APPENDIX B: Input/Output Matrix

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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

Output From	#	Title	Quarter	FY	Task	Production Task	Delivery Task	Storage Task	Fuel Cells Task	Safety Task	Codes & Stds Task	Tech Valid'n Task	Education Task	Systems Analysis Task	Systems Integ'tion Task	Manufacturing Task
Fuel Cells	F2	Develop preliminary hydrogen quality requirements	2	2005	10									1	5	
Production	P1	Hydrogen production technology for distributed systems using natural gas with projected cost of $3.00/kg hydrogen at the pump, untaxed, assuming 500 manufactured units per year.	4	2005	1							2.1, 2.2				
C&S	C1	Completed hydrogen fuel quality standard as ISO Technical Specification.	3	2006	6	1,2,3,5	1 --> 7	5	9			1, 2.1			5	
C&S	C2	Technical assessment of Standards requirements for metallic and composite bulk storage tanks.	3	2006	2		1,3,5,6	5				1, 2.1				5
C&S	C3	Final standards (balloting) for fuel dispensing systems (CSA America).	4	2006	4		2,5,6, 7	5				1,2.1,2.2				
C&S	C4	Draft standards (balloting) for refueling stations (NFPA).	4	2006	4		1,2,4--> 7					2.1, 2.2				
Delivery	D1	Initial H2A Delivery models characterizing the cost of hydrogen delivery by pipeline, gaseous tube trailers, and cryogenic liquid H2 trucks.	4	2006	1									1		
Delivery	D2	Hydrogen contaminant composition and issues.	4	2006	2,4,5,6									1	2	
Fuel Cells	F3	Provide automotive stack test data from documented sources indicating durability status.	4	2006	10							1				
Production	P2	Assessment of H2 quality cost and issues from production	4	2006	2		4,5,6	5	8, 9			2.1				
Storage	St1	Report on compressed and cryogenic liquid storage tanks and evaluation against 1.5 kWh/kg and 1.2 kWh/L.	4	2006	1							1				
Tech Val	V1	Validate maximum fuel cell system efficiency.	4	2006	1				10							

Output From	#	Title	Quarter	FY	Task	Production Task	Delivery Task	Storage Task	Fuel Cells Task	Safety Task	Codes & Stds Task	Tech Valid'n Task	Education Task	Systems Analysis Task	Systems Integ'tion Task	Manufacturing Task
Tech Val	V10	Hydrogen refueling station analysis - proposed interstate refueling station locations.	4	2006	1.3 & 2.5									1	2,3	
Storage	St5	Baseline hydrogen on-board storage system analysis results including hydrogen quality needs and interface issues.	1	2007	5		5,6,7							1	2	
Storage	St3	Report on metal hydride system and evaluation against 2007 targets	2	2007	2				9			1, 2.1				
Production	P3	Impact of hydrogen quality on cost and performance.	3	2007	1,2,3							2.2, 2.3			2,4,5	
Tech Val	V2	Final report for first generation vehicles and interim progress report for second generation vehicles, on performance, safety, and O&M.	3	2007	1									1	4	
Tech Val	V7	Final report on infrastructure and hydrogen quality for first generation vehicles.	3	2007	2.1									1	5	
Systems Analysis	A0	Initial recommended hydrogen quality at each point in the system.	4	2007	1	1,2,3,5	6	5	9		6	1, 2.1				
Systems Analysis	A1	Complete technoeconomic analysis on production technologies currently being researched to meet overall Program hydrogen fuel objective.	4	2007	1	1,2,3,5	2 --> 7								2	
C&S	C5	Materials compatibility technical reference.	4	2007	1		4,6	5								
Delivery	D3	Hydrogen delivery infrastructure analysis results.	4	2007	1									1	3	
Fuel Cells	F1	Research results of advanced reformer development.	4	2007	8	1,2										
Tech Val	V3	Technology Status Report and provide feedback to the R&D program.	4	2007	1, 2.1									1	4	
Tech Val	V9	Final report on safety and O&M of three refueling stations.	4	2007	2.2	1,2,3	2,4-->7	5		4,6	1,6			1	5	
Tech Val	V11	Composite results of analyses & modeling from vehicle and infrastructure data collected under the learning demonstration project.	4	2007	1.3 & 2.5									1	2	1,2,3,8
Fuel Cells	F4	Verify short-stack cold start (-20 C) to 50% of rated power in 60 seconds	1	2008	10							1				

Output From	#	Title	Quarter	FY	Task	Production Task	Delivery Task	Storage Task	Fuel Cells Task	Safety Task	Codes & Stds Task	Tech Valid'n Task	Edu-cation Task	Systems Analysis Task	Systems Integ'tion Task	Manu-facturing Task
Safety	Sf3	Publish a Best Practices Handbook for hydrogen safety.	1	2008	7							1, 2.1	1,2,3		2	
Safety	Sf2	Report of common accident scenarios.	2	2008	2								1,2,3			
C&S	C6	Final draft standard (balloting) for portable fuel cells (UL).	4	2008	4				8							
Storage	St2	Report on advanced compressed/cryogenic tank technologies.	4	2009	1							1				
Storage	St6	Final On-board hydrogen storage system analysis results of cost and performance; and down-select to a primary on-board storage system candidate.	1	2010	5		5,6,7							1	2	6
Systems Analysis	A2	issue a report on the infrastructure analysis for the hydrogen scenarios	2	2010	1		2 --> 7								2	
C&S	C7	Codes and Standards for Delivery Infrastructure complete.	2	2010	4		2 --> 7									
C&S	C8	Final Hydrogen fuel quality standard as ISO Standard.	2	2010	6	1,2,3,5	2 --> 7	5	9			1, 2.1			5	
Tech Val	V4	Final report for second generation vehicles, on performance, safety, and O&M.	3	2010	1									1	4	
Tech Val	V8	Final report on infrastructure, including impact of hydrogen quality for second generation vehicles.	3	2010	2.1									1	5	1,2
Delivery	D4	Assessment of impact of hydrogen quality requirements on cost and performance of hydrogen delivery.	4	2010	2 --> 7									1	3	
Delivery	D5	refueling site compression technology recommended for validation.	4	2010	2							2.1, 2.2				
Delivery	D6	Recommend refueling site stationary storage technology for validation	4	2010	6							2.1				6
Production	P4	Hydrogen production technology for distributed systems using natural gas with projected cost of $2.50/gge hydrogen at the pump, untaxed, assuming 500 manufactured units per year.	4	2010	1							2.1, 2.2				8

Output From	#	Title	Quarter	FY	Task	Production Task	Delivery Task	Storage Task	Fuel Cells Task	Safety Task	Codes & Stds Task	Tech Valid'n Task	Edu-cation Task	Systems Analysis Task	Systems Integ'tion Task	Manu-facturing Task
Tech Val	V5	Technology Status Report & Re-Focused R&D Recommendations.	4	2010	1, 2.1									1	4	1,2,3
Tech Val	V12	Final composite results of analyses & modeling from vehicle and infrastructure data collected under the learning demonstration project.	4	2010	1.3 & 2.5									1	2	1,2,3,8
Systems Analysis	A3	issue a report on the status of the technologies and infrastructure to meet the demands for the hydrogen fuel and vehicles	1	2011	1										2	
Storage	St4	Report on full-cycle chemical hydrogen system and evaluation against 2010 targets.	1	2011	3		5,6,7		9			1				
Fuel Cells	F5	Provide automotive stack test data from documented sources indicating durability status.	2	2011	10							1				
Tech Val	V6	Validate Cold Start-Up capability (in a vehicle with an 8-hour soak) against 2010 targets (time and start-up and shut-down energy).	3	2011	1.3 & 2.5				9,10					1	4	
Manufacturing	M6	Report on high volume manufacturing processes for electrolysis membrane assemblies	4	2011	9	3										
Delivery	D7	Recommended liquefaction technology for potential validation.	4	2012	3							2.1				
Delivery	D8	Recommended pipeline technology for validation.	4	2012	4							2.1				
Manufacturing	M1	Report on process for assembling stacks	4	2012	2				3, 10							
Production	P6	Hydrogen production technologies for distributed systems using renewable liquids with projected cost of $3.80/kg hydrogen at the pump, untaxed, assuming 500 manufactured units per year.	4	2012	2							2.2				8
Production	P7	System making Hydrogen for $3.70/gge (delivered) from distributed electrolysis.	4	2012	3							2.1				8,9
Production	P8	System making Hydrogen for $3.10/gge (plant gate) from central wind electrolysis.	4	2012	3							2.3				

Output From	#	Title	Quarter	FY	Task	Production Task	Delivery Task	Storage Task	Fuel Cells Task	Safety Task	Codes & Stds Task	Tech Valid'n Task	Education Task	Systems Analysis Task	Systems Integ'tion Task	Manufacturing Task
Production	P9	System making hydrogen for $1.60/gge from biomass at the plant gate.	4	2012	5							2.2				
Safety	Sf1	Sensor meeting technical targets.	4	2012	1							1, 2.1			5	
Tech Val	V13	final report for 3500 hour durability test	4	2012	1.3 & 2.5									1	4	
Systems Analysis	A4	Issue a report on the results of the infrastructure analysis for the long term technologies and requirements for technology readiness	2	2015	1										2	
Systems Analysis	A5	Issue report of the environmental analysis of the Hydrogen Program	4	2015	1										2	
Manufacturing	M2	Report on fabrication and assembly processes for polymer electrolyte membrane automotive fuel cell that meets cost of $30/kW	4	2015	2				3, 10							
Manufacturing	M3	Report on fabrication and assembly processes for high-pressure hydrogen storage technologies that can achieve a cost of $2/kWh	4	2015	6			5								
Manufacturing	M4	Report on manufacturing of distributed reforming of natural gas system to achieve $2.00/gge (delivered)	4	2015	8	1										
Production	P5	Hydrogen production technology for distributed systems using natural gas with projected cost of $2.00/gge hydrogen at the pump, untaxed, assuming 500 manufactured units per year.	4	2015	1							2.1			2,5	
Tech Val	V14	Report on the status of validation of 5000 hour durability target and cold start capability	2	2016	1.3 & 2.5				10					1	4	
Tech Val	V15	composite data products for infrastructure report	2	2016	1.3 & 2.5									1		
Manufacturing	M5	Report on manufacturing a distributed reforming of bio-derived renewable liquid fuels system to achieve $3.00/gge (delivered)	4	2017	8	2										