FUEL CELLS AND HYDROGEN
JOINT TECHNOLOGY INITIATIVE

autostack moves

Autostack

Workshop Intermediate results

February 8, 2011

CEA Grenoble

Technology Roadmap

Per Ekdunge

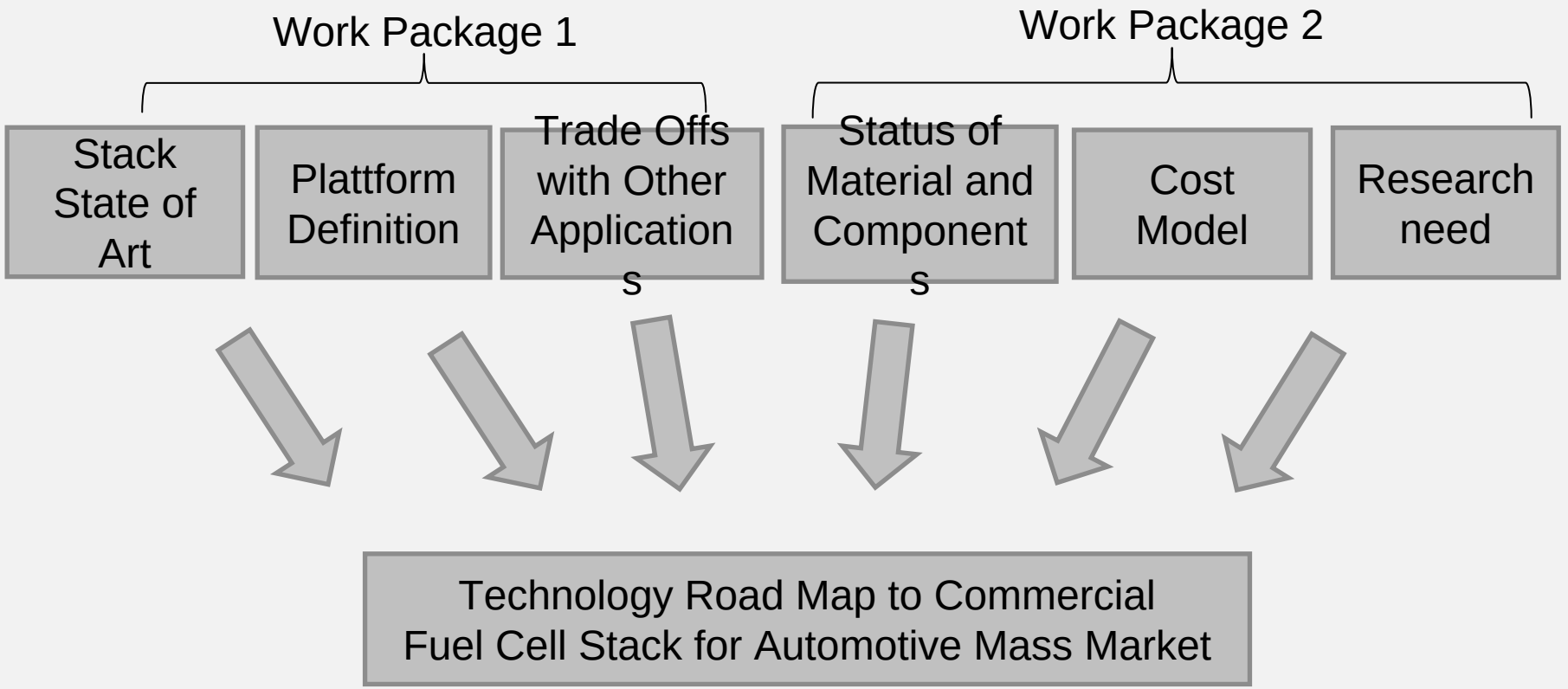
PowerCell Sweden AB

POWERCELL

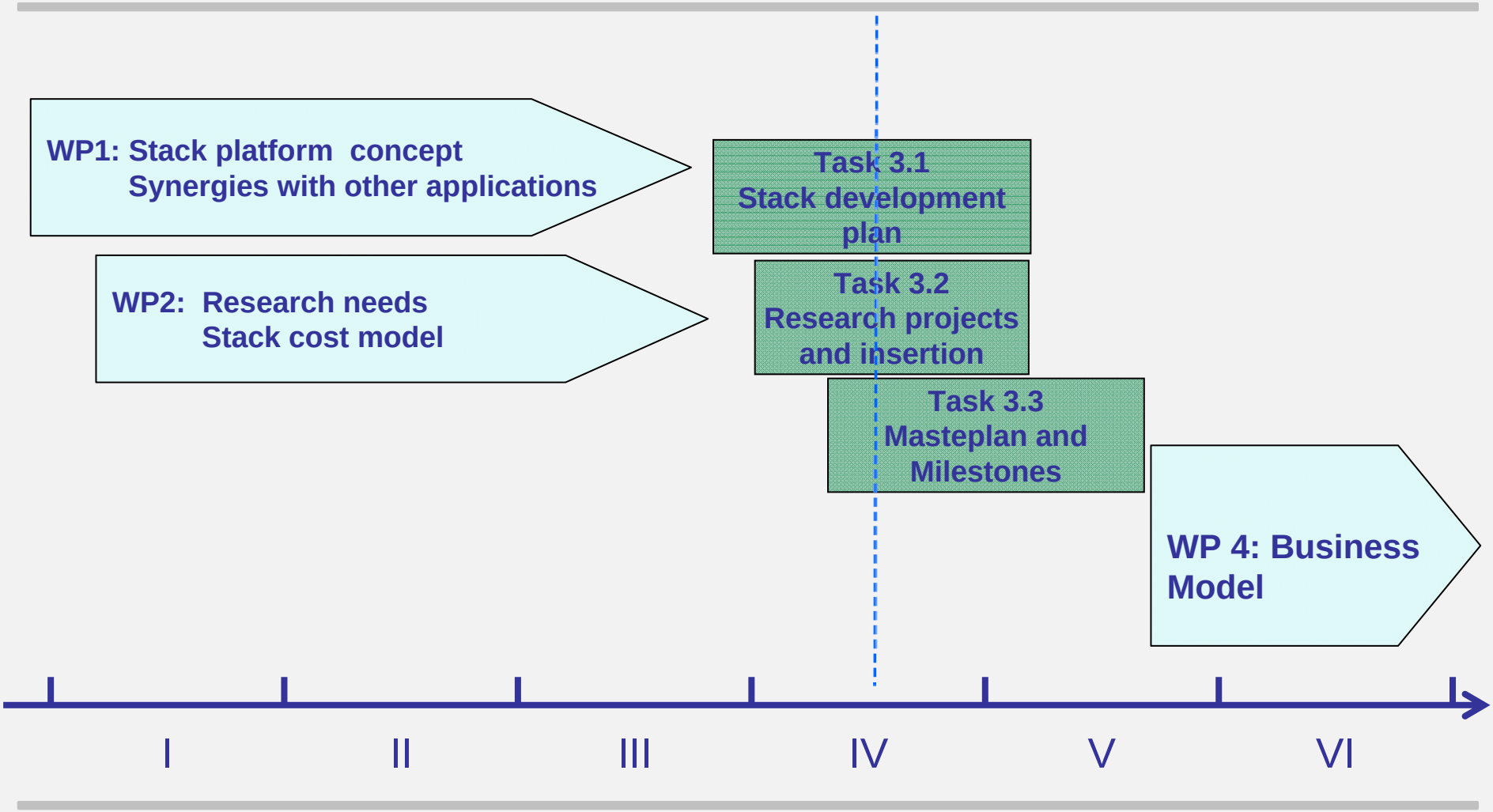
WP 3 Overall Objectives & Participants

- Participants
  - Powercell, CEA, Daimler, DANA, Freudenberg , JRC, PSI, Solvicore, Umicore, VW, ZSW
- Objectives
  - Setting up a structured and consistent technology roadmap for stack development
  - Check of alignment with running or required research projects
  - Provide a master plan
- Start: Month 10
- End: Month 15
- Final deliverables
  - Roadmap for stack development
  - Masterplan for commercialization
  - Needed research results and insertion points

Technology Road map

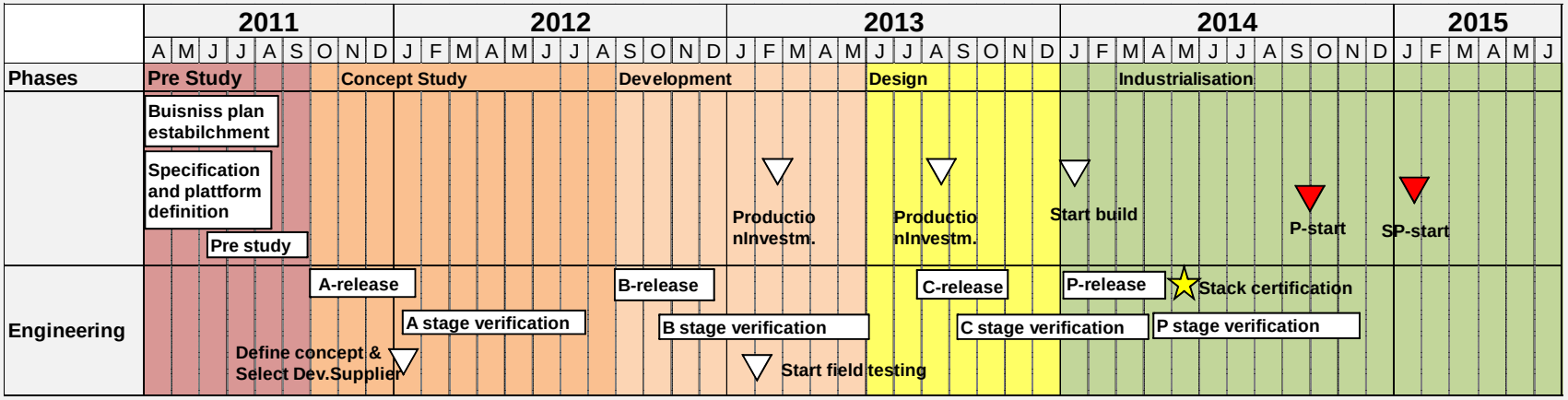


WP 3 Timing


WP1: Stack platform concept
Synergies with other applications
WP2: Research needs
Stack cost model
Task 3.1
Stack development plan
Task 3.2
Research projects and insertion
Task 3.3
Masteplan and Milestones
WP 4: Business Model
I
II
III
IV
V
VI

Stack Development plan, 1st generation stack.

- Assumptions
  - Fuel cell stack development begin in 2011
    - The stack will be based on today's stat of art materials and components
  - Fuel cell stacks needed to support fleet programs in 2015
  - The fuel cell stack will have a OEM market of about 1000 units
  - A trade of with other applications is possible
    - Total volume >10000 units



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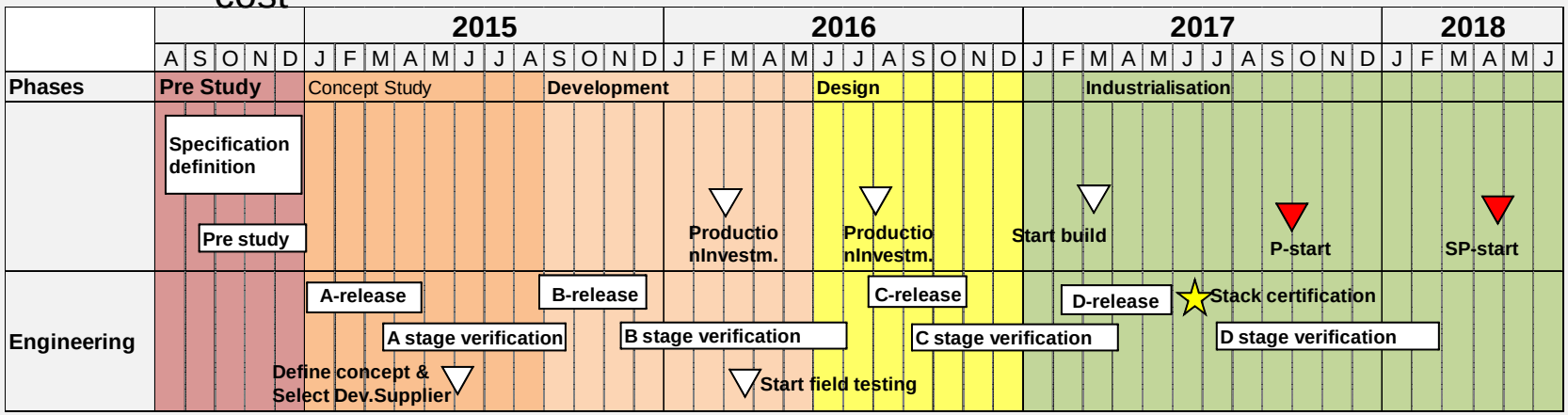
Stack Development plan, 2nd generation stack.

- Assumptions
  - Fuel cell stack development begin in 2014/2015
    - The stack will be based on advanced materials and components
  - Fuel cell stacks needed to support mass market ramp up around 2020
  - The fuel cell stack will be able to meet all the OEM requirements (from WP1) including cost targets.
  - The OEM market is big enough for justify all investment and development cost



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WP 3.2: Research projects and insertion points

Dr. Volker Banhardt

Freudenberg FCCT

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Task 3.2: Research Projects and Insertion Points

- Objectives
  - Alignment of ongoing research projects with the stack development plan
  - Insertion points of research results into the stack roadmap and the corresponding fuel cell application
- Contributors
  - FFCCT (leader), CEA, PSI, JRC, DANA, ZSW, SC, UC
- Description of Work
  - Define research needs based on topics identified in WP2.3 and propose insertion points
- Input from: Task 2.3, Task 3.1
- Output to: Task 4.2

Task 3.2: Subtasks

- Analysis of output from WP 2.3, 3,1
- Analyze research needs for FC stack components and align with milestones of WP3.1
- Define milestones
- Work package report

Task 3.2 Research Projects and Insertion Points

- Status
  - Report of WP2.2 on research needs and classification available and analysed
  - FFCCT provided questionaire worked out in WP3 to AUTOSTACK partners
  - provided questionaire suggests research areas
  - all returned information has been collected
  - insertion points are currently aligned to proposed stack development plan for generation 1 and generation 2

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Task 3.2 Research Projects and Insertion Points

- Since more input is needed to sumarize on research needs → current status is open for discussion
- Questionaire for
  - BPP
  - MEA
  - GDL
  - Seal
  - Current collector
  - Stack assembly

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Task 3.2 Research Projects and Insertion Points

- Bipolar plate

No	Subtopic	Requirements	Developm. priority	Begin	End
1	Plate material	inexpensive, formable and corrosion resistant	High	Q1-2012	Q3-2014
2	Plate surface coating	Conductive, adhesion to plate, corrosion resistance	High	Q3-2011	Q3-2014
3	Plate design (generation 1)	optimized flowfield	High	Q3-2011	Q4-2012
4	Plate design (generation 1)	optimized feed region	High	Q3-2011	Q4-2012
5	Plate design (generation 2)	optimized flowfield	medium	2013	2014
6	Plate design (generation 2)	optimized feed region	medium	2013	2014

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Task 3.2 Research Projects and Insertion Points

- Further components still to be included
  - end plates
  - cell voltage monitoring
  - housing

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WP 3.3 : Master Plan and Milestones

Dr. Raimund Stroebel

DANA-Reinz

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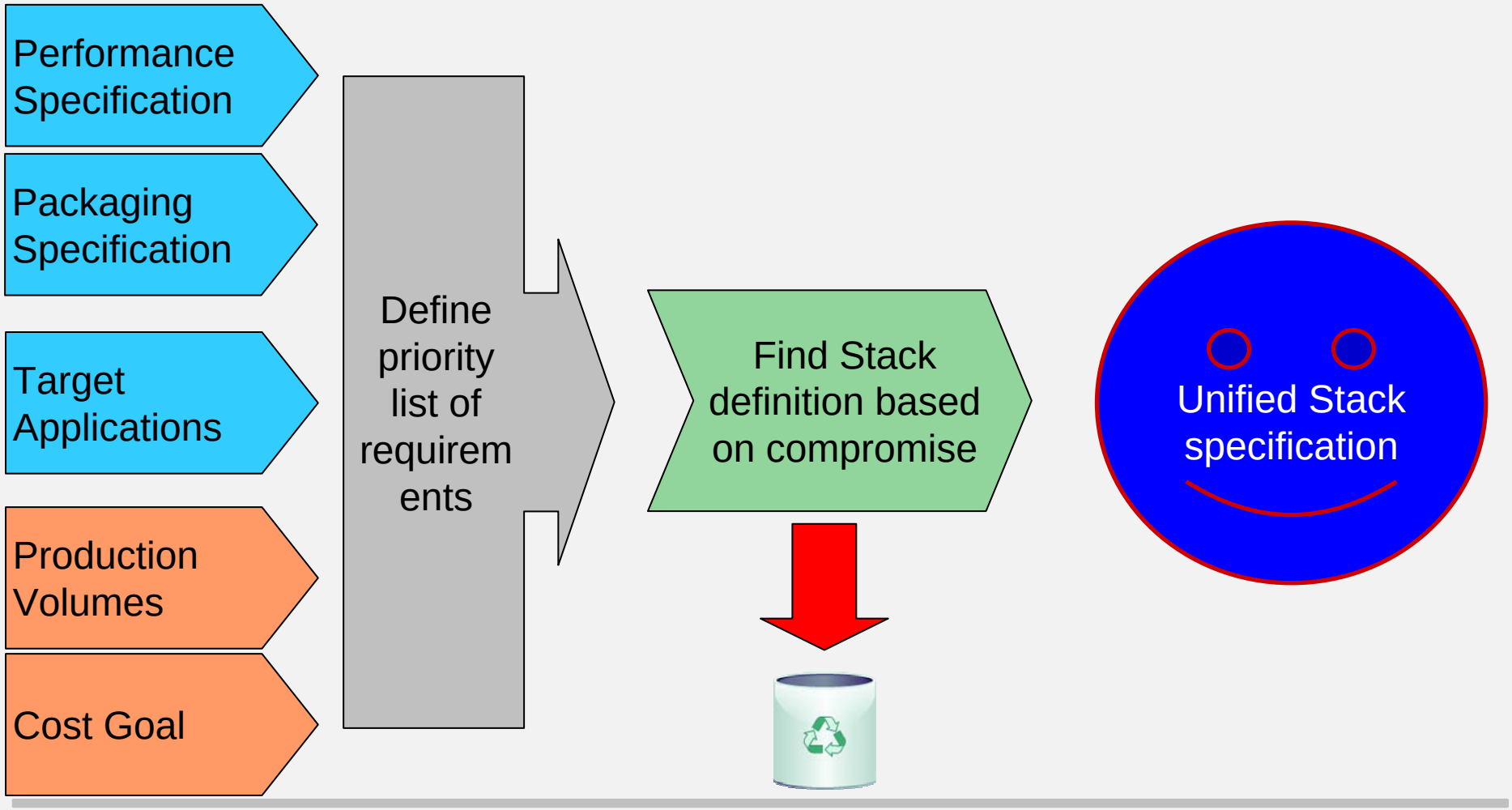
Task 3.3 Master Plan and Milestones

- Objectives
  - Master plan for automotive FC commercialization including non-classic/emerging vehicle concepts and related application
- Contributors
  - DANA (leader), CEA, FFCCT, ZSW, VOLVO, DAI, VW, CRF
- Description of Work
  - Develop a master plan for automotive fuel cells which takes into account the addition vehicle concepts, e.g. urban (fleet) and service vehicles, plug-in hybrids, range extenders, public transport vehicles, light traction vehicles and related applications.
  - Break down the big step towards an automotive FC mass market into several smaller steps.
- Input from: Task 3.1, Task 3.2, Task 4.2
- Output to: Task 4.2.

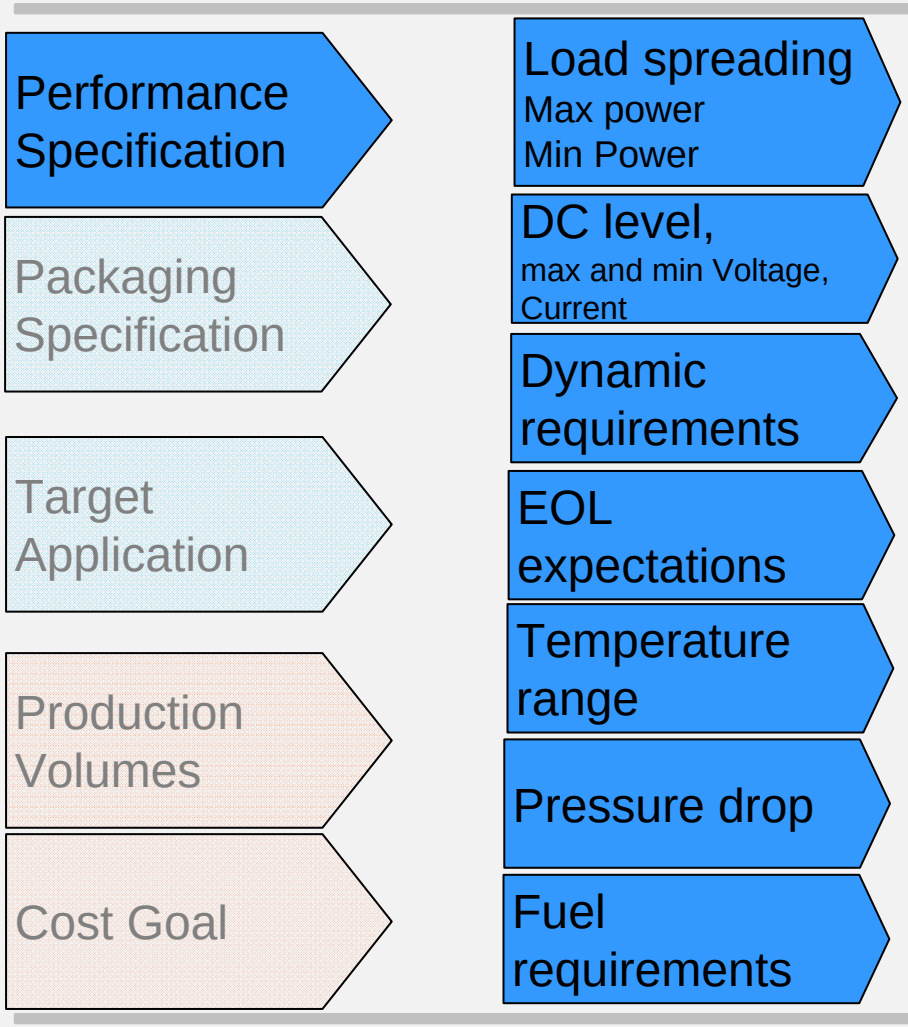
Task 3.3: Subtasks

- Analysis of output from WP 2.2, 3,1, 4.1, 4.2
- Analyze related FC vehicle applications
- Assess other fuel cell stack related application
- Define milestones
- Compile master plan
- Preparation of milestone report

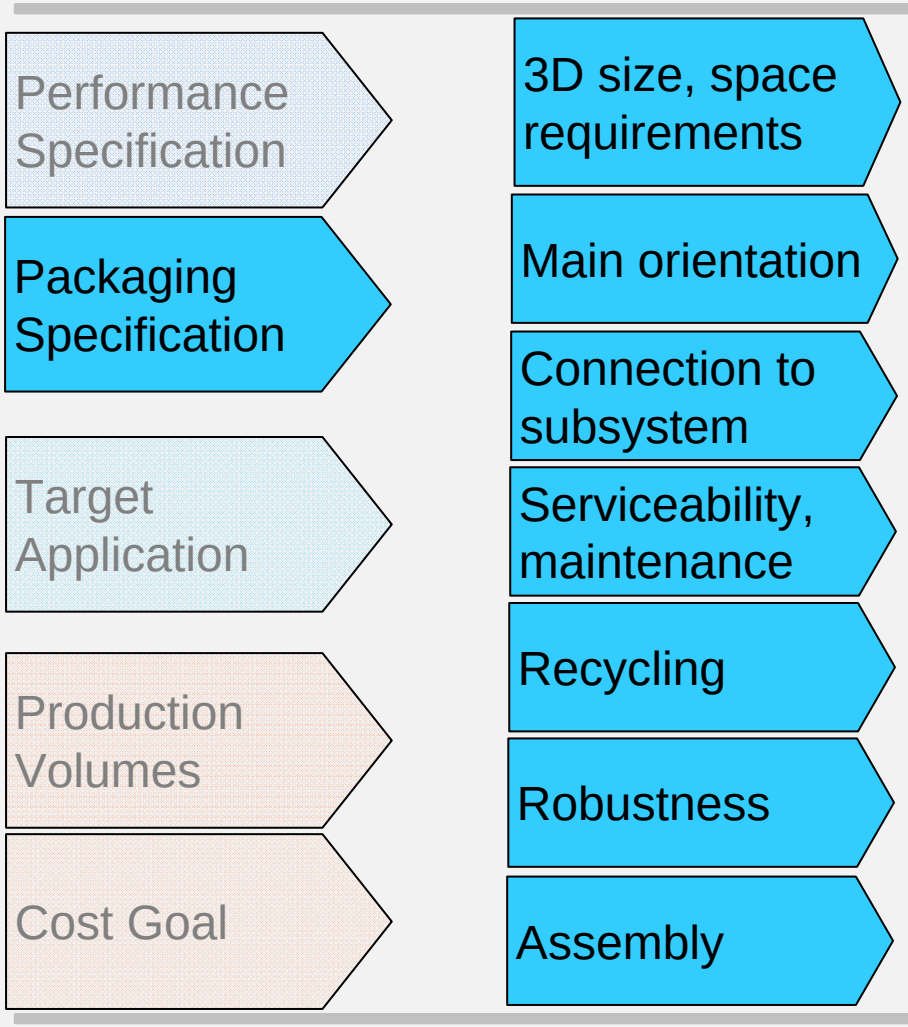
Task 3.3: Master plan



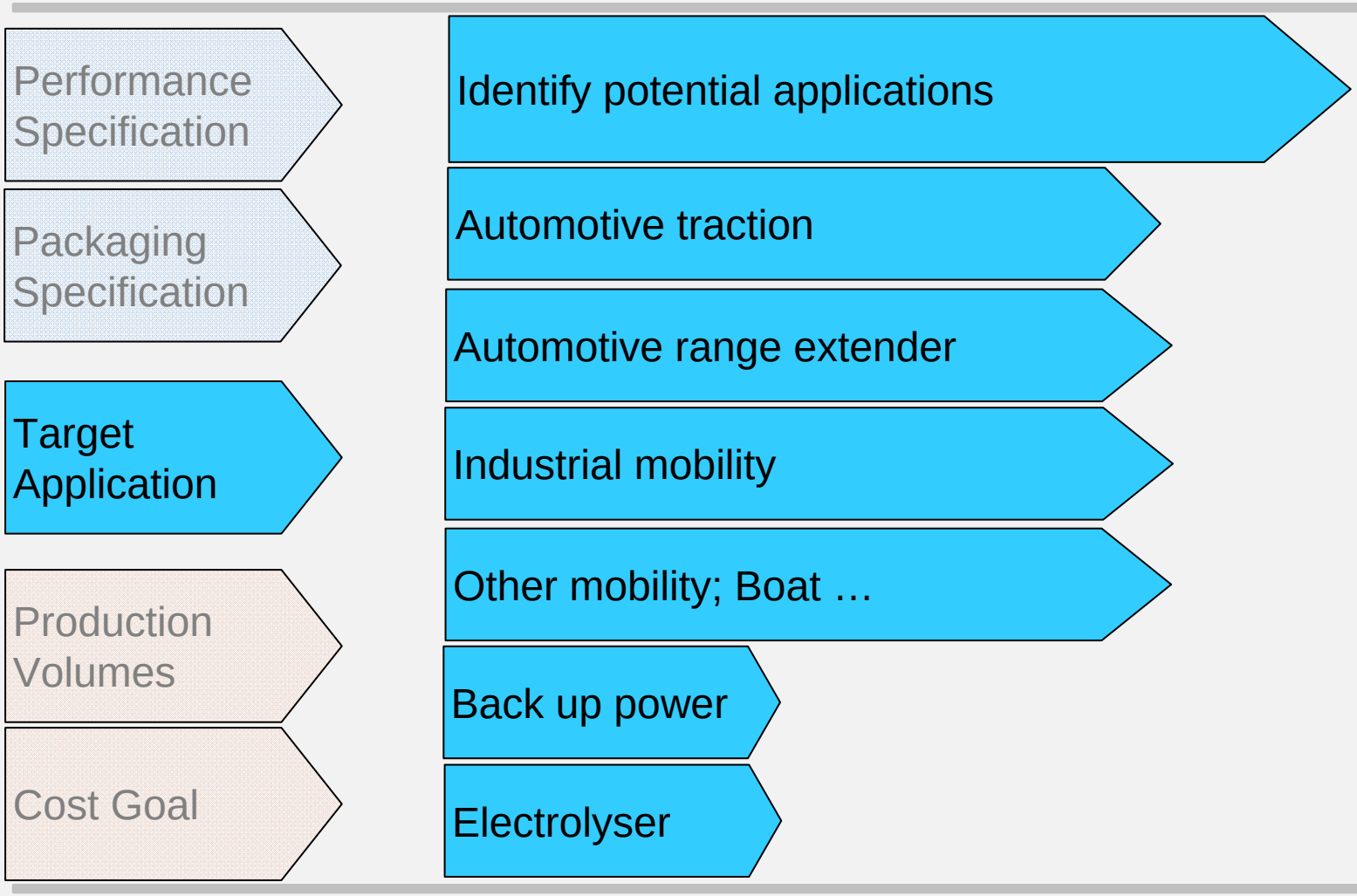
Task 3.3: Master plan



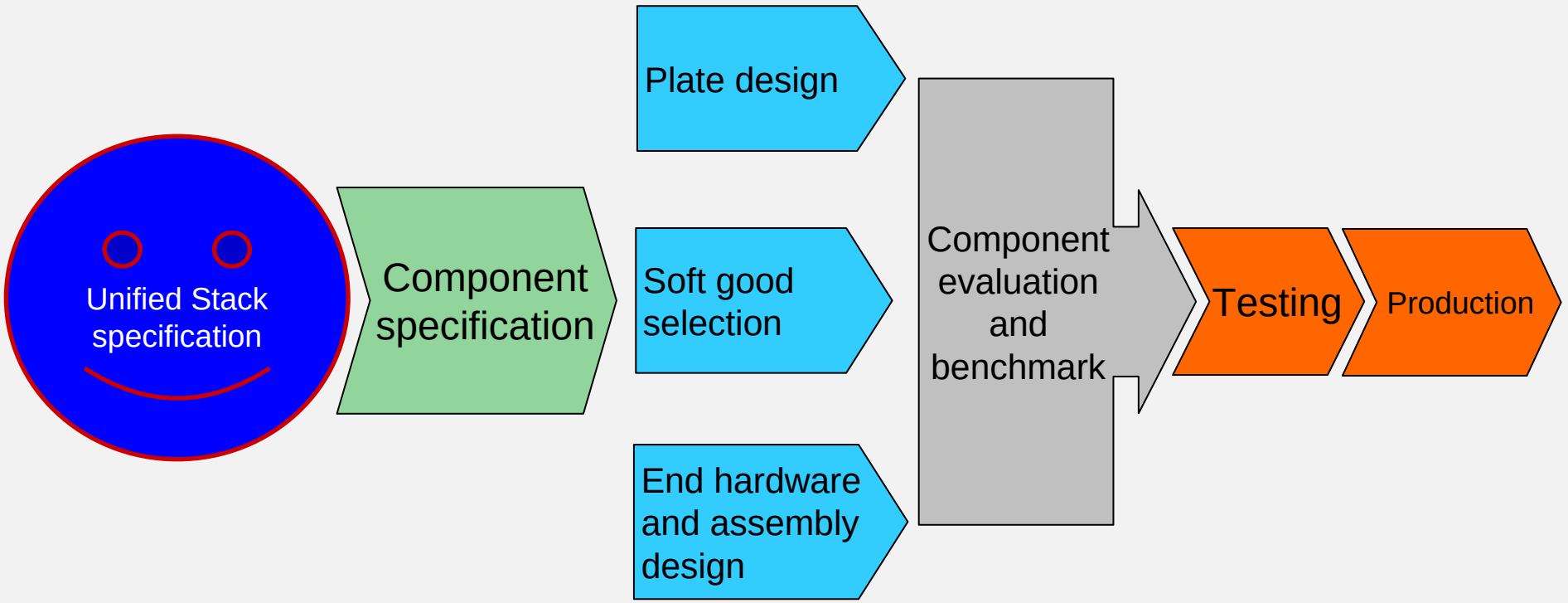
Task 3.3: Master plan



Task 3.3: Master plan



Task 3.3: Master plan



Task 3.3: Milestones

- Fix specifications, applications, targets and goals
- Priorities technical and commercial parameter list
- Fix compromise on priorities
- Define unified stack specification
- Evaluate extended application potential
- Generate component specification
- Design and select components
- Benchmark and evaluate components
- Stack evaluation and testing
- Stack production

Task 3.3: Applications

Application	Stack size
• Automotive FC traction	50 to 100 kW
• Automotive FC range extender	5 to 30 kW
• Bus FC traction / range extender	50 to 200 kW
• Boat, Ship FC traction / range extender / APU	2 to 100 kW
• Truck APU	5 to 10 kW
• Fork Lifts, Industrial vehicles	2 to 10 kW
• UPS; Back up	2 to 100 KW?
• Fuel	Hydrogen, Reformate
• Electrolyser	