DOE Hydrogen Program Record		
Record #: 8002	**Date:** October 31, 2008	
Title: Fuel Cell System Cost - 2007		
Update to: Record 5005		
Originator: Nancy Garland and Jason Marcinkoski		
Approved by: Sunita Satyapal	**Date:** April 3, 2009	

Item:

The cost of an 80-kW automotive polymer electrolyte membrane (PEM) fuel cell system operating on direct hydrogen and projected to a manufacturing volume of 500,000 units per year is $94/kW for 2007 technology in 2007 dollars ($82/kW in 2002 dollars for comparison with targets).

Rationale:

In fiscal year 2007, TIAX LLC (TIAX) and Directed Technologies, Inc. (DTI) each updated their 2006 cost analyses of direct hydrogen, 80-kW, PEM automotive fuel cell systems based on 2007 technology and projected to manufacturing volumes of 500,000 units per year [1,2].

The TIAX 2007 analysis was based on a fuel cell system model developed by Argonne National Laboratory using properties of a state-of-the-art nanostructured thin film ternary platinum-alloy catalyst layer with a platinum group metal (PGM) loading of 0.3 mg/cm^2 (developed by 3M) and stack power density of 753 mW/cm^2. The DTI 2007 baseline analysis assumed conventional dispersed platinum (Pt) nanoparticle catalyst on carbon supports with a platinum group metal loading of 0.65 mg/cm^2 and stack power density of 700 mW/cm^2, but assumed balance-of-plant component technologies that are further developed compared to the TIAX 2007 analysis [1,2].

The DOE, in collaboration with the FreedomCAR and Fuel Partnership's Fuel Cell Technology Team, evaluated the 2007 status technology and agreed to use an average of available data from three vendors for catalyst loading and power density. DTI revised its analysis to use a stack power density of 583 mW/cm^2 and PGM loading of 0.35 mg/cm^2 based on the results of this evaluation [3].

The revised DTI analysis was selected as the basis for determining the status of the projected fuel cell system cost for 2007 because it assumes balance-of-plant technologies that are currently viable in automotive applications and PGM loading and stack power density representative of 2007 state-of-the-art automotive technology.

Both the DTI and TIAX 2007 cost analysis models use 2007 dollars and a Pt commodity cost of $1100 per troy ounce. DTI and TIAX also performed a sensitivity analysis to evaluate the impact of Pt commodity cost on system cost.

As shown in Table 1, technology advances have led to a reduction of Pt loading that, despite decreased power density, significantly contributes to the $15/kW cost reduction

for the fuel cell stack from 2006 to 2007. In 2006, TIAX and DTI values were averaged, resulting in $65/kW stack cost.

Table 1: Key Assumptions of Cost Analyses and Resulting Cost

		2006		2007
Characteristic	**Units**	**TIAX**	**DTI**	**DTI**
Stack power	kW_{gross}	90	87	90
System power	kW_{net}	80	80	80
Cell power density	mW_{gross}/cm^2	700	700	583
PGM loading	mg/cm^2	0.65	0.65	0.35
PGM content	g/kW_{gross}	0.93	0.93	0.60
PGM content	g/kW_{net}	1.0	1.0	0.68
Pt cost	$/troz. [a]	1100	1112	1100
Stack cost	$/$kW_{net}$ [a]	56	74	50
Balance-of-plant cost	$/$kW_{net}$ [a]	41	40	42
System assembly and testing	$/$kW_{net}$ [a]	-	3	2
System cost	$/$kW_{net}$ [a]	97	118	94

[a] Dollars are in year of analysis.

For comparison to the DOE targets developed in 2002 and quoted in 2002 dollars ($45/kW by 2010 and $30/kW by 2015), the 2007 cost status was estimated to be 82/kW[1] in 2002 dollars.

[1] Stephen Lasher, et al., "Direct Hydrogen PEMFC Manufacturing Cost Estimation for Automotive Applications," Hydrogen Program Annual Merit Review & Peer Evaluation, May 18, 2007, http://hydrogen.energy.gov/pdfs/review07/fc_27_lasher.pdf

[2] Brian James, et al., "Mass Production Cost Estimation for Direct H_2 PEM Fuel Cell Systems for Automotive Applications," Hydrogen Program Annual Merit Review & Peer Evaluation, May 18, 2007, http://hydrogen.energy.gov/pdfs/review07/fc_28_james.pdf

[3] Brian James, et al., "Mass Production Cost Estimation for Direct H_2 PEM Fuel Cell Systems for Automotive Applications", U.S. Department of Energy Hydrogen Program 2008 Annual Progress Report, http://www.hydrogen.energy.gov/pdfs/progress08/v_a_2_james.pdf

[1] Estimation in 2002 dollars uses U.S. Bureau of Economic Analysis Price Indexes for Gross Domestic Product.