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Power for all humankind

NuScale Power

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Oregon Senate Energy and Environment Committee

Dr. José Reyes
Co-founder & Chief Technology Officer

NuScale Update

NuScale Power provides scalable advanced nuclear technology for the production of electricity, heat, and clean water to improve the quality of life for people around the world.

- 1st Small Modular Reactor to earn US NRC Design Approval in Aug 2020.
  - No AC/DC power required for safety
- $1B private/public investment to date
- 400 employees in 5 US offices and one office in London
  - 323 located in our Corvallis and Portland offices
- 560 patents pending or granted in 20 countries.
- Completed >$100M in test programs
- First project is the UAMPS Carbon Free Power Project in Idaho (2029 COD).

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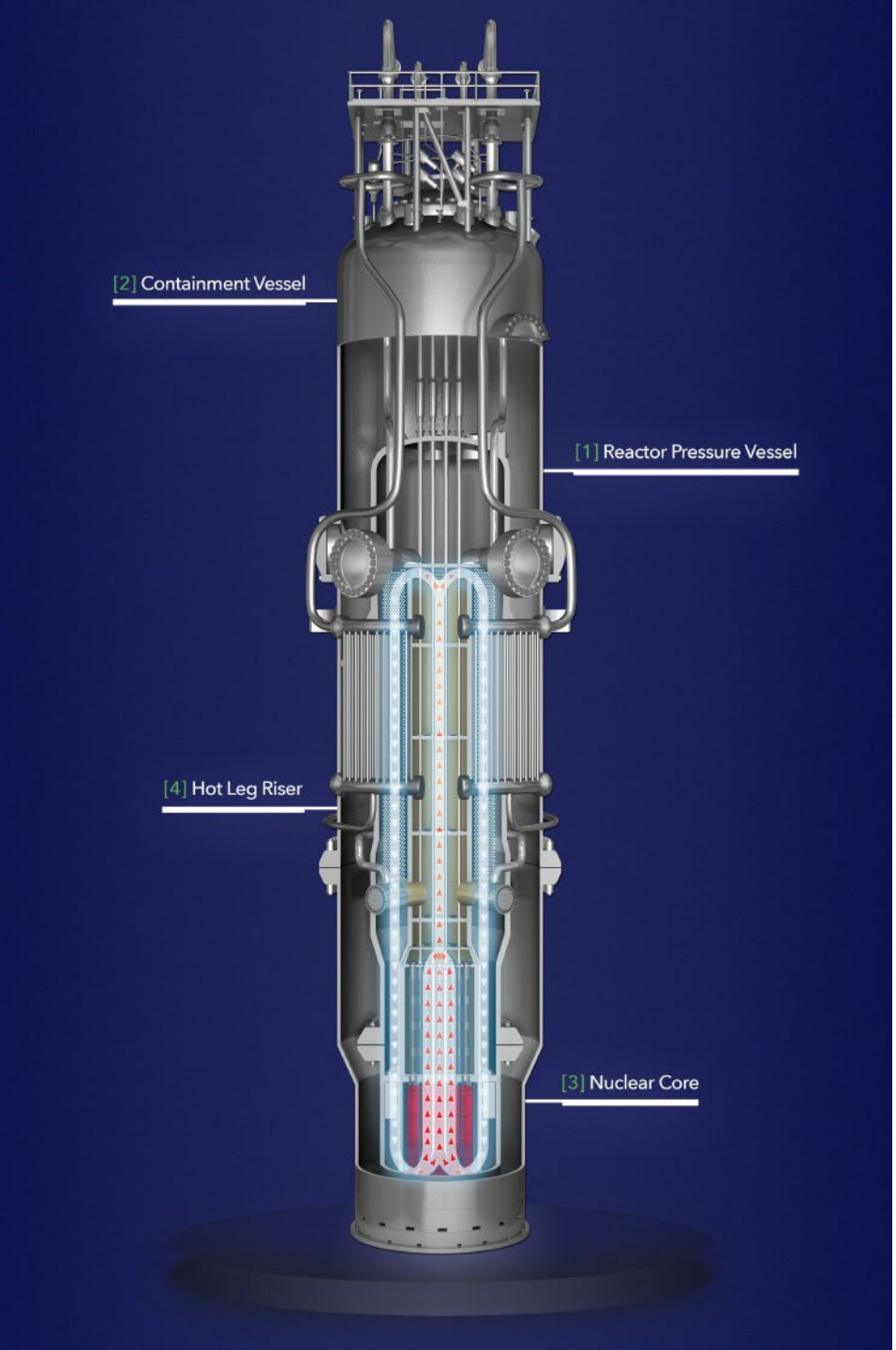
Core Technology: NuScale Power Module™



- A **NuScale Power Module™** (NPM) includes the reactor vessel, steam generators, pressurizer, and containment in an **integral package** – simple design that eliminates reactor coolant pumps, large bore piping and other systems and components found in conventional reactors
- Each module produces **up to 77 MWe**
  - Small enough to be factory built for easy transport and installation
  - Dedicated power conversion system for flexible, independent operation
- Modules are incrementally added to match load growth
  - Up to **12 modules for 924 MWe** gross output
  - Smaller power plant solutions available for 4-module (308 MWe) and 6-module (462 MWe) plants

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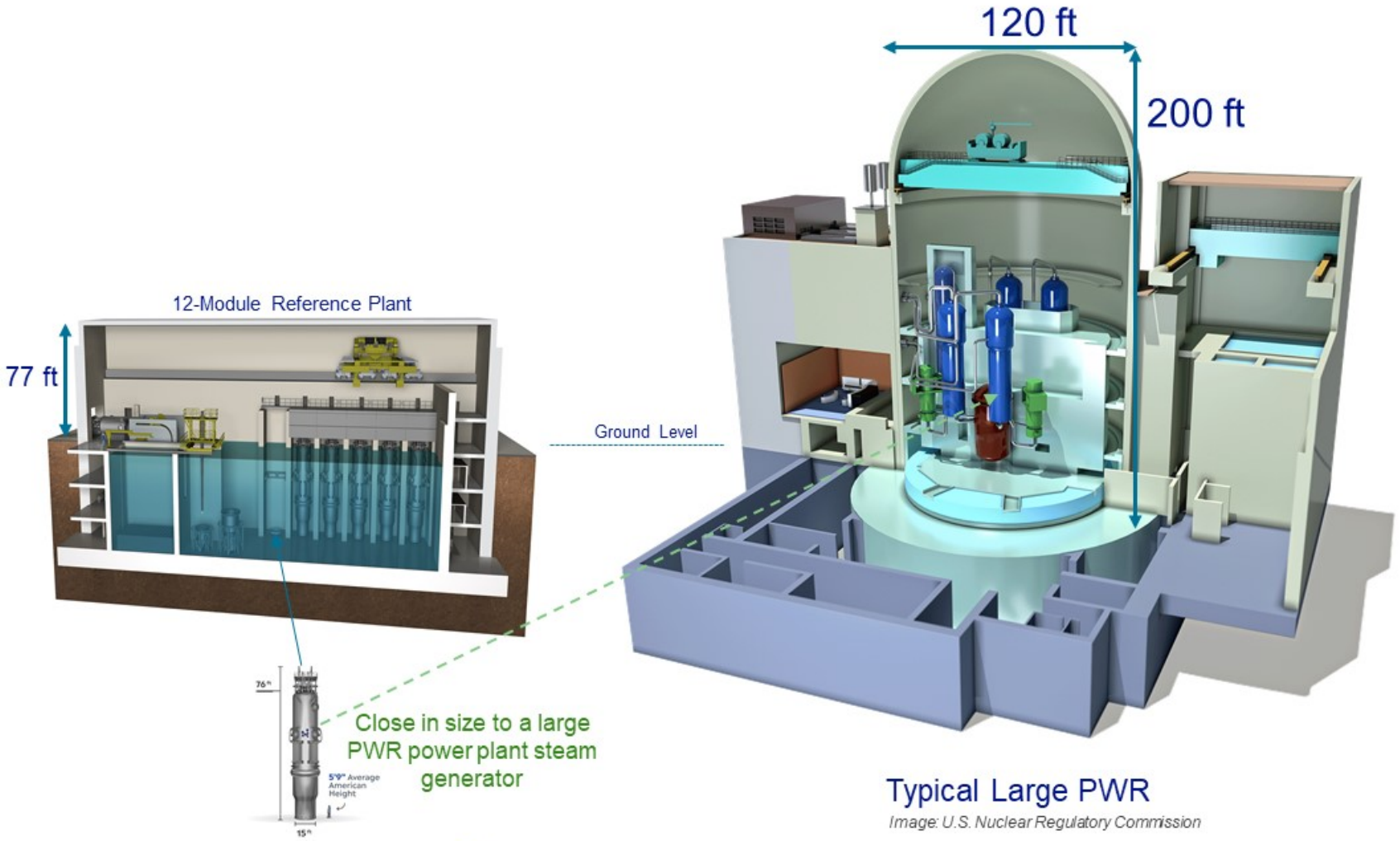
Comparison to a Large Pressurized Water Reactor (PWR)



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Simplicity Enhances Safety

Natural Convection for Cooling

- Passively safe - cooling water circulates through the nuclear core by natural convection eliminating the need for pumps.

Seismically Robust

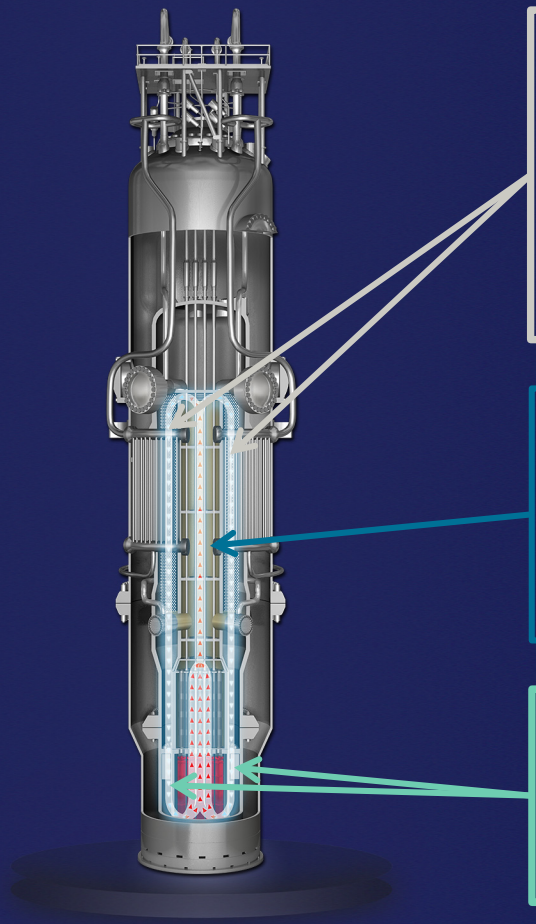
- System submerged in a below-grade pool of water in an earthquake and aircraft impact resistant building.

Simple and Small

- Reactor core is 1/20th the size of large reactor cores.
- Integrated reactor design - no large-break loss-of-coolant accidents.

Defense-in-Depth

- Multiple additional barriers to protect against the release of radiation to the environment.



Conduction **– the water heated by the nuclear reaction (primary water) transfers its heat through the walls of the tubes in the steam generator, heating the water inside the tubes (secondary water) and turning it to steam. This heat transfer cools the primary water.**

Convection **– energy from the nuclear reaction heats the primary water causing it to rise by convection and buoyancy through the riser, much like a chimney effect.**

Gravity / Buoyancy **– colder (denser) primary water "falls" to bottom of reactor pressure vessel, and the natural circulation cycle continues.**

Reactors shut down safely without operator action, AC/DC power, and cool for an unlimited period without adding water.

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A New Level of Plant Resiliency

FEATURES AND CAPABILITIES NOT FOUND IN OTHER NUCLEAR PLANTS

Climate Adaptation

Black-Start and Island Mode Following Loss of Offsite Power

A single module can be Black-Started and can power the entire plant in case of loss of the grid; no operator or computer actions, AC/DC power or additional water required to keep the reactors safe.

First Responder Power

On loss of the offsite grid, through variable (0% to 100%) steam bypass, all 12 modules can remain at power and be available to provide electricity to the grid as soon as the grid is restored.

Resilience to Natural Events

Reactor modules and fuel pool located below grade in a Seismic Category 1 Building

- Capable of withstanding a Fukushima type seismic event
- Capable of withstanding hurricanes, tornados, and floods.

Resilience to Aircraft Impact

Reactor building is able to withstand aircraft impact as specified by the NRC aircraft impact rule.

Cybersecurity

Module and plant protection systems are non-microprocessor based using field programmable gate arrays that do not use software and are therefore not vulnerable to internet cyber-attacks.

Electromagnetic Pulse (EMP/GMD)

Resilience to solar-induced geomagnetic disturbances (GMDs) and electromagnetic pulse (EMP) events beyond current nuclear fleet.

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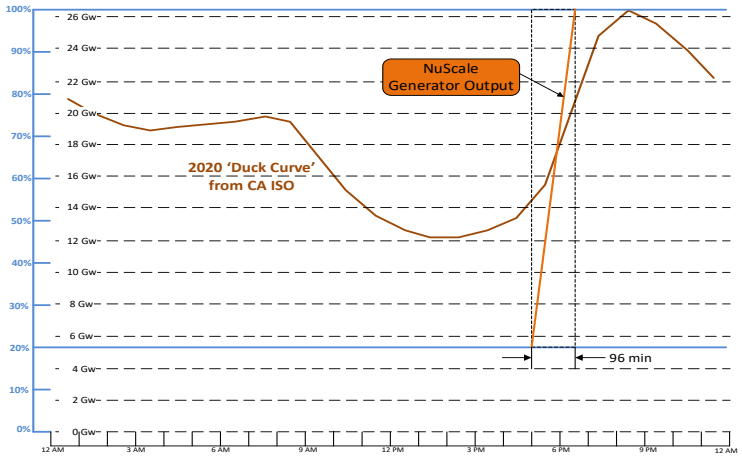
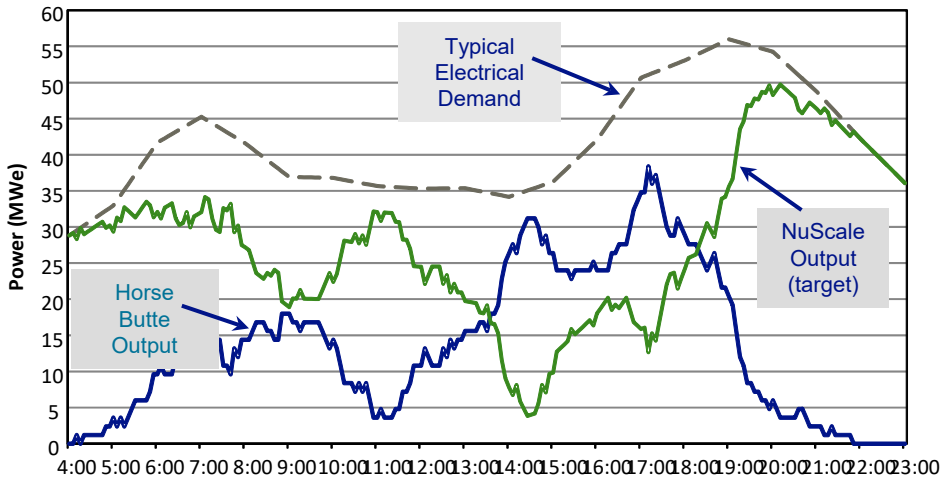
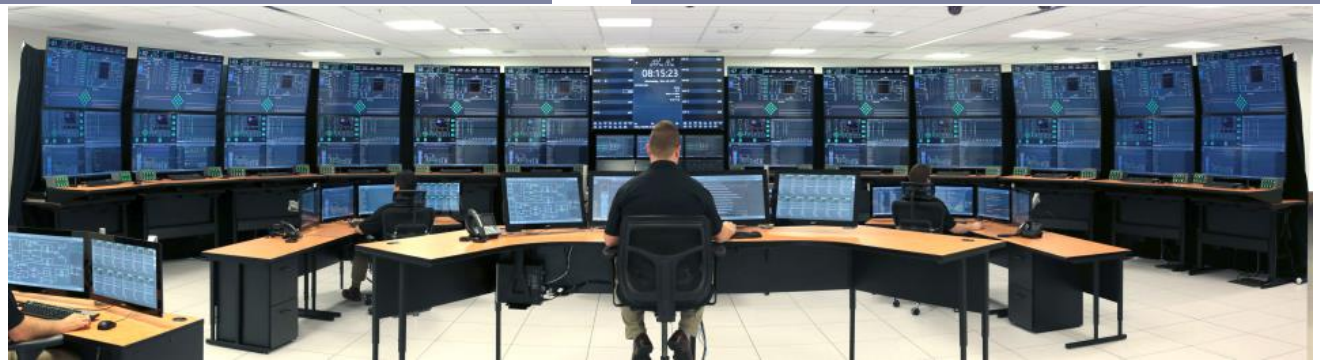
Integrating Renewables: Load Follow Strategies





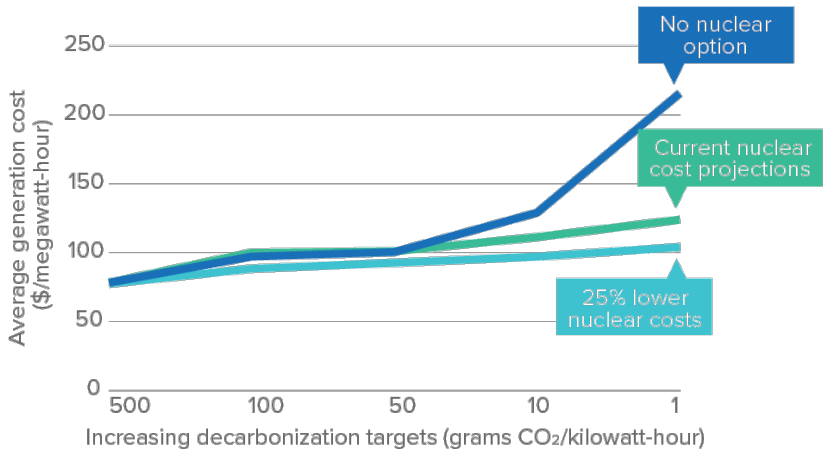
NuScale plant is designed to work with renewables, including being able to ramp up power quickly enough to meet high evening demand when solar ramps down.

NuScale design meets or exceeds EPRI Utility Requirements Document (URD), Rev. 13, load following and other ancillary service requirements.



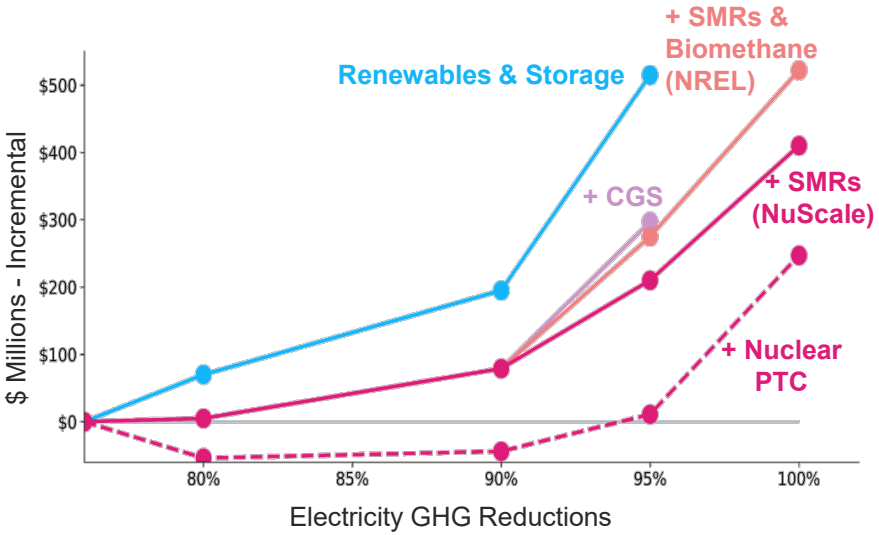
Future Trends: Continuing and Increasing Recognition that Nuclear Needs to Be Part of the Clean Energy Portfolio

Decarbonization of Power Sector



- 2015: Jacobson et al. study and RE100 for companies promote 100% renewable, including only wind, solar, and hydro to meet all U.S. electricity needs
- 2017: Clack et al. evaluate Jacobson study and find significant shortcomings
- 2018: MIT Energy Initiative study finds that decarbonizing the power sector will be most economical if nuclear energy's capacity for providing vast amounts of carbon-free electricity is brought to bear (shown in graph)
- 2018: California passes SB100, which is open to technologies of the future
- 2019-2020: Washington, Oregon, New Mexico, and other states are all considering clean energy legislation that allow for carbon-free nuclear

NuScale SMRs Reduce Cost Compared to Other Baseload Carbon-Free Competitors



- "CGS ('Columbia Generating Station') + NuScale SMRs reduce system costs by almost $8B per year relative to RE ('Renewable Energy') + Storage" – E3 study
- Domestic and international carbon pricing initiatives support demand for renewables in the short-term, while the generating capacity and cost profile of nuclear SMRs allow it to be a market leader in the long-term

NuScale SMRs are a baseload technology that integrates with other carbon-free energy sources to enable future low carbon electricity generation that the world requires

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Cost-Competitive, Carbon-Free Hydrogen Production

- Hydrogen has the capability to help decarbonize both the electricity and transportation sectors by being used for energy storage or as a fuel for hydrogen fuel-cell vehicles, trains, ships, and airplanes.
- Most hydrogen today is produced by fossil fuels and is not carbon-free.
- NuScale's innovative technology is ideal for producing clean hydrogen in a cost-competitive manner:
  - A single NuScale module can produce 2,053 kg/hour of hydrogen, or **50 tons/day** – enough hydrogen to power 38,000 fuel cell vehicles or 1,500 long-haul fuel cell trucks annually
  - Hydrogen produced by a high temperature steam electrolysis system using heat and electricity from a NuScale module is forecasted to be **cost competitive with green hydrogen** (produced from renewable electricity)

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Changing the Power that Changes the World

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