

Early Station Costs Questionnaire



Marc Melaina Hydrogen Technologies and Systems Center

Market Readiness Workshop

February 16-17th, 2011 Washington, DC

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Questionnaire Goals

- The Early Station Costs questionnaire provides an anonymous mechanism for organizations with direct experience with hydrogen station costs to provide feedback on current costs, near-term costs, economies of scale, and R&D priorities.
- This feedback serves the hydrogen community and government agencies by increasing awareness of the status of refueling infrastructure costs

Questions for Market Readiness Workshop Attendees

- Are these questions the right ones to be asking?
- How can we improve this questionnaire to provide more useful information to government agencies, hydrogen supplier/auto companies and potential investors?

Questionnaire Development and Execution

Maintain anonymity

- Questionnaire will be fielded electronically by an independent third party, IDC Energy Insights
- IDC will establish anonymous means of communication and interaction with respondents, similar to "clean room"
- Critical mass of responses required for reporting

Engage stakeholders in development

- Preliminary discussions with CaFCP working group
- The Beta version in Excel will be available for review by key stakeholders (at DOE discretion)
- Revisions proposed by workshop attendees and Beta version reviewers will be collected and synthesized

Design: Phased Approach

- First round will be for System Integrating stakeholders
- Second round for component suppliers

Cost reductions will be quantified on a cost-component level (examples with 4 components below)



- A and B are distinct stations/pathways, C shows reductions for a particular pathway
- Cost reductions can be due to multiple factors

Beta version is in Excel: 3 Sections, 15 questions

	Hydrogen Infrastructure Market Readiness CostQuestionnaire
	Prepared by the National Renewable Energy Laboratory Bath Marsing the Devices Only (Devices, 2011)
1	weta ver son ter wavew oney (January, 2011)
	Ferner infernd er od tapen ib frakten, met nes reisingen igen. Nete het is det Mitter i stratter i transforder i de andere i fanse der stat.
	prese and the enveryment of the service time to the presence of the part decreased
	And a first sector of the sect
	ratio france and a second based on the second
	The branch have been all standard prove the second standard by the s
	0010 - Culpet and an analytical by K21 media
U	Kartine & Introduction and Defension Countings
	The sector of the sector secto
	Text behaling of her net study on the testing only no task out angles and set of typing end dates handed informed group of the sets. The balance was for Te
	helpespectration at the stateging darketing polarizers and search instant partial descripting an attain in any piece and. Their apprendix
	eprestien selection for GMC (alternis Antical Actionality) and NOW (values) Cogenia (and Actionality) and the selection of th
	where it shall be a first and the state of the second s
	high second states from the second states in the second state states of the states of the set states of the second states and the second states and the second states and the second states and the second states are states and the second states are st
	habed has promote a process with tops returns a function have been depined. The part of the quadrantian is to add of the first and the first a
	in addition to developments of the site of a factors for the test state of POTA), a development to ingred to the test state of the stat
\mathbf{n}	bei faj ed het er beret het en steret het Televelse het enversiely oder hjerger Hechafter. Het geleken bekomm Teshen ererheiteret et Tes
	Tennedy werden () KEN, 2) without fixed by and 2) the fitness increasing gard with fixing expected and the daming to ensure the and quadress fature
	publics on the respective burneries peterint qualities are testical invasity active (
	31. Which of the billing subgrade that making the subgraduation from the subgraduation is a subgraduation of the superfact of here the statement are subgraduated with a subgraduation of the billing of the statement of the subgraduation of the subgraduation.
	 a) inducting processing the proceeding compared to a second se
	 Emblementation per data
()	
UJ	a) Advertised a faith
	1) Relat (Sush an efforciae)
	el Eller
	52 is stated to binning typing metals into procept at inclusion deligibilities? Note the proceed of the part in the device Transformation
	punchers produces to respect to more the new metric) places sample to within quantum stars.
\cap	 A beind aber and the set of the
	 A second s
	s) Ad within a fying a Diffuse
	42. What of the following that a number of proceeding to provide the relative to by the development? Note: Any example, and the temperature of the state of th
	waters
n	
	al Companya Sanata
	 Construction Construction
	2. Non-Instance of
	Make there advantes not reactive barrand, local and reactive height. 64. Which of the balance had describe our information for the output standard for the basis of the contribution of the output standard form.
	d mer el trat el Tal app.
_	al January Press
	6) Advantation and a
()	 a) Inground States
	· Development
	1) Manufacturing
	al Lead
-	1 Sector of sector sectors
\frown	 Germanistan analysis
	11 Samerentite
	-) =
	18. Her many hydrogen being installations has your experiention indust for density on ar Unique 22 years? Note to mark in second a transmission provider the second action of the
1 A A A A A A A A A A A A A A A A A A A	ni i na Cannava fa Can aga na dina. Taga " jang ani a fan Agama an Handi ta di na yan San Aliji.
	i i state
	a) 20 induktion
	2) 02 statutes
	1 DE Indefen
	g) MeetherDischlater
	A rest of any specific target states and the set of the test of the test states in the set of the test of test
	a solar of indianaya kata paratar "gar" (agari dan badana a da dina) na an tan (1)
\leq	a) New Sector Se
	at 31 ministra
	2) El statutes
	a) bill middlen
	g) Mexilian Direct laters
	Region B. Datasen Mathematical estantica. Cont Mathematica
	petron a. Hyprogen warket and INT & Studius Cost Attributes. Premers bills such events tills and biblid annual effolliges besid shababe selabiles being endes) and Tr. Daminental Resolutions and attributes attributes and attributes
	(2) (Search Search and a mainter in the index index (1) // one folding energy ge/(2), and, dute (10), indire antisister index and then, per
	For presence to be used as input of an end of dimension of the KK match and Termulas of Corporated by and Termula and an inclusion of Singly dependences. The set of the second sector of the second sector of the second sector of the second sector.
	In spannersen maan gemeine er bestigten (Tydage i Stalander unde 1, 200 m) Testis, 3 het Geven uid, 3 the 200 m, and 3 and 3 and 4 for 54 differen widde de stalander (Stalander under Stalander und Stalander under Stalander under Stalander und Stalander und Stalander und Stalander under Stalander under Stalander under Stalander und Stalander under Stalan
	In Approximation of a standard free of the definition of the States are the first table (Second and the stat Approximation, and togs Tables are instantial
	Rely Greeners and Descard all designed within give subject separations. Shill be been and all the basely processes were tool before
	2. States (Charles) States, Name and all falling an electric and the following of the form
	 The datases would be induced and approximate the Dia 200 Dia best area.
	 The dataset would include the read record generalizes of expression, but would not reasonable include records. "Several relies" surgements
	Statistical contract of processing fields in the 140. The definition of the statistical field contract is in the statistical contract of the statistical contrac
	2 In the second state of the second state o
	destruction for the extended and represent metals) an abright generates fairs fairs for the fair fair for the
	The datasets the ready visite with the process of support. The dark to read a fittle dropping by by the first documentary data
	Units among separated as a press tyles or stars in the sense surger (1945) and Darped arging separated as a lyse of
	a Canadina er lan an Santuain, sudian a 102, al Seraito e fut en Sin eras Canada Sin.
	 The statismum shall be support graving demand in a parabiting market angles, and to ensure adapted ERD. The state address have detended an education of the first first and the first first address of the first address of the first address of the first first
	 The difference of makes and relations for any fight region in the metal of the providence of the fight region of the providence of the providen
	stations (Frag factor in the and momentum of probabiles)
	i Badhina, Kalaris baji kawai dina, Minjapite kao anto, Kindadat Mina an Alas king taipiti kalipiteti.
	ويستعدد الشارية وتشريبية وبالبالي مسروا بالبليان ليستا السالي مستعاد المتكر ويتقا بتنصيب والابتا ومستعده ومراجع
	Energy State . Story States list of a bit Connect Way, bi Suged in fair science Jpl. To write Special science is is united at a Connect Ada a, Uppelling of a set is service by data as . Or at data as is remain as well is by Servers (data, still State) as a supe
	Encoded and the second
	The sector is the sector of th
	Except State: A fair is the sense data. At any of in fight second d. To which and a sense is a unit of an interface parameters of the sense of
	Every Electric Index to Converse of these Laboratory in the intervention. The market physical sources is a market back to converse of the source of the
	Control of the second sec
	Every Electric Industria ton Service (Alton, Milling of Indige Alton Service). The web Alton Service Alton Service (Alton Service) and the service Alton Service Alto
	Construction C
	Harp Steel. It op Steel and hard band banders fall har of the fight and second it. To write the point annual to a main fail the fight and second it is an annual to a main fail the fight and second it. It op Steel and annual band band band band band band band band
	Every Electric Isolation (Serverse differs, Mithing and Inclusion). The work of April 2010 and the server of the server of the server of the serverse differs differs of

It what would be the contral squarty of them hydrogen sta	Care of (176 mentioned)				
		1			
 Lesstfor 30 Hg/Day 	-	Barly Commercial	Mare Hallows	Larger 31ali en	1
c) 30 kg/de.					
a) 100 kg/day d) 210 kg/day					
) 300 %g/bey 					
1) 732 %g/day					
1) 130 Kg/day					
i) Mars from 1200 spikes					
 Specify a size (optimum); 					10.24
1. What would be the average utilization rate of these body 5 do of 75% would produce an average 700% gibra)		er Deir essensiel d	Conf Personals	a 1000 g/daystate	n with a si
	The State	Just Communici	Mars Malana	James Mallana	
An energy in the time of all success ratios. Transfer de contrage en diput					te la s
 What is the result is also and government these hydrogen states 	Care of				
	The other	Barly Commercial	New States	Larger Stations	
 Costs potation is show on Taxa relating 					
 Consta production for discharged and all Constants in March Constants and Andread 					
 Defining to the dation by liquid test track 					
 Californy for California population California (Association) 					
It what we bis describe the performance and market require	en en fas her Olesse stads				
Number of rolling shi and in a past 1-four time particle		Barly Commercial	Mare Malana	Larger Stations	
Personage of Syllegen produced from recording					(%)
to tion Cost Questions					
to and quarters being inquire shout the following types of a	and and and parame	ters.			
 NISD DESKATING COSTS 					
 VARIA ELE OPERATIVO COSTS. 					
 ADD IT ID NAL, COST IT BY 3 BOAN CAL, AS \$4,000 TO 10 					
The survey billing these quantities a providition is trial source and	et most all allows to pay	industing a later and	af fyinger (idea	established using th	
CONTAC CORTS, What would be the sect of the following re-	ijer sopi fal sest serry	and all a			
erreislie Great Carital Gale Please provide as worth defails	a pasible. Yes see a	specific to both samp	energy and and to	the further front and	
ing to diverse design manages that words, we far a value in the father	r satisfy, the tata	I value in commend of	betters)		
Total Article	-	Barly Commercial	New Malace	laner Malier	
Jan (ig/ar	0		Lamasa Raiy Carrow	120	No. Carr
TabiN webs of Zahara induite	unquella d		200	In manufacts Carrier	-
Carl gurden	101.001		Lances Lety Comm.	In manufactly Comm.	
And the second second second second					
2) Adamer					See.
 Water Bes 2011 					Sint.
 Pressure a sing a Damplian unit 					\$10.5
 Endergeneent Endergeneent 					101
a) Companyo					\$101 m
A) Department					\$101 ···
 Estarem efgined Effer 6 and a second distance same fails 					5100 m
					Side Tar
					\$10.20
					Sinte Sinte
					skan Skan Skan
Test True Yand Panine Dalary Contactilies					\$10.5 \$10.5 \$10.5
Tanii Tanak and Agadine Galinary Canjiganshina 4) Tanii Tanak ang kat					2101- 2101- 2101-
Test Trus 1 and Applies Officery Carl produces a) Test Test tests 5) Applies and second second second at					3/451- 3/451- 3/451- 3/451-
Tanil Tou Y and Agatine Schlary Carl gurdians a) Tou Tout and Hi 2) Agains and Samardian agala 2) Agains and Samardian					21453
Text Truck and Applies Dations Carl produces 1. Text Text angle 2. Applies and second as angles 2. Starge 2. Carponies 3. Depression					2/45.5 2/45.5 2/45.5 2/45.5 2/45.5 2/45.5 2/45.5
Test Trust and Papeline Settings Setjandians 4) Test Test wards 4) Test and Section sets (1) 4) Testes 4) Despense 4) Despense 4) Despense 5) Setting Section Section sets (1) 5) Section Section Section Section sets (1) 5) Section S					\$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1
Feel That and Papeline Dationsy Configurations a) The Nation and All and State and All and All and All and All and All and All and all and All and All and All and All and All and b) Department b) Color the State and All and All and All and China State and All and All and All and All and China State and All and All and All and All and China State and All and All and All and All and China State and All and All and All and All and All and China State and All					\$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1
Test Trust and Papeline Settery Set guidelaws 4) Test Look angels 5) Testers and angels 6) Denges 6) Denges 6) Denges 7) Denges 7) Denges the angels 7) Set of the gene the angels on scores 6) Tester Set Set of Laboration scores 6) Den Set Set of Laboration scores 6) Den Set Set of Laboration scores 6) Den Set					\$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1 \$10.1
Test Truck and Paydon Didlawy Conference 4) Test Truck and All 2) Despine 2) Despine 2) Despine 2) Despine 3) Des					2101 2101 2101 2101 2101 2101 2101 2101
Tea Trea and Append Damy Carly and an 4 - Sailtean and an 20 - Barger 20 - Barge					2101 2101 2101 2101 2101 2101 2101 2101
San Tura ya Angelo Zalang Lengtong Lengtong San Tura ya Angelo Zalang Lengtong San Tura ya Angelo Zalang San					2101 2101 2101 2101 2101 2101 2101 2101
Tas Tran and Append Samy Carly and an 1 Sam Sam Same 2 Sam Sam Sam Same 2 Hange 2 Hange 3 Hange		a de la constante de			2101 2101 2101 2101 2101 2101 2101 2101
Ine True i pel forget Defining Configuration 1 True True and annual annual a 2 True True and annual annual a 2 True True and annual annual a 2 True and annual annual annual 2 True and annual annual annual annual 2 True and annual annual annual annual 2 True annual annual annual annual annual 2 True annual annual annual annual annual 2 True annual annual annual annual annual annual 2 True annual annual annual annual annual annual annual 2 True annual annual annual annual annual annual annual annual annual 2 True annual ann		Elent u pfați	Sare Helens	Login Halima	2011 2012 2012 2012 2012 2012 2012 2012
The frame of provide latency (Legiperature 1) Nations and an exploit 2) Nations of an exclusion series 2) Despite 2) Despi		Elizad a pfat Enty Second	Marellators	Longo Haliwa	2011 2011 2011 2011 2011 2011 2011 2011
The The Lag Copyres Selecting Configuration () The Theorem and Association an		i Direct as pfinit Direct as pfinit	E es Heires	LogerStations	2011 2011 2011 2011 2011 2011 2011 2011
The True of Spatial Setting Series Setting Sec. 1. The True manufacture spatial 2. The True manufacture spatial 3. The Section Sect		Eliment as price () Eliment as price ()	Stare Halters	Loger Stations	2001 2001 2001 2001 2001 2001 2001 2001
The The 1 of Paylor Differs (on puttine 1) The Theorem 21 2) The Theorem 21 2)		i fond agist	Net laters	loge Hiller	2001- 2001- 2001- 2001- 2001- 2001- 2001- 2001- 2001- 2001- 2001- 2001- 2001- 2001- 2001- 2001- 2001- 2001-
The True of Agrin Datases (and particle) The True of Agrin Datases (a)) The True of Agrin Datases (a)) The True of Agrin Datases (a)) The Agrin Datases (b)) The		i indiana india	Ver listen	loge Holes	3/445- 3/445- 3/445- 3/445- 3/445- 3/445- 3/445- 3/445- 3/445- 3/445- 3/445- 3/445- 3/445- 3/445- 3/445- 3/445-
The The 1 of Paylor Differs (See Junction 1) The Theorem 2) 2) The Theorem 2) 3) Theorem 2) 4) Theorem 2) 4) Theorem 2) 4) Theorem 2) 4) Theorem 2) 5) Theorem 2)		i Dred upfal) brih Szorariai	Nee laters	inger Hidlers	3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444-
Tea Tool of Agains Datases Confusiones 1 - Tool Confusiones 2 -		i Breed sugfaq Breed sugfaq Breed sugfaq	Mee States	Linger Hallers	3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444- 3/444-
The The Left Payme Science (or gradues 1 The Theorem 2 (1) 2 The Theorem 2 (1) 3 Theorem 2 (1) 3 Theorem 2 (1) 4 Theorem 2 (1) 4 Theorem 2 (1) 5 Theorem		i Drud og fall	Wes listers	Logo Héles icon Héles	31444 314444 314444 314444 314444 314444 3144444 3144444 314444 314444
The True of April District Confusion 1 Section and April District Confusion 2 Section and 2 2 Section and 2 2 Section		i Bank Secona (d)	Nee Haters Emiliaters	inger Hickey	Sint- Sint-
The True of Papels Define Series Series Series 1 The True and Papels Define Series 2 The True Series 3 Series 4 Series 5		i Send upfal)	New Yoless	Loge Holes	Sint- Sint-
Ins Total of Papels Delay Confusion 1 - Sections and Apple Delay Confusion 2 - Sections and Apple Delay Confusion 2 - Section Del		i Dred u pfał	Ver listen	log: 100m	Sinte Sinte
The True of Again Select plants and Again Select plant		Send up fait	Verfiter	Logo Méleo Logo Méleo	Sinta - Sinta
Ine Tota of Paper Delay Confusion 1 - Section and a section set of the section o		 Branch ang play Bra	Verlisten	inge förers	Sinta - Sinta
The True of Again Data program (Annual Section 2014) and the Section 2014 (Annual Section 2014) and the Section		Sevel upfați	Ver Falen	Logo Héleo Logo Héleo	Sida - Sida - Si
The The T of Apple Stars (or public of the Stars (or		 Branch ang Artik Branch ang Artik	Verlisten	inge förers	Sinta - Sinta
The True of Agein Datase Lengthsonian 1 - Surface and Agein Datase Lengthsonian 2 - Surface and Agein 2 - Surface and Agein 3 - Surfa		Send upfol		Logo Hilling	Sinta - Sinta
The True of Again Safety Safety Safety Safety 1 - The True manufacture of the Safety 2 - The True manufacture of the Safety 2 - The Safety Safety Safety Safety 2 - Safety Safety Safety Safety Safety 2 - Safety Safety Safety Safety Safety 3 - Safety Safety Safety Safety Safety 3 - Safety Safety Safety Safety Safety 3 - Safety Safety Safety Safety Safety Safety Safety Safety 3 - Safety Saf		indexplay		ingen Holen ingen Holen ingen Holen	Sinta and Sinta
Are in a first program in the second se		Ered applet		Logo Million Logo Million Logo Million Logo Million Logo Million	Sint - Sint - Si
The True of Agrin planes (argument) 1 - The International (argument) 2 -		Stradusplay		inger Holes inger	Side to a second
Inc. Inc. of Argen Defausy Confusion 1 - State Market State		E could any fact buth Second any fact buth Second any fact and a Second any second any fact any factors and a second any second any factors any factors any factors any factors and a Second any factors any factors any factors any factors and a Second any factors any factors any factors any factors and a Second any factors any factors any factors any factors any factors any factors and a second any factors any factors and a second any factors and a second any factors any factors and a second any factors and a second any factors any factors and a second any factors any factors any factors and a second any factors and a second any factors and a second any factors any factors and a second any factors any f		is and a final sector of the s	Sint - Sint - Si
The first of dyna Datase Carlynowine 1 - Datase Carlow Carlynowine 2 - Datase Carlow Carlynowine 2 - Datase Carlow Carlynowine 2 - Datase Carlynow		ered up for by for Second up for by for Second up for before approximation before approximation of the Second up for before approximation of the Second up for the Second up for before approximation of the Second up for the Second up for before approximation of the Second up for the Second up for the Second up for the Second up for the Second up for the Second up for the Second up for the Second up f		ingen 12 dag og som	Sinte Sinte
har has before period putties 1 - Sei har an einer auf an einer auf		i den de print i de la constant internet de la constan		inge fölge	Sint - Sint - Si
The first of dyna being to dynamic 1 - being the second s		Construction	New Haters Keeliden Land to the wither Description	inger Hill an inger Hill an in	Side to Side t
Institute of dyna States (september) 1 - Shi have set 2 - Shi ha		Construction Construction Construction Construction Construction Construction Construction Construction Construction	Ves listes Kes listes Kes listes	is any fiding a second	Sinte and Sinte
har for all of approximations of the second		Print Sectors		ison I Ging	Slate Slate
The True of Parts Description. The True of Parts Description. 2 - Without Series (Series Series (Series Series (Series Series (Series Series (Series Series Series (Series Series Series Series Series (Series Series Series Series Series (Series Series Se				Longo Tida as Longo Tida as Lo	Slats Slats
har has before the provide set of the set of		 And a part of the second second			Sinta - Sinta
The first of Agency Science Confusions 1 - The first of Agency Science Confusions 2 - The first of Agency Science Confusions 2 - The Scienc					Skitter Skitte
The first of stars descriptions:		and a given and a		ing tion	Skats Skats Skats
The first of dyna being to dynamic and a set of dyn		Construction		Luga Didar Installing	Side 1
The first of dyna plane plane plane. The first of dyna plane plan				Log 15 and	Å(1)
har for a for any form the form of purption 1 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 -		Internet of the second seco		uptiles	Side 1

Cost Questions

m



 \square

Section A. Introduction and Preface to Questions

- A1. Which of the following categories best matches the core expertise of your organization? Note: To maintain anonymity, responses to this question will not be reported if fewer than 3 responses are received within each category. Responses in the "other" category can be fewer than 3, and will be reported as "other".
- A2. In which of the following hydrogen markets does your organization have a strategic interest? To respond distinctly for more than one market, please complete multiple questionnaires.
- A3. Which of the following best characterizes your organization's expertise in relation to hydrogen infrastructure development?
 - a) Component supplier
 - b) Station design and integration
 - c) Station business operations
 - d) Policy development
- A5. How many hydrogen fueling installations has your organization helped to develop over the past 10 years? Note: to maintain anonymity, responses to this question will not be reported by organization "type" (organization types are identified in question A1).

Section B. Hydrogen Market and Infrastructure Cost Attributes

This questionnaire includes questions on four types of hydrogen infrastructure costs:

- 1) State-of-the-Art
- 2) Early Commercial
- 3) More Stations
- 4) Larger Stations

State-of-the-Art stations would be deployed within the 2011-2012 timeframe. By definition, each of the other three types would be associated with later time periods:

- Early Commercial stations would be deployed at a later date than State-ofthe-Art stations
- More Stations are identical to Early Commercial stations but deployed in larger numbers
- Large Stations are identical to Early Commercial stations but designed with higher output capacities.

State-of-the-Art Stations

1) State-of-the-Art Stations

Newly installed hydrogen stations with the following attributes:

- The stations would be installed and operational within the 2011-2012 timeframe.
- The stations would include the most recent generations of major components, but would not necessarily include novel or "demonstration" components that have not been previously tested in the field.
- The stations would be sized to meet hydrogen demands in a geographic region with promising future market demand.

Early Commercial

- 2) Early Commercial Stations. Based upon your organization's understanding of the growth in demand for hydrogen in the near future (next 5-20 years from the fuel cell electric vehicle, transit bus and material handling equipment markets), consider hydrogen stations to be "Early Commercial" stations if they have the following attributes:
- The stations are financially viable with little government support. Based on financial criteria, such as ROI, and requiring far less financial support or subsidy than the average support offered to all previous hydrogen stations in the same area or region (70-90% less). Disregard ongoing support offered to all types of alternative or low carbon fuels, such as a LCFS, alternative fuel credits or carbon credits.
- The stations are sized to support growing demand in a promising market region, and to ensure adequate ROI. This size could vary from station to station and neighborhood to neighborhood, but consider what might be a typical size for new Early Commercial stations.
- The station design enables cost reductions because it is replicable. The same station design may be used for other stations, reducing the cost of subsequent stations through standardization and economies of production.

3) More Stations. Identical to Early Commercial stations, but deployed in larger numbers. Default value is 10 times more stations being deployed than anticipated in the time period identified for Early Commercial stations. Additional cost reductions are achieved through standardization, mass production, streamlining of installation processes and learning by doing.

4) Larger Stations. Identical to Early Commercial stations, but designed for higher volume output. The number deployed is assumed to be similar to Early Commercial stations, but growth in market demand warrants larger station sizes. Default value is a 1.5 increase in size over the Early Commercial stations, with 2000 kg/day as an upper limit.

B1. When does your organization anticipate that hydrogen stations could begin to be installed that meet the attributes for Early Commercial hydrogen stations?

		Early Commercial
a)	Today	
b)	2011-2012	
c)	2013-2014	
d)	2015-2017	
e)	2017-2020	
f)	2020-2025	
g)	After 2025	
h)	Never	
i)	Specify a year (optional):	

OLOR KEY for unde	rstanding input and output cells:
	RED = Radio dials (yes or no responses)
	BLUE = Input Numeric Value
	GREEN = Input Text
	GOLD = Output values caculated by H2A

B2. What would be the nominal capacity of these hydrogen stations? (the next question inquires about the utilization rate)

		<u>State-of-the-Art</u>	Early Commercial	More Stations	Larger Stations
a)	Less than 50 kg/day				
b)	50 kg/day				
c)	100 kg/day				
d)	250 kg/day				
e)	500 kg/day				
f)	750 kg/day				
g)	1000 kg/day				
h)	1500 kg/day				
i)	More than 1500 kg/day				
j)	Specify a size (optional):				

B3. What would be the average utilization rate of these Early Commercial stations over their economic lifetime? (For example, a 1000 kg/day station with a utilization rate of 70% would produce on average 700 kg/day)

	<u>State-of-the-Art</u>	Early Commercial	More Stations	Larger Stations	
Average lifetime utilization rate:					% of capacity
Implied average output:					kg/day

B4. What is the most likely configuration of these hydrogen stations?

- a) Onsite production by steam methane reforming
- b) Onsite production by electrolysis
- c) Delivery to the station by gaseous tank truck
- d) Delivery to the station by liquid tank truck
- e) Delivery to the station by pipeline
- f) Other (please describe):

<u>State of the Art</u>	Early Commercial	More Stations	Larger Stations

B5. What metrics describe the performance and market requirements for these stations?

Number of refills achieved in a peak 1-hour time period: Percentage of hydrogen produced from renewables:

State-of-the-Art	Early Commercial	More Stations	Larger Stations	_
				(#)
				(%)

Station Cost Questions

The cost questions below inquire about the following types of costs and cost parameters:

CAPITAL COSTS FIXED OPERATING COSTS VARIABLE OPERATING COSTS ADDITIONAL COST ITEMS FINANCIAL ASSUMPTIONS

Station Attribute	<u>State-of-the-Art</u>	Early Commercial	More Stations	Larger Stations	-
Size (kg/day):			Same as Early Comm.	1.5X	kg/day
Total Number of Stations Installed:	unspecified		10X	Same as Early Comm.	number
Configuration:			Same as Early Comm.	Same as Early Comm.	
Year:	2012-2013		unspecified	unspecified	year

Example of detailed H2A cost tables

Depreciable Indirect Capital Costs (enter response in \$/station)

	<u>State-of-the-Art</u>	Early Commercial	More Stations	Larger Stations	
a) Site Preparation (\$)					\$/station
b) Engineering & design (\$)					\$/station
c) Process contingency (\$)					\$/station
d) Project contingency (\$)					\$/station
e) Other (Depreciable) capital (\$)					\$/station
f) One-time Licensing Fees (\$)					\$/station
g) Up-Front Permitting Costs (\$)					\$/station
Sum of depreciable indirect capital costs:					\$/station

SUMMARY COST RESULTS: Based upon your responses to the cost questions above, each of the four station types would have the following attributes:

"State-of-the-Art" Hydrogen Station Attributes	State-of-the-Art	Early Commercial	More Stations	Larger Stations	
✓ Delivered cost of hydrogen:					\$/kg
✓ Station Size (nominal):					kg/day
✓ Configuration:					
✓ Average output:					kg/day
✓ Year of introduction:					year
✓ Breakdown of \$/kg result:					
 Total capital costs 					\$/kg
 Fixed operating costs 					\$/kg
 Variable operating costs 					\$/kg
 Additional cost items 					\$/kg

Respondents can see how revisions influence \$/kg results

Section C. Effective use of research funds to support hydrogen infrastructure technology research and development

The matrix shown below categorizes different hydrogen infrastructure technology R&D options by pathway component and stage of innovation and commercialization. Given your understanding of the technology advances required to meet the cost per kg, market acceptance, and public policy goals needed for successful hydrogen infrastructure rollout, where do you see the most effective use of research funds over the next 1-3 years for each category indicated? You have 100 points to allocate among the various categories. Comment boxes are provided for additional recommendations on the topic of hydrogen infrastructure technology research and development.

	Stage of	Technology Innov	ation and Comm	ercialization	
omponent	Information, #8.0	Pilot Projects &	Teslette	Commercial isation &	Comments or
•		Demonstrations	Jan Cop	Deployment	clarifications
RODUCTION (upstream/central)					
Steam methane reforming of natural gas (large scale)	45	45	45	48	
Electrolysis (large scale)					
Biomess reforming (indirect)					
Biomess reforming (direct, or other)					
Cost gas ification					
Photobiological production					
Photoelectrochemical production					
Other production methods (specify in comment box)					
LIVERY					
Gescous truck delivery					
Liquefaction					
Liquid Truck Delivery					
Pipeline technology					
Compressors					
PSA separation					
Membrane separation					
Electrochemical separation					
ORAGE (upstream)				•	
Above ground gaseous storage (5000 psi)					
Above ground gaseous storage (10,000 psi)					
Underground gaseous storage in caverns (large scale)					
Liquid storage					
Metal hydride					
Carbon structures					
IELING STATION TECHNOLOGIES (onsite/forecourt)	-				
Steam methane reforming of natural gas (onsite)					
Above ground gaseous storage (5000 psi)					
Above ground geseous storage (10,000 psi)					
Compressors					
Sensors					
Geacous dispersers					
Liquid dispensers					
	-				
TOTAL POINTS	USED:				
General comments on technology research and develop	ment:				1

Questions?

Comments can be send to: marc.melaina@nrel.gov