Innovation Expectations – a common language

Design of TRL and MRL and implementation in UK

Andy Eastlake

Low Carbon Vehicle Partnership – UK

April 2014

LowCVP Low Carbon Vehicle Partnership

Connect
Collaborate
Influence

LowCVP – Vision, Mission and Aims

Our aspiration is for ‘Sustainable and efficient global mobility with zero life cycle impact.

We will work towards this through our mission of “Accelerating a sustainable shift to low carbon vehicles and fuels and stimulating opportunities for UK businesses”

Through:

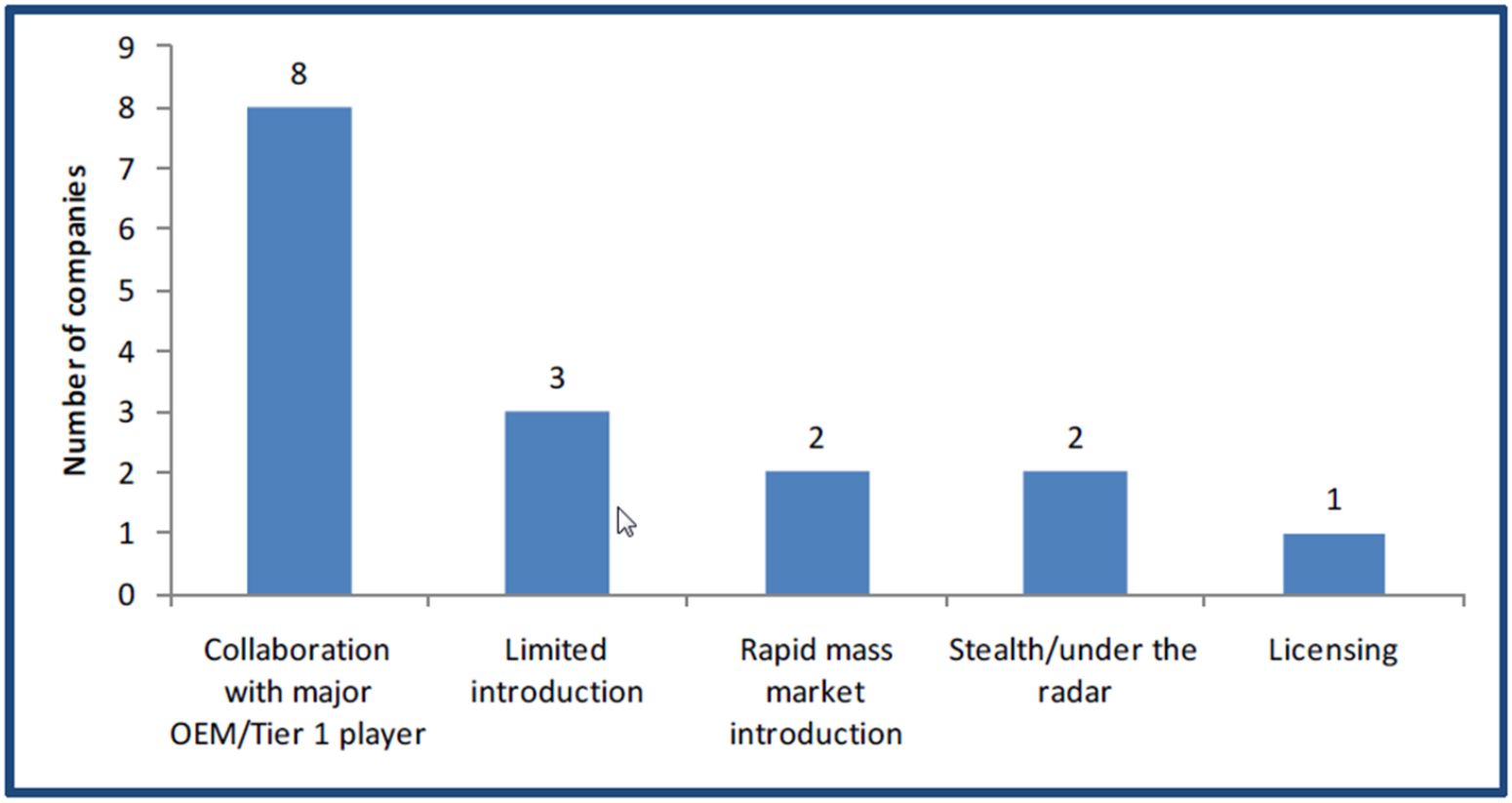
- Connecting stakeholders to build understanding and consensus regarding the optimal pathways to low carbon road transport.
- Collaborating on initiatives that develop the market for low carbon vehicles and fuels.
- Influencing Government and other decision makers on future policy directions and optimal policy mechanisms.

History – LowCVP collaboration across all stakeholders

LowCVP – Innovation working group, SMEs and technology companies working to create opportunities for UK companies a key focus was to understand barriers for entry to the automotive market.

Financing - Support – Credibility

Most saw OEM/Tier 1 as primary route to market



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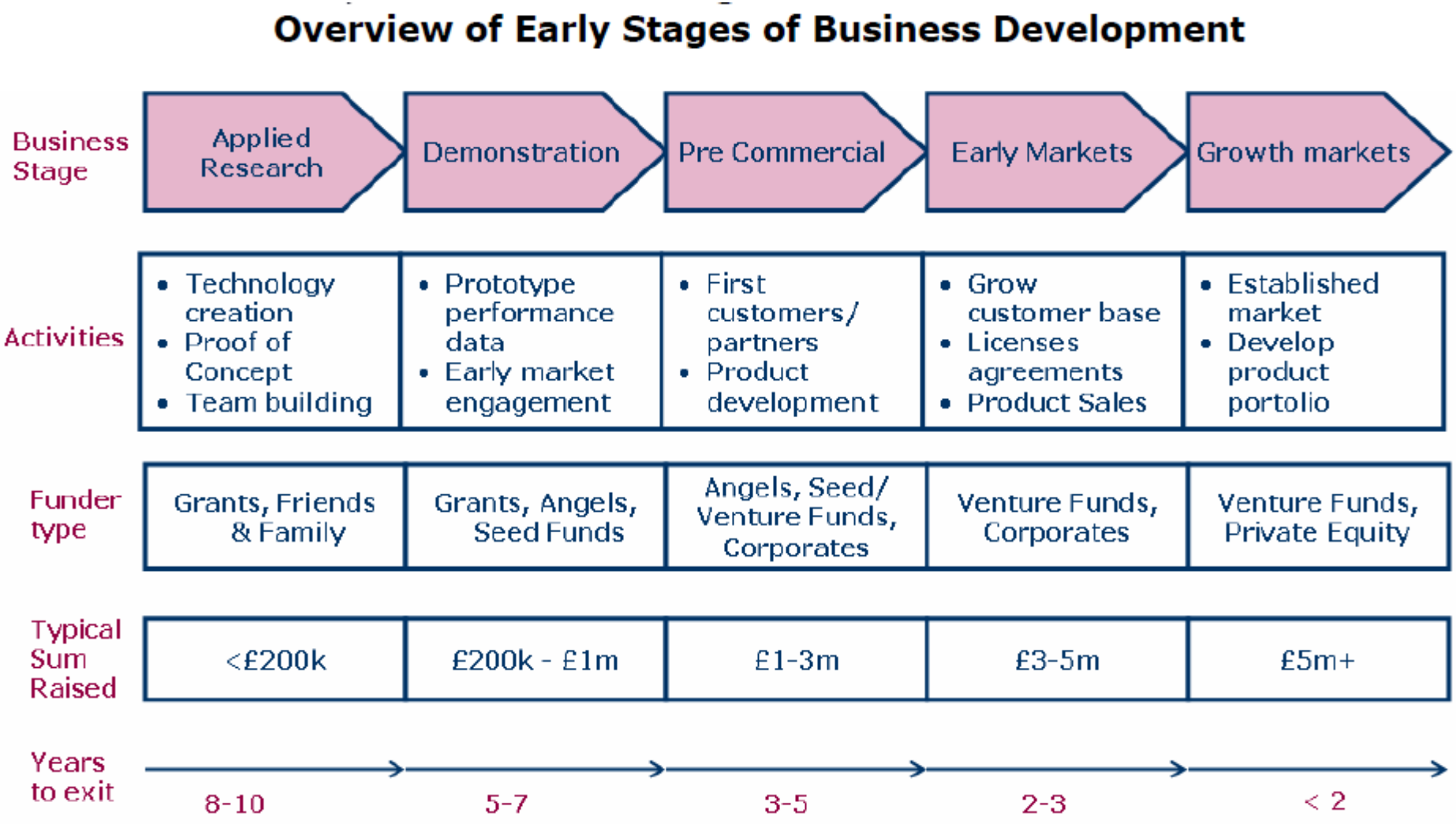
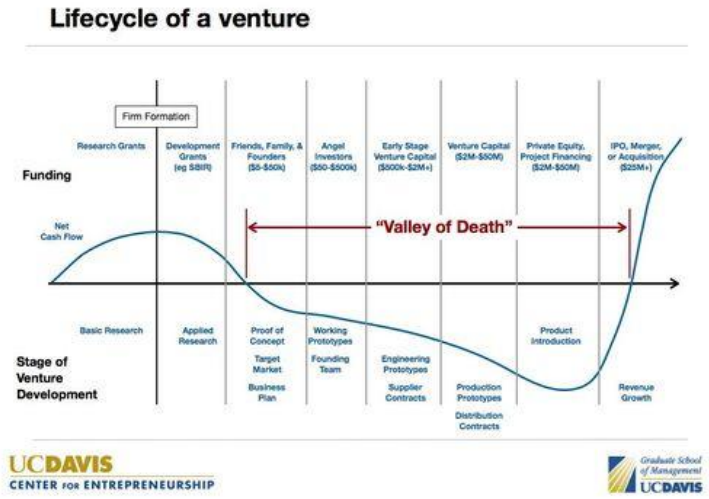
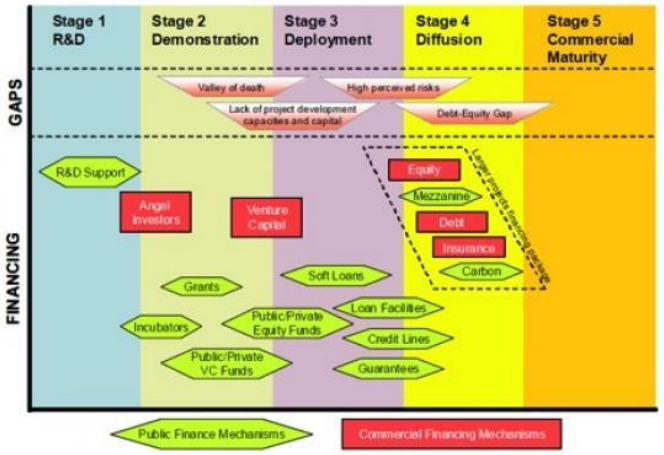
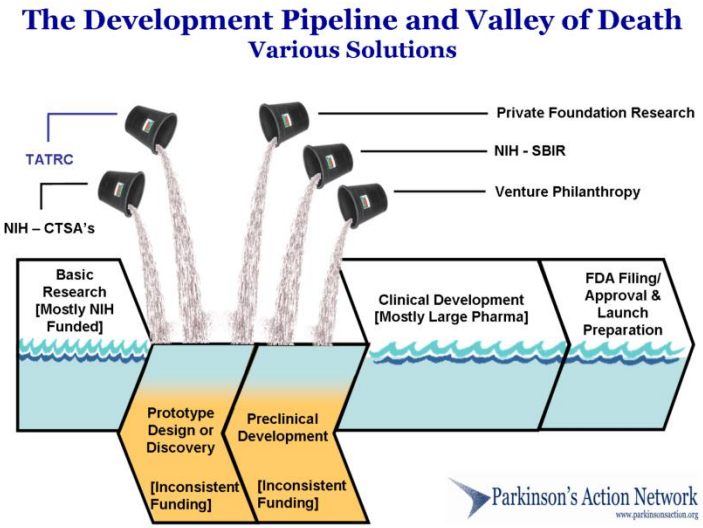
Engaging with Investors – LowCVP study 2008

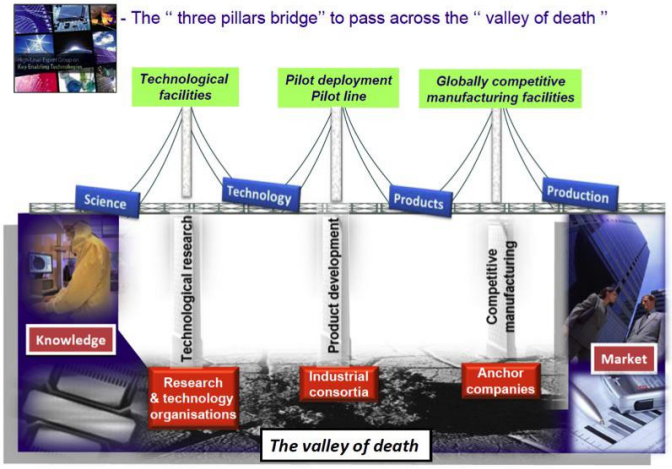


The ‘Valley of Death’ – established in many areas









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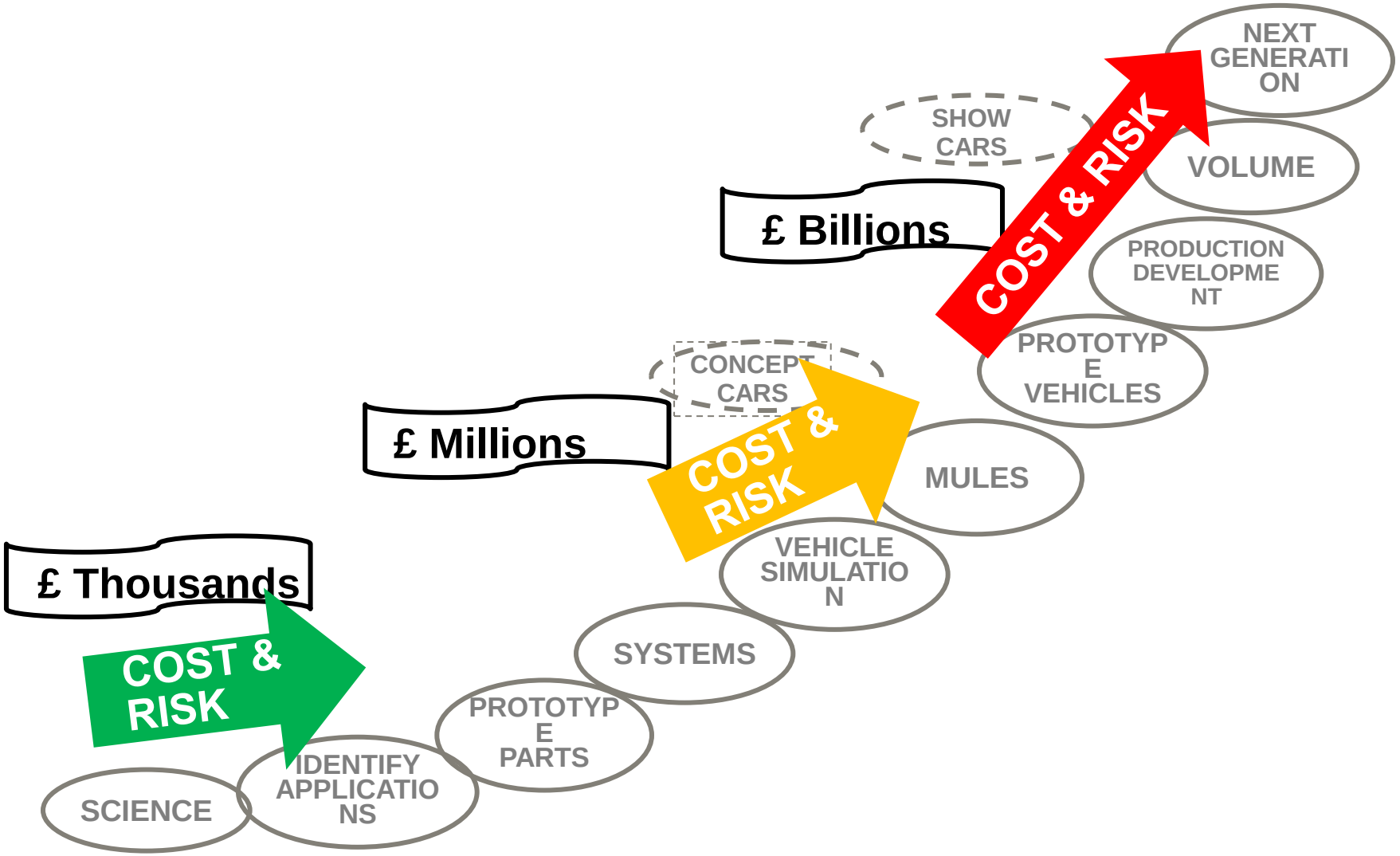
The Industry Challenge:

Cost and risk increases dramatically as programmes develop



Need to establish a ‘Common Language’ for Automotive

Technology Readiness Levels

Technology Readiness Levels (TRLs) convey the development status of a technology to deliver its function. These range from desk based research to demonstration and validation to a product proven for mass market adoption.

Automotive Technology and Manufacturing Readiness Levels

A guide to recognised stages of development within the Automotive Industry

Manufacturing Readiness Levels

Manufacturing Readiness Levels (MRLs) communicate the maturity of a product to be produced. These range from proof of concept through prototyping to volume production, deployable globally and to appropriate quality levels.

automotive council UK · BIS · LowCVP · SMMT Driving the Motor Industry · Technology Strategy Board

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Survey the SMEs on expectations/needs

Technology Readiness Levels		
Research	TRL 1	Paper studies and scientific experiments have taken place; Performance has been predicted;
	TRL 2	Application specific simulations or experiments have been undertaken; Performance predictions have been refined;
	TRL 3	Performance investigation using analytical experimentation and/or simulations is underway;
Demonstration	TRL 4	The technology component and/or basic subsystem have been validated in a laboratory or test house environment;
	TRL 5	The component and/or basic subsystem have been validated in a relevant environment, e.g. via a mule or adapted current vehicle;
	TRL 6	A prototype of the system or subsystem has been demonstrated within a test house, test track or similar operational environment;
	TRL 7	Multiple prototypes have been demonstrated in an operational, on-vehicle environment;
Product readiness	TRL 8	The technology has been proven to work in its final form and under expected conditions;
	TRL 9	The technology has been successfully applied in its final form and under real-world conditions;
	TRL 10	The technology is successfully in service in multiple application forms, vehicle platforms and regions;

Manufacturing Readiness Levels		
Proof of concept	MRL 1	Basic manufacturing implications have been identified;
	MRL 2	Manufacturing concepts and feasibility have been determined and processes have been identified;
	MRL 3	Experimental hardware has been created, but is not yet integrated or representative; Supply chain requirements determined;
Prototypes	MRL 4	Capability exists to produce the technology in a laboratory or prototype environment; Design optimised for production;
	MRL 5	Capability to produce prototype components in a production relevant environment;
	MRL 6	Capability to produce integrated system or subsystem in a production relevant environment;
	MRL 7	Capability to produce systems, subsystems or components in a production representative environment; Procurement plans made;
Low & high volume production	MRL 8	Initial production is underway; An early supply chain is established and stable; Manufacturing processes have been validated;
	MRL 9	Full/volume rate production capability has been demonstrated; Major system design features are stable and proven;
	MRL 10	Full Rate Production is demonstrated; Lean production practices are in place and continuous process improvements are on-going; The manufacturing capability is globally deployable;

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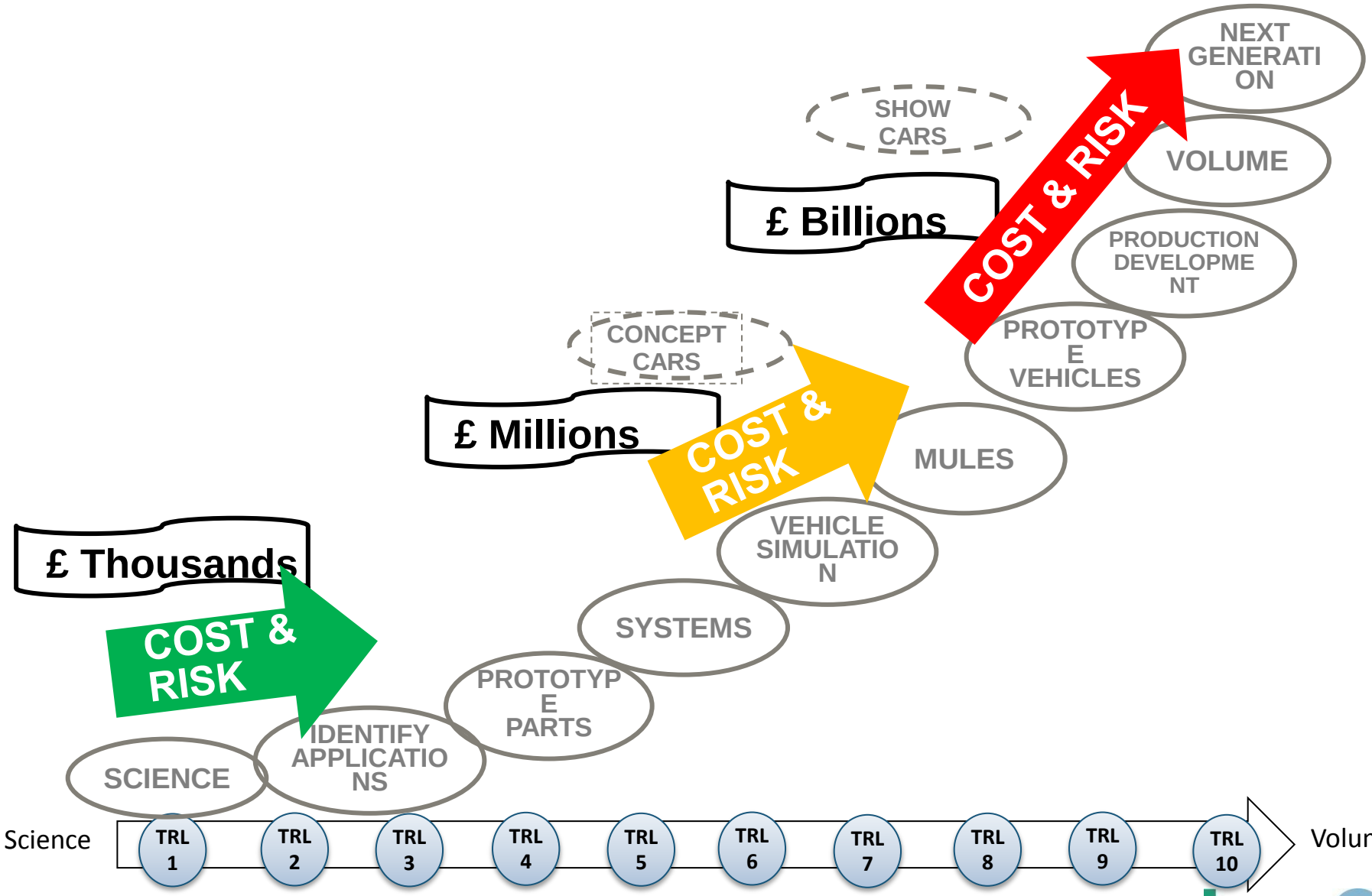
Applying the language



Building Bridges

How can OEMs & Tier 1s help with TRLs?	
Research (TRL 1 - 3)	Ideal spec development; market guidance; test data verification; access to facilities & engineering expertise
Demonstration (TRL 4 – 7)	TSB projects; cost, weight, size and durability targets; IP protection; closer engagement with engineering expertise and test facilities; mule vehicles; support finance and financial commitment; component manufacture; prototype testing; access to trial customers
Product readiness (TRL 8 – 10)	Fleet trials and in-use validation; demo vehicles; vehicle programme selection; support finance; volume manufacturing capability; partnership agreement; commitment to realistic volumes and ramp-up; professional services; quality control
How can OEMs & Tier 1s help with MRLs?	
Proof of concept (MRL 1 – 3)	Expertise on related components; future production volume info; quality & cost targets; detailed launch plan (timing/volume); finance; production sample development
Prototypes (MRL 4 – 7)	Design for manufacture help; tooling commitments & demand for prototypes; pre-production requirements; process development; technology road map; validation data; licence technology; cost analysis; commercial agreement and commitment; realistic pricing of prototypes (i.e. more than mass production prices); access to quality systems
Volume production (MRL 8 – 10)	QMS, lean manufacture & 6-sigma expertise & validation; partnership agreement; investment support; agreement on run/rate capabilities; early visibility of appropriate schedule; production process sign-off; finance; orders!

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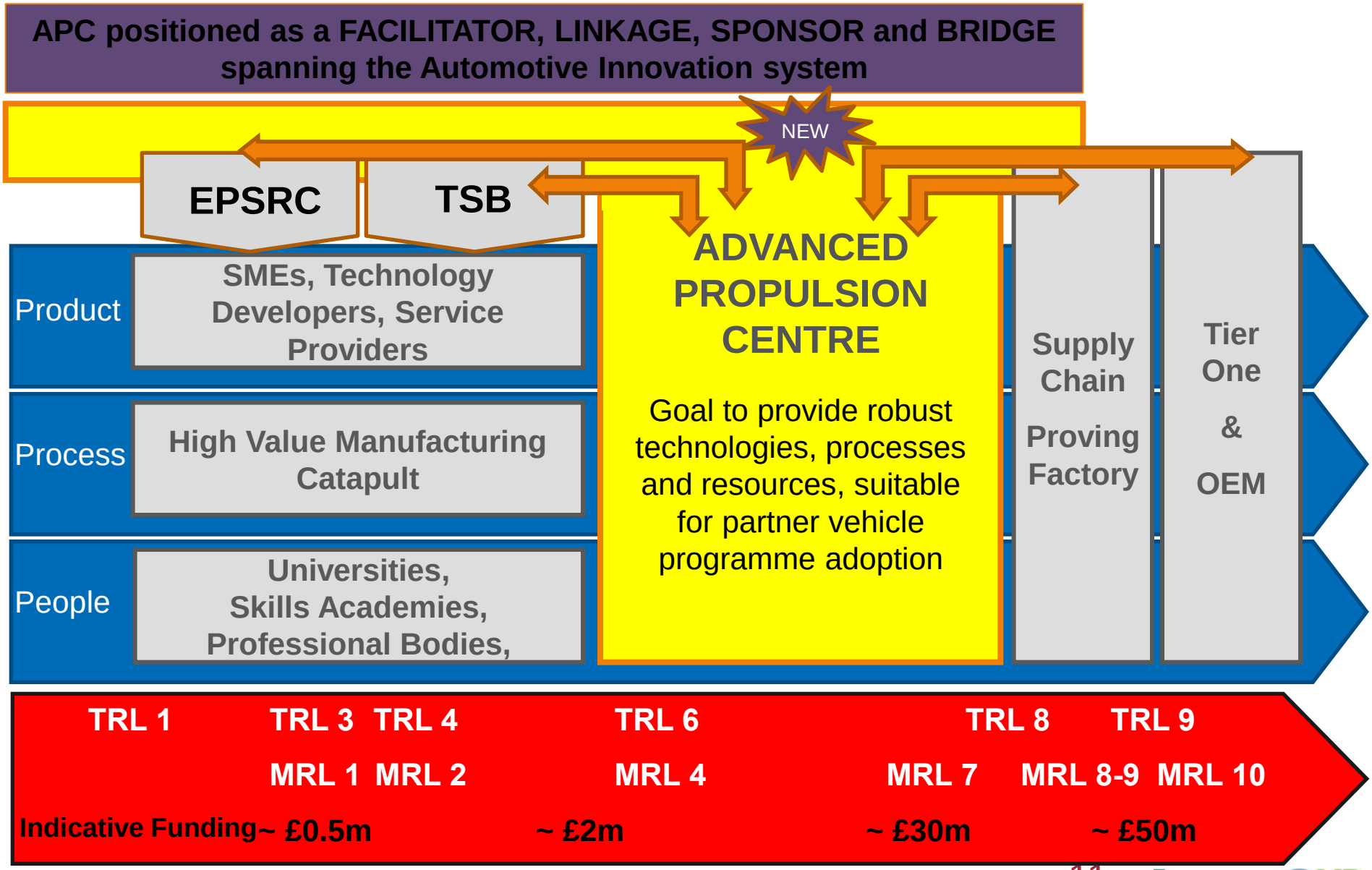
UK Initiatives – The Advanced Propulsion Centre



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Embedding the language

APC – Summary of key points

- Entry requirements
  - achieved at least TRL 5 and the majority of MRL 4

- Exit requirements
  - Achievement of TRL 8 and MRL 6 were it does not breach state aid
  - a commercially viable roadmap towards production and volume manufacture
  - a defined exit strategy allowing for commercialisation and market entry at a globally competitive price level

Technology Strategy Board
Driving Innovation

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Universal Adoption

Technology Strategy Board
Driving Innovation

Department for Business Innovation & Skills

Advanced Propulsion Centre: Building UK manufacturing strength in low carbon vehicles

COMPETITION FOR COLLABORATIVE R&D FUNDING

DECEMBER 2013

automotive council UK

Each project needs to consider how it will develop and accelerate the technology readiness levels (TRL) and, importantly, the manufacturing readiness levels (MRL). To be considered in scope for this competition, the consortia need to demonstrate that they have already achieved at least TRL 5 and the majority of MRL 4 within the proposal. For further information, see the report on automotive technology and manufacturer readiness levels created by the Low Carbon Vehicle Partnership in association with the Automotive Council (**www.automotivecouncil.co.uk/technology-group/reports/**)

As part of the assessment process and throughout the project life, applicants will need to demonstrate:

- how the project will develop capability to bring products to market more quickly
- an ability to build and grow significant supply chain capability within the UK
- achievement of at least MRL 6 and TRL 8 along with a commercially viable roadmap towards production and volume manufacture

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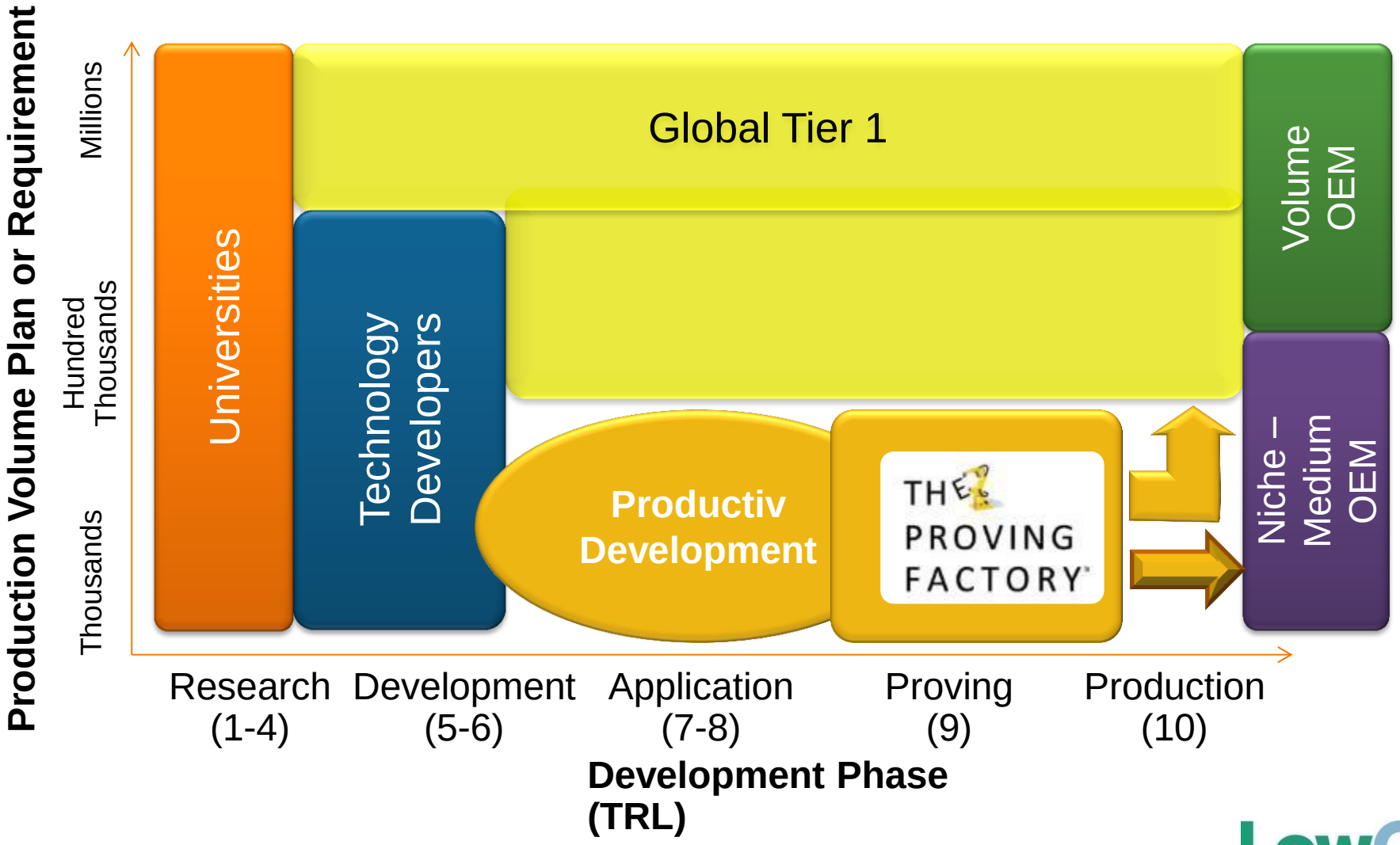
UK Initiatives – The Proving Factory
Tier 1 suppliers don't invest in low volume technology



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Taking technologies into production

The Proving Factory

is a unique manufacturing, assembly and validation organisation of the UK automotive industry

BRIDGING THE GAP BETWEEN TECHNOLOGY DEVELOPER & OEM

WHO'S INVOLVED	Consortium of companies with aligned interests led by Productiv and Tata Steel.
WHAT IT DOES	Proving volume production of low carbon technologies.
RESULTS	• 10 investing partners • 2 factories • £21.8m investment • 250 jobs • 6 technologies • 1 vision

PRODUCTIV · TATA STEEL · MIRA · mtc · BLADON JETS · Hybrid · LOTUS






PEOPLE

Recruiting, training and developing outstanding people

PROCESSES

Developing flexible industrialisation, manufacturing and assembly processes

PRODUCTS

Turning low carbon technologies into products and making them

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Embedded into Horizon 2020

Horizon 2020 – Work Programme 2014-2015 Annex

HORIZON 2020 – WORK PROGRAMME 2014-2015

General Annexes

G. Technology readiness levels (TRL)

Where a topic description refers to a TRL, the following definitions apply, unless otherwise specified:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

Key Points

- Common Language
- Developed in collaboration to meet the needs of all
- Simple enough for everyone to understand and embrace
    - Technology experts
    - Financiers
    - Purchasing
    - Government
    - Cross industry collaborators
- Developed jointly with Government, Industry, Research and User communities
- Working together with regular review

The Low Carbon Vehicle Partnership

Connect |Collaborate| Influence

- **Connect**: With privileged access to information, you'll gain insight into low carbon vehicle policy development and be introduced to key stakeholders.
- **Collaborate**: You'll benefit from many opportunities to work – and network - with key UK and EU government, industry, NGO and other stakeholders
- **Influence**: You'll be able to initiate proposals and help to shape future low carbon vehicle policy, programmes and regulations

LowCVP is a partnership organisation with over 170 members with a stake in the low carbon road transport agenda.

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