

# HFTO Subprogram Perspectives

## HFTO – Program Managers

*Moderated by Eric L. Miller, HFTO Chief Scientist*

2024 Annual Merit Review and Peer Evaluation Meeting

May 6, 2024– Arlington, VA

*Eric L.  
Miller*



*Dave  
Peterson*



*Ned  
Stetson*



*Dimitrios  
Papageorgopoulos*



*Jesse  
Adams*

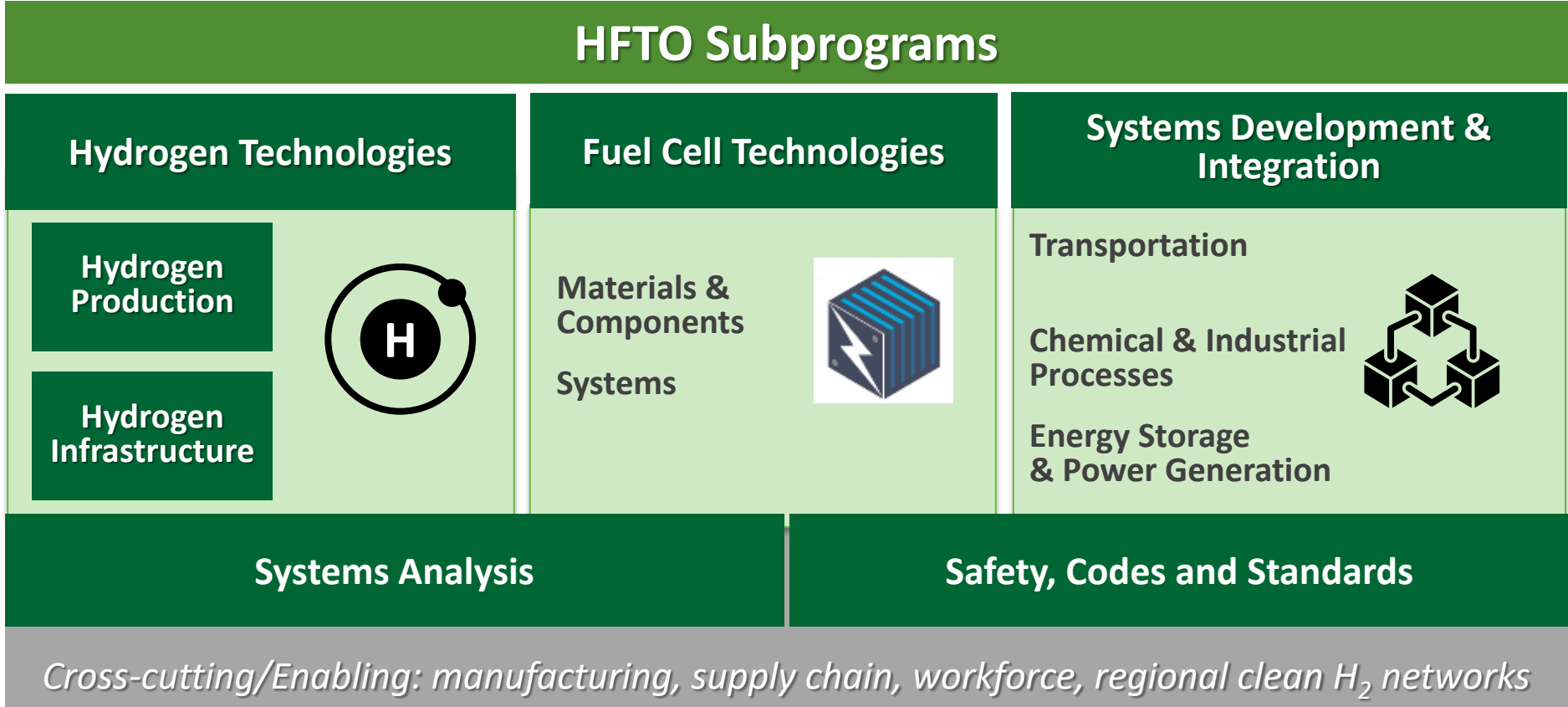


*Neha  
Rustagi*



# The Hydrogen and Fuel Cell Technologies Office (HFTO)

<b>Mission</b>	<p>Research, development and demonstration (RD&amp;D) of hydrogen and fuel cell technologies to advance:</p> <ul style="list-style-type: none"> <li>• Clean Energy and Emissions Reduction Across Sectors</li> <li>• Job Creation and a Sustainable and Equitable Energy Future</li> </ul>
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Enabling

# Hot Off the Press- HFTO's Updated MYPP!



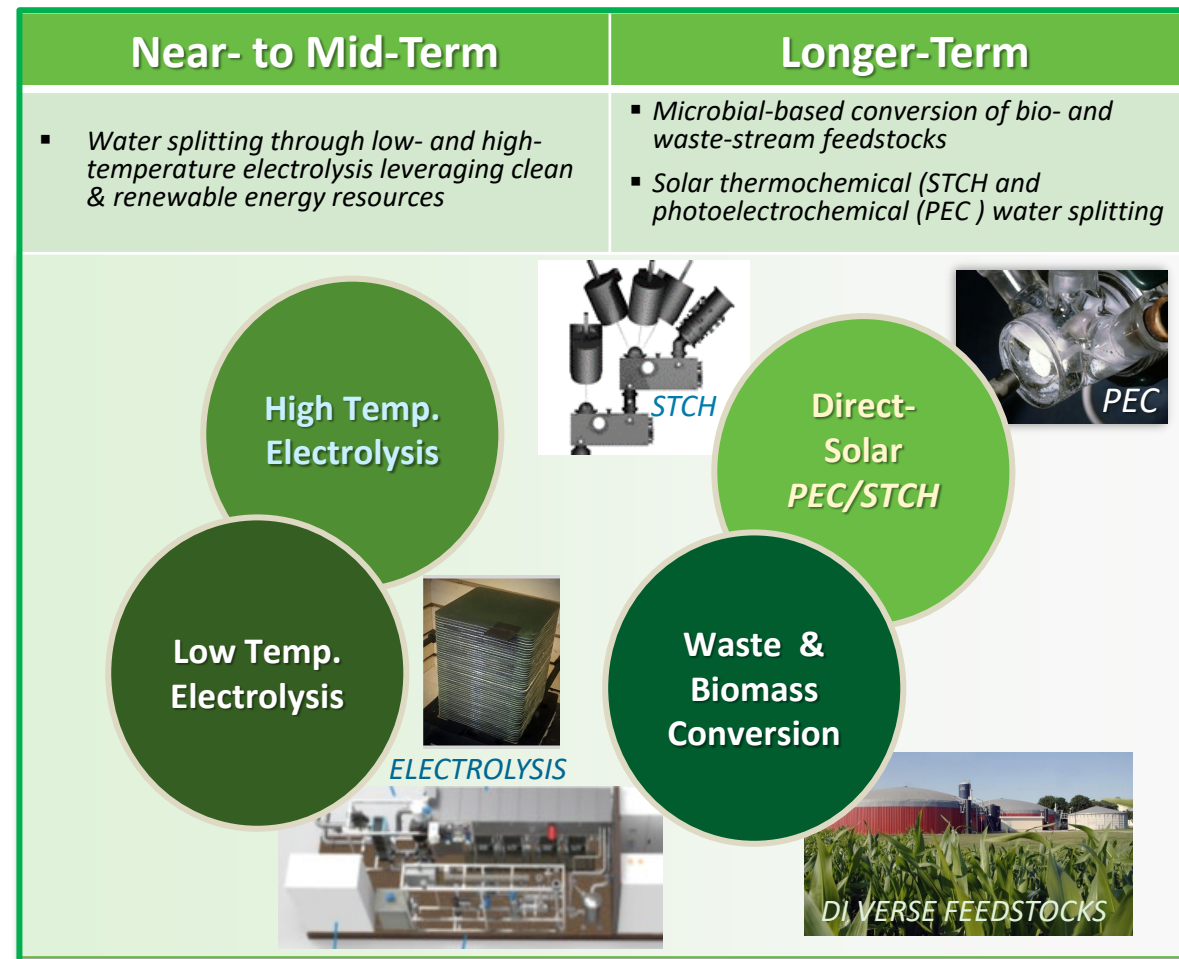
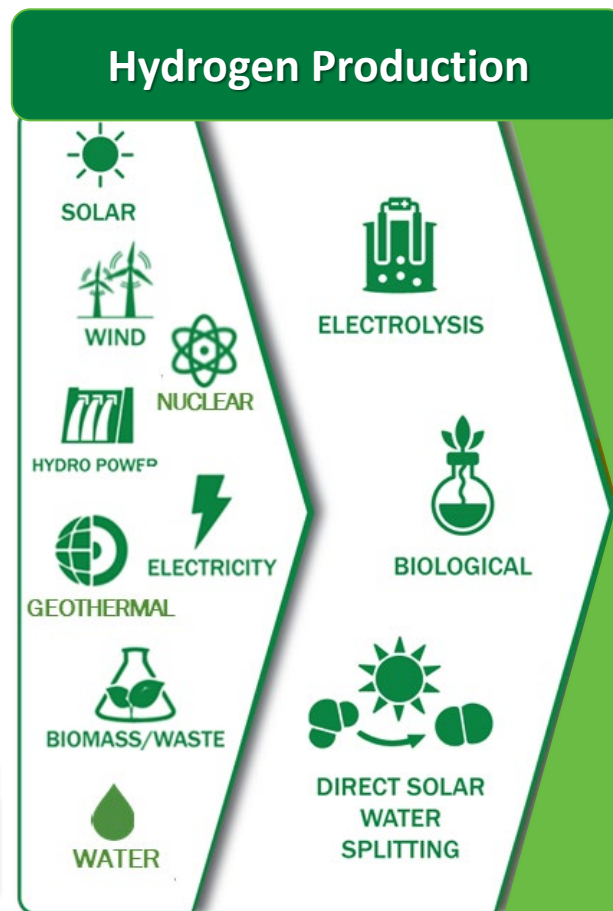
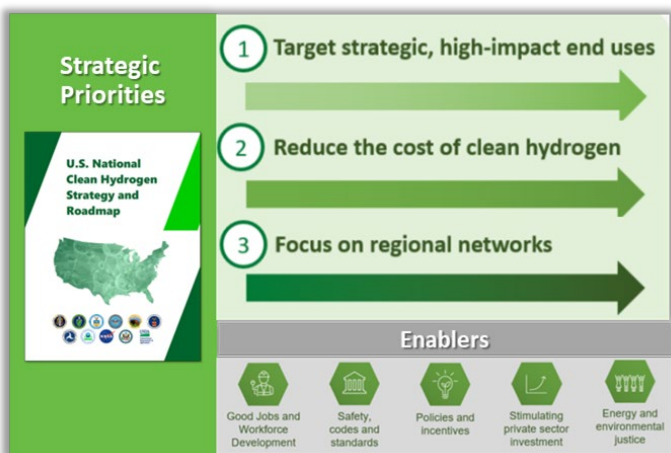
Strategic Priorities		Near-Term 2025	Mid-Term 2030	Longer Term
<b>Clean Hydrogen Production</b>	<ul style="list-style-type: none"> <li>Affordable, efficient, and durable electrolyzers for GW-scale operations</li> <li>Innovative approaches to clean H<sub>2</sub> production, beyond electrolysis</li> </ul>	→	→	→
<b>Hydrogen Infrastructure Technologies</b>	<ul style="list-style-type: none"> <li>Affordable and reliable components and systems for H<sub>2</sub> transport and dispensing in heavy-duty applications</li> <li>Advanced H<sub>2</sub> liquefaction and carrier distribution concepts</li> <li>Low-cost vessels for high-pressure gaseous and cryogenic liquid H<sub>2</sub> storage</li> <li>Innovative H<sub>2</sub> storage materials for high-density, low-pressure storage</li> </ul>	→	→	→
<b>Fuel Cell Technologies</b>	<ul style="list-style-type: none"> <li>Efficient, durable, and cost-competitive fuel cells for heavy-duty applications</li> <li>Advanced materials and components for next-generation fuel cell technologies in diverse applications</li> </ul>	→	→	→
<b>Systems Development and Integration</b>	<ul style="list-style-type: none"> <li>Transportation and H<sub>2</sub> fueling demonstrations</li> <li>Chemical and industrial processes integrating H<sub>2</sub> technologies, focusing on decarbonization</li> <li>Energy storage and power generation including integrated and resilient hybrid energy systems</li> </ul>	→	→	→
<b>Systems Analysis</b>	<ul style="list-style-type: none"> <li>Tools, modeling, and analysis to prioritize RD&amp;D and inform early-market deployments</li> <li>Regional analysis to support energy transition planning and assess impacts</li> <li>Integrated analysis to inform supply chain expansion and sustainable market growth</li> </ul>	→	→	→
<b>Safety, Codes and Standards</b>	<ul style="list-style-type: none"> <li>H<sub>2</sub> component technologies safety, including materials compatibility and environmental modeling, emphasizing near-term dispensing applications</li> <li>Safety, codes, and standards with additional emphasis on bulk storage and large-scale applications of hydrogen</li> </ul>	→	→	→
<b>Crosscutting/ Enabling</b>	<p>Collaboration within HFTO and across offices and other federal agencies to enable low-cost, high-volume domestic manufacturing and recycling, a robust domestic supply chain, good-paying U.S. jobs, regional clean hydrogen networks, and energy and environmental justice and diversity, equity, inclusion, and accessibility.</p>			

[www.energy.gov/eere/fuelcells/mypp](http://www.energy.gov/eere/fuelcells/mypp)

# Hydrogen Production Subprogram Overview

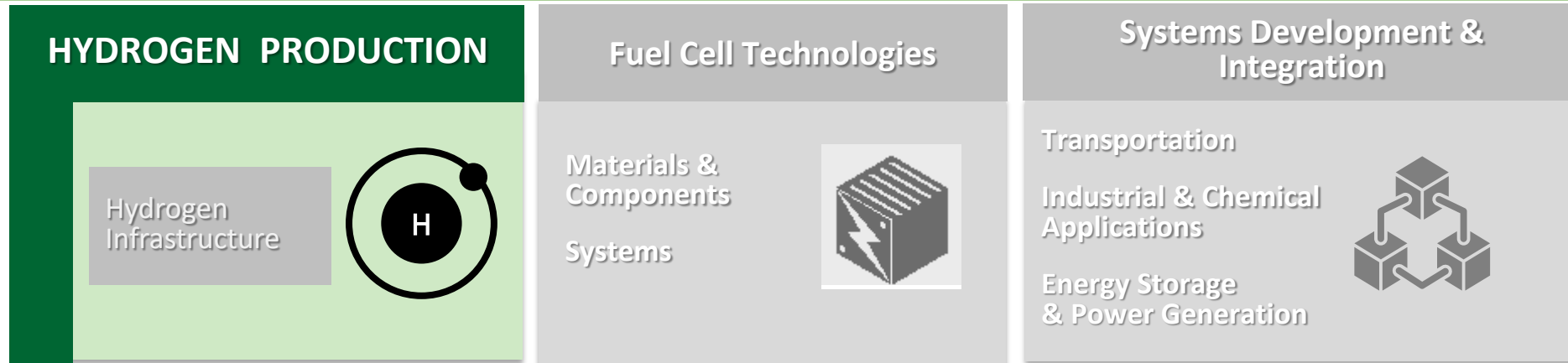


H<sub>2</sub> Production subprogram directly supports the National Clean Hydrogen Strategy and Strategic Priority #2



*Focus on hydrogen production pathways that utilize renewable/clean resources*

# Hydrogen Production Strategic Priorities



Hydrogen Production Strategic Priorities	Safety, Codes and Standards		
	Near-term 2025	Mid-term 2030	Longer- Term
<ul style="list-style-type: none"> <li>Affordable, efficient and durable electrolyzers for <b>GW-scale</b> operations</li> <li>Innovative approaches to clean H<sub>2</sub> production, beyond electrolysis</li> </ul>			
<i>Cross-cutting/enabling: manufacturing, supply chain, workforce, regional clean H<sub>2</sub> networks</i>			

Clean H <sub>2</sub> Electrolysis Program Cost Target	2026	\$2/kg H <sub>2</sub>
Hydrogen Energy Earthshot Cost Target	2031	\$1/kg H <sub>2</sub>

# The Hydrogen Production Team

## Technology Managers

### Acting Program Manager



David Peterson



McKenzie Hubert



Anne Marie Esposito



Elias Pomeroy



James Vickers



Kat Rinaldi

## Support Contractors



Leah McGovern



David Aguerrebere



Corey Schaffer

## Technical Project Officer



Kim  
Cierpik-  
Gold

## Fellows



Open  
Position



Open  
Position

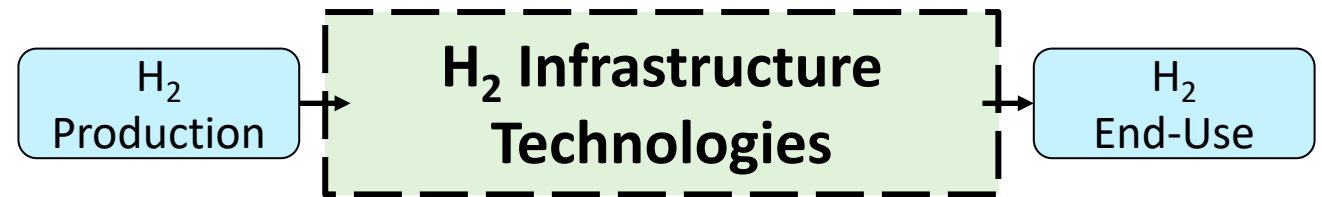
# H<sub>2</sub> Infrastructure Technologies Subprogram

Mission: To carryout RD&D activities to develop H<sub>2</sub> infrastructure technologies to enable achieving the National Hydrogen Strategy and decarbonization goals

## Infrastructure Technologies



Hydrogen may be moved or stored as a gas, cryogenic liquid, or materials-based carrier



- **H<sub>2</sub> Conditioning:** compression, liquefaction/vaporization, H<sub>2</sub> carrier hydrogenation/dehydrogenation, purification
- **H<sub>2</sub> Transmission/Distribution:** on-road trailers, pipelines, rail, marine, bulk storage, transfers, sensors/monitoring
- **H<sub>2</sub> Dispensing:** dispensers, nozzles/receptacles, breakaways, temperature control, cascade storage, compressors, pumps
- **End-Use:** on-site, on-vehicle storage

Infrastructure pathways may take place on a single property, a region, or across multiple continents (e.g., international export)

# The Hydrogen Infrastructure Technologies – Team Fantastic

## Program Manager



Ned  
Stetson



Mark  
Richards



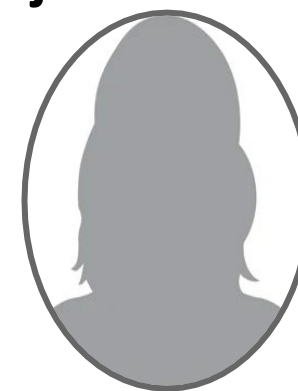
Marika  
Wieliczko



Zeric  
Hulvey



Kevin  
Carey



New  
TM/TPO



New  
TM/TPO

## Technology Managers/Technical Project Officers

## ORISE Fellows



Asha-Dee  
Celestine



Zakaria  
Hsain

## Lab Detailee



Abhi  
Karkamkar



Josh  
Farley

## Support Contractors



Nikkia  
McDonald

Haboon  
Osmond

# To Meet Decarbonization Goals – Focused on Three Sectors

- Medium & Heavy-Duty Transportation
- Chemical & Industrial Processes
- Energy Storage
- Developing Scenarios for Each

## Example: MD/HD Refueling

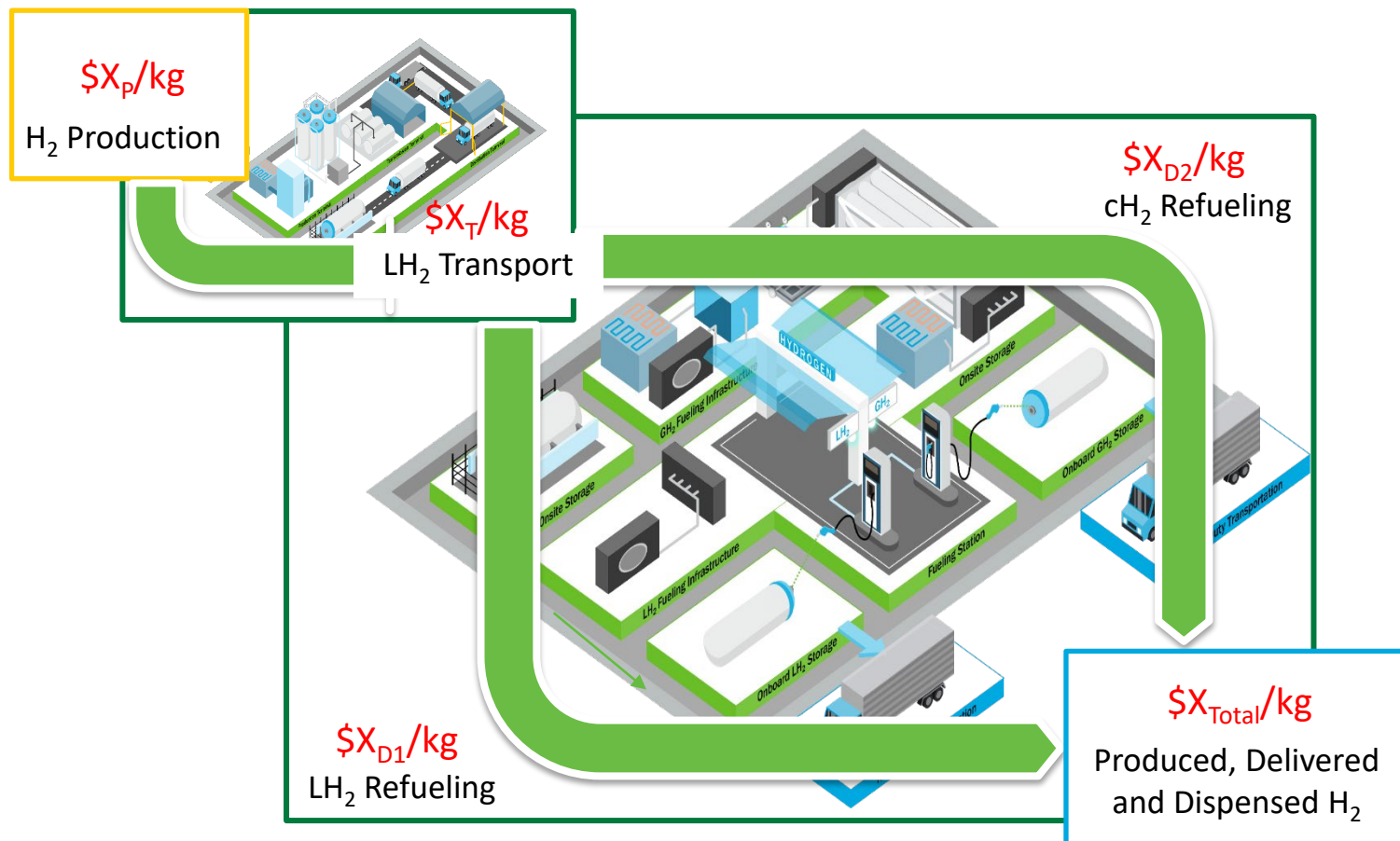
Assume LH<sub>2</sub> delivery to stations in near-term

Need to consider both cH<sub>2</sub> and LH<sub>2</sub> onboard storage

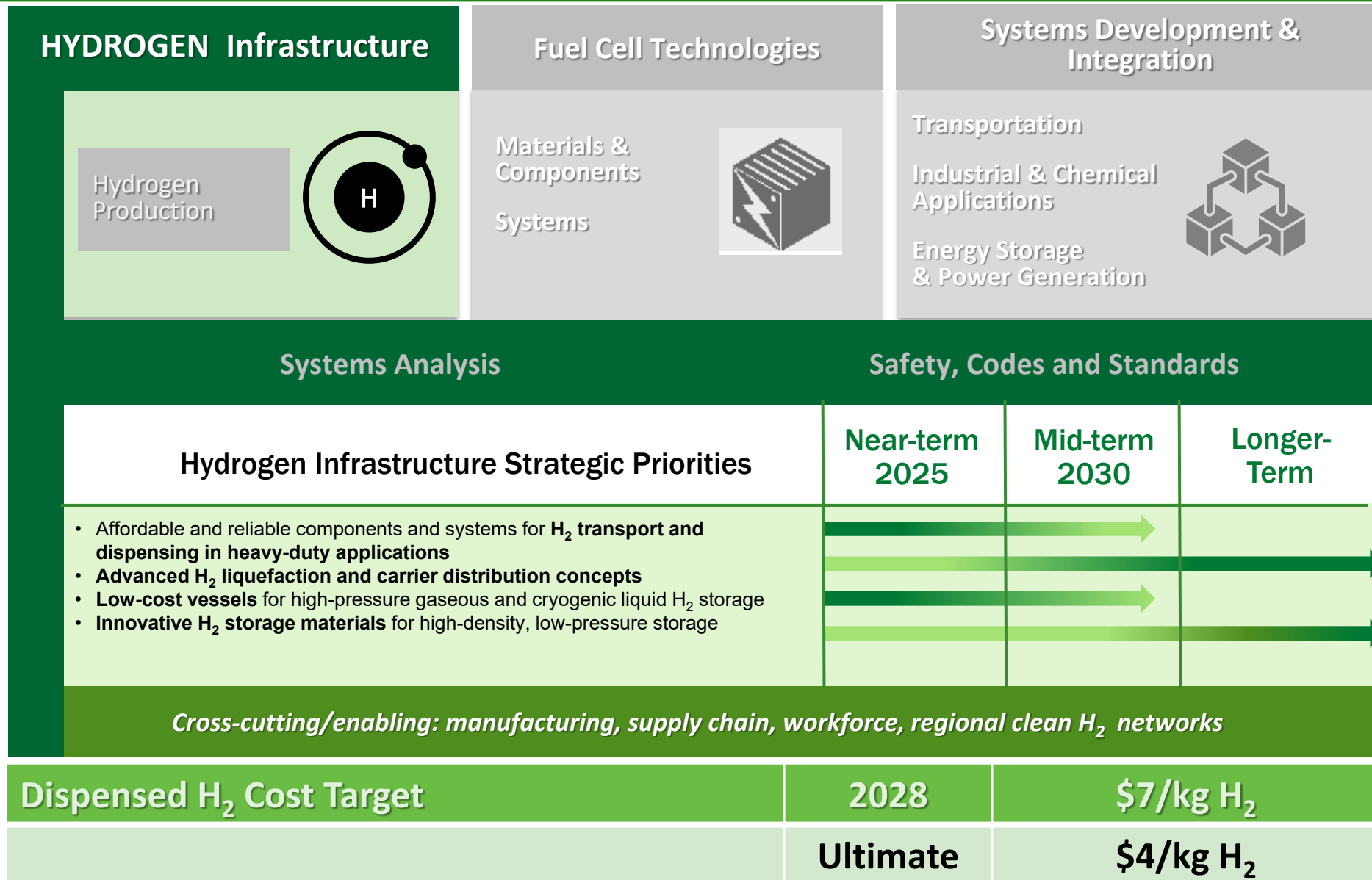
### Strategic Focus Areas

- Analysis
- Materials
- Liquefaction
- Cryopumps
- Compression
- Storage

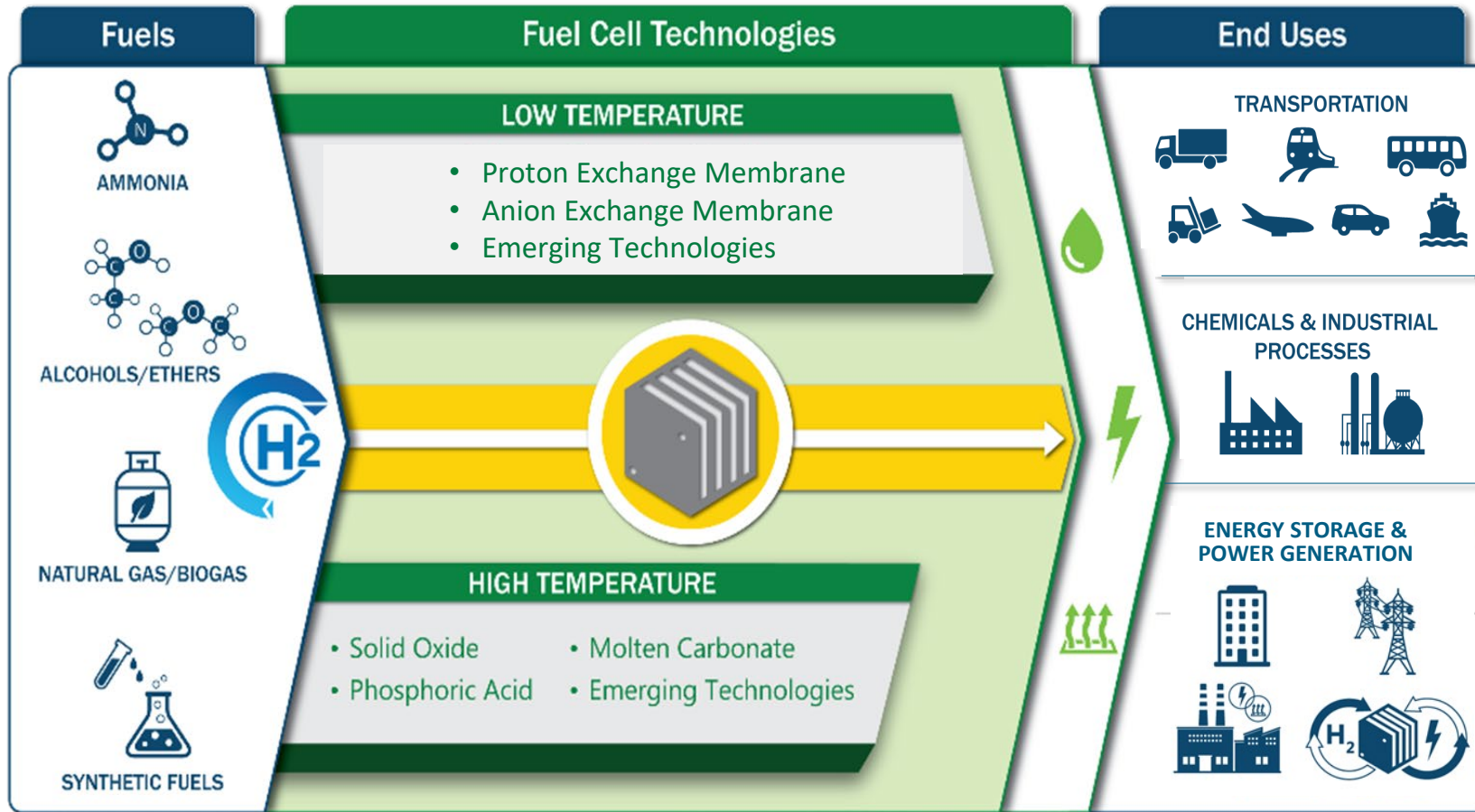
## Key Metric: Cost of Hydrogen to the End Users



# Hydrogen Infrastructure Technologies Strategic Priorities



# Fuel Cell Technologies Subprogram



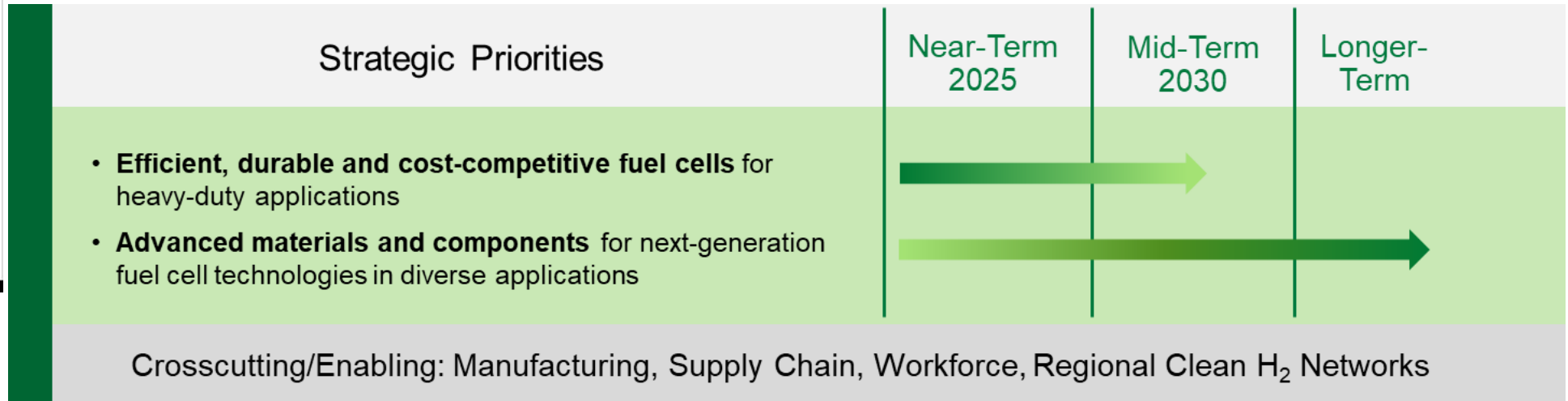
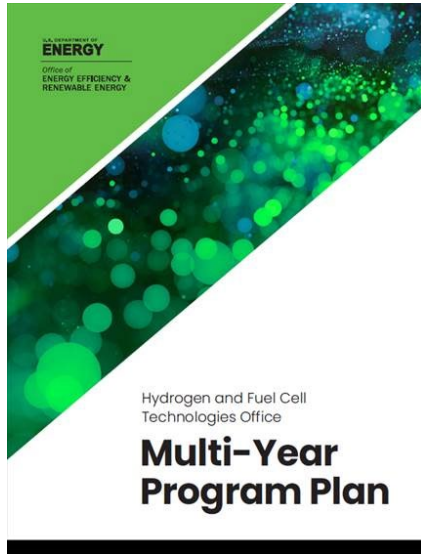
**Goal**  
*Fuel cells that are competitive with incumbent and emerging technologies across applications*

*Efforts support clean H<sub>2</sub> end-use and broader market adoption objectives as outlined in the DOE National Clean Hydrogen Strategy and Roadmap*

*Fuel cells use a wide range of fuels and feedstocks; deliver power for applications across multiple sectors; provide long-duration energy storage for the grid in reversible systems.*

[DOE National Clean Hydrogen Strategy and Roadmap \(energy.gov\)](https://www.energy.gov/doe-national-clean-hydrogen-strategy-and-roadmap)

# Fuel Cell Technologies – Strategic Priorities



Includes baselines and targets that are periodically assessed and adjusted as needed based on updated information, analysis, and stakeholder feedback

End Use	2023 Status	2030 Target	Ultimate Target
Heavy-Duty Transportation	<ul style="list-style-type: none"> <li>•Cost \$170/kW</li> <li>•Durability &gt;10,000 h</li> <li>•Peak efficiency 64%</li> <li>•PGM loading &gt;0.4 mg/cm<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>•Cost \$80/kW</li> <li>•Durability 25,000 h</li> <li>•Peak efficiency 68%</li> <li>•PGM loading ≤0.3 mg/cm<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>•Cost \$60/kW</li> <li>•Durability 30,000 h</li> <li>•Peak efficiency 72%</li> <li>•PGM loading ≤0.25 mg/cm<sup>2</sup></li> </ul>

# The Team

**Dimitrios Papageorgopoulos**  
Fuel Cell Technologies Program Manager  
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Scan for  
Open  
Positions



## Technology Managers



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**Open position**

Technology Manager



**Open position**

Technical Project Officer

## Fellows and Contractors



**John Kopasz**

Technical Advisor from ANL  
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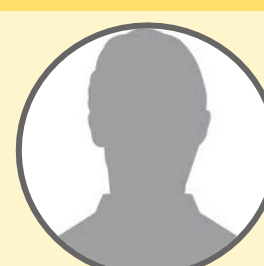
**Mike Ulsh**

On Detail from NREL  
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**Open position**

Fuel Cell Technologies Fellow



**Open position**

Manufacturing & Recycling Fellow



**Ty Genard**

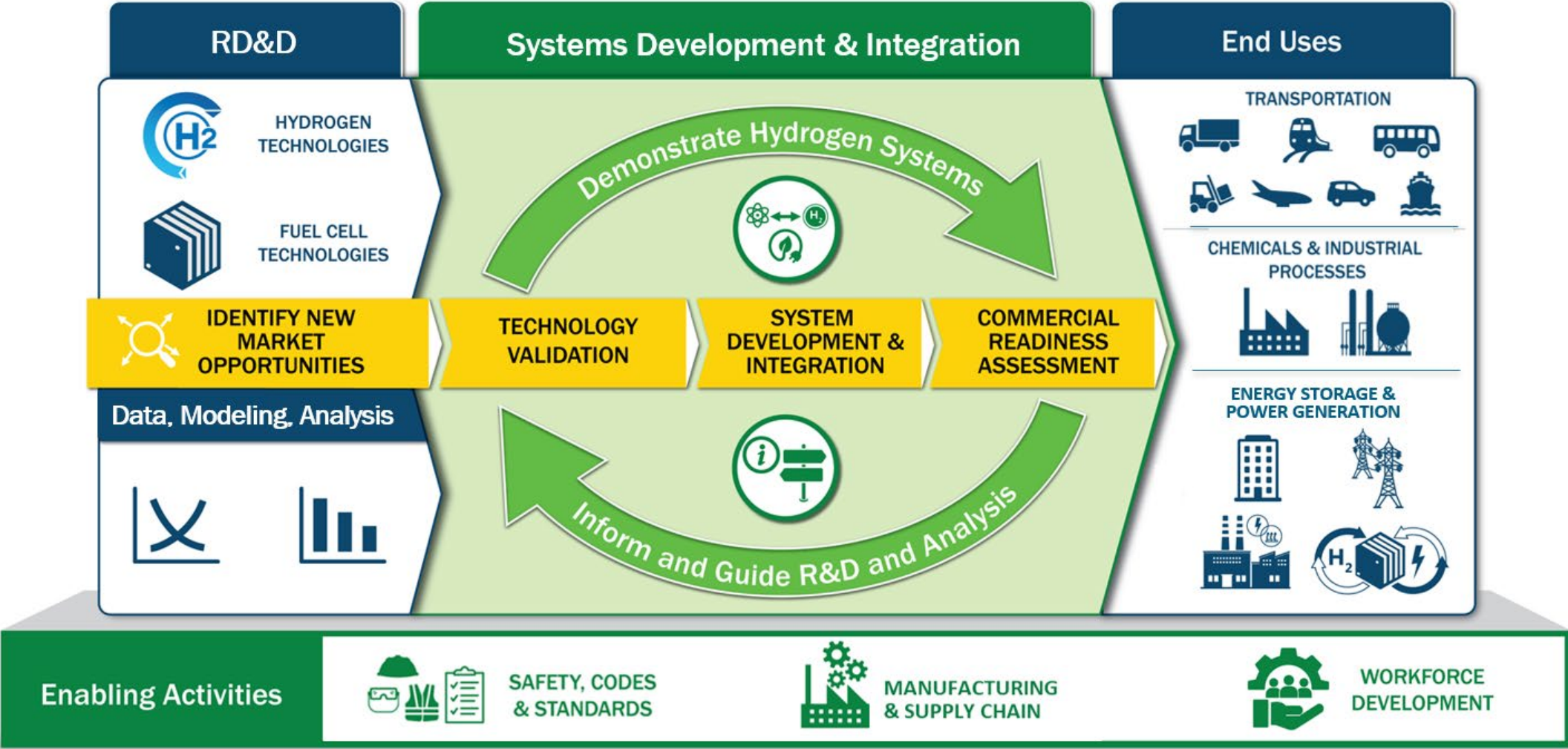
Contractor  
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**Joe Troy**

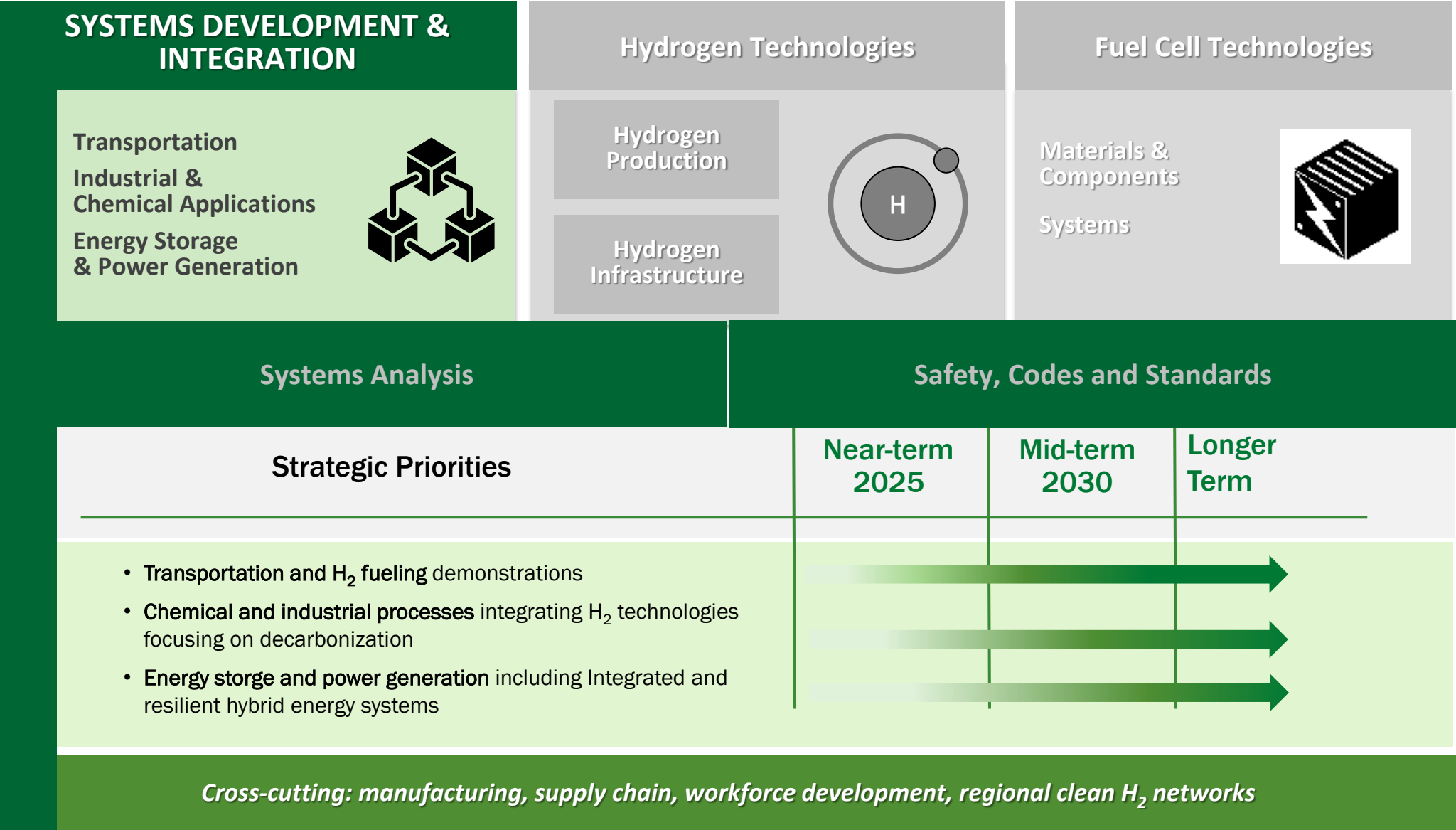
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# Systems Development & Integration Subprogram Overview

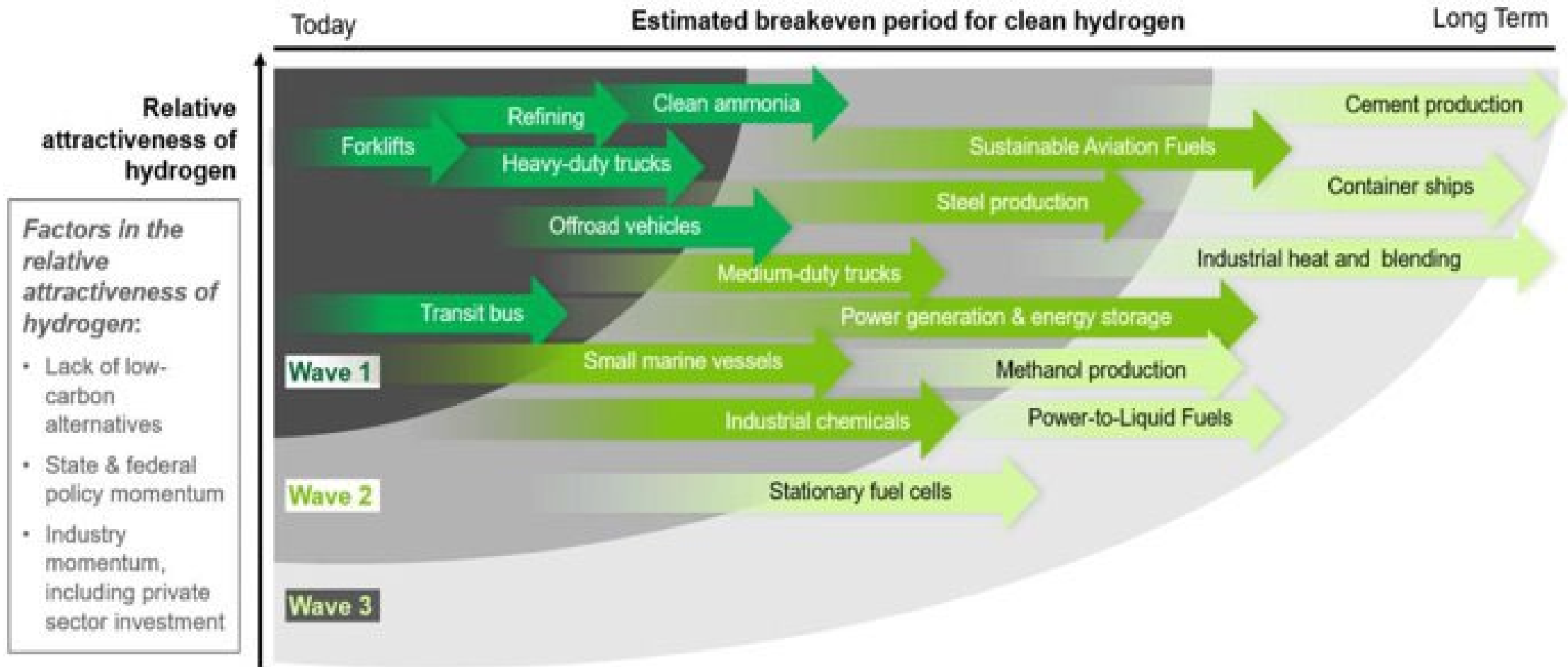


*Bridging the Gap Between R&D and Deployments with First-of-a-Kind Integrated H<sub>2</sub> Demonstrations*

# Strategic Priorities – Guiding SDI RD&D



# Strategic Priorities – Guiding SDI RD&D



# Systems Development & Integration (SDI) Team



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H2Hubs, Grid Integration & Power Gen



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Grid Integration & Power Gen



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Chemical & Industrial



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Technology Manager



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Technical Project Officer



**Elizabeth Brennan**  
ORISE Fellow



**Ashley Bird**  
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ORISE Fellow



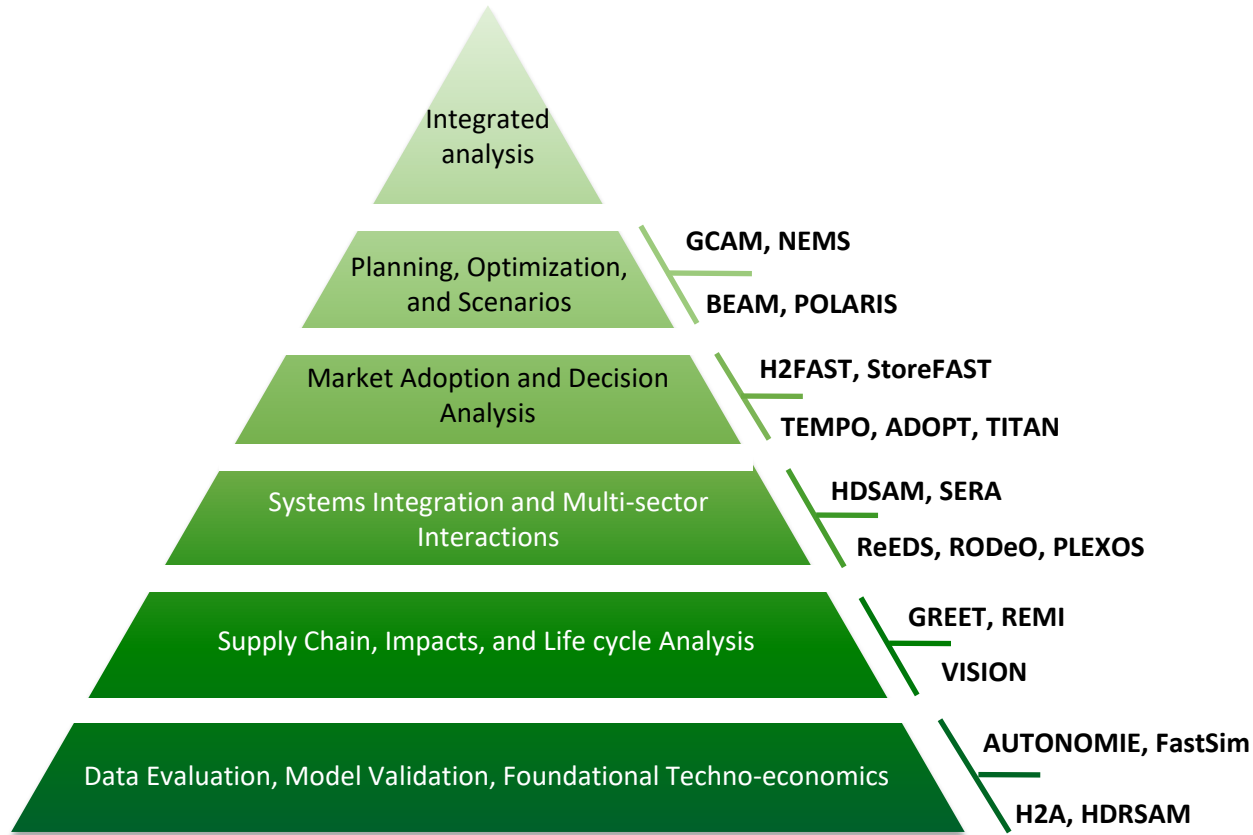
**Will Luppino**  
[Will.Luppino@ee.doe.gov](mailto:Will.Luppino@ee.doe.gov)  
Contractor Team Lead - Contractor



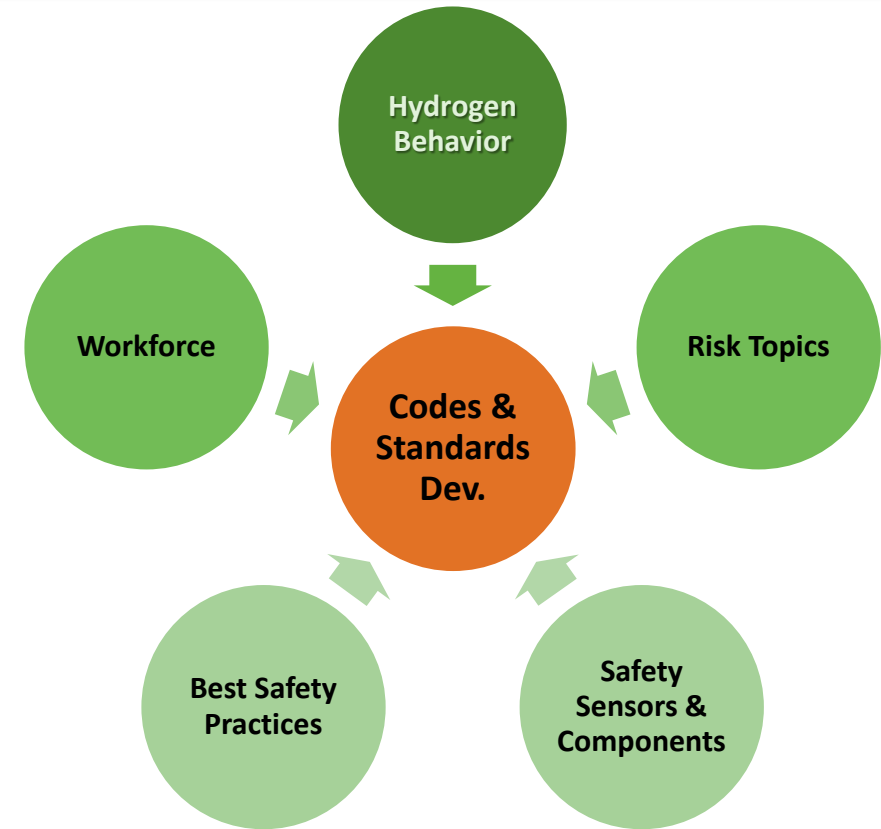
**Tom Jacobs**  
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Program Analyst - Contractor

# Analysis, Codes & Standards Subprogram Overview

Enabling activities to inform research, development, demonstrations and deployments



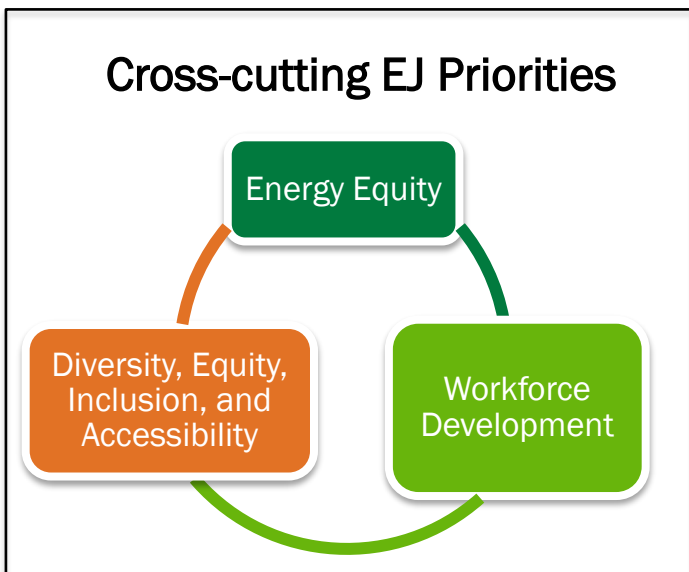
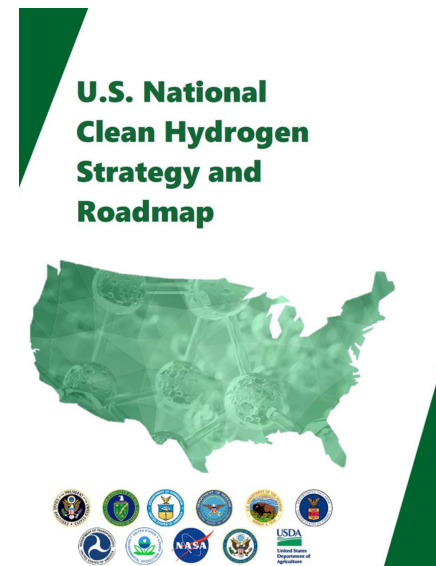
Systems Analysis identifies priority markets for hydrogen technologies and assesses impacts



Safety, Codes, & Standards informs safe design and operation of technologies, and addresses regulatory and permitting challenges.

# Analysis, Codes & Standards Priorities

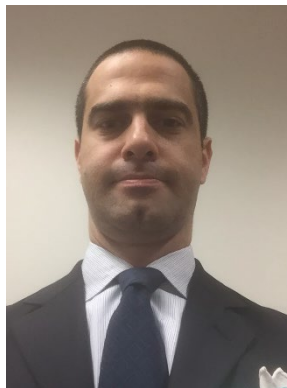
Data, Modeling, Analysis			
Strategic Priorities	Near-term 2025	Mid-term 2030	Longer-term
<ul style="list-style-type: none"> <li>• <b>Tools, Modeling &amp; Analysis</b> to prioritize RD&amp;D and inform early-market deployments</li> <li>• <b>Regional Analysis</b> to support energy transition planning and assess impacts</li> <li>• <b>Integrated Analysis</b> to inform supply chain expansion and sustainable market growth</li> </ul>	→	→	→



Safety, Codes and Standards			
RD&D Priorities	Near-term 2025	Mid-term 2030	Longer Term
<ul style="list-style-type: none"> <li>• <b>Codes and standards</b> to enable global harmonization, safety, and commercial readiness</li> <li>• <b>Prioritize safety</b> by sharing resources, best practices, and lessons learned</li> </ul>	→	→	→

# The Dream Team!

## Systems Analysis Sub-Program



**Jacob Englander**  
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Senior Advisor

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## Program Manager



**Neha Rustagi**

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## Safety, Codes & Standards Sub-Program



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GREET Fellow

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**Tomas Green**  
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*Vacancy  
for ORISE  
Fellow*



**Natalie Alvarado**  
ORISE Fellow

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**QUESTIONS?**

***Let's Ask the Team!***



# AMR: HFTO Subprogram Tracks

DOE Hydrogen Program 2024 AMR Program-at-a-Glance																			
Topic	Monday, May 6		Tuesday, May 7						Wednesday, May 8						Thursday, May 9				
	Room	Hydrogen Production Technologies	Hydrogen Infrastructure Technologies	Fuel Cell Technologies	Systems Development and Integration	Analysis, Codes and Standards	Intra-Agency Activities	Hydrogen Production Technologies	Hydrogen Infrastructure Technologies	Fuel Cell Technologies	Systems Development and Integration	Interagency Activities	Intra-Agency Activities	Hydrogen Infrastructure Technologies	Fuel Cell Technologies	Systems Development and Integration			
		Regency E	Regency AB	Potomac III-VI	Regency CD	Regency F	Washington	Regency E	Regency AB	Potomac III-VI	Regency CD	Regency F	Washington	Regency AB	Potomac III-VI	Regency CD			
	*All times in Eastern Time	8:00 AM	Continental Breakfast						8:00 AM	Continental Breakfast						8:00 AM	Continental Breakfast		
		8:30 AM						8:30 AM		IA013					8:30 AM	ST237			
1:00 PM	Welcome Opening Remarks Keynote Speeches	9:00 AM	P000	IN000	FC000	SDI000	SA-SCS000	FE000	9:00 AM	P216	SCS037	FC352	TA048	IA001		9:00 AM	ST241	FC331	TA053
		9:30 AM	ELY-BIL001	IN025	FC160	TA056	SA187	FE001	9:30 AM	P218	IN043	FC363	TA037	IA002		9:30 AM	ST001	FC330	TA052
		10:00 AM	SDI006	H2041		TA057	SA188	FE005	10:00 AM	P209	SCS042	FC327	TA030	IA003	JO000	10:00 AM	ST235	FC355	
		10:30 AM	Break						10:30 AM	Break						10:30 AM	Break		
1:30 PM	Plenary	11:00 AM	P148	IN039	FC339	TA058	SA178	FE003	11:00 AM	P213	ST127	FC336	TA062	IA004	BETO000	11:00 AM	OCED001		
		11:30 AM		IN001a		SCS031	SA174	FE004	11:30 AM	P214		FC344	SDI002	IA006	WETO000	11:30 AM	OCED002		
		12:00 PM		IN001b		SA181	FE016	12:00 PM	P215	ST209	FC345	SDI001	IA008	NE000	12:00 PM	OCED003			
3:15 PM	Break	12:30 PM	Lunch (provided)						12:30 PM	Lunch (provided)						12:30 PM	Lunch (provided)		
3:45 PM	Plenary	1:45 PM	P196	IN021	FC353	TA016	SCS019	FE002	1:45 PM	P208	ST212	FC348	TA018/SDI004	IA010	BES000	1:45 PM	OCED004		
		2:15 PM		IN016	FC337	TA059	SCS028	FE007	2:15 PM	P210	ST213	FC347	TA028	IA011	EJE000	2:15 PM	OCED005		
		2:45 PM		IN036	FC338	TA065	SCS021	FE011	2:45 PM	P212	ST217	FC346	TA039	IA012	AMMTO000	2:45 PM	OCED006		
		3:15 PM	Break						3:15 PM	Break						3:15 PM	OCED007		
4:45 PM	Plenary	3:45 PM	P204	IN015	FC349	TA001	SCS001	FE008	3:45 PM	P211	ST218	MNF-BIL001	NE001		OTT000	3:45 PM			
		4:15 PM	P170	IN040	FC350	TA029	SCS011	FE010	4:15 PM	P217	ST234		TA044		ARPAE000	4:15 PM			
		4:45 PM	P200	IN034	FC351	TA063	SCS010	FE006	4:45 PM	P205	ST242	FC354	TA051/TA060		EIA000	4:45 PM			
		5:15 PM	P179	IN035			FE009	5:15 PM	P206	ST243		TA064			5:15 PM				
5:30 PM	AMR Awards Closing Remarks	5:30 PM	POSTER SESSION						5:30 PM	POSTER SESSION						5:30 PM			
6:00 PM		7:00 PM							7:00 PM							7:00 PM			

# Mahalo Nui Loa from Planet Earth...

**On Behalf of HFTO  
Thanks to All  
& Welcome to AMR!**



# H2



U.S. DEPARTMENT OF  
**ENERGY**

## Hydrogen Program 2024 Annual Merit Review and Peer Evaluation Meeting

**Michael Berube**

*Deputy Assistant Secretary for  
Sustainable Transportation & Fuels,  
Office of Energy Efficiency and  
Renewable Energy  
U.S. Department of Energy*



May 6, 2024