Johnson Matthey Fuel Cells

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A Fuel Cell Supply Chain in the UK

Fuel Cell Cars – the supplier's dilemma

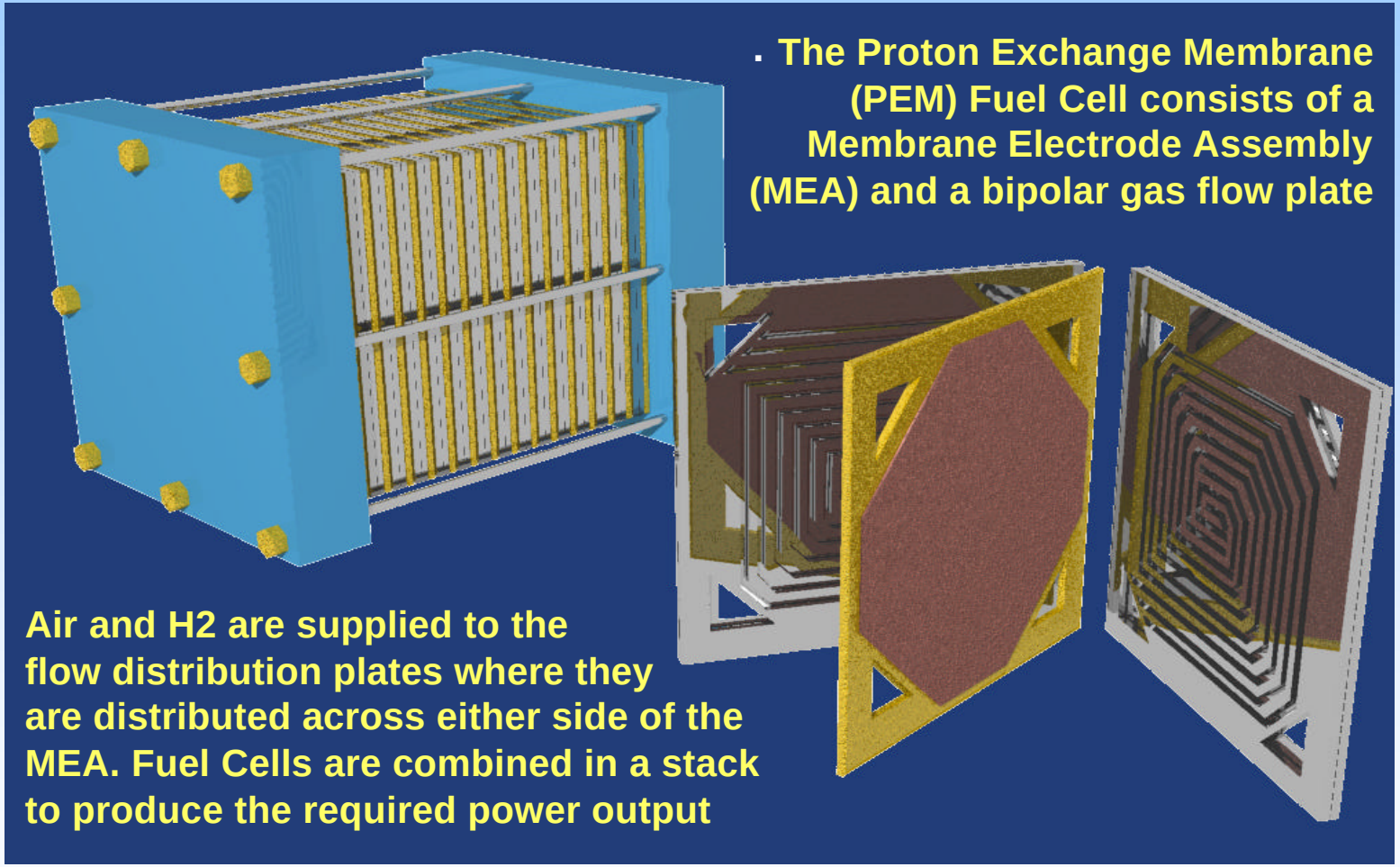
- No fuel cell car market
- Technically demanding
- Substantial product development needed
- New materials and processes
- Steep learning curve

- Potentially large market
- Intermediate revenues from stationary
- High barriers to entry

Fuel Cell Cars – the supplier's dilemma

- No one company has all the skills and resources to bring fuel cells to market.
- Specialist suppliers have skills but ….
  - Smaller companies
  - Limited visibility of FC car market
  - Limited resources for long term development

Fuel cell stack



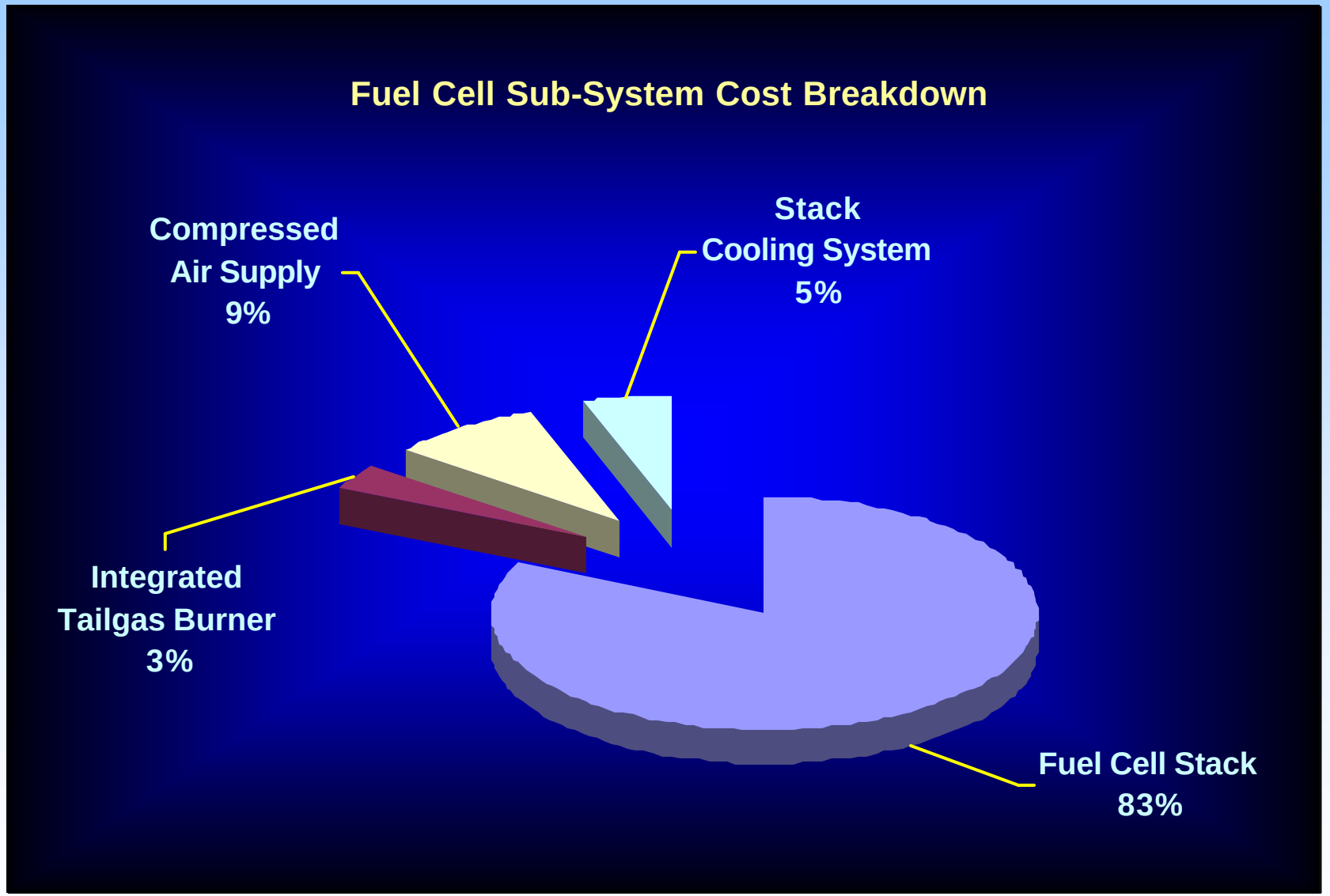
- The Proton Exchange Membrane (PEM) Fuel Cell consists of a Membrane Electrode Assembly (MEA) and a bipolar gas flow plate

Air and H2 are supplied to the flow distribution plates where they are distributed across either side of the MEA. Fuel Cells are combined in a stack to produce the required power output

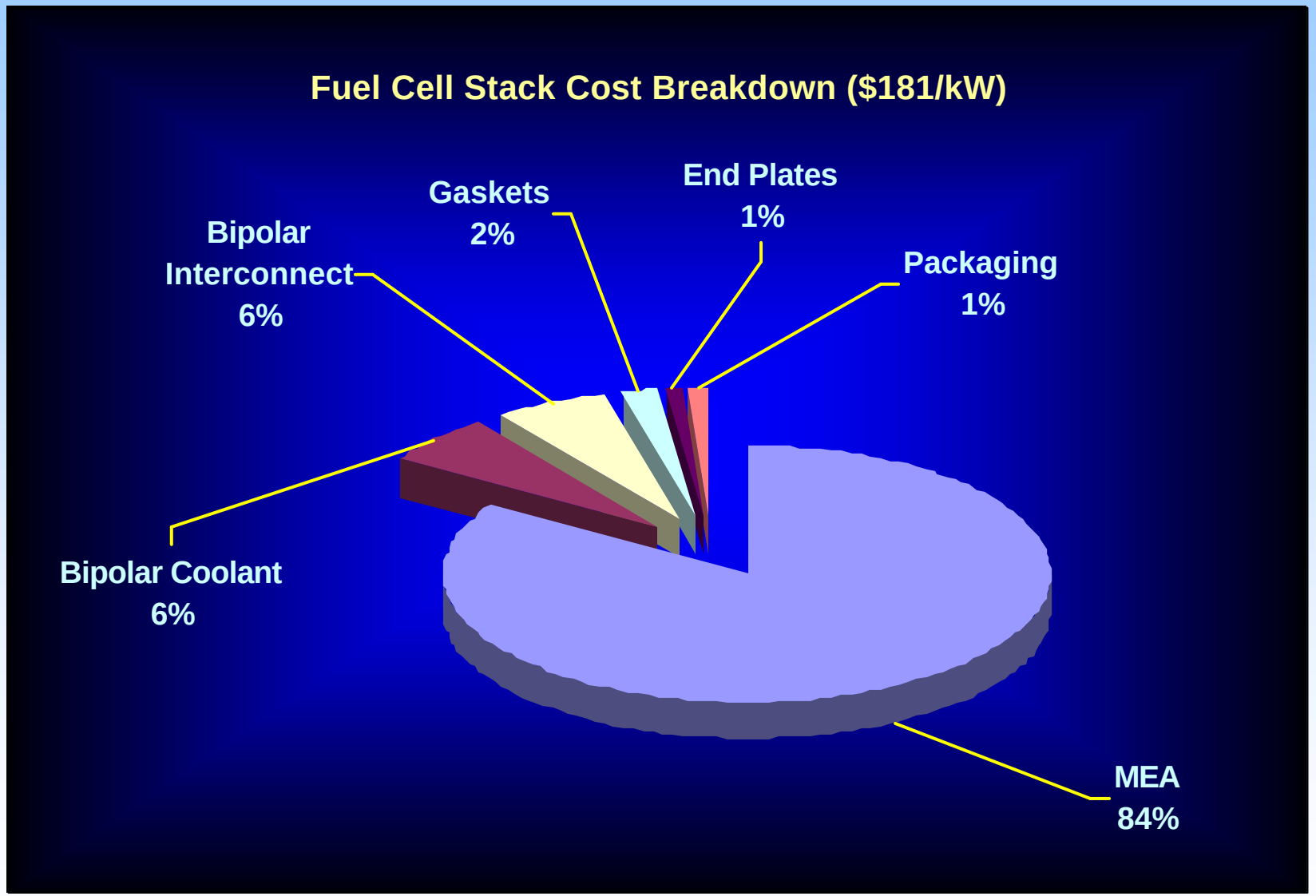
The MEA – a critical component

- JM has selected the MEA as its key product offering to the fuel cell industry
  - Contains expensive materials including Pt catalysts
  - Major determinant of fuel cell system performance
  - Considerable scope for performance improvement and cost reduction

PEM Fuel Cell Costs



PEM Fuel Cell Costs



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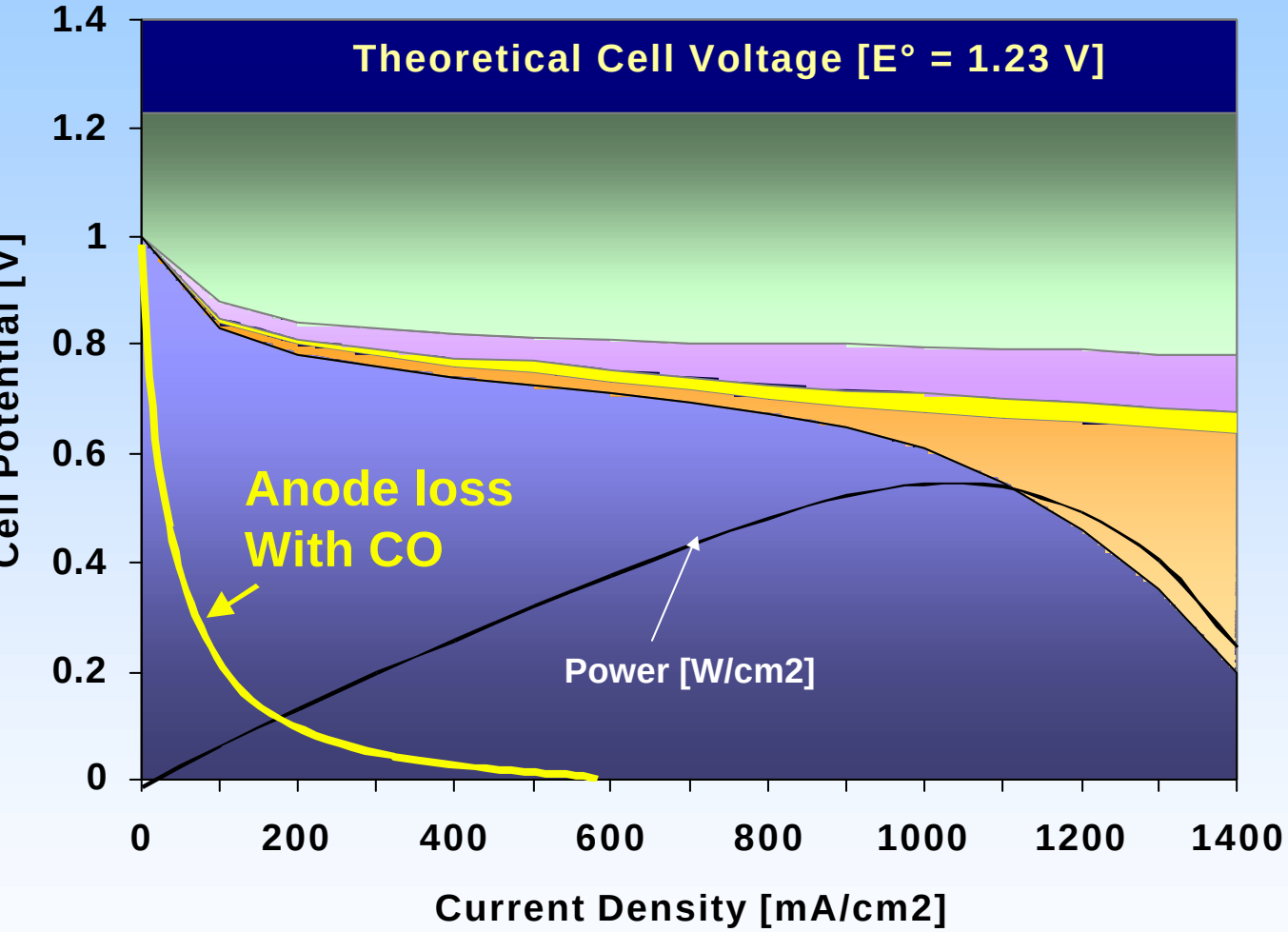
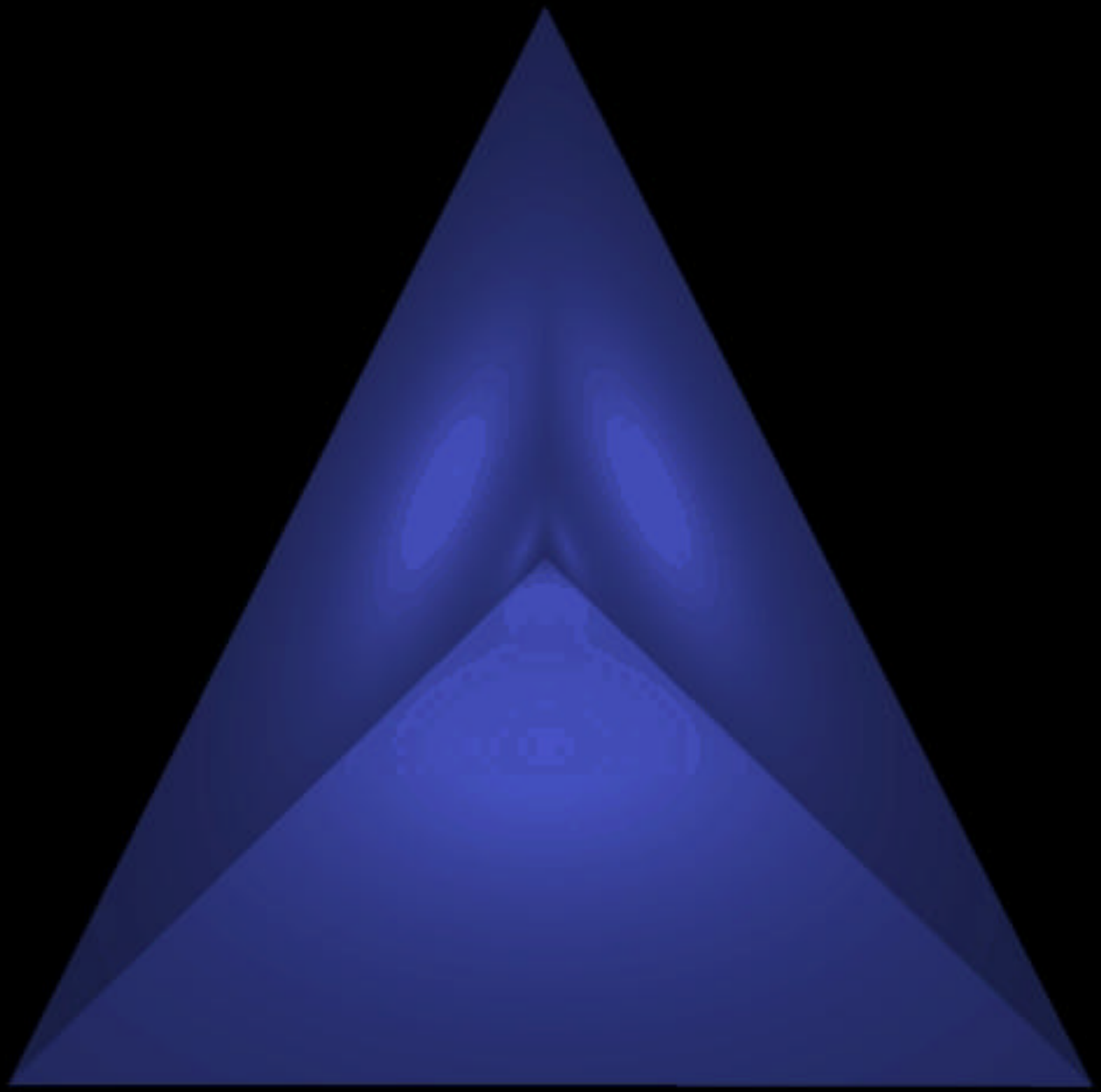
Fuel Cells – the upside





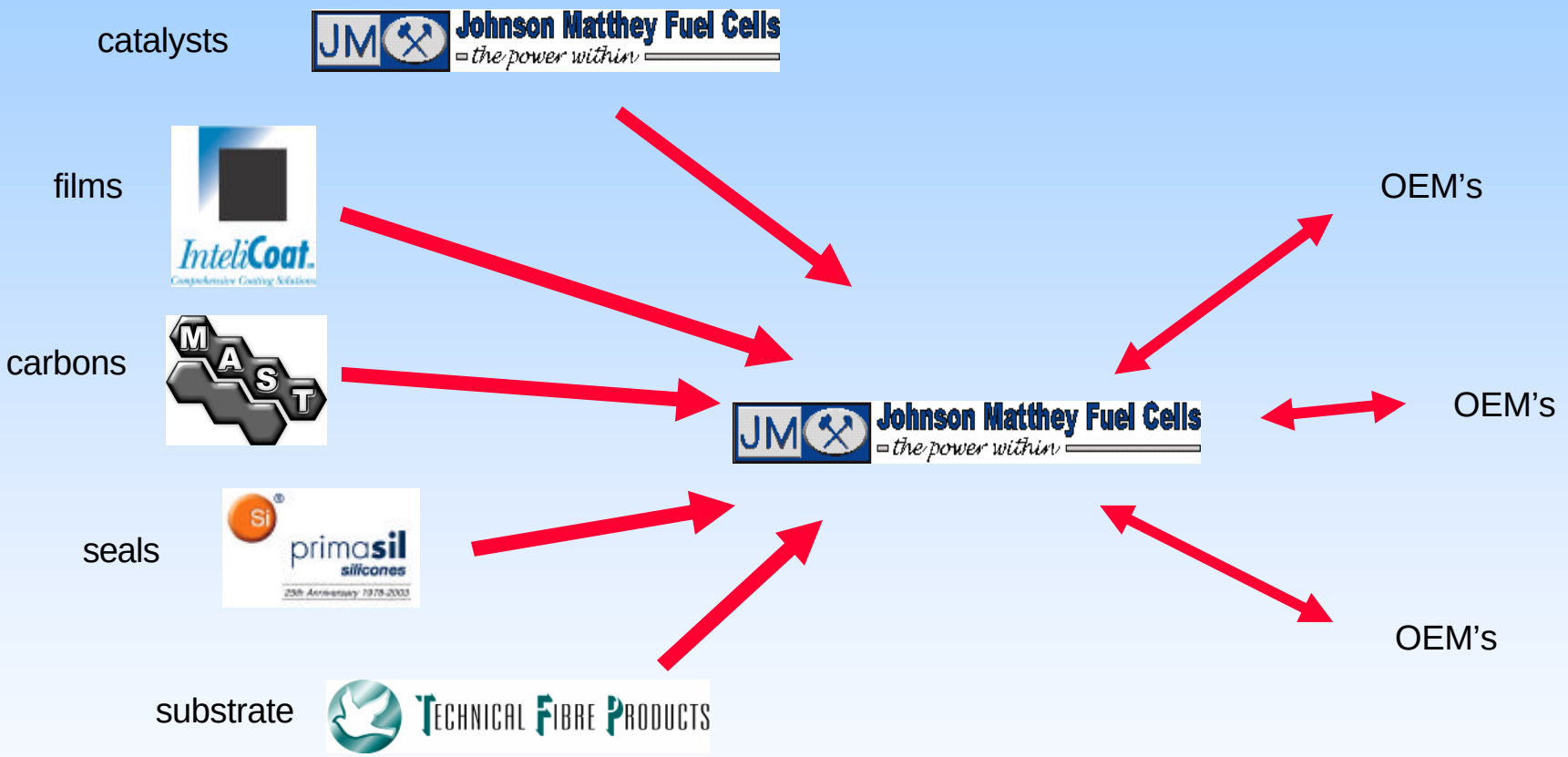
MEA Suppliers must

- Work closely with the development teams in the OEM's
- Be capable of scaling production from 10,000 to over 100 million units over a few years while maintaining quality
- Develop successive generations of products with much lower cost and higher performance
- Access key suppliers of their own

MEA Suppliers

- JM is positioned as an MEA integrator
- Source materials from internal and external sources (often Japan)
- Use expertise to assemble and customise to OEM requirements
- Has formed a group of UK companies with complementary expertise to co-develop and manufacture components of the MEA

Structure of DTI sponsored project team to develop “An Automotive Class MEA”



Potential to link this group with the SuperGen EPSRC fuel cells proposal

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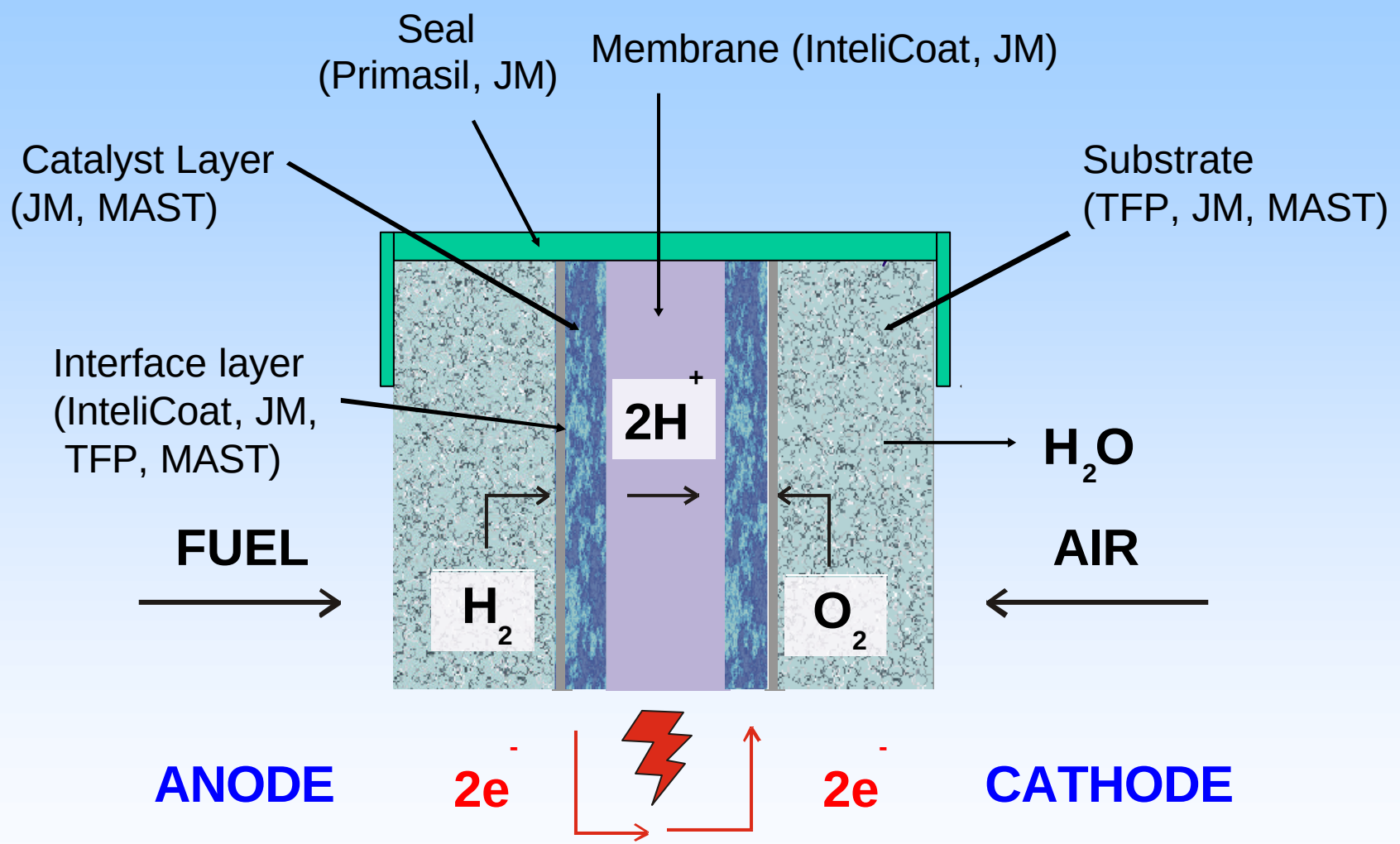
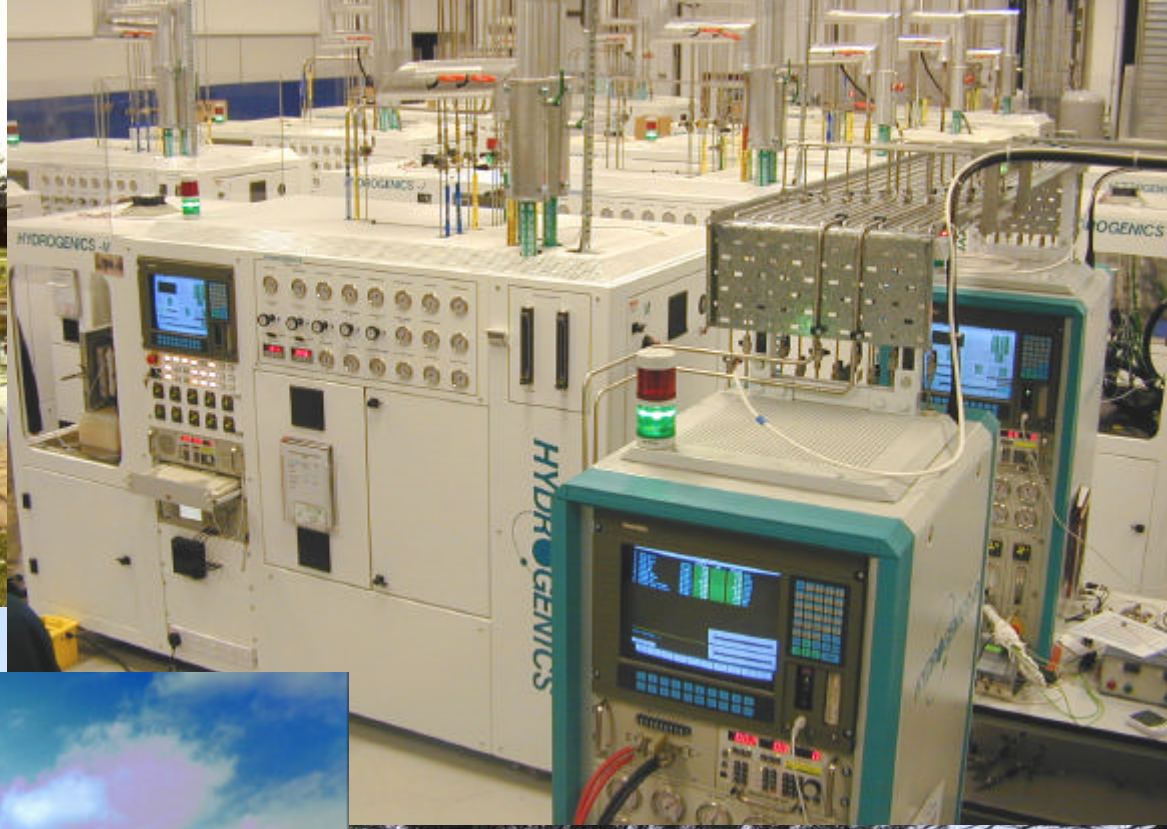
The MEA Components




HYDROGENICS

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Fuel Cell Supply Chains

- Fuel Cell supply chains are critical to the success of fuel cell vehicles
- They face special difficulties
  - Potential suppliers may be in different industries or lack resources
  - Long term nature of development may deter some suppliers
  - Market uncertainty is very high
- The UK MEA supply base is addressing this by:
  - Solid commitment from Johnson Matthey
  - Advanced technology collaborations
  - Co manufacturing and development
  - DTI support for R+D

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