Innovation and Skills Development for the Emerging Technologies Sector

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Outline

- Guiding Policy Frameworks
- Innovation as a means to reverse the resource curse
- Emerging Industry Sectors
- Technology Development
- Opportunities for Local Manufacturing
- Skills Development for Emerging Technologies
- Potential Partnerships
- Concluding Remarks

Guiding Policy Frameworks

- National Development Plan
  - Investments in *energy infrastructure*
  - Affordable *tariffs* for needy households
  - *Diversify* energy resources and supply options
- National Climate Change Response Strategy
  - Long Term Mitigation Scenarios (Peak, Plateau and Decline)
- Industrial Policy Action Plan
  - Re-industrialisation
  - Support for local beneficiation of SA resource base
  - Local manufacturing.
- Energy Act (IEP and IRP)
  - Universal access to *modern forms* of energy services
  - Energy security through guaranteed supply
  - Optimal usage of economically *viable energy resources*
  - Addressing constraints on the development of the renewable industry.

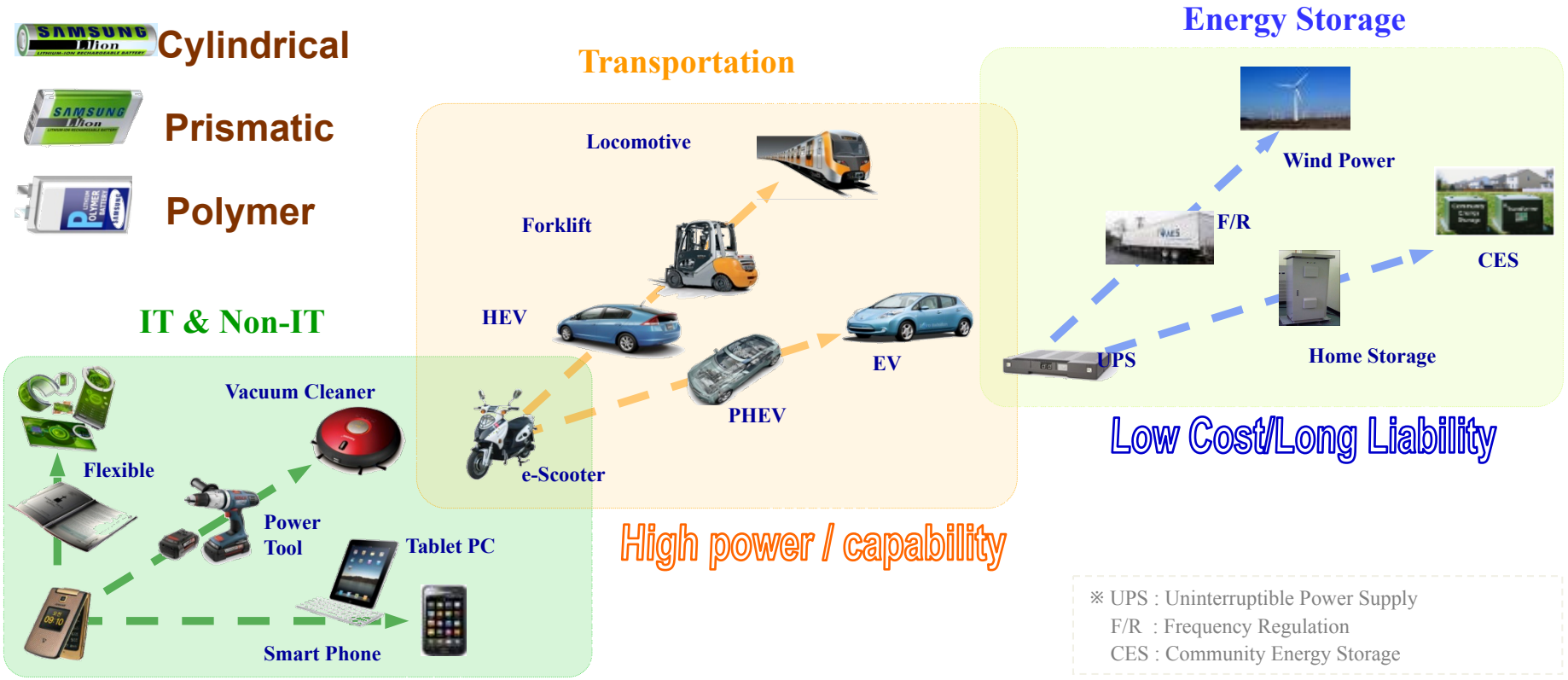
The Need to Reverse the Resource Curse [1,2]

- 69% of people in extreme poverty are in resource-driven countries
- Almost 80% of countries whose economies have historically been driven by resources have per capita income levels below the global average, and more than half of them are not catching up
- Almost 90% of resources investment has historically been in upper-middle-income and high-income countries
- Investment in gas and minerals will need to increase significantly to 2030 to meet strong demand, particularly in emerging markets
- 540 million people in resource-driven countries could be lifted out of poverty by effective development and use of natural resources
- Lack of technical, financial and human resources may stop the creation of new industry clusters
- Education remains critical to develop the necessary skills required to maximize the potential of resource - driven economies
- Academia, government and industry make up the three main helices that contribute to the process of innovation.

1. Extracted from MGI article on Reverse the Resource Curse: Maximizing the potential of resource-driven economies, December 2013
2. MISTRA Study: South Africa and the Global Hydrogen Economy

Emerging Industries that require Skills

- New application for transportation & energy storage
- Need for high capacity and low cost



※ UPS : Uninterruptible Power Supply
F/R : Frequency Regulation
CES : Community Energy Storage

Small-Size (Wh) **Mid-Size (kWh)** **Large-Size (MWh)**

The Interest in HFCT

- Hydrogen and fuel cell technologies (HFCT) have evolved greatly in recent years and offer efficient and low emission power generation
- The four key international drivers for HFCT include: Energy security, Environment protection, Economic growth and Energy efficiency, also referred to as the '4E' Strategy
- Key markets include stationary power, backup power, auxiliary power units, and transportation (cars, buses, trucks, forklifts, mining)
- Hydrogen fuel cell vehicles (FCVs) and battery electric vehicles (BEVs) offer considerable emission reduction advantages near term, with potential for major reductions in the future
- Consumers seem attracted to FCVs partly due to their green attributes and also because they are seen as better cars
- Distributed energy technologies provide more opportunities for job creation
- Further R&D effort is required to reduce cost and improve material performance in order to realise increased uptake, as a precursor for large scale manufacturing.

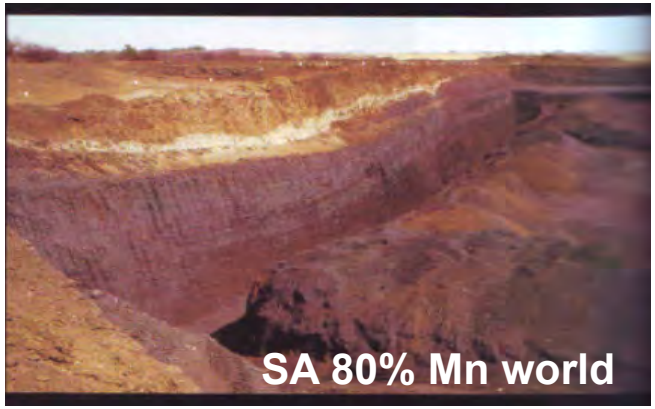
HySA Implementation Phases

- Recruit mission-critical staff
- Identify initial markets
- Develop first-pre commercial technologies

- Establish critical supply chain capability
- Deliver first products to market
- Demonstrate capabilities in pilot markets

- Contribute to international innovation
- Compete successfully on world market
- Capture 25% of global catalysis value chain in hydrogen and fuel cells

Manganese Precursor Programme



Delta EMD

- Global leader in supplying precursor material for primary batteries
- World class IP was a target of international companies in 2015;
- DST acquired the IP and retained technical expertise for the country;
- DST is supporting further development of IP for LIB precursors.

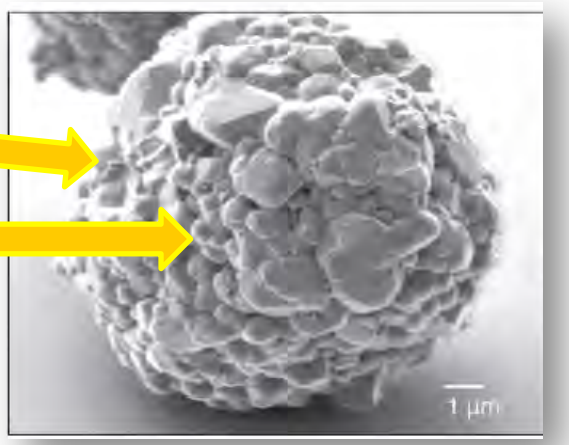
Progress to date

- Completed construction of the pilot facility in Nelspruit;
- Batch process for LMO sample completed;
- Bench scale NMC processing initiated;
- Engaged with potential customers;
- Investigated local material suppliers.

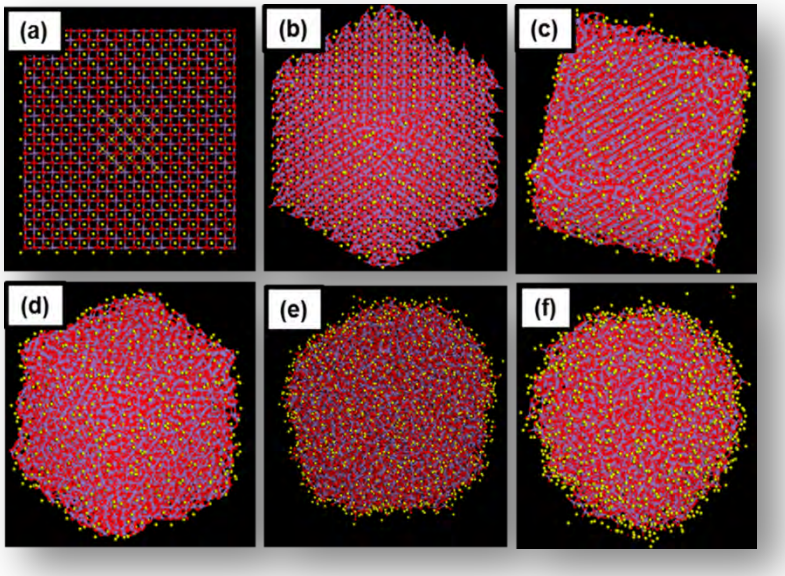

NMC reactor 1

Simulated Synthesis of Real Cathode Precursor Particles for LIBs

Real secondary particle from agglomeration of smaller **primary nanoparticles**



Each nanoparticle has composite a structure



Simulated cathode nanoparticle

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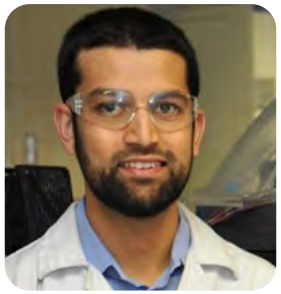
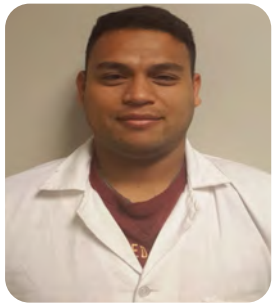
Some Graduates from the HySA Programme



Graduates in Catalysis and related technologies



Graduates in Hydrogen production, storage and compression technology

Graduates in Fuel Cell Systems Integration and Technology Validation


Internships at Spin-off company

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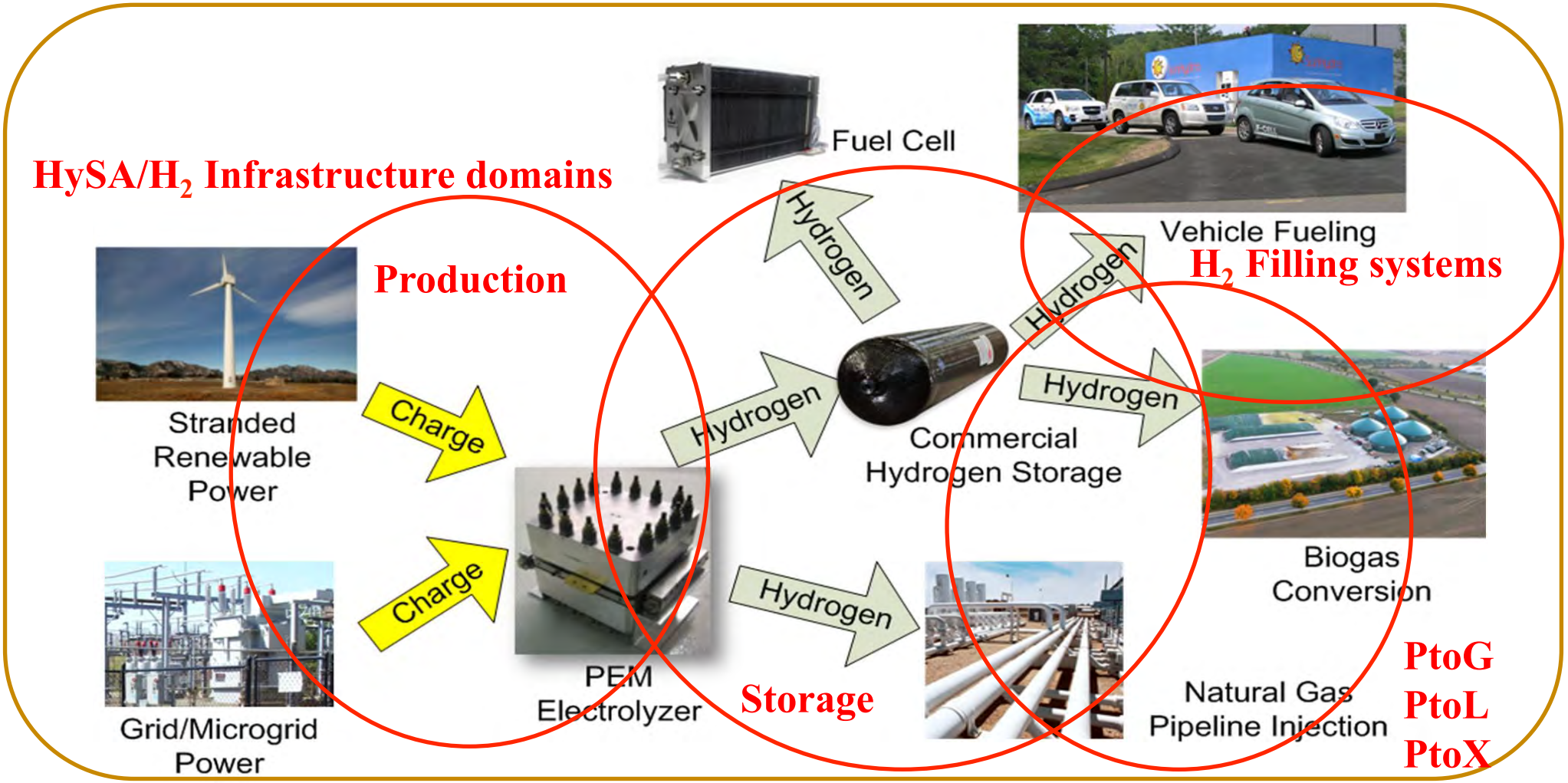
Technology and Skills Development Evolution

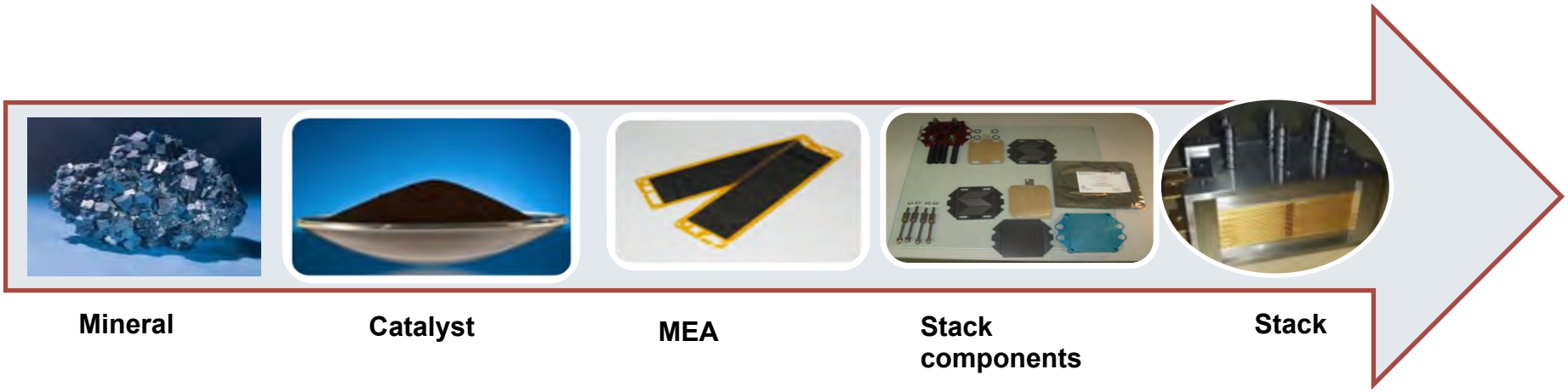
Technology Development	Technology Demonstration	Technology Deployment
Masters and PhDs, Postdocs	Intermediate Stage, Internships	Technicians and service personnel
Material selection	Installation and performance verification/monitoring	Focus on installations, manufacturing
Proof of concept, Energy balance	Durability testing	Technology refinement informed by field testing
Material performance and measurements	Focus on cost reduction	Focus on material performance in real life environment.
Safety considerations	Durability testing	Servicing and maintenance
Prototype development, system integration	Technology maturity, Value chain analysis	Life cycle performance, Supporting infrastructure
Manufacturability	Focus on enabling infrastructure to support increased uptake	Market maturity anchored by local manufacturing

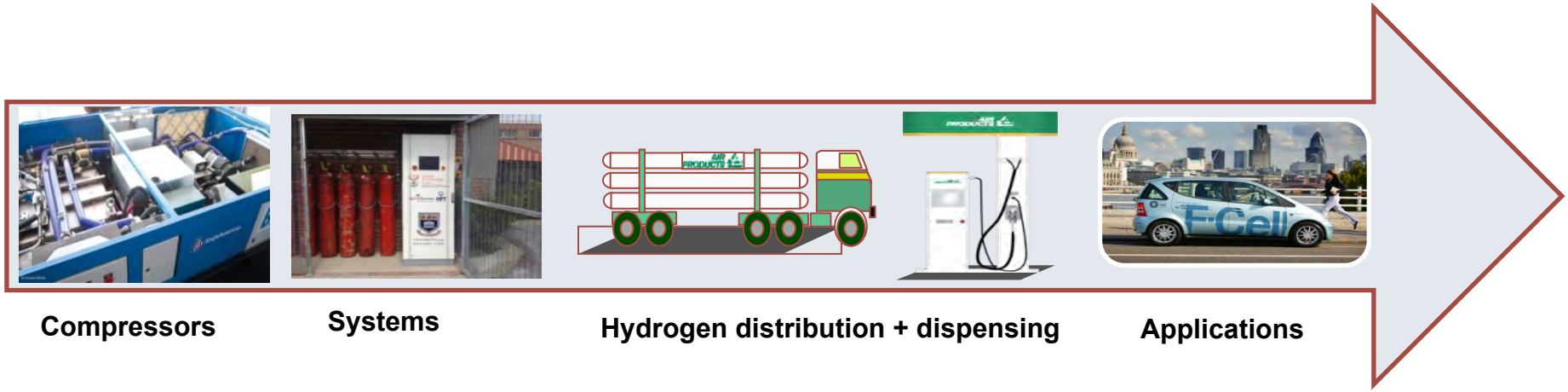
Value Chain Analysis: Hydrogen production, storage and delivery



Source: Proton OnSite

Fuel Cell Technology Development





Emerging Technology Demonstrations in South Africa

Anglo Platinum – May 2012

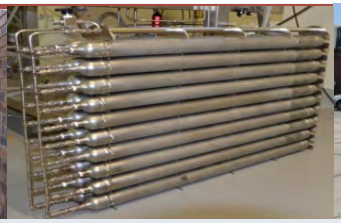
Ahifambeni – October 2012

Naledi Trust Village – August 2014

UWC Nature Reserve – October 2014

Cofimvaba Schools–June 2015

Windsor East Clinic– September 2015



Impala Platinum – MH Compressor and forklift - March 2016

Poelano High School– February 2018

Opportunities for Fuel Cell local Manufacturing

Sustainable local manufacturing will be anchored by local IP

Establishment of special economic zones (SEZs) with incentives to support manufacturing of:

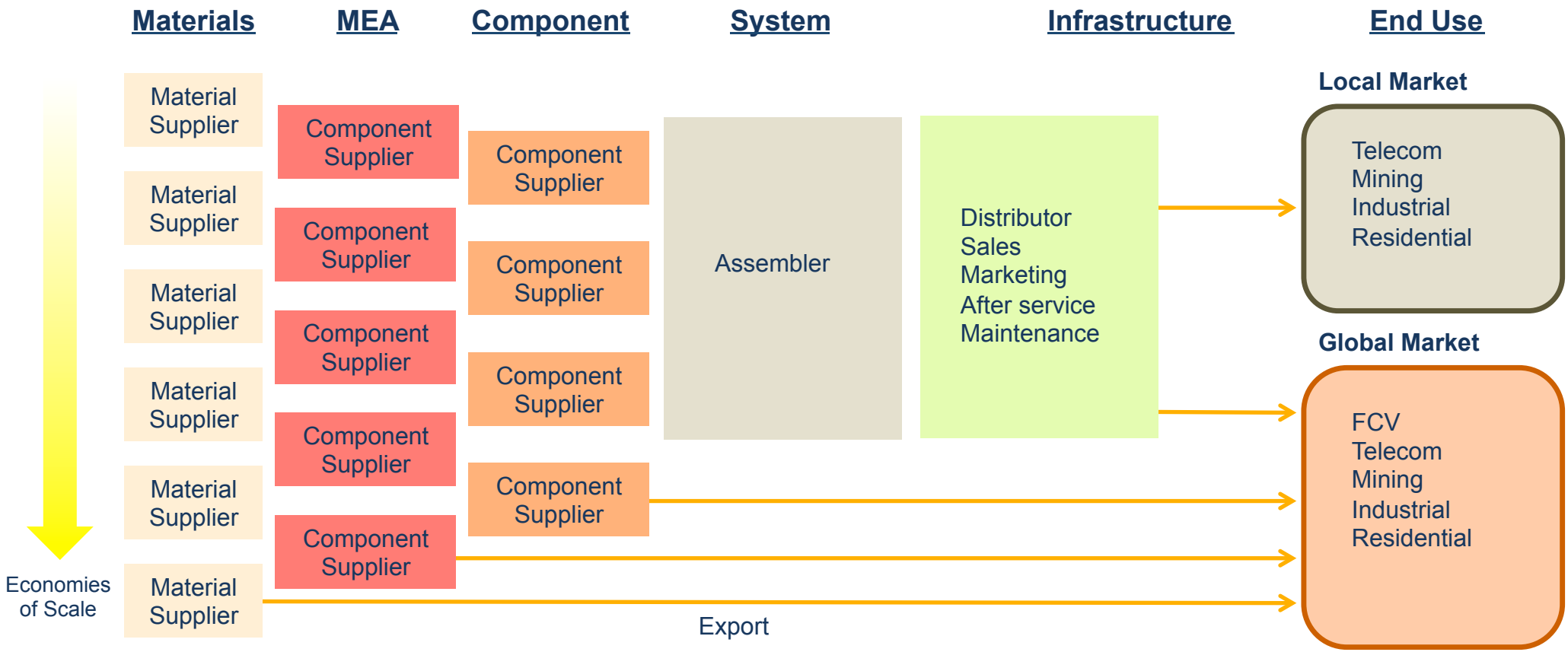
- Platinum based catalysts
- Membrane electrode assemblies (MEAs)
- Stack components
- Balance of plant (pipes, electronics etc.)

Market enablers required to facilitate fuel cell industry growth in SA include

- Creation of local demand through off take agreements
- Gas availability and infrastructure
- Skills development through internships (universities & TVETs)
- DST is seeking partnerships to develop the necessary skills to support manufacturing and deployment across the country and the SADC region
- Skills development is central to a knowledge driven economy as outlined in the NDP.

Potential Value Chains: Fuel Cells

Upstream → **Downstream**



Cluster Development

Multi-stakeholder forums
R&D, Information networking,
Platinum Valley, Standardization, Technical Seminars
Benchmarking, Seeds Mapping, Joint Research, Technical coordinator, Feasibility Study

Commercialization

Venture support, Market Creation,
Subsidiary, Business Match making
Special economic zones

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Potential Partnerships

Potential Partnerships in Skills Development exist or are being explored with:

Department of Higher Education and Training

- Skills focused on technology development and innovation

Energy and Water SETA

- Skills to support the installation and servicing of distributed energy infrastructure

Gauteng Province

- Skills to support local manufacturing of fuel cell components in the Springs Special Economic Zone

Limpopo Province:

- Skills to support local manufacturing of fuel cell components in the Tubatse Special Economic Zone, with a focus on mining related equipment

Automotive Industry Development Centre

- Skills to enhance trade and artisan development initiatives to support emerging technologies in the electric vehicle space (fuel cell and battery powered vehicles)

Concluding Remarks

Fuel cells and associated hydrogen infrastructure represent an exciting new market which could drive growth for platinum demand.

Benefits of developing hydrogen infrastructure and fuel cell market in SA include:

- Platform for mineral beneficiation
- Increase demand for platinum group metals and manganese
- Reduction of the carbon footprint in both the energy and transport sectors
- Means of meeting increasing demand for energy
- Opportunities for exporting high value products
- Job creation through local manufacturing as well as service and maintenance (involvement of SMMEs).

Thank you

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