

APPENDIX B: Input/Output Matrix

revised June 2013

Appendix B shows the linkages of all the inputs and outputs from various technical sections of the MYPP to one another. These inputs and outputs are also reported in the R&D Milestone Charts at the end of each technical section. The task numbers reported in Appendix B are those from the associated R&D Milestone Chart

Outputs						Inputs												
Output From	Output #	Title	Quarter	FY	Task	Production Task	Delivery Task	Storage Task	Fuel Cells Task	Safety, Codes, & Stds. Task	Tech Valid'n Task	Edu. Task	Market Trans. Task	Systems Analysis Task	Systems Integ'tion Task	Manu-facturing Task	Program	
Systems Analysis	A1	Report on the status of the technologies and infrastructure to meet the demands for the hydrogen fuel and vehicles.	1	2011	1													
Systems Analysis	A2	Cost of competing vehicle powertrain.	4	2012	1				10									
Systems Analysis	A3	Preliminary well-to-wheel power plant efficiency analysis for advanced material systems.	4	2013	1		4	3										
Systems Analysis	A4	Analysis for costs for optimal hydrogen pressure contributions at each point in the system from production to dispensing at point of use.	4	2013	1		1											
Systems Analysis	A5	Update on hydrogen delivery and refueling data for well to power plant efficiency analysis for advanced material systems.	2	2015	1													
Systems Analysis	A6	Report on the status of composite tank costs.	3	2015	1			3										
Systems Analysis	A7	Update on onboard automotive fuel cell system power, input pressure, and vehicle refill time.	4	2015	1													
Systems Analysis	A8	Report on the results of the infrastructure analysis for the long term technologies and requirements for technology readiness.	4	2015	1											1		
Systems Analysis	A9	Update on onboard automotive fuel cell system power, input pressure, degree of hybridization and vehicle refill time.	4	2015	1			3										
Systems Analysis	A10	Report on the environmental analysis of the Hydrogen and Fuel Cells Program.	4	2015	1											4		
Systems Analysis	A11	Report on the projected performance of materials-based systems for onboard hydrogen storage.	1	2018	1			3										

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Systems Analysis	A12	Report on the status of advanced materials system costs.	2	2019	1			3									
Systems Analysis	A13	Annual market reports on status of fuel cell and hydrogen industry.	4	2011 - 2020	1							2, 3, 4					
Systems Analysis	A14	Annual report on the status of commercial products and patents resulting from government funded R&D.	4	2011 - 2020	1												
Systems Analysis	A15	Report on the status of government policies on non-automotive fuel cell industry.	4	2011, 2013, 2015, 2017, 2019	1							3, 4					
Systems Analysis	A16	Report on the projected performance of hydrogen storage systems for non-automotive applications.	3	2020	1			3									
Systems Analysis	A17	Revised hydrogen threshold cost based on fuel and automotive technology advances, if required.	4	2014, 2017, 2020	1												
Safety, Codes & Standards	C1	NFPA2: Hydrogen code document.	2	2012	4		6				1 - 3						
Safety, Codes & Standards	C2	Hydrogen fuel quality standard (SAE J2719).	3	2012	4	1-6	1	1, 2	5		1 - 3				1		
Safety, Codes & Standards	C3	International hydrogen fuel specification standard.	3	2012	4												
Safety, Codes & Standards	C4	Updated best practices handbook on hydrogen safety.	4	2012	5							1					
Safety, Codes & Standards	C5	GTR Phase 1.	1	2013	4												
Safety, Codes & Standards	C6	Updated materials compatibility technical reference manual.	4	2013	2, 5	1-6	6	1, 2			1 - 3	1			1		
Safety, Codes & Standards	C7	Materials reference guide and properties database.	4	2014	2, 5	1-6	6	1			1-3		2			1-8	

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Safety, Codes & Standards	C8	National indoor fueling standard.	2	2016	2, 4		1, 6				1-3		1				
Safety, Codes & Standards	C9	Revised NFPA 2.	1	2017	4												
Safety, Codes & Standards	C10	GTR Phase 2.	4	2017	4												
Safety, Codes & Standards	C11	Updated international fuel specification standard.	4	2018	4												
Delivery	D1	Delivery pathways that can meet an as-dispensed hydrogen cost of <\$4/gge (\$1/100ft ³) for emerging fuel cell powered early markets.	1	2013	1						3		1	1, 2			
Delivery	D2	Provide candidate station compression technologies for potential technology validation.	1	2014	2						3						
Delivery	D3	Provide candidate liquefaction technologies for potential validation.	4	2014	5						3						
Delivery	D4	Recommended pipeline technology for validation.	4	2014	3						3						
Delivery	D5	Provide options that meet <\$4/gge for hydrogen delivery from the point of production to the point of use for emerging regional consumer and fleet vehicle markets.	4	2015	1						3		1		1		
Delivery	D6	Technology and material characteristics of advanced delivery systems.	2	2018	6					2, 3							
Delivery	D7	Provide options that meet <\$2/gge for hydrogen delivery from the point of production to the point of use in consumer vehicles.	4	2020	1						3		1		4		
Fuel Cells	F1	Cost of the baseline automotive fuel cell system.	1	2012	10										1		
Fuel Cells	F2	Report on the effect of impurities from storage materials on fuel cells.	3	2014	5			1, 2									

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Fuel Cells	F3	Provide micro-combined heat and power system test data from documented sources indicating performance status.	4	2015	9						1				4		
Fuel Cells	F4	Provide auxiliary power unit system test data from documented sources indicating performance status.	4	2015	9						2				4		
Fuel Cells	F5	Provide automotive stack test data from documented sources indicating performance status.	4	2017	5						2				4		
Manufacturing	M1	Report on high-speed, low-cost fabrication of gas diffusion electrodes for membrane electrode assemblies.	4	2013	3				5								
Manufacturing	M2	Report on fabrication and assembly processes for high pressure hydrogen storage tanks that cost 10% less than the baseline cost of \$18/kWh for Type IV, 700 bar tanks.	4	2015	7			2									
Manufacturing	M3	Report on fabrication and assembly processes for polymer electrolyte membrane fuel cells that meet the transportation fuel cell system cost target of \$30/kW.	4	2017	4				3								
Vehicle Technologies Program	O1	U.S. DRIVE baseline vehicle system architecture (e.g., hybridization) and fuel economy.	1	2012					10								
Production	P1	Hydrogen production system based on centralized biomass gasification technology producing hydrogen at a projected cost of \$2.10/kg at the plant gate.	4	2015	3						3					8	
Production	P2	System based on distributed production of hydrogen from electrolysis at a projected cost of \$3.90/kg without compression, storage and dispensing.	4	2015	2						3					8	

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Production	P3	Hydrogen production system based on centralized electrolysis technology producing hydrogen at a projected cost of \$3.00/kg at the plant gate.	1	2016	2						3					8	
Production	P4	Solar hydrogen production system based on centralized high-temperature thermochemical conversion technology producing hydrogen at a projected cost of \$3.10/kg at the plant gate.	4	2020	4						3						
Production	P5	Solar hydrogen production system based on photolytic biological hydrogen production from water at a solar to hydrogen conversion efficiency of 5%.	4	2020	6						3						
Production	P6	Solar hydrogen production system based on photoelectrochemical hydrogen production from water at a solar to hydrogen conversion meeting 2020 targets.	4	2020	5						3						
Storage	S1	Update status of composite tank costs.	3	2014	3									1		7	
Storage	S2	Technical and economic update from storage on promising storage material system.	1	2015	2, 3		4										
Storage	S3	Material characteristics and performance data on advanced storage materials and systems.	1	2015	1, 2					2.4							
Storage	S4	Update of fuel quality from promising storage materials.	3	2015	1				5	2.4							
Storage	S5	Projected performance of materials-based systems for onboard hydrogen storage.	1	2017	2, 3		4				2			1	4		
Storage	S6	Update status of advanced materials system costs.	2	2018	2, 3									1			

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Storage	S7	Projected performance of hydrogen storage systems for non-automotive applications.	3	2019	2, 3									1				
Market Transformation	T1	Report on the status of early market deployments and industry needs.	1, 4	2013, 2014	1, 2							3, 4						
Technology Validation	V1	Final learning demonstration summary report published.	3	2012	4													
Technology Validation	V2	Validate achievement of a refueling time of 3 minutes or less for 5 kg of hydrogen at 5,000 psi using advanced communication technology.	3	2012	2		6	3		2				1				
Technology Validation	V3	Publish/post composite data products for material handling and backup power, including safety event data.	3	2012	4					1			2, 3	1				
Technology Validation	V4	Validate stationary fuel cell system that co-produces hydrogen and electricity and report on durability and efficiency.	4	2014	3								1, 2, 3	1				
Technology Validation	V5	Report on the validation of residential fuel cell micro combined heat and power systems' efficiency and durability.	4	2015	1				9				1					
Technology Validation	V6	Validate 700-bar fast fill fueling stations against DOE fueling targets.	3	2016	4		6			2								
Technology Validation	V7	Validate novel hydrogen compression technology durability and efficiency.	4	2016	3		2							1				
Technology Validation	V8	Complete validation of commercial fuel cell combined heat and power systems' efficiency and durability.	4	2017	1				9				1					

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Technology Validation	V9	Validate status of truck auxiliary power unit durability.	4	2017	2				9				1					
Technology Validation	V10	Validate distributed production of hydrogen from electrolysis at a projected cost of \$3.90/kg with an added delivery cost of <\$4/gge.	4	2018	3	1								1, 2				
Technology Validation	V11	Validate station compression technology provided by the delivery team.	4	2019	3		1							1				
Technology Validation	V12	Validate light duty fuel cell vehicle durability.	4	2019	2				6					1				
Technology Validation	V13	Validate onboard storage system weight capacity and energy density.	4	2019	2			2										
Technology Validation	V14	Validate liquefaction technology provided by the delivery team.	4	2019	3		5							1				
Technology Validation	V15	Validate pipeline technology provided by the delivery team.	4	2019	3		3							1				