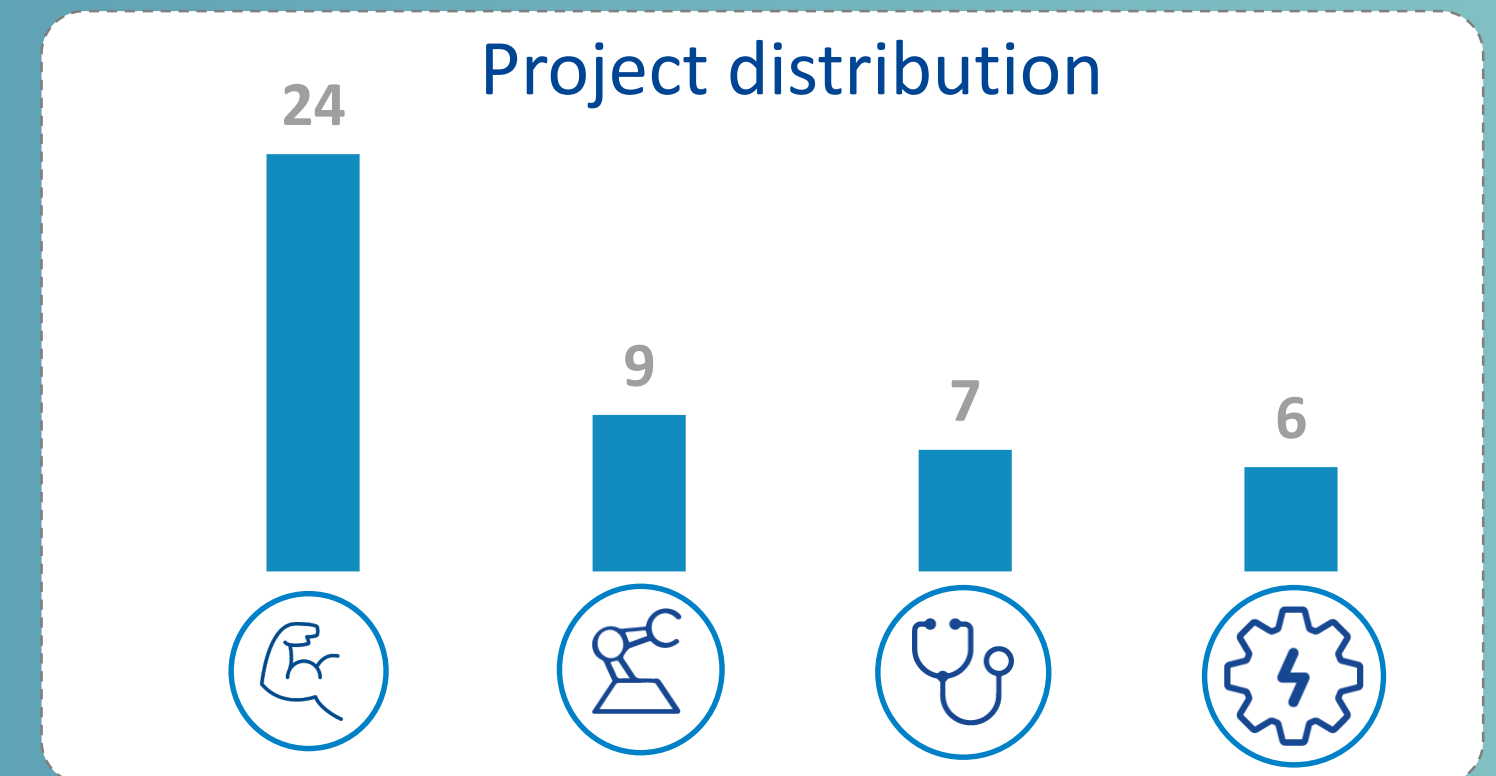
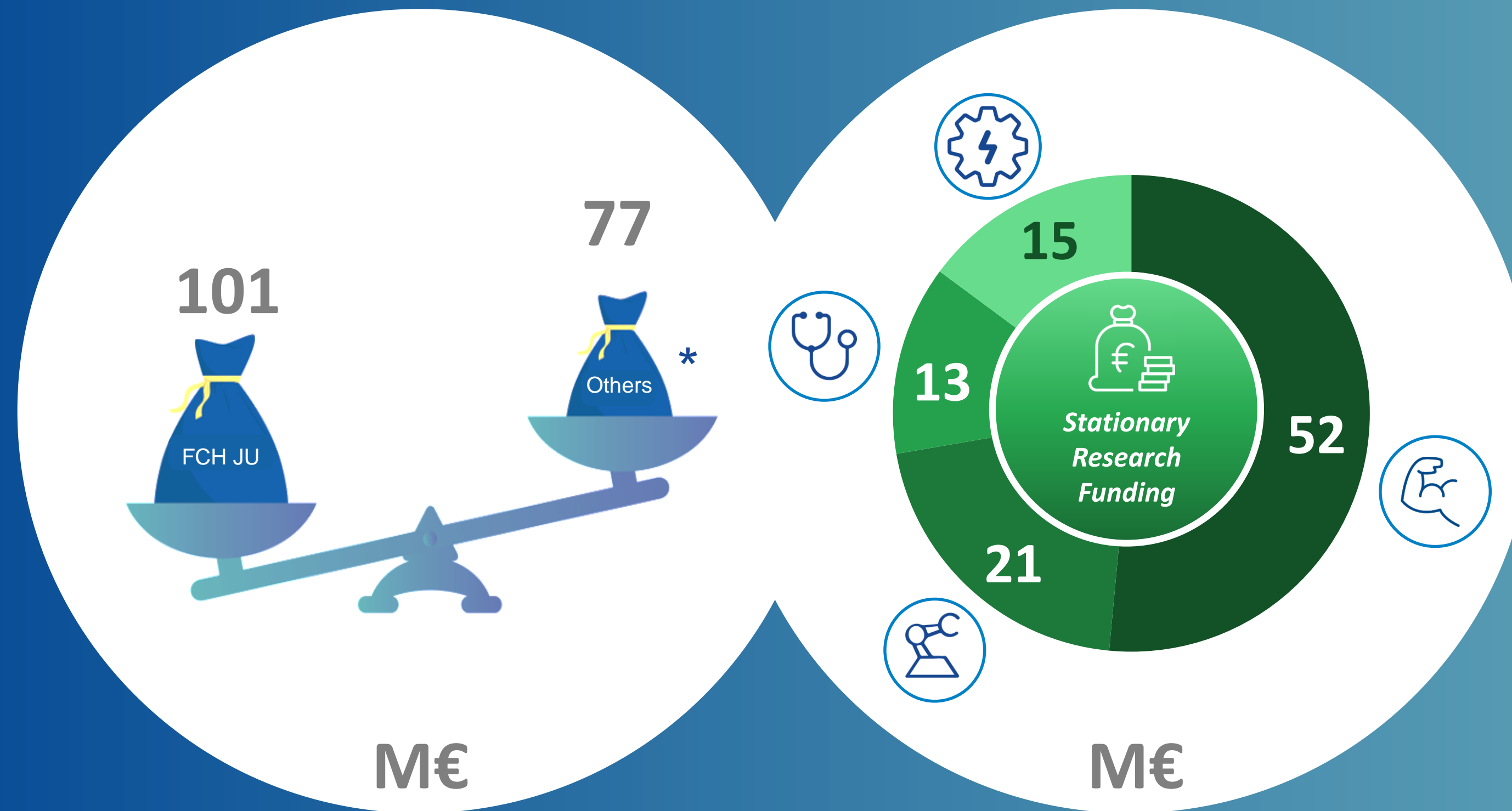
101 M€

46 Projects



Research portfolio

46 projects – 178 M€



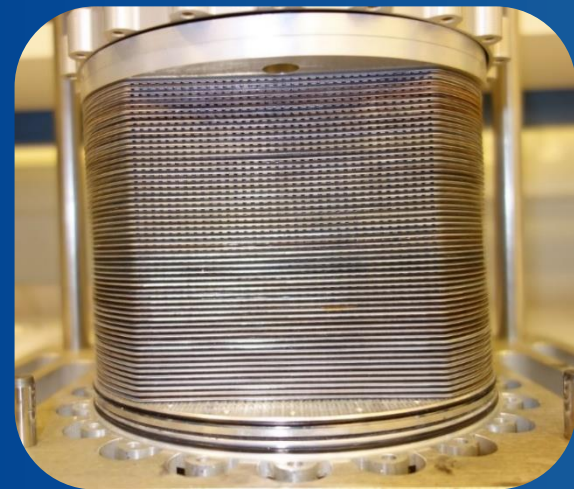
- Next generation, lifetime & performance
- Monitoring & Diagnostics
- System Aspects
- Manufacturing



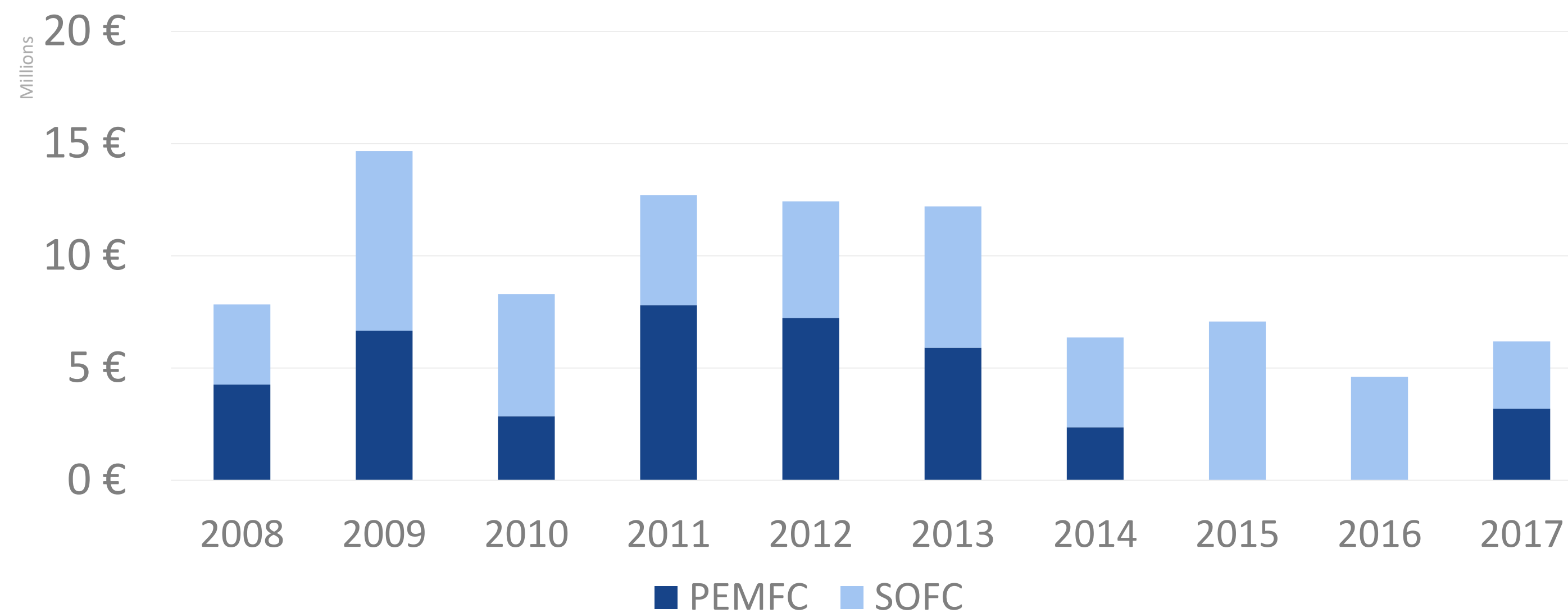
* Other resources including private and national/regional funding

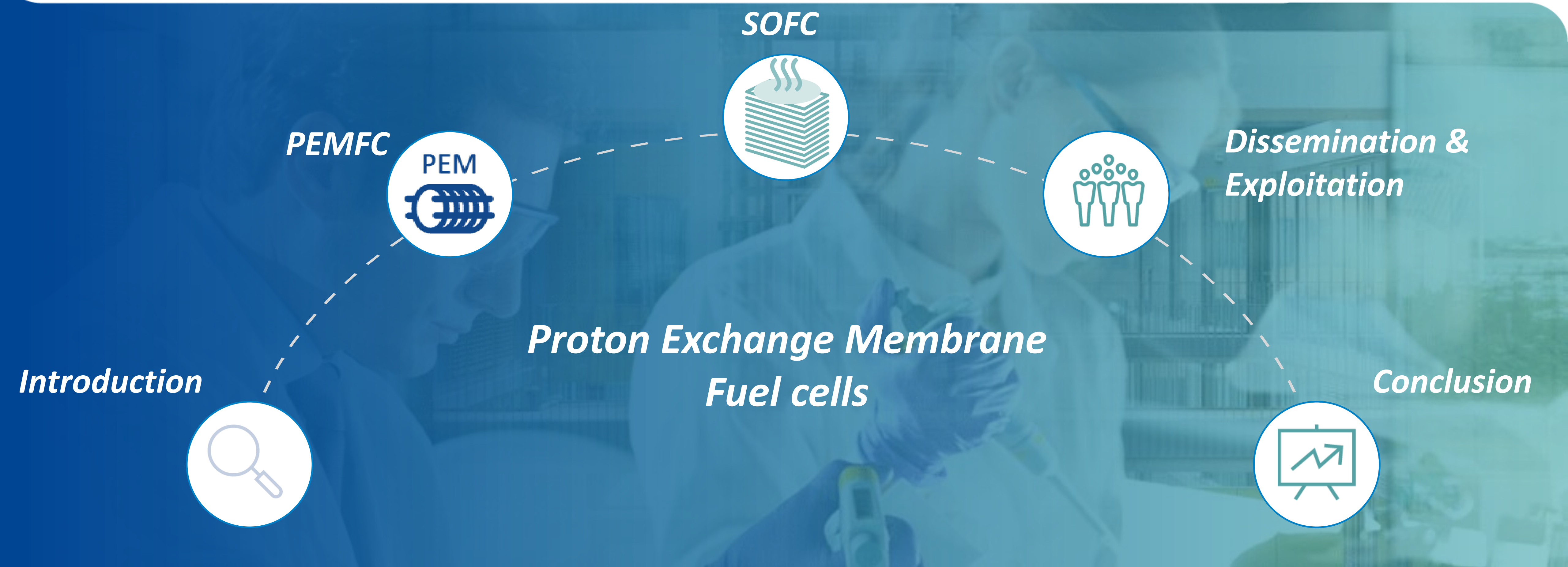
From lab scale to mass manufacturing

Technology neutral approach – Wide research scope



Technology Funding





PEMFC – Performance on track but stack durability still an issue

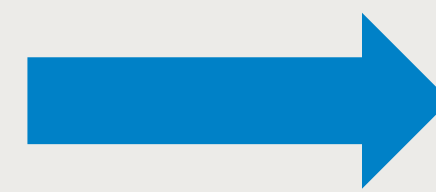
MEA in the center of attention



Understanding degradation
Novel catalysts/Gas diffusion layers

Textured electrodes for:

- mCHP
- Commercial
- Industrial



Average electrical efficiency improved by 5%

For mCHP and Back-up power
Target: 25% lifetime increase



mCHP Novel bio-ethanol reformer



| KPI | AWP/MAWP* target for 2020 | FCH JU projects results 2017* |
|---------------------------------|---------------------------|-------------------------------|
| Lifetime | 20,000h | 15,000 |
| Degradation | 0.25% | 0.7% |
| Power density W/cm ² | 0.67 | 0.7 |
| *El. Efficiency % | 42-60% | 50% |



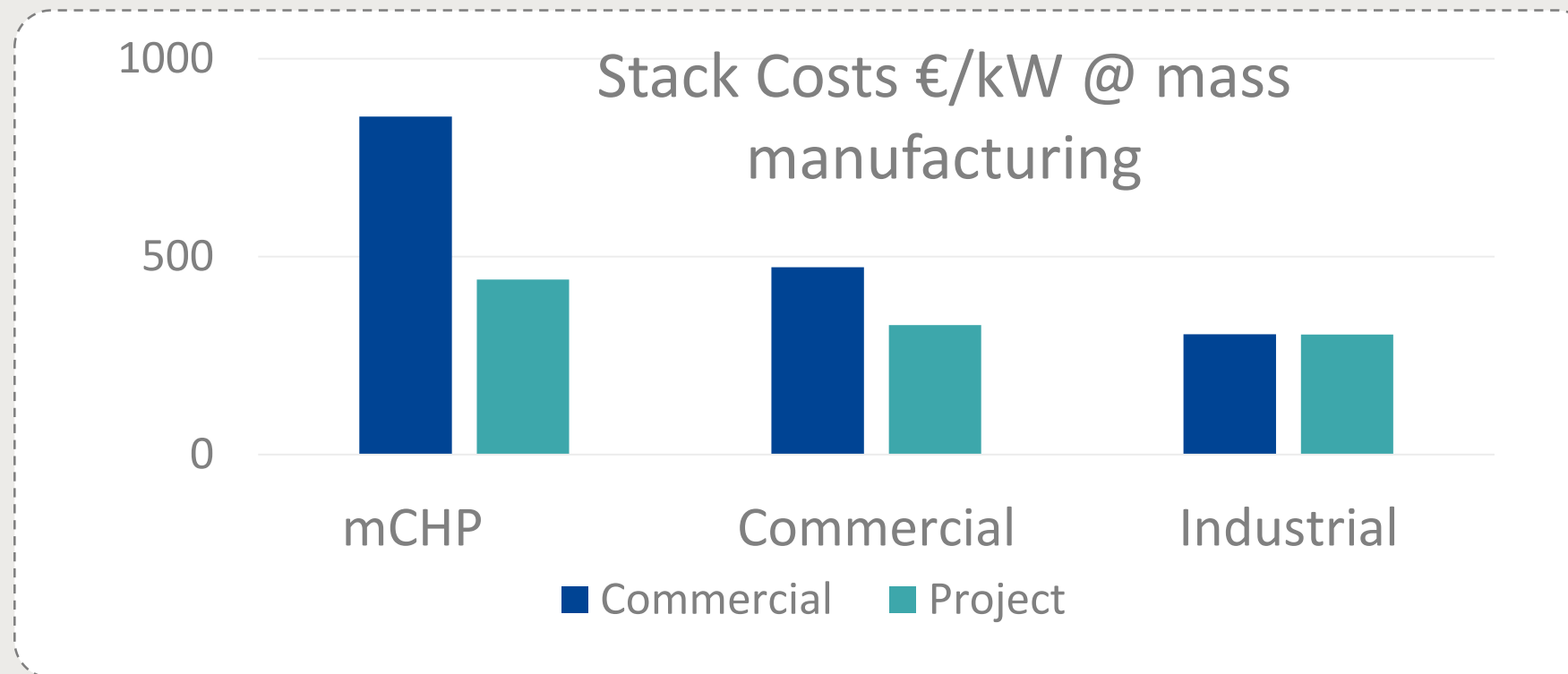
PEMFC - Automation reducing costs even at low production volumes



Minimising use of critical raw materials



Validation of screen printing pilot line
Automated MEA assembly



Up to **50%** cost reduction with new design

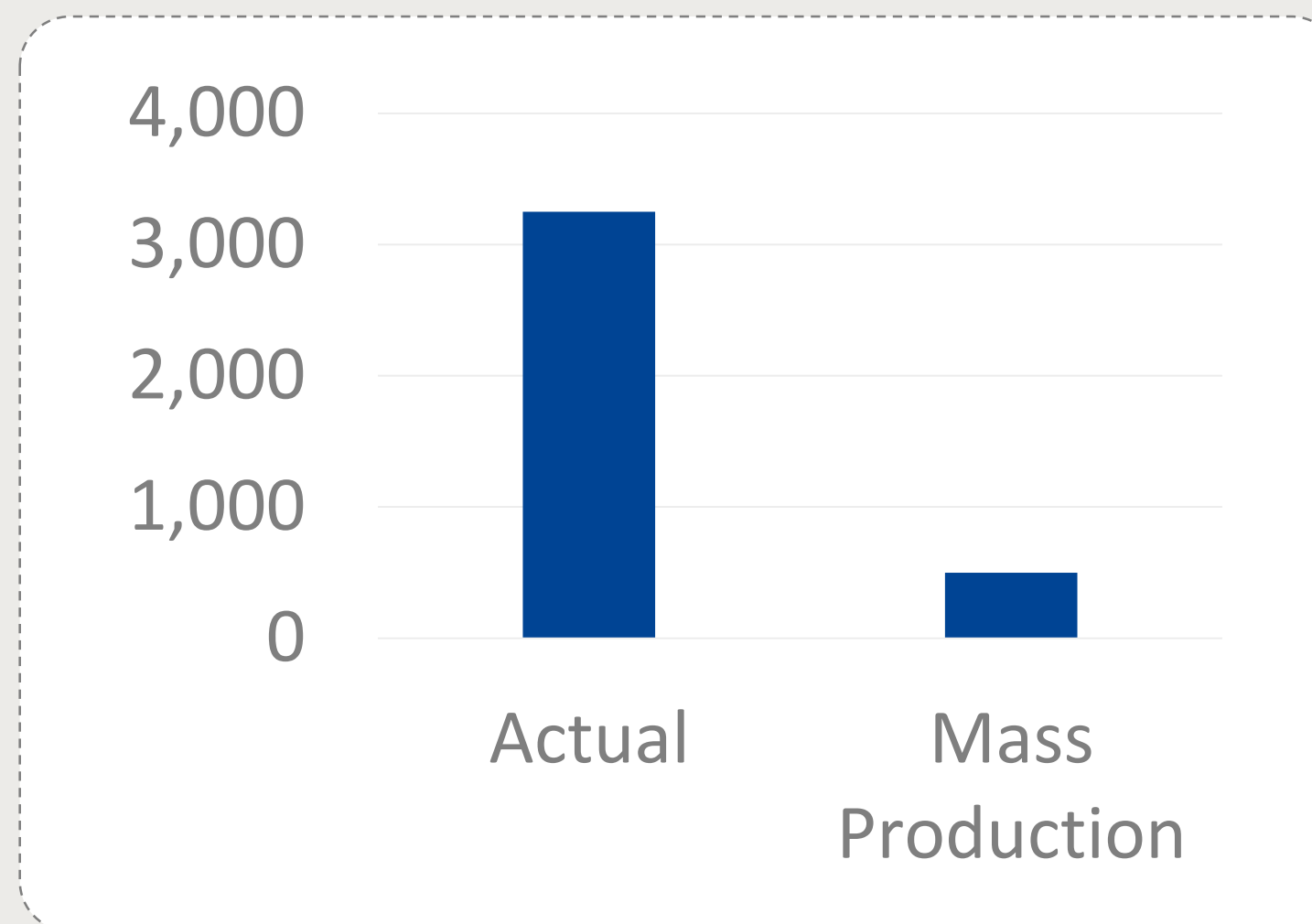
Minimising the use of critical raw materials



15% reduction of platinum loading recorded since 2016

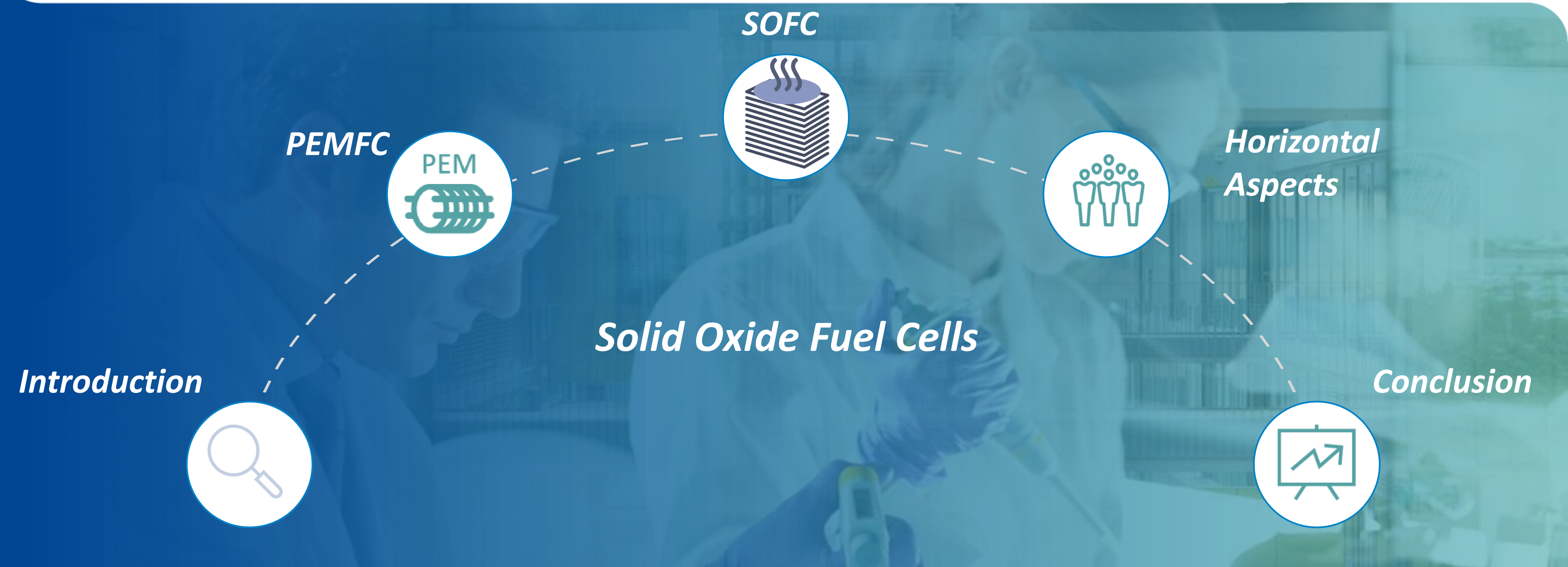


Reported Stack Costs (€/kW)



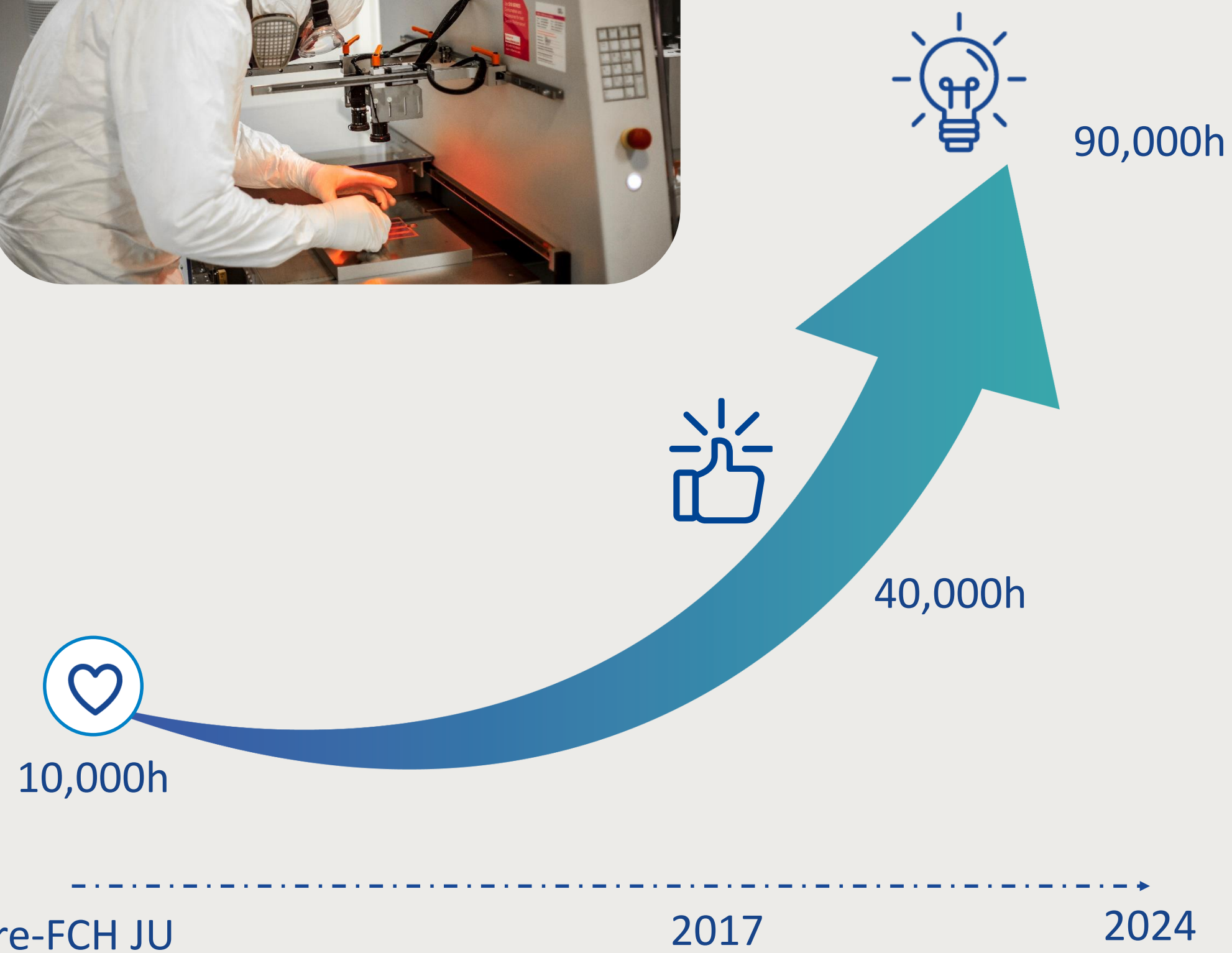
Stack Cost Target for 2020





European leaders in SOFC steadily improving their products

Setting ambitious long-term targets and expanding their markets



| SOFC KPIs | 2012 SoA | MAWP/AWP 2017 Target | FCH2 JU project results 2017 |
|------------------------------------|----------|----------------------|------------------------------|
| System Electrical Efficiency (%) | 35-60% | 35-60% | ✓ |
| System total efficiency (%) | 85% | 85-88% | ✓ |
| Stack Durability (h) | 25,000 | 40,000 | ✓ |
| Power Density (W/cm ²) | - | 0.35 | ✓ |
| Degradation | 0.4% | 0.2% | ✓ |
| Stack Cost €/kW | 8,000 | 6,500 | ✓ |

Based on 2017 project data gathered in the FCH2 JU 2018 data collection exercise



SLIDO Question



Q: What is the highest electrical efficiency recorded within our projects at stack level?

A1: 64%

A2: 68%

A3: 74%

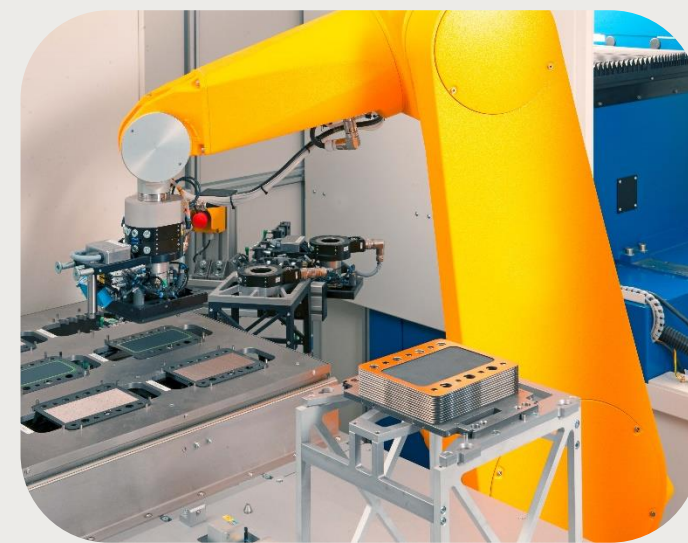
A4: 78%



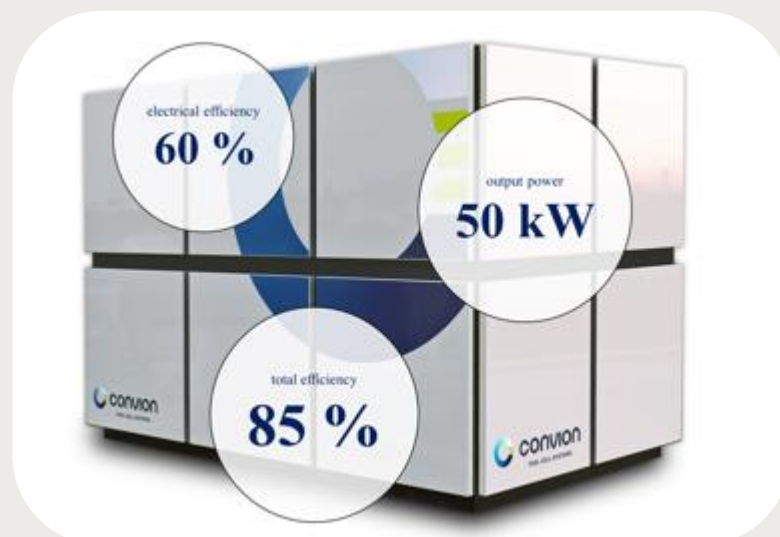
Use your smartphone; go to www.sli.do and insert the code **#PRD2018**

Exploitation of research results for commercial applications

Research results providing second generation products



- Stack target 1,000€/kW
- Cell cost 400€/kW



- System electrical η 60%
- Target of 4,000€/kW



- 3 stack iterations
- Record Breaking Efficiency

NELLHI

INNO-SOFC

qSOFC

Market Pull

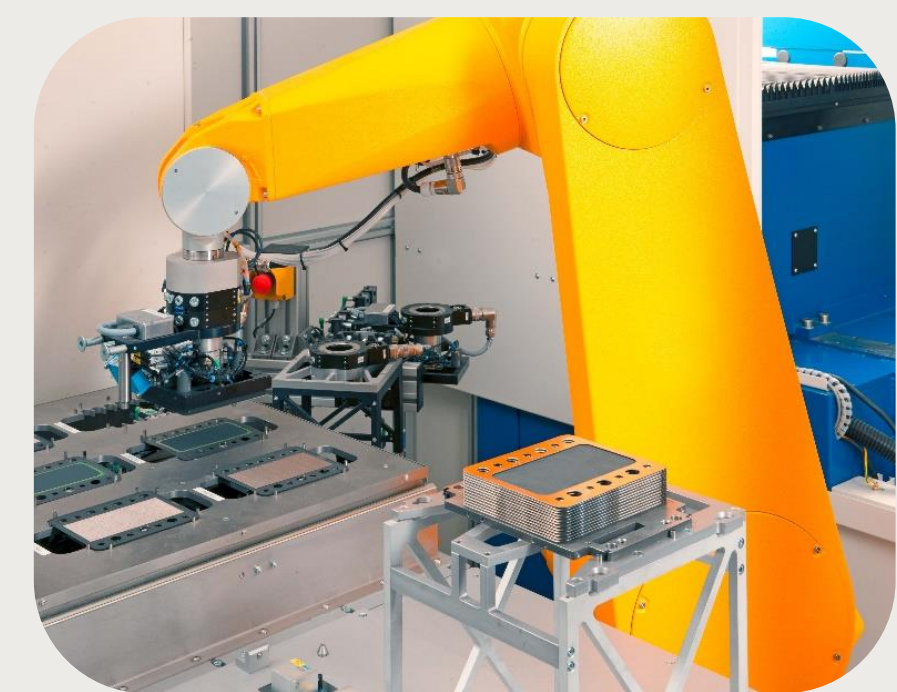
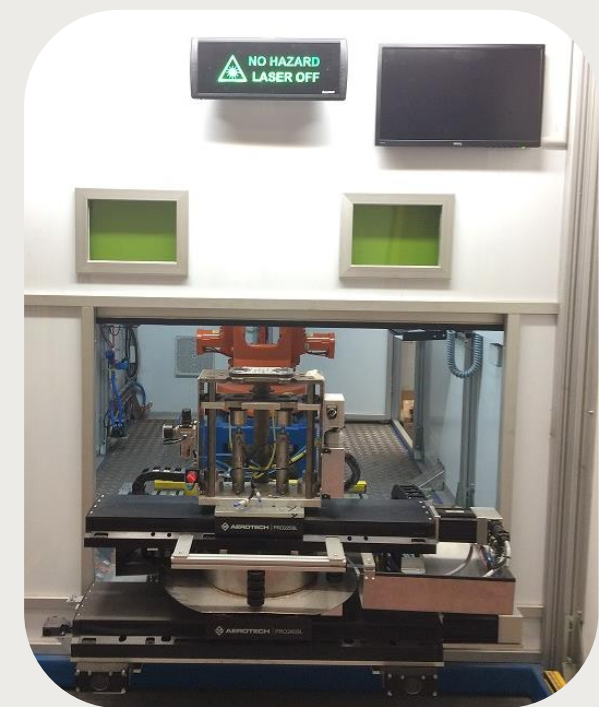
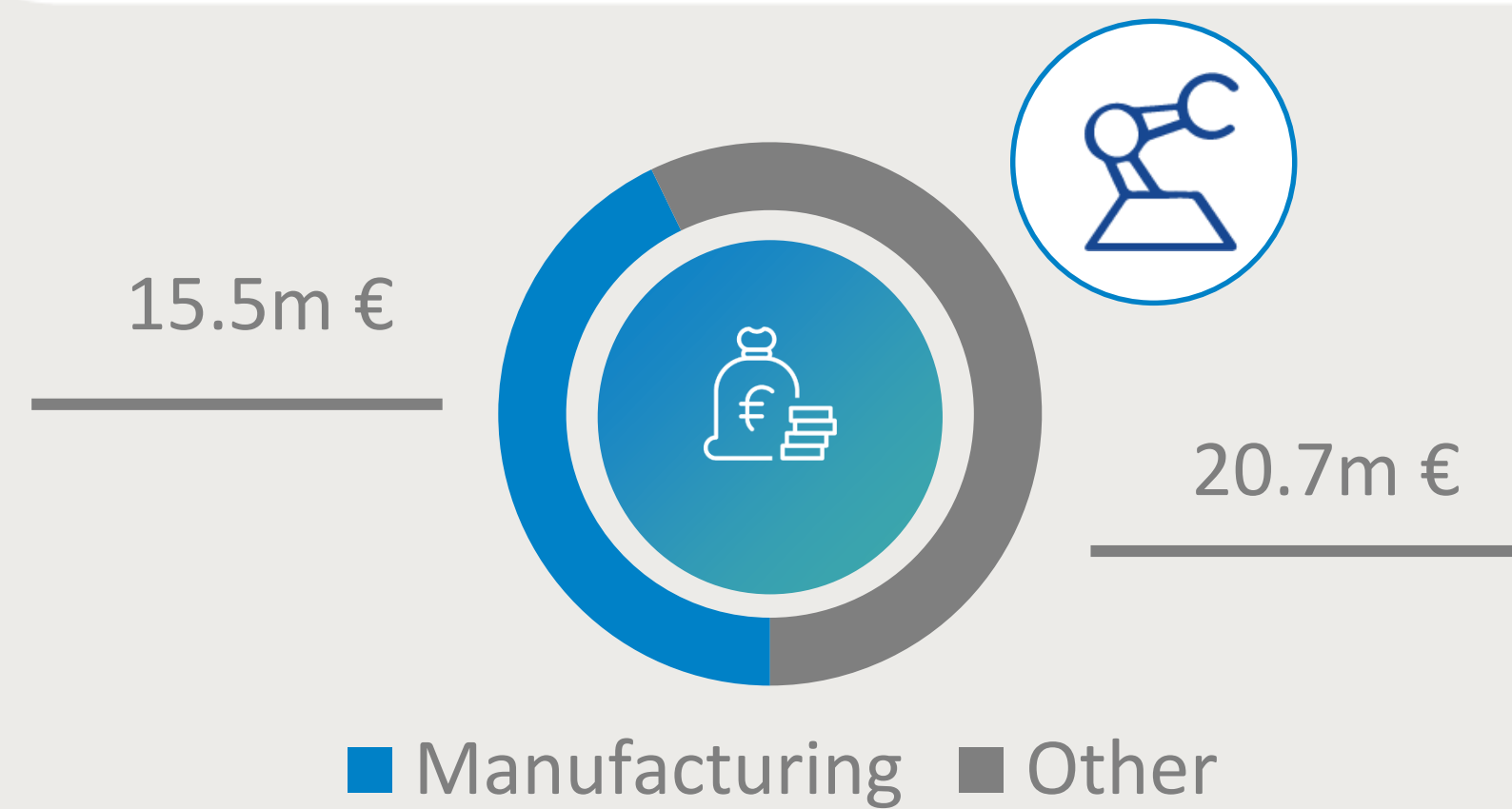


Smart grid



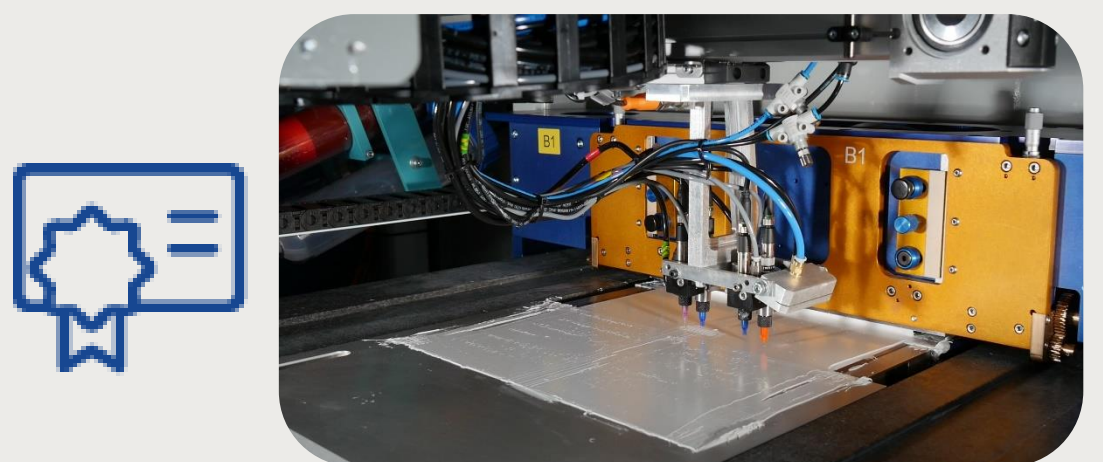
SOFC - Manufacturing taking a central role

Consolidated research results for first generation products utilised for scaling up production volumes



- Critical material reduction
- Quality Control
- Lean Manufacturing
- Automation
- Coatings
- Sealants
- Stack Conditioning

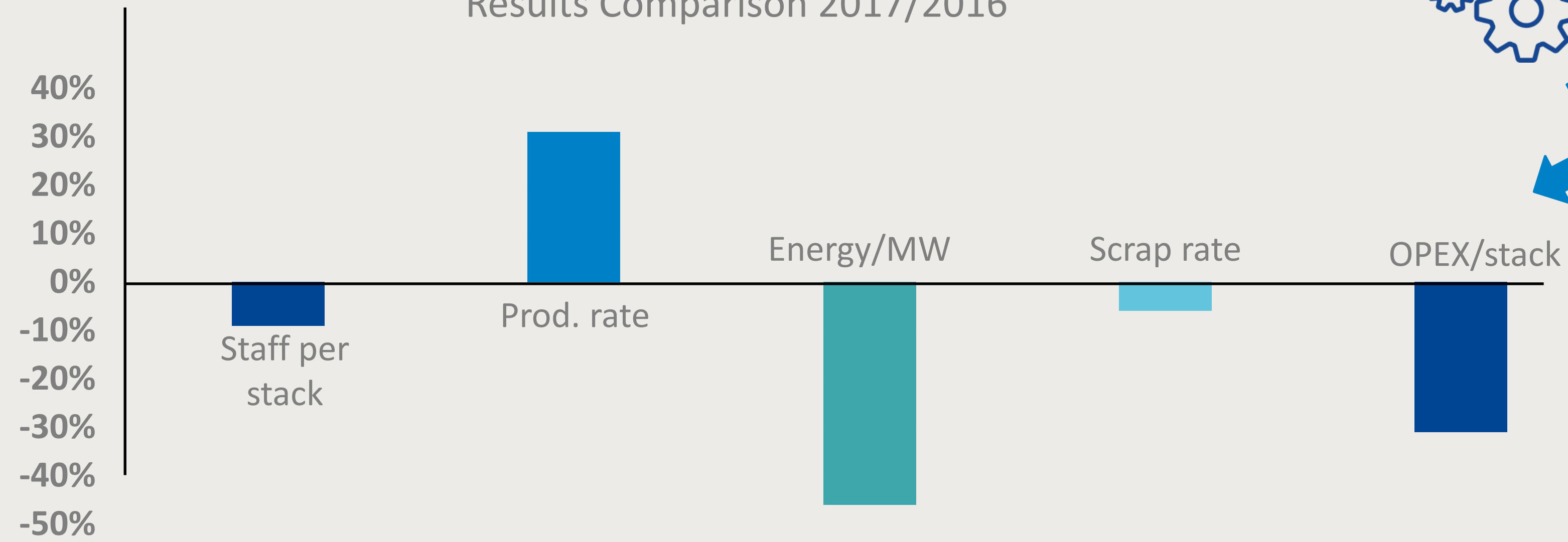
3D printing SOFC stacks
Innovation Award Nominee



Cell3Ditor



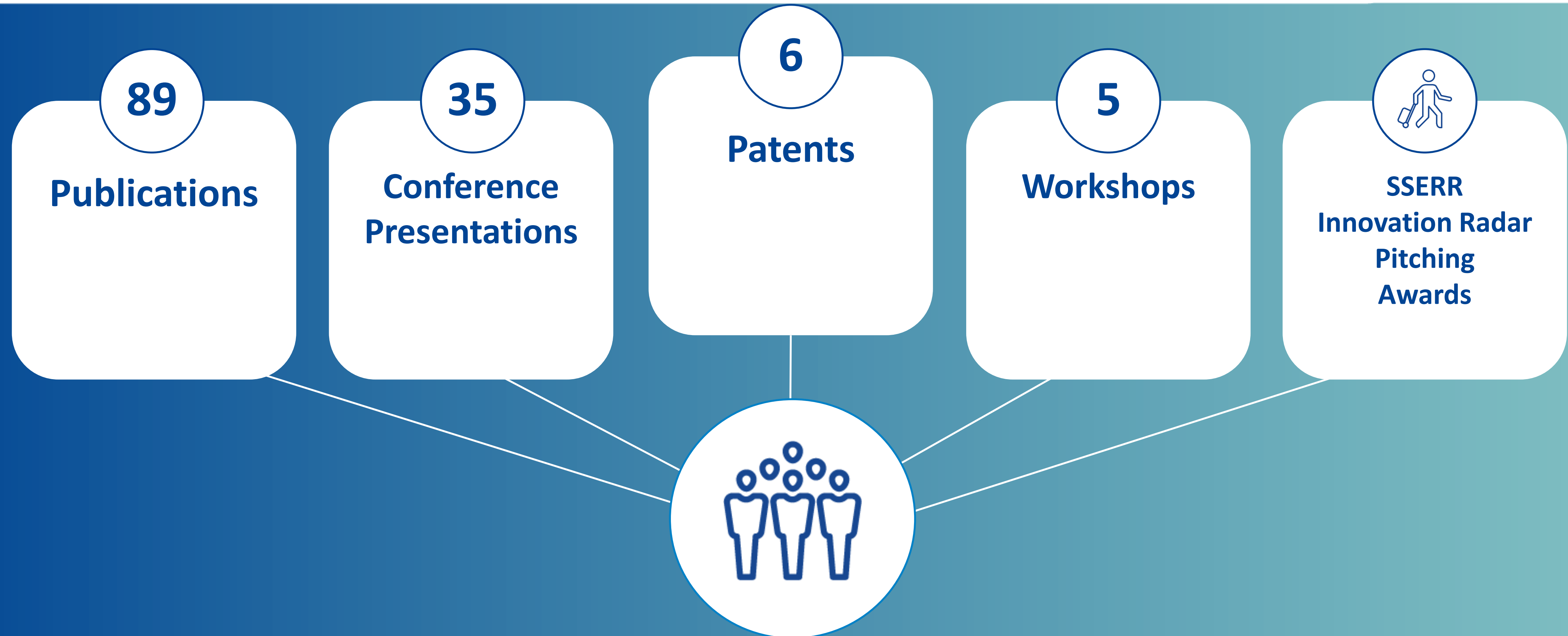
Results Comparison 2017/2016





Dissemination contributing to open science

Widening exploitation channels



Research Portfolio



Research providing the foundations for next generation systems

Repeating the mCHP success story in the commercial size segment



Research projects feeding into the second wave of demonstration projects



Exploitation of breakthrough results in commercial size CHP



Manufacturing research continues to deliver cost reductions





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FCH JU