IAEA
International Atomic Energy Agency
Atoms for Peace and Development

Climate Change and Nuclear Power 2020

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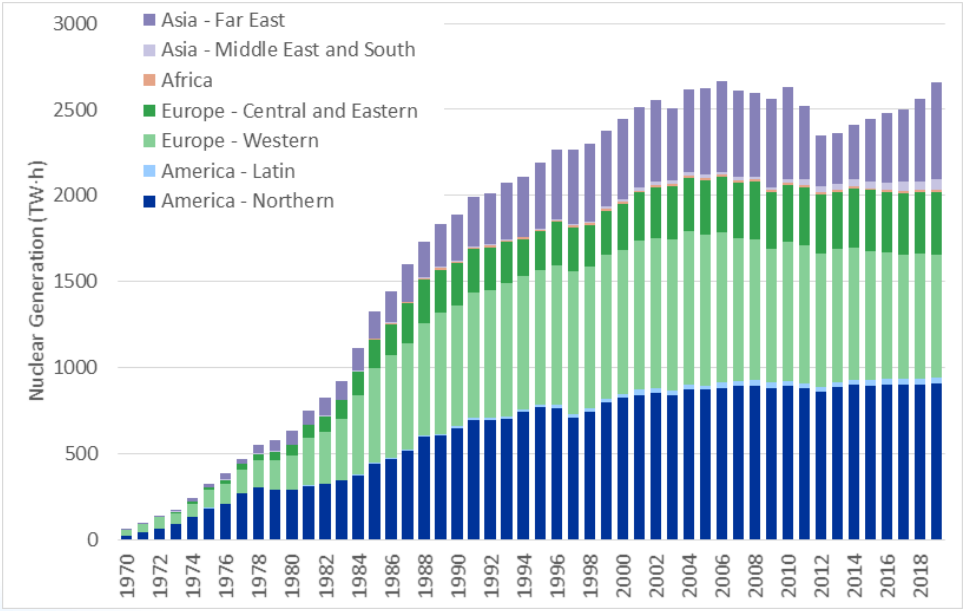
Webinar
Cutting emissions for good:
what role for nuclear?
16 September 2020

Context

- 2020: year of COVID19
- Nuclear has proven resilient

- Nuclear generation showed a record in 2019: second highest after all time high 2006

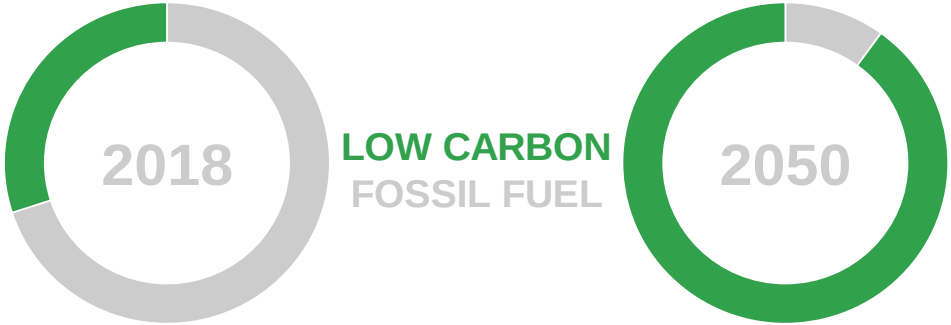


Source: IAEA PRIS database

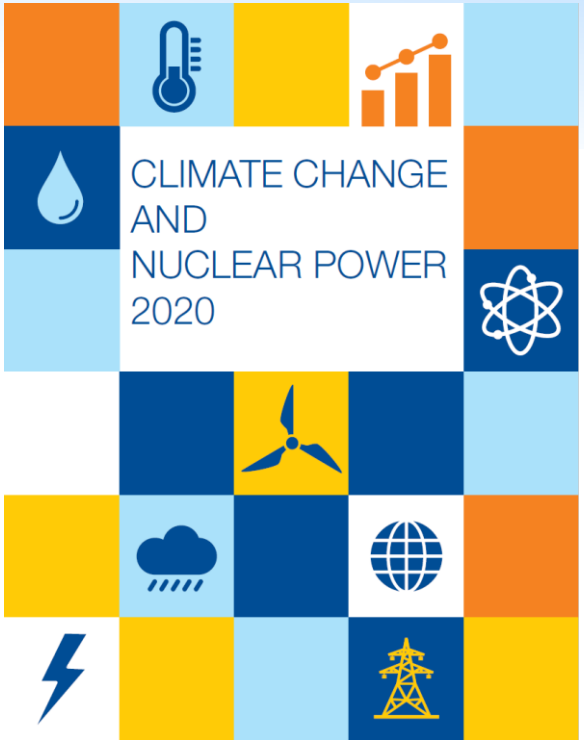
The Role of Nuclear Power in Climate Change Mitigation

- Contribution to CO_2 emissions reduction
  - 66% energy related
  - 22% electricity

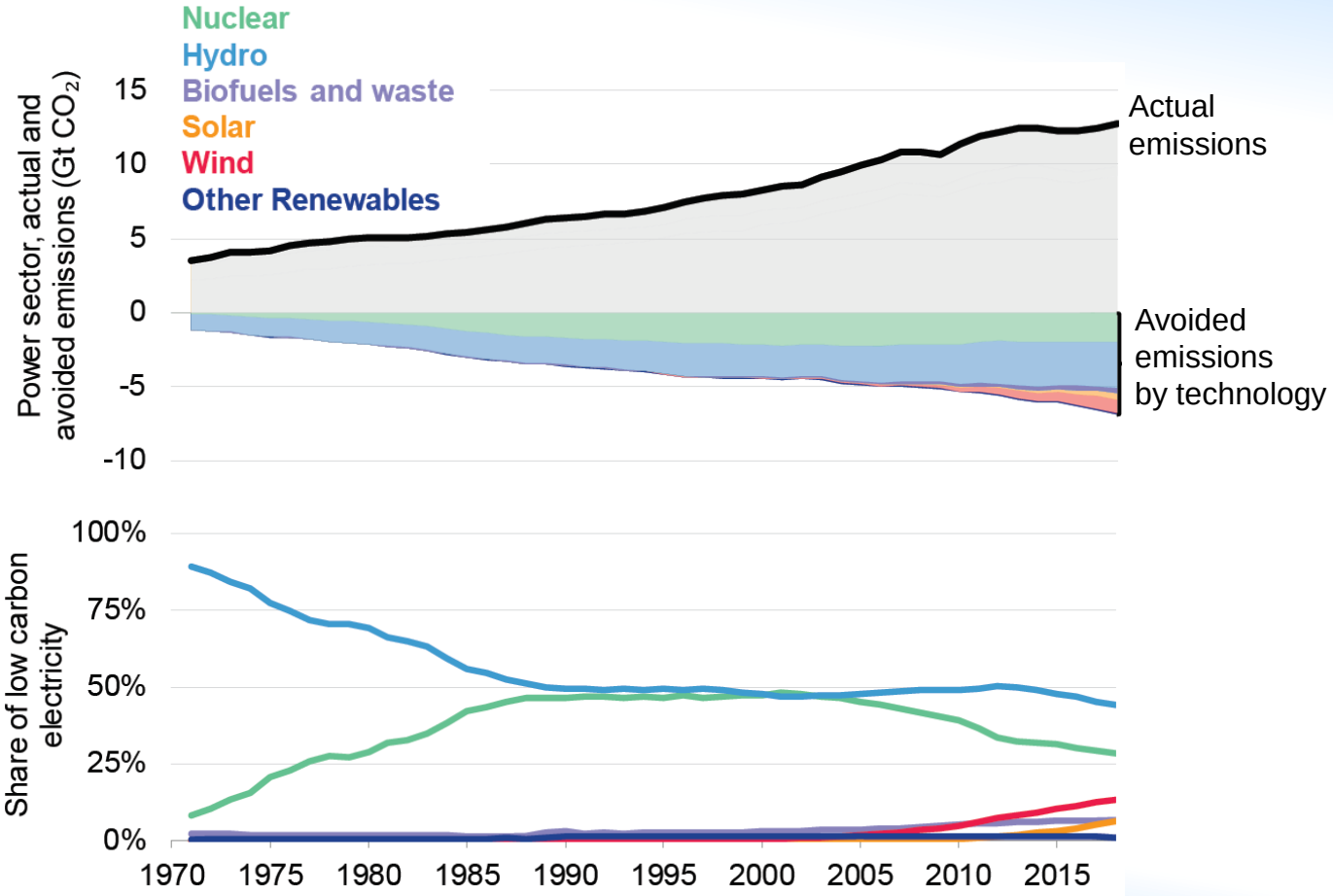
    → growing strongly



According to IPCC, when limiting temperature rise to 1.5° C above pre-industrial levels

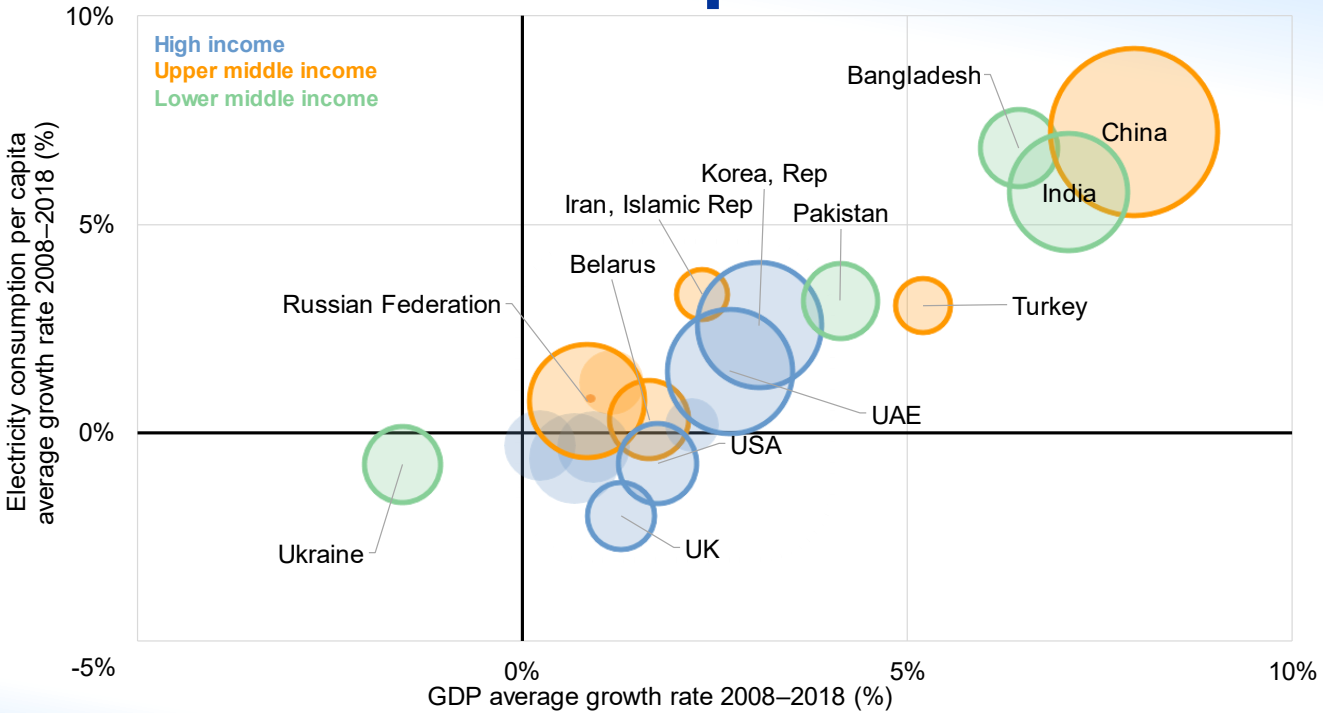


A track record CO_2 emissions avoidance



Annual CO_2 emissions would have been around 2 gigatonnes (Gt) higher over the past decade.

Nuclear electricity contributes to economic development

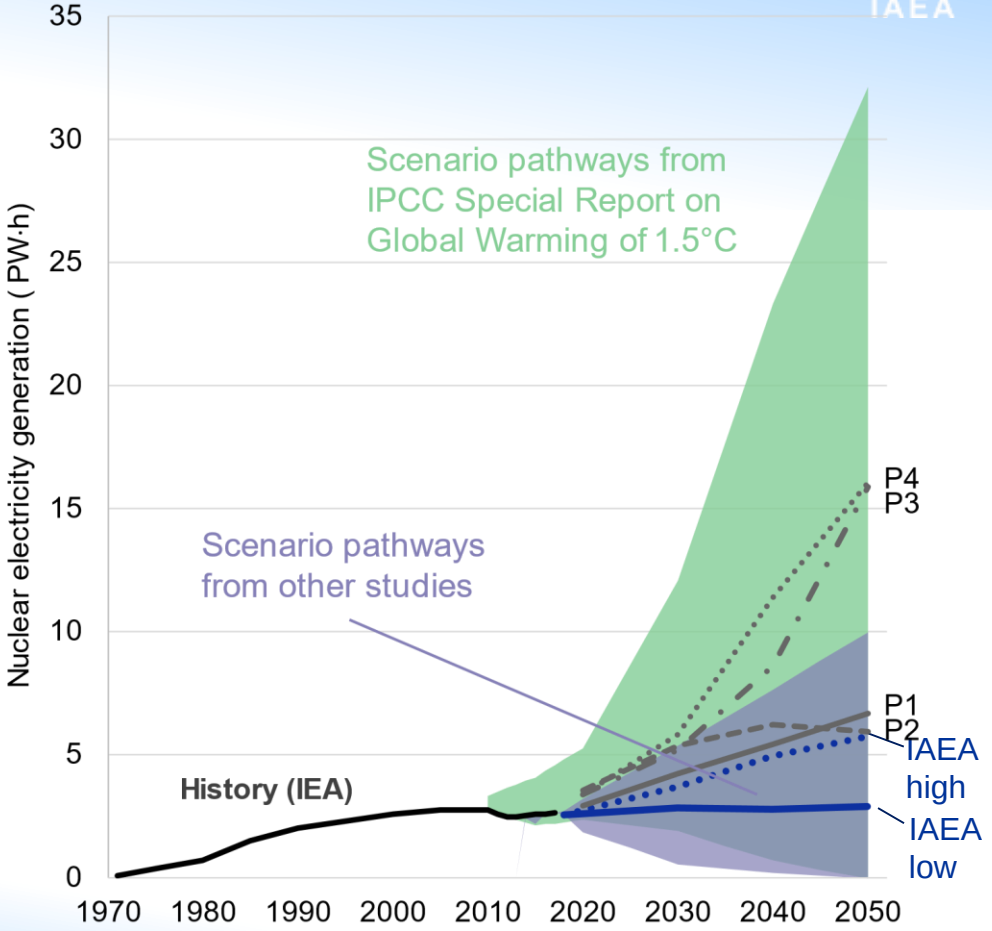


Bubble size represents the total net electrical capacity of reactors under construction by country in 2020

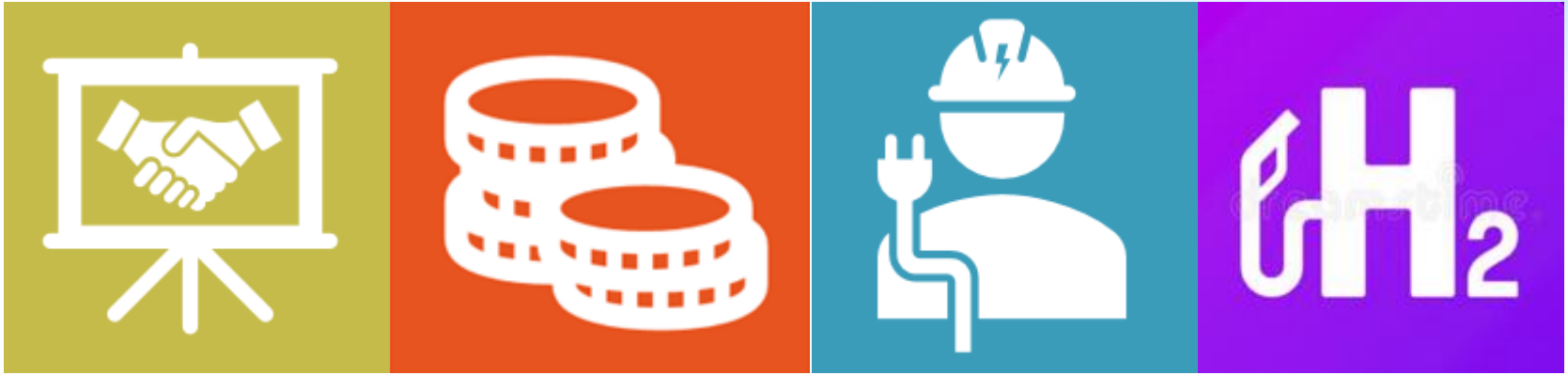
Many nuclear programmes are now underway in emerging economies

Projecting the future

- Most scenario studies project nuclear capacity increases
- IPCC: four illustrative pathways in 2018 1.5°C report
- IAEA: low and high projections
  - High projection means that 500 GW are to be added in 30 years time



Enabling factors to support nuclear power deployment

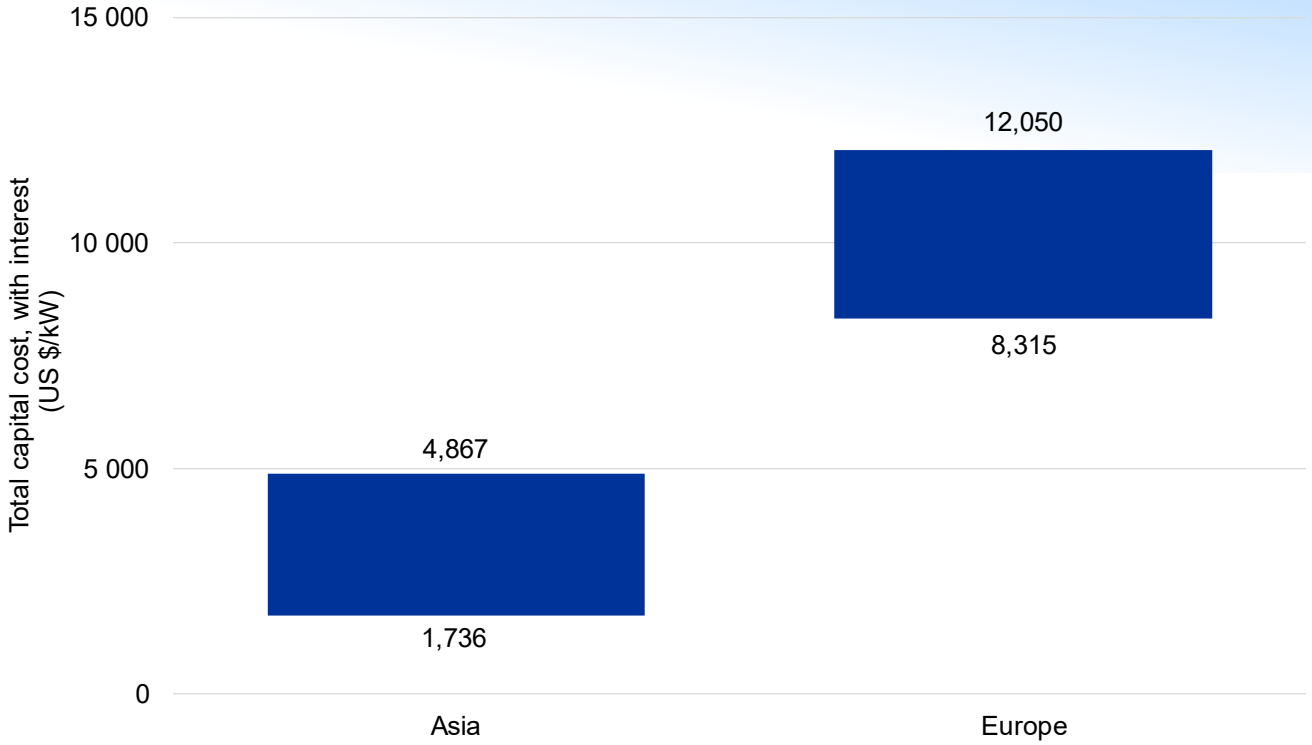


Strong mitigation target, consistent policy signals, social acceptance	Control of costs, access to finance	Recognition of the value of nuclear power to the stable and resilient operation of the electricity system	Penetration of markets beyond electricity

Policy incentives to strengthen climate response

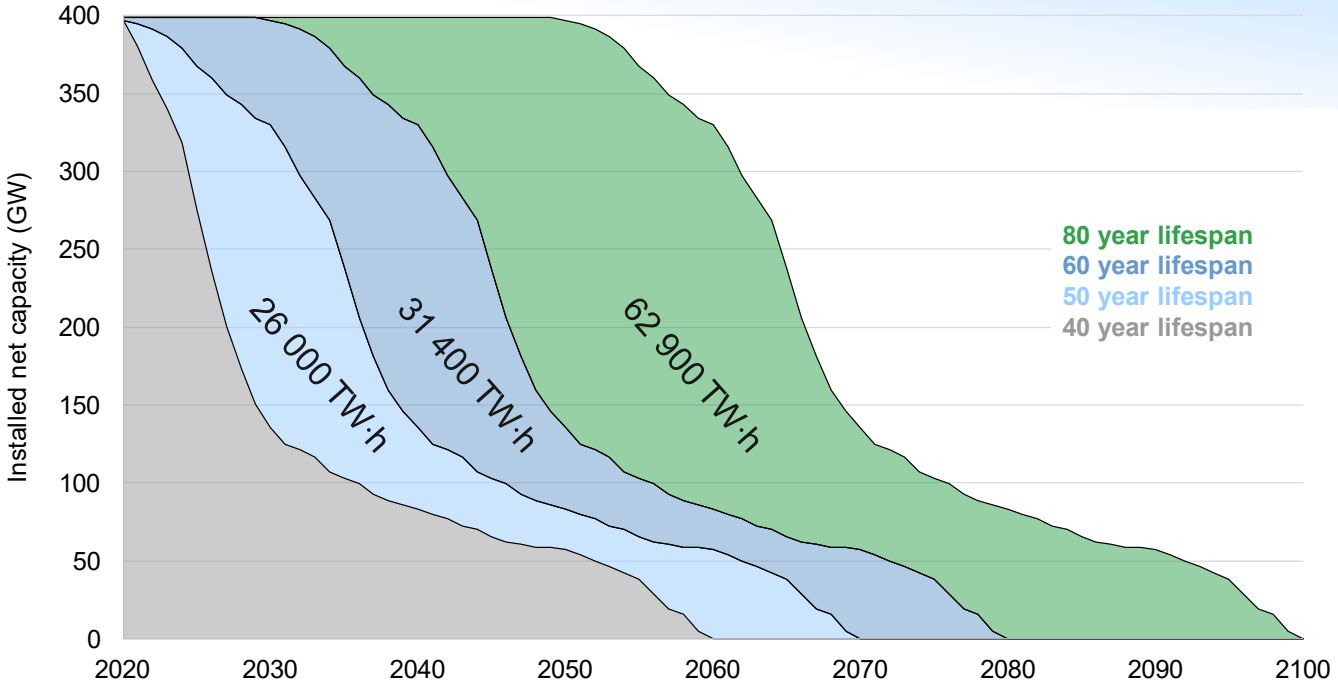
- competitive short term electricity markets for efficient dispatch
- frameworks for the adequate provision of capacity, flexibility and infrastructure for transmission and distribution
- **measures to foster long term investment in low carbon technologies**
- internalization of system costs
- carbon pricing

Nuclear plant construction costs



Large differences in construction costs of recent nuclear newbuild projects

Climate value of nuclear lifetime extension



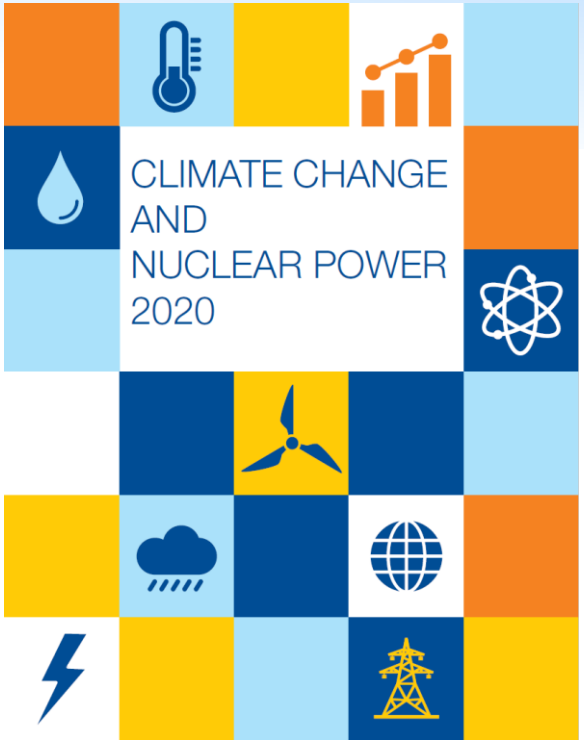
Investments in nuclear plant lifetime extension lead to one of the **most economical sources of low carbon electricity**

Beyond electricity: alternative products with nuclear power

- Nuclear energy can serve decarbonization in **additional sectors beyond electricity**
- Potential alternative products, e.g. hydrogen, for utilities with operating NPP
- Future potential: advanced reactor designs with higher temperatures offer potential for other non-power applications

Link to the report:

https://www.iaea.org/publications/14725/climate-change-and-nuclear-power-2020



Cutting Emissions for Good: What Role for Nuclear

Case of Poland

IAEA Climate Change and Nuclear Power 2020

Zbigniew Kubacki
Ministry of Climate, Poland
September 16, 2020

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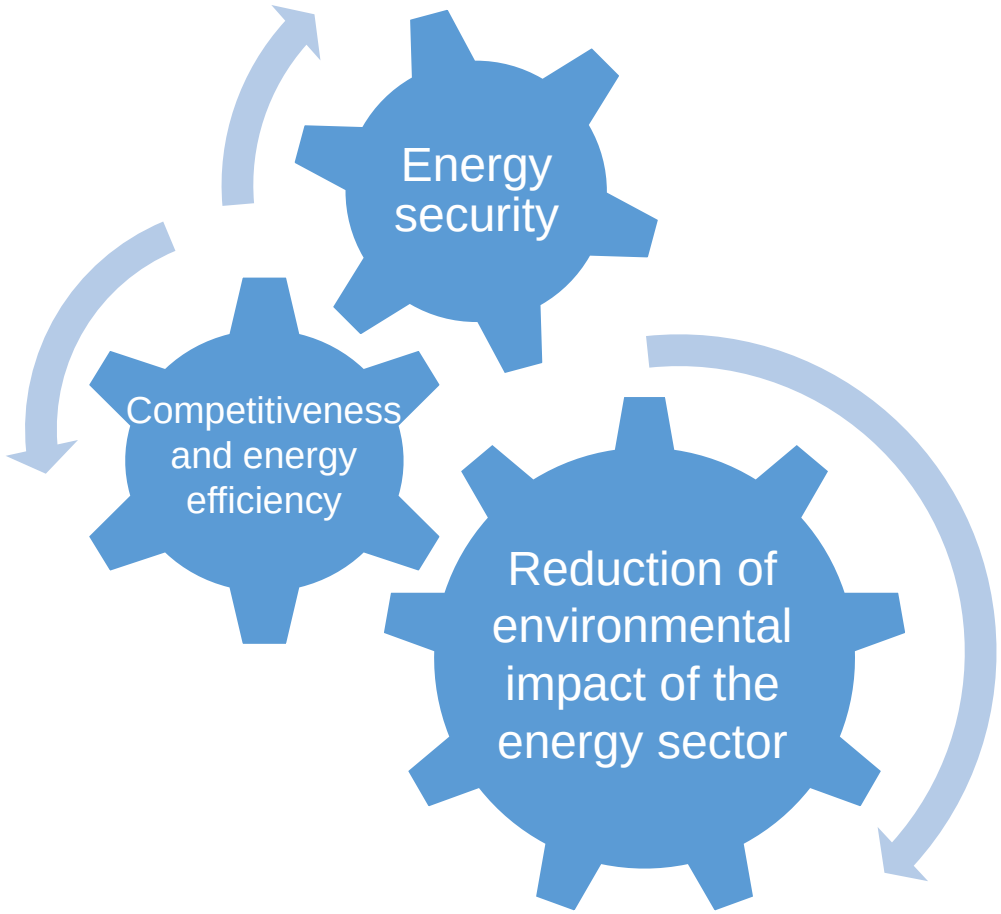

THE OBJECTIVE OF THE POLISH ENERGY POLICY IS:

To provide energy security, while ensuring competitiveness of the economy, energy efficiency and reduction of environmental impact of energy sector. Long –Term Polish Energy policy will be based on three pillars: just transition, zero- emission power sector and clean air.

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Polish way to zero-emission energy system (II pillar)

OFFSHORE WIND

about 8-11 GW to 2040

Investment outlays around 130 bln PLN

NUCLEAR ENERGY

about 6-9 GW

Investment outlays around 150 bln PLN

LOCALIZED AND PROSUMER POWER GENERATION

Increase of prosumers actively take part in Energy market

300 self-sustainable communities and 1 mln prosumers till 2030

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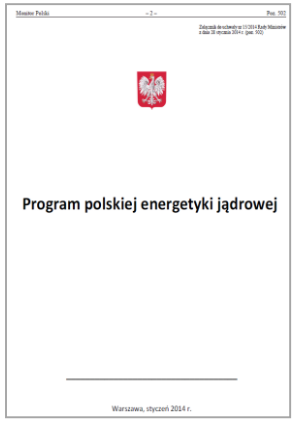
Polish Nuclear Power Program

PNPP was approved on January 28th 2014 by the Council of Ministers as a Comprehensive Report for National Decision



Its key goals resulting from the Long–Term Energy Policy for Poland:

- ✓ assuring long-term **security of electricity supply**
- ✓ maintaining **stable electricity prices** at levels acceptable by the national economy and society
- ✓ **reducing emissions** of CO_2 and other air pollutants

Current status:

On 6 August 2020, after six year of implementation the Ministry of Climate has submitted the new update of “Polish Nuclear Power Program” for public and intergovernmental consultations. All remarks to the document were submitted in August. After reviewing remarks the new PNPP will be submitted to GoP for approval in the last quarter of this year

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WHAT IS NEW IN THE UPDATE OF PNPP

- First nuclear installation 1-1,5 GW until 2033
- 6 nuclear units till 2043 (target 6-9 GW) in the same technology
- Modification of legal conditions
- Proposed new business and operational model
- Bigger role of State in the Program
- Active role of the enhanced Regulator
- Future role of small/modular nuclear technologies in Poland (HTR, SMR)

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Climate policy benefits from nuclear power in Poland

NPPs with combined capacity of ca. 6 – 9 GWe

Electricity production of around 70 TWh per year

Saving emission of around 48 million tons* of CO_2 each year or even more if cogeneration (district heating) is considered

This is around **30% of current CO_2** emissions level in Polish electricity generation sector

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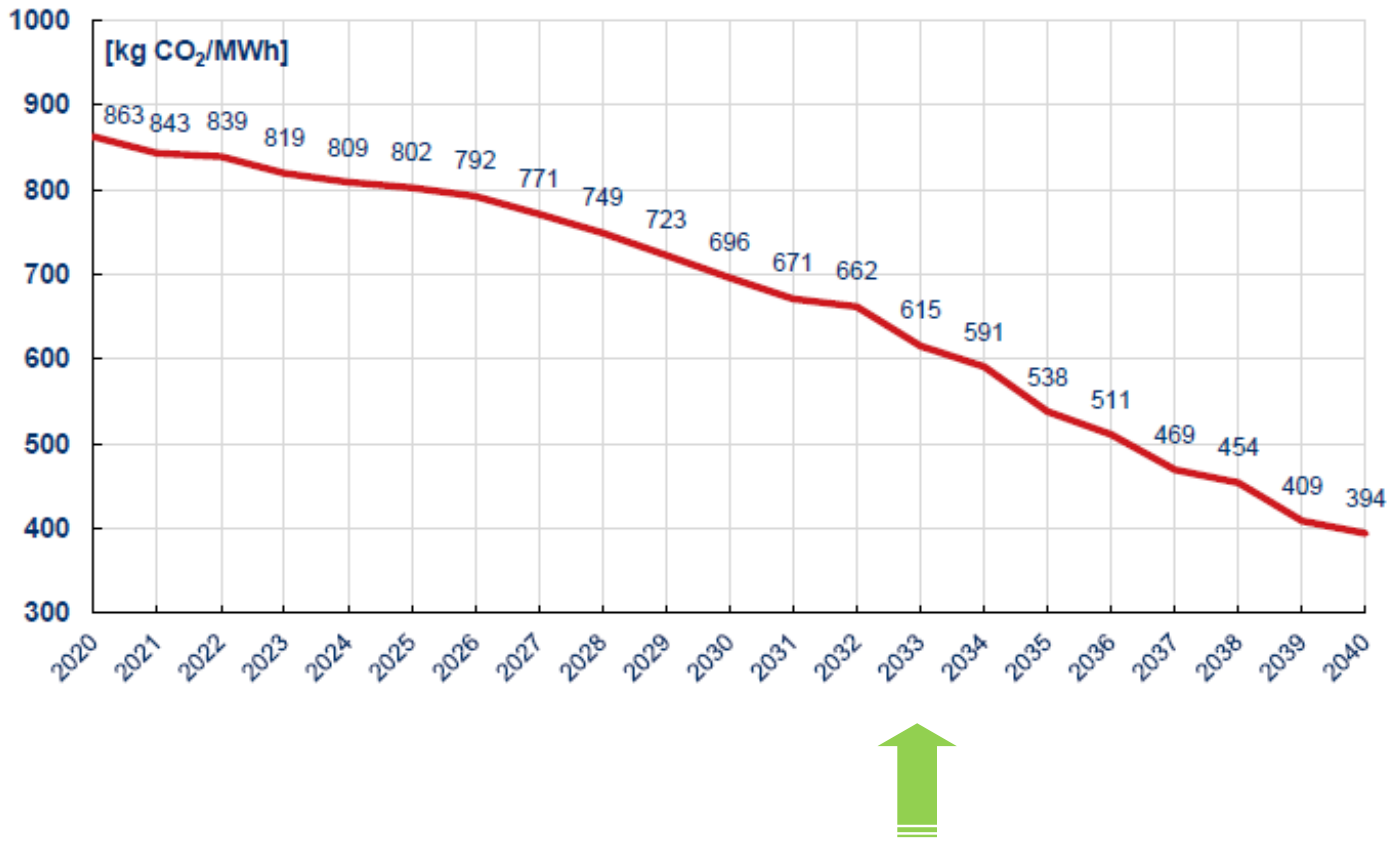
Average emission intensity of electricity production by 2040



Significant reduction of emissions caused by:

1. nuclear power plants introduction
2. RES implementation
3. higher share of gas turbines
4. closing of exploited coal power plants

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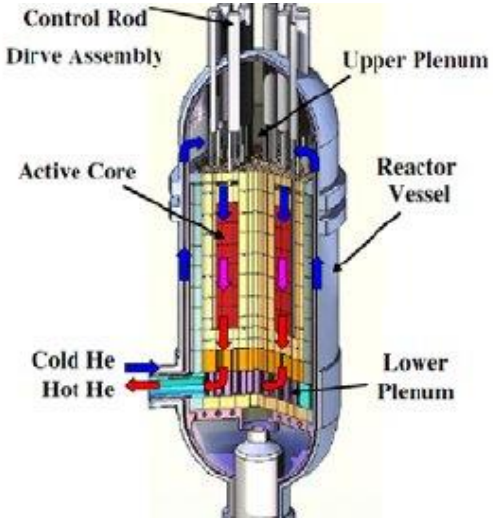
Advanced nuclear technologies in Poland – new opportunities for climate change mitigation

Although priority od Poland is to implement nuclear power programme based on large-scale reactors we are aware of potential future benefits of SMRs (like HTGRs). As a result we initiated the scientific project on HTGRs (especially for industrial cogeneration) with the following objectives:

Decreasing dependence on fossil fuel import.
HTGR may be an alternative to replace fossil fuels for industrial heat production. With expected growth of CO_2 tax and low discount rate, the cost of the steam from HTGR could be comparable to that from gas, while having more secure availability and more predictable prices.

Decreasing sensitivity of economy to environmental regulations.
Industry dependent on fossil fuels might become less competitive in case of stronger environmental regulations (CO_2 tax, emission limits, etc.). HTGR being a zero emission technology is immune to that.

Synergy with multi-GW LWR programme.
Increasing scientific and industrial potential, upgrading the regulatory framework, developing human resources and creating a supply chain, will be beneficial for both HTGR and LWR projects.



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Thank you for attention

Zbigniew Kubacki, Ministry Of Climate, Poland

Cutting Emissions for Good: What Role for Nuclear

IAEA Climate Change and Nuclear Power 2020

Michael G. Green

September 16, 2020

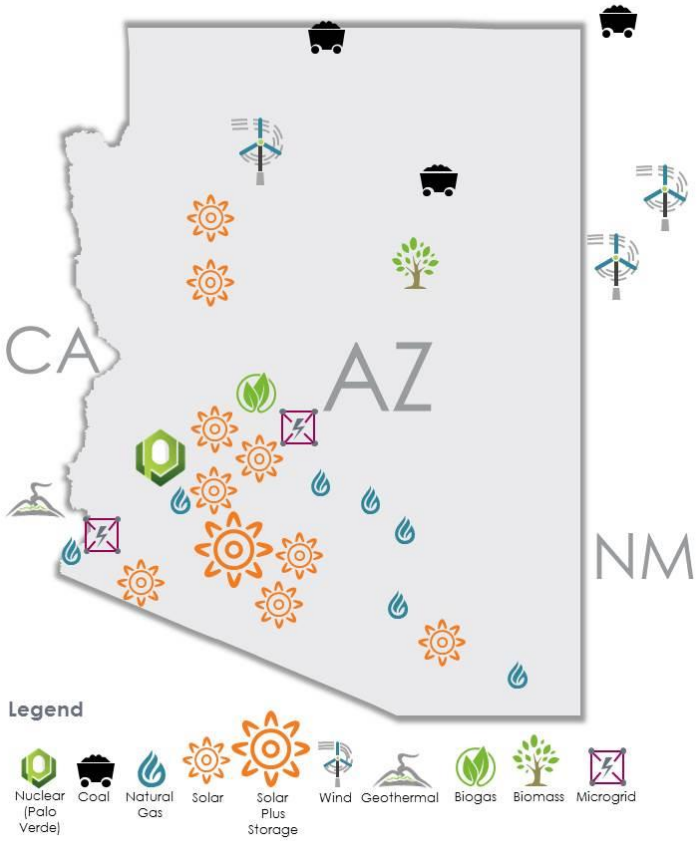
About APS

Arizona's largest and longest-serving utility – since 1886

- Service Territory
  - 11 of 15 counties
  - 34,646 square miles
  - 1.2 million customer accounts
- $3.4 B annual economic impact
  - $1.0 B spent annually with local businesses statewide
  - Arizona's largest taxpayer
- About 6,000 employees
- Peak load ~7,600 MW

APS Resource Diversity

Total Resources	**10,609 MW**
Nuclear	1,146 MW
Coal	1,672 MW
Natural Gas	4,929 MW
Owned Resources	3,469 MW
PPAs	1,460 MW
Total Microgrid	32 MW
Renewables	883 MW
Solar	564 MW
Owned Resources	239 MW
PPAs	325 MW
Wind (PPAs)	289 MW
Other (PPAs)	30 MW
Customer-Based	1,947 MW
Energy Efficiency	1,032 MW
Distributed Energy	876 MW
Demand Response	39 MW

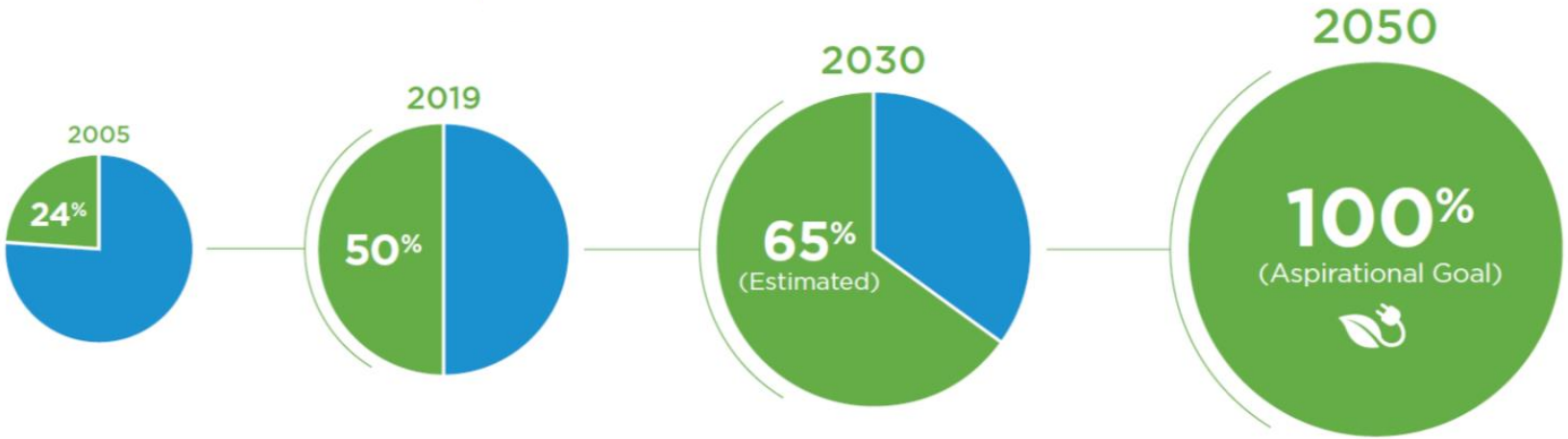


Imagine a world with 100% clean energy.

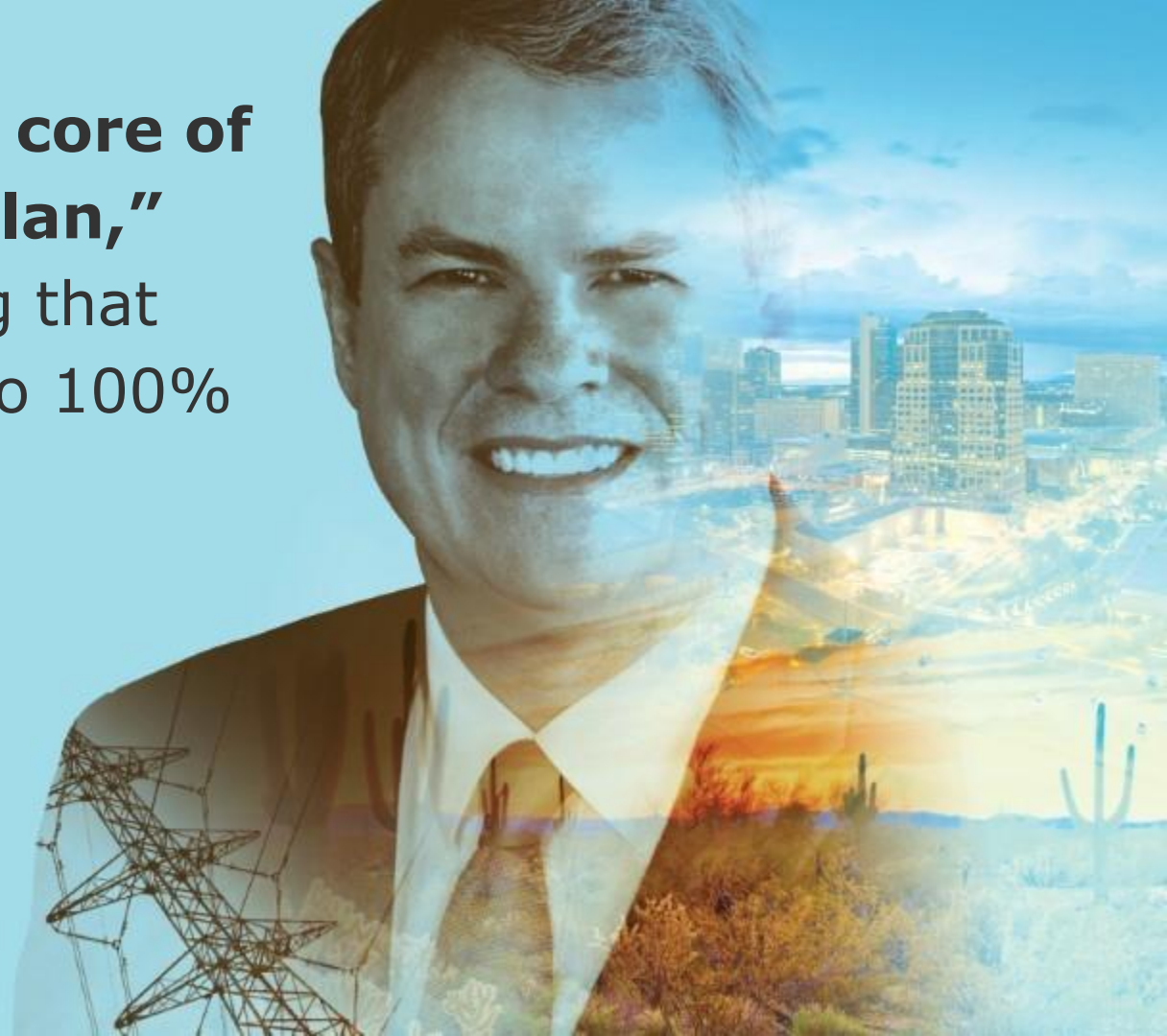
We are.

aps

APS Clean Energy Commitment



“Palo Verde is the core of this whole clean plan,” Guldner said, adding that he sees no way to go 100% carbon free without nuclear energy.



APS will eliminate carbon emissions by 2050 and close coal plant ahead of schedule, CEO says; January 22, 2020

THE ARIZONA REPUBLIC

U.S. Department of Energy
Office of Nuclear Energy
Funding Opportunity Announcement

DOE NE Mission

- Advance nuclear power as a resource capable of meeting the Nation's energy, environmental, and national security needs

FOA Objective

- Support innovation and competitiveness through cost-shared commercial application demonstrations of nuclear energy integration into non-electric, and/or hybrid applications that have high potential to improve the overall economic outlook for nuclear power

Utility and National Laboratory Partnership

Partners

- APS, Energy Harbor, Xcel Energy, and Idaho National Laboratory (INL) Light Water Reactor Sustainability Program

Partnership concept

- First of a kind demonstration of integrated use of nuclear power for hydrogen generation

Utility and National Laboratory Partnership (cont'd)

Bases

- Significant global and domestic increase in demand for hydrogen as a fuel and feed-stock over the next 30 years
- Substantial increase in electrolysis hydrogen generation using electrical and thermal energy
- Nuclear energy carbon-free source for hydrogen production

Objectives

- Advance large-scale hydrogen cost effective generation
- Identify and support development of efficient hydrogen uses
- Achieve decarbonization goals