

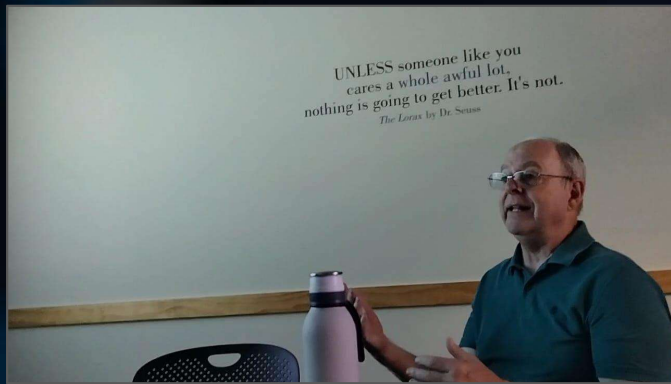
Club Name : Hydrogen 4 You

Project Title : Next Generation Steam Methane Reforming - an energy efficient, non-toxic, approach to power up transportation

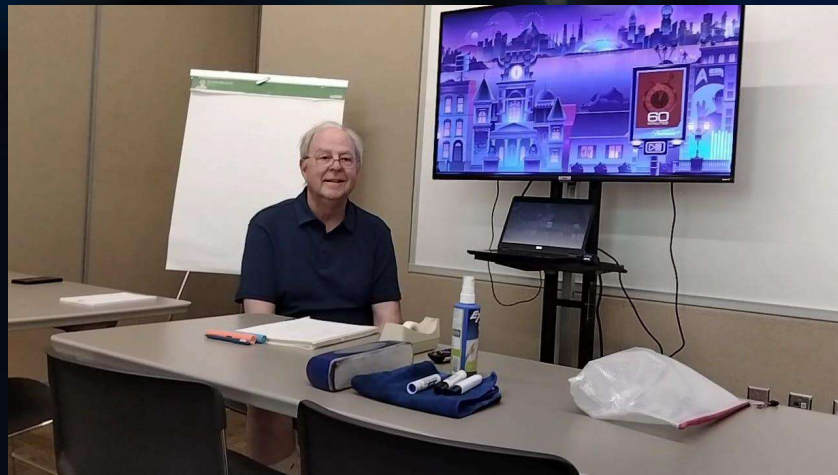
Advisor's name : Dennis Walters, Chief of Staff, STARS Technology Corporation

The problem of global warming gave me an inspiration to research clean and economically viable renewable energy options as a solution towards a greener and sustainable future. In this process, I was captivated by the ability of hydrogen to be a fuel source and I researched and found that a company, STARS Technology Corporation, operating in Southern California was extensively working on producing hydrogen to power the transportation sector. I approached Dennis Walters, Chief of Staff at STARS Technology Corporation who accepted to be my mentor. I had several hours of brainstorming sessions with him in understanding the Steam Methane Reforming (SMR) process in which hydrogen is produced from methane obtained from biomass. This process is adopted by STARS for producing hydrogen in a cleaner way. With this learning as a starting point, I applied hydrogen as a fuel source and came up with innovative designs of tunnel boring machines and street cars. I designed the novel hydrogen powered tunnel boring machine to help provide healthier conditions for construction workers that are otherwise powered by fossil fuels creating emissions. Besides, the hydrogen powered street car was designed for better mobility which is otherwise limited by tracks and electrical lines. As a next step, to educate the community, I designed a poster on SMR process and educated the transportation related professionals about how hydrogen can be produced onsite. I conducted this outreach at Green Transportation Summit and Expo 2023 and was well received. I approached and gave a presentation to the leadership of Citizens Climate Lobby group, a local climate advocacy group. Based on their feedback I came up with simpler content for explaining SMR methods to general audience. I also gave extensive presentations to Tri-City Chamber of Commerce, the City of Richland, and the City of Pasco who in turn posted my presentations on Facebook and Youtube. This way the importance of hydrogen gained outreach well and beyond my community. Dennis Walters supported the outreach extensively by posting my video on LinkedIn which gave visibility to professionals in his network. In this way, the project started through brainstorming and learning sessions, and further reached a large audience who have appreciated the need for hydrogen for a greener future.

Goal and initiatives: Learning about hydrogen production, brainstorming ideas, and developing best case scenarios for the transportation sector



Learned about Hydrogen production through Steam Methane Reforming (SMR) process from Dennis Walters, Chief of Staff, STARS Technology Corporation



Brainstormed with Dennis and arrived at a preferred case scenario highlighting the need for high quality hydrogen in public transit

Nirbhuy Arun

Age: 8

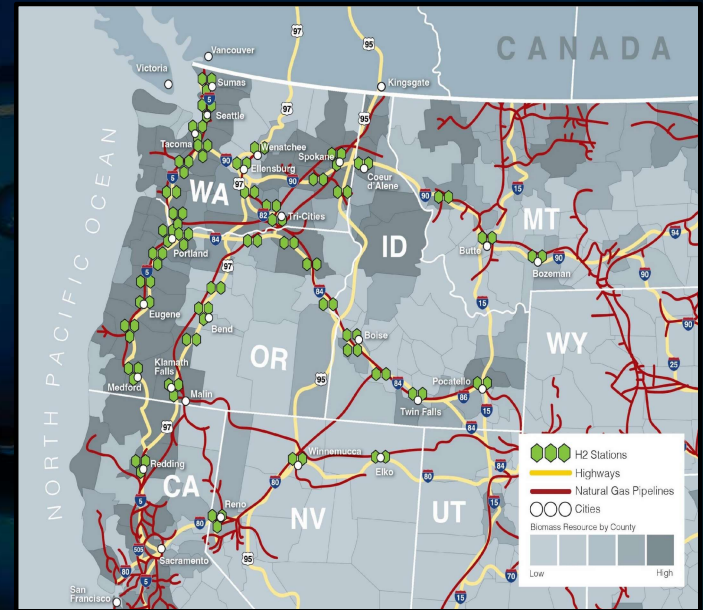
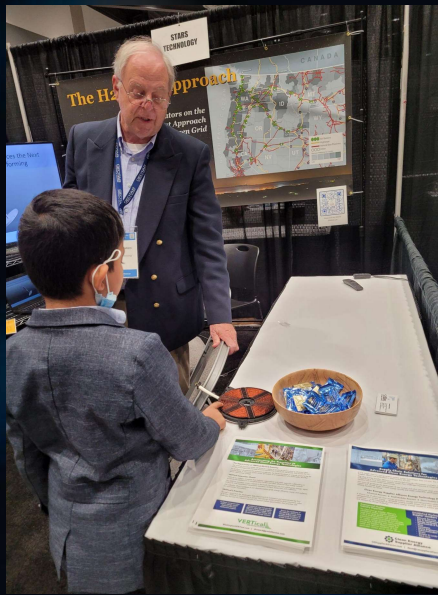


In my opinion, the preferred scenario is:

- You can purchase high quality hydrogen.
- You just need to purchase Hydrogen, and fuel the buses.
- Finally, the probability that the on-site bus company will have a vapor cloud, jetfire, or an explosion is less because the bus company has small Hydrogen storage tanks. .

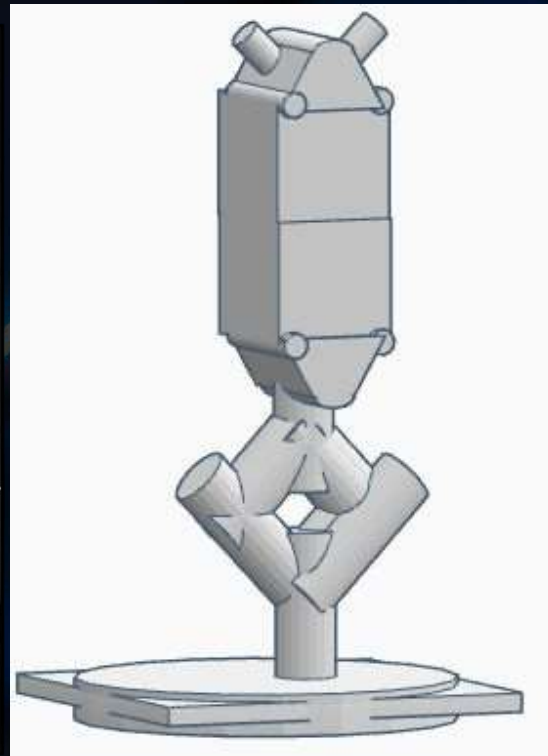
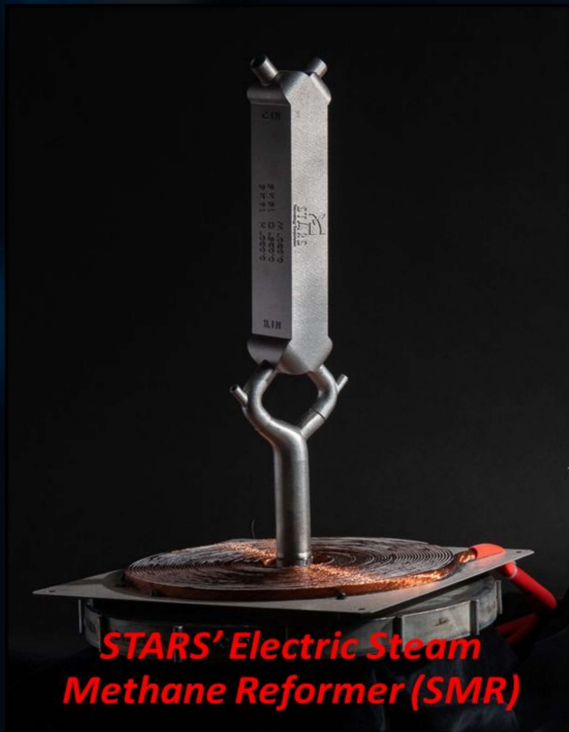
Best case scenario developed for bus company mentioning the need for high quality hydrogen

Initiatives: Learning about STARS Technology Corporation's heat exchanger used in hydrogen production. Learnings about STARS' vision in mass producing hydrogen



Dennis Walters thoroughly explained to me about the heat exchanger used at STARS at the Green Energy Transportation Expo 2023, Tacoma, Washington. Also learned about STARS goal of building fueling stations along the Natural gas pipelines as a way to mass produce hydrogen at a lower cost.

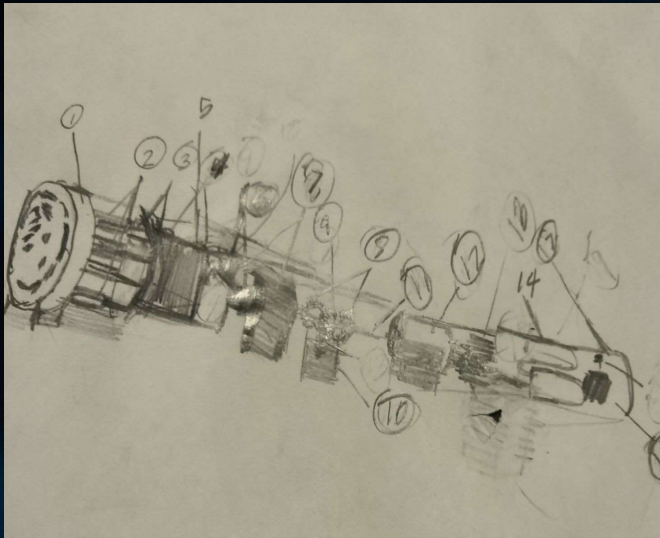
Designing: Developed TinkerCAD 3D Models of heat exchanger used for hydrogen production at STARS Technology Corporation



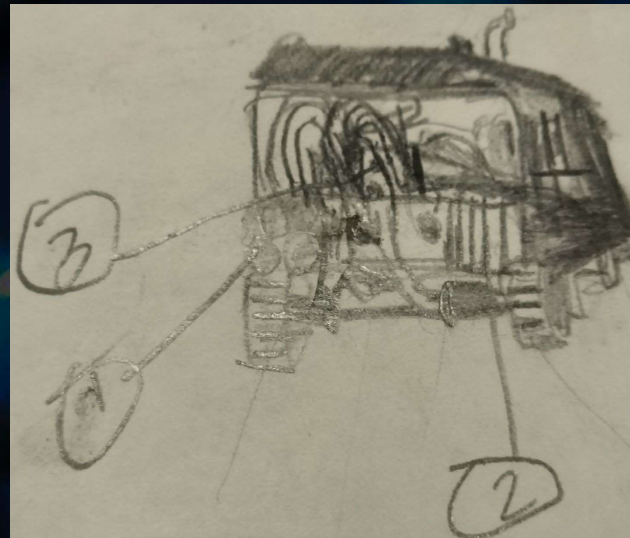
I learned from STARS the components of the hardware used in producing hydrogen are 3D printed from a program called SolidWorks. STARS' Electric Steam Methane Reformer (SMR) has a heat exchanger and a reactor.

I later developed the TinkerCAD 3D model version of STARS SMR and heat exchanger.

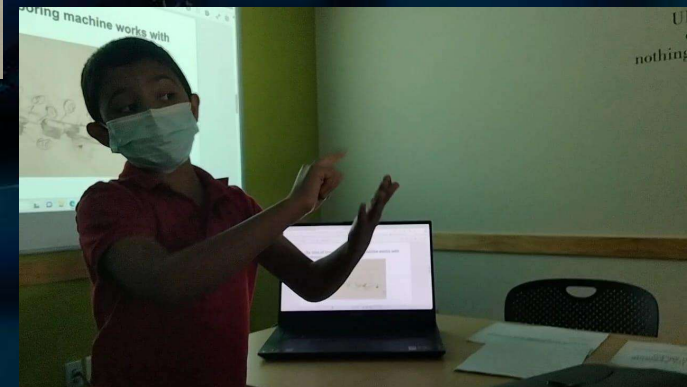
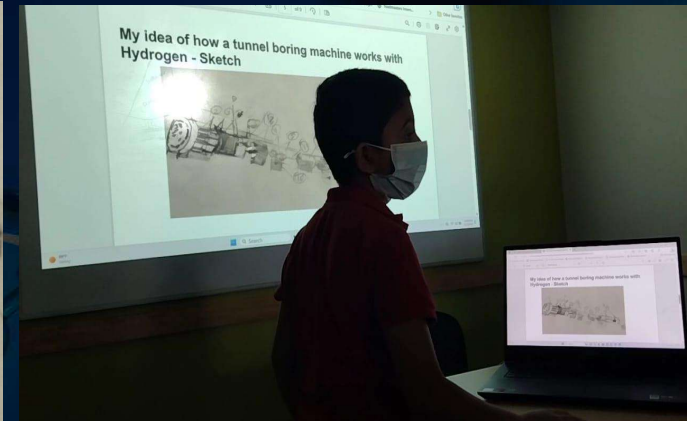
Taking the learning beyond and innovating novel designs:



I designed a novel tunnel boring machine powered by hydrogen for providing a greener and healthier environment for construction workers which is otherwise powered by fossil fuels creating emissions.

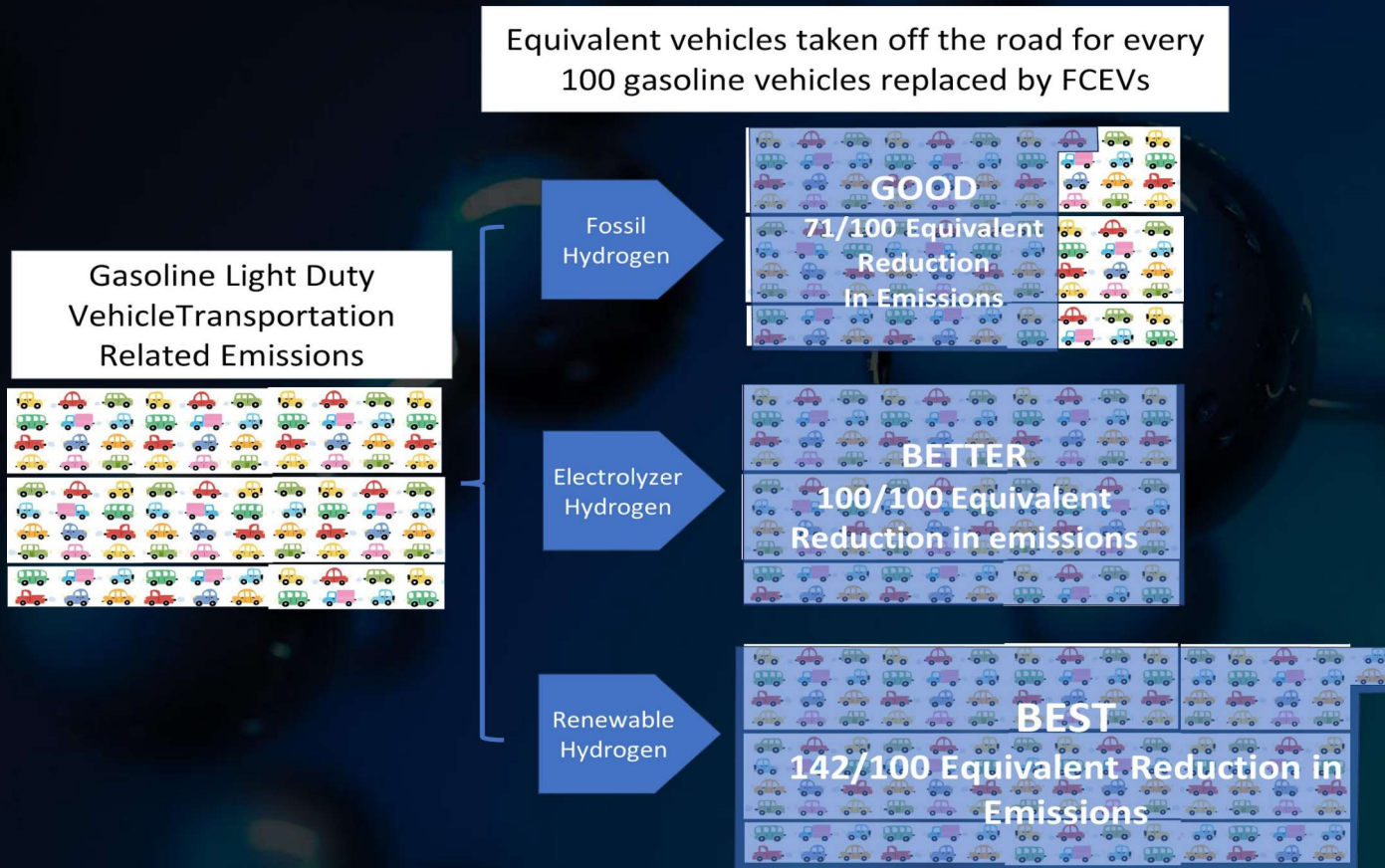


Here is my design of novel street car powered by hydrogen for better mobility which is otherwise limited by tracks and electrical lines.

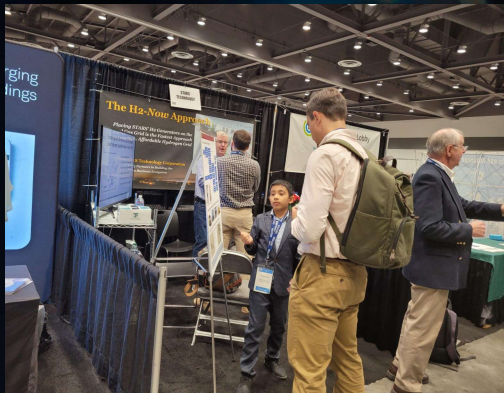
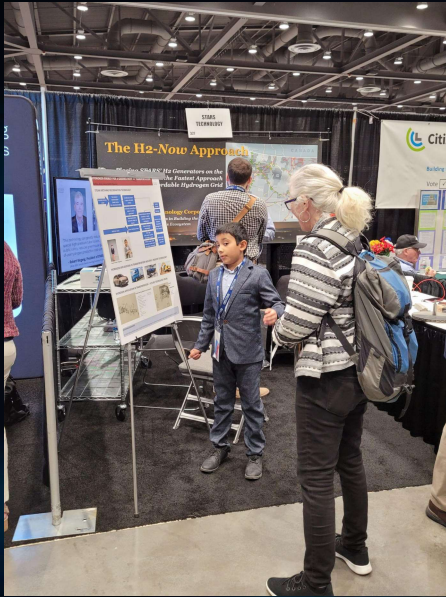


I presented my novel ideas to STARS and received feedback

Outreach Content : Emphasis of hydrogen based transportation as a pathway to a carbon negative future using quantitative models to gain insight.



Outreach events: Green Transportation Summit and Expo



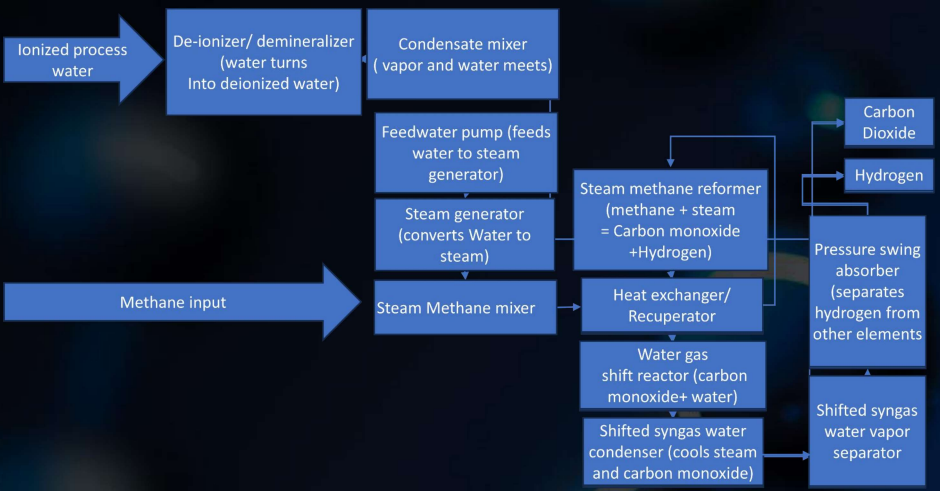
With the mentorship from STARS, I developed a poster on SMR technology for hydrogen production and educated transportation related professionals about how hydrogen can be produced on site for fleet operators of fuel cell vehicles. The Expo was well attended. I spoke to many and my outreach was successful.

Outreach: Citizens Climate Lobby



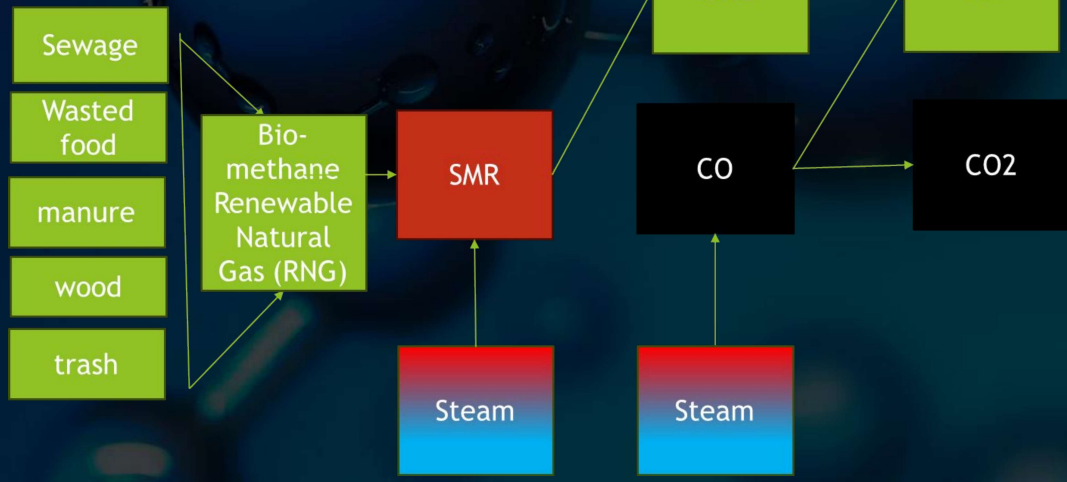
I made technical presentations in our community to the leadership of Citizens Climate Lobby, a local climate advocacy group. I received feedback to turn technical content to simpler versions to reach various audiences. I implemented the feedback and came up with a simple version of explaining the complex SMR process for producing Hydrogen. My model helped me to reach out to various audiences.

Implementing feedback in outreach content development



Content for general audience

Content for technical audience

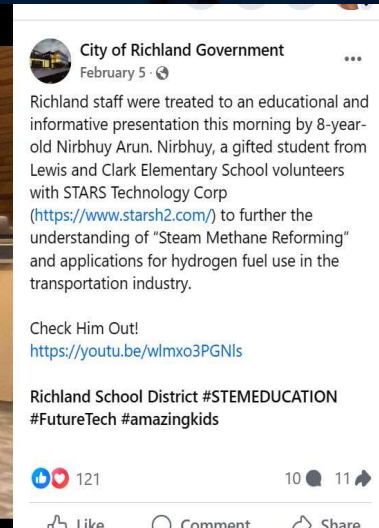
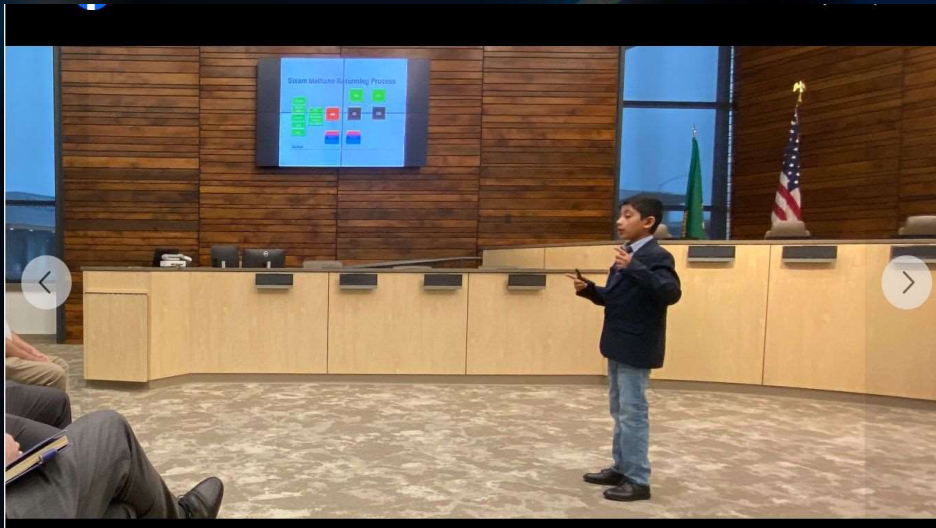


Outreach at Tri-Cities Economic Development Council



I approached Tri-Cities Economic Development Council (TRIDEC) and delivered a presentation on the technology behind hydrogen production through SMR. I also showcased my innovative ideas of applying hydrogen technology in street cars and tunnel boring machines. The Council appreciated my outreach efforts in educating the community about the impact of hydrogen. They also showcased my efforts on their Facebook page which reached wider audiences.

Outreach: City of Richland Transportation Department



Over 30 city workers from a variety of disciplines in environment and energy sector attended the presentation at the City of Richland. The outreach led to several thought provoking questions and the transportation sector at the City of Richland was well convinced. City of Richland valued the need for hydrogen and showcased my presentation on Youtube and Facebook. The presentation indeed got visibility to my whole school district. Showcasing on social media extended the outreach above and beyond my community. The posts received over 200 responses from our city which showed the impact of outreach.

Youtube

<https://youtu.be/wlmxo3PGNIs>

LinkedIn as an Outreach platform for professional audience



Dennis Walters • 3rd+

Chief of Staff at STARS Technologies Corporation

2mo •

+ Follow ...

I want to share with you a young student who is working with STARS to learn about how hydrogen is made using steam methane reforming.

Nirbhuy Arun is 9 years old. I have had the pleasure of answering his questions about the STARS steam methane reformer that is currently undergoing its first commercial demonstration at SunLine Transit Agency in Thousand Palms California. Well Done Nirbhuy!!!

<https://lnkd.in/gZrPpYfz>



Nirbhuy Arun - City of Richland Presentation

[youtube.com](https://www.youtube.com)

Dennis Walters, Chief of Staff, STARS technology was very supportive in showcasing my outreach videos on LinkedIn. This indeed reached various professional audiences throughout his network.

Outreach events: City of Pasco



I also conducted a thorough outreach to various City of Pasco disciplines. I emphasized the advantages of producing hydrogen from biomass, and touched upon the economics behind low cost hydrogen production. The questions in this presentation emphasized the need for the audience to know the abundance of biomass as a near future solution for producing hydrogen in a greener way.