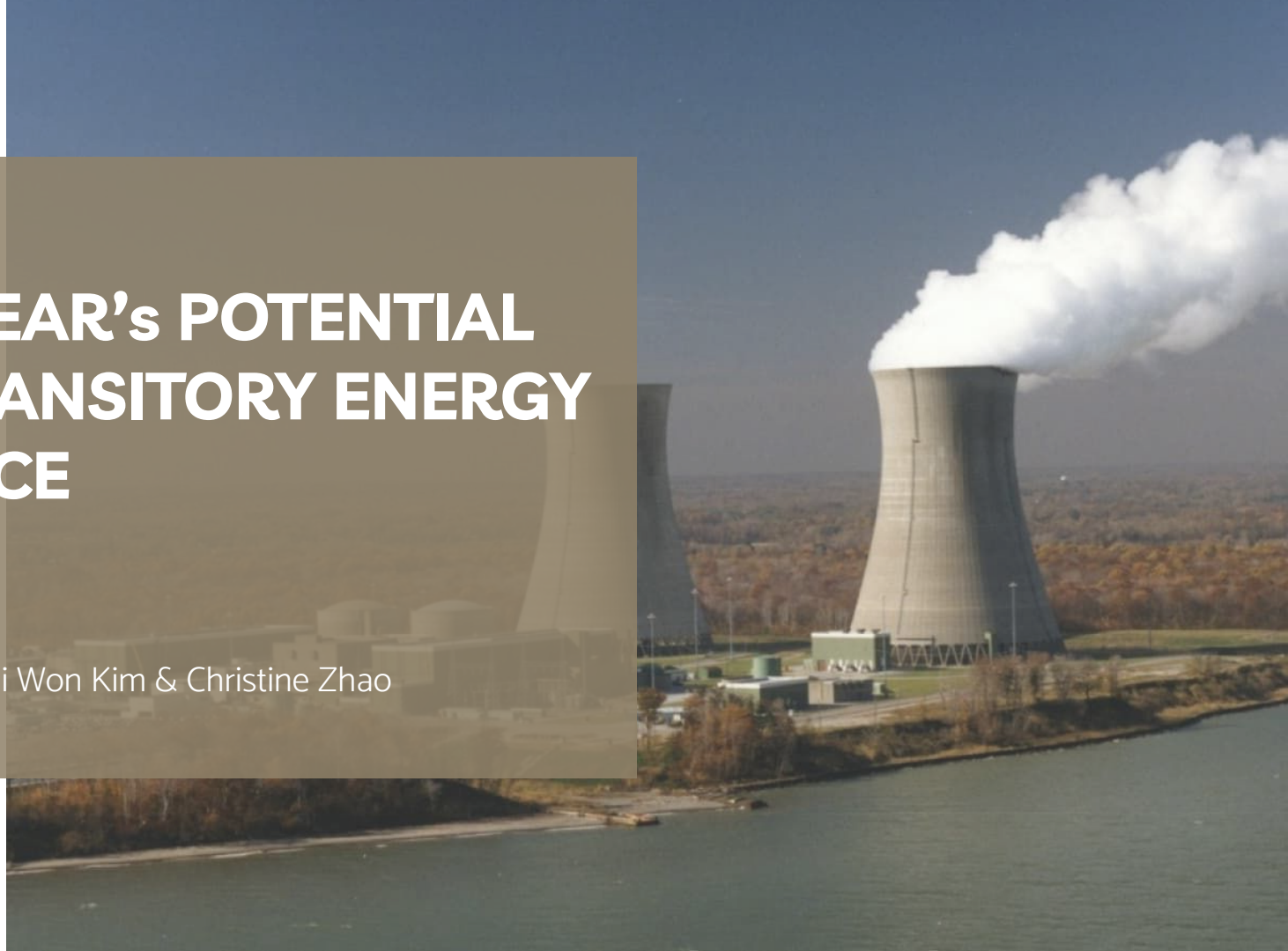


NUCLEAR'S POTENTIAL AS TRANSITORY ENERGY SOURCE

ENST 250

Lizzy Gaviria, Ji Won Kim & Christine Zhao



🗨️ When poll is active, respond at Pollev.com/christinezha138

📱 Text **CHRISTINEZHA138** to **22333** once to join



AUDIENCE POLL

How many people died in the aftermath of the Three Mile Island, NJ nuclear meltdown?

How many people died in the Three Mile Island, NJ nuclear meltdown in 1979?





NO TO NUCLEAR POWER

YES TO ~~RENEWABLES~~ GAS



Serving Mother Russia since 1971

the Earth

ENVIRONMENTAL
DEFENSE FUND®



en
ica®

An aerial photograph of a nuclear power plant. In the foreground, several large, cylindrical cooling towers are visible, with white steam rising from them. The plant is situated on a riverbank. In the background, a large body of water, likely a reservoir or a wide river, stretches across the landscape. Beyond the water, there is a residential area with houses and buildings, and a road with a bridge. The sky is clear and blue. A semi-transparent dark brown box is overlaid on the center of the image, containing white text.

**What technology and
policy implementations
are needed to make
nuclear a viable energy
source in the near future?**

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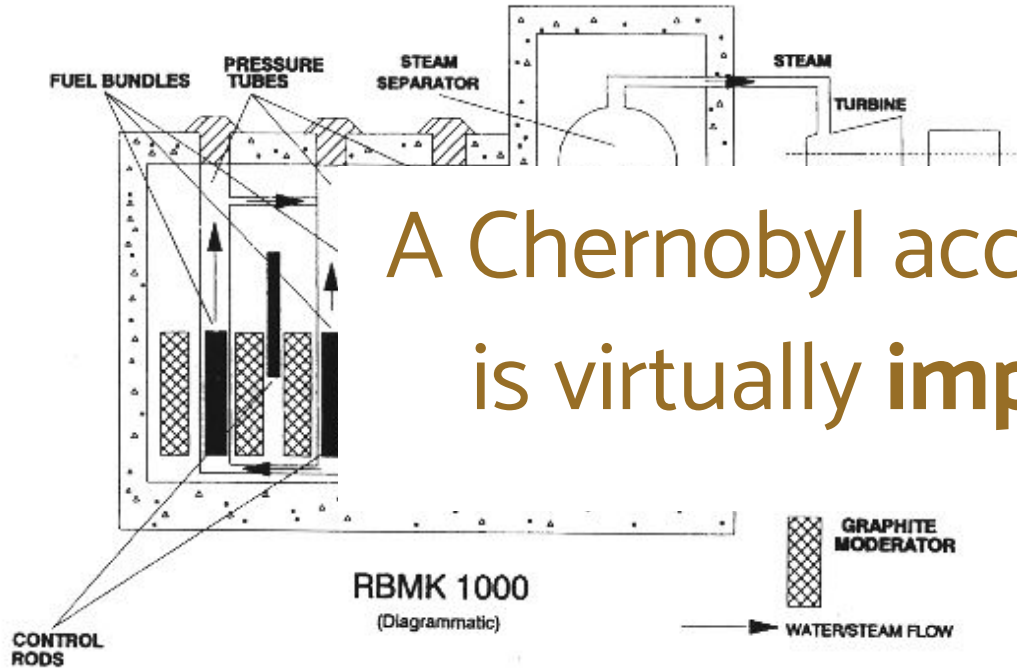
NUCLEAR AS A TRANSITORY ENERGY

Where does nuclear power fit into the future energy mix of the U.S.?



Nuclear: Facts & Fiction

01

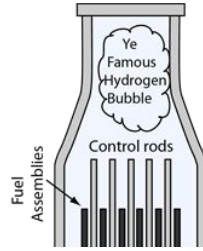


A Chernobyl accident now
is virtually impossible

nobyl



Made into a movie
melting the



**Nuclear Explosion!!
(was not possible)**

General panic from
disinformation & lack of
consistent messaging caused
unnecessary exodus

**file
ent**
in US.
ortion?



JOHN HERBEIN, METROPOLITAN EDISON

**"I don't know why we need to tell you each and
every thing that we do"**

**actors
completed since Three
Mile**

NEW REACTORS IN THE U.S.

50% opposed after
Japan accident

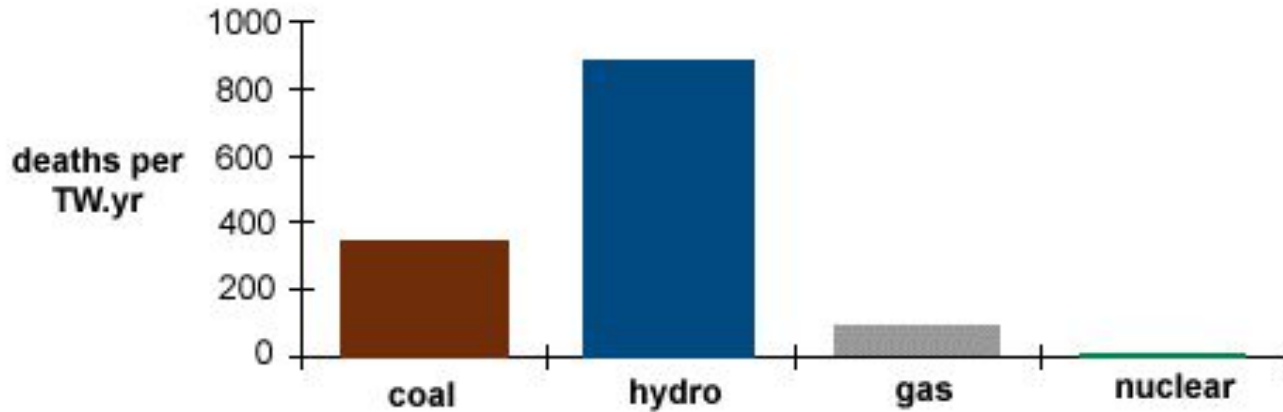
Just 34% opposed
in 2008

©CPS

**Fukushima:
Nail in the Coffin**



Deaths per TW/yr by Energy Sector



Source: Paul Scherrer Institut 1998, considering 1943 accidents with more than five fatalities.

Note: One TW.yr is the amount of electricity used by the world in about five months.

A photograph of a nuclear power plant facility. In the foreground, a green field with a fence and several cows grazing is visible. In the middle ground, there are several large, grey, conical cooling towers. In the background, there are industrial buildings and several high-voltage power line towers with multiple cross-arms and insulators. The sky is clear and blue.

Current State of Nuclear Energy

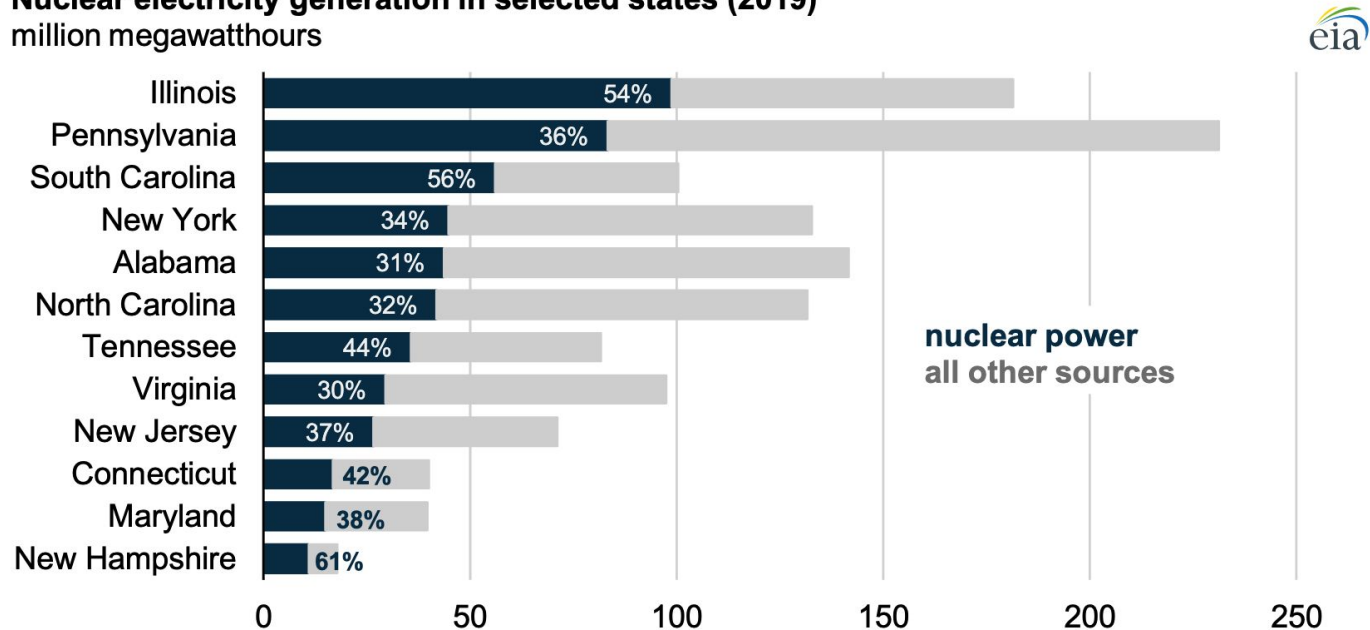
02

Current State of Nuclear Energy Supply

Nuclear supplies 20% of total energy consumed by the US since 1990.
12 states generated more than 30% of their electricity from nuclear power. (2019)

Nuclear electricity generation in selected states (2019)

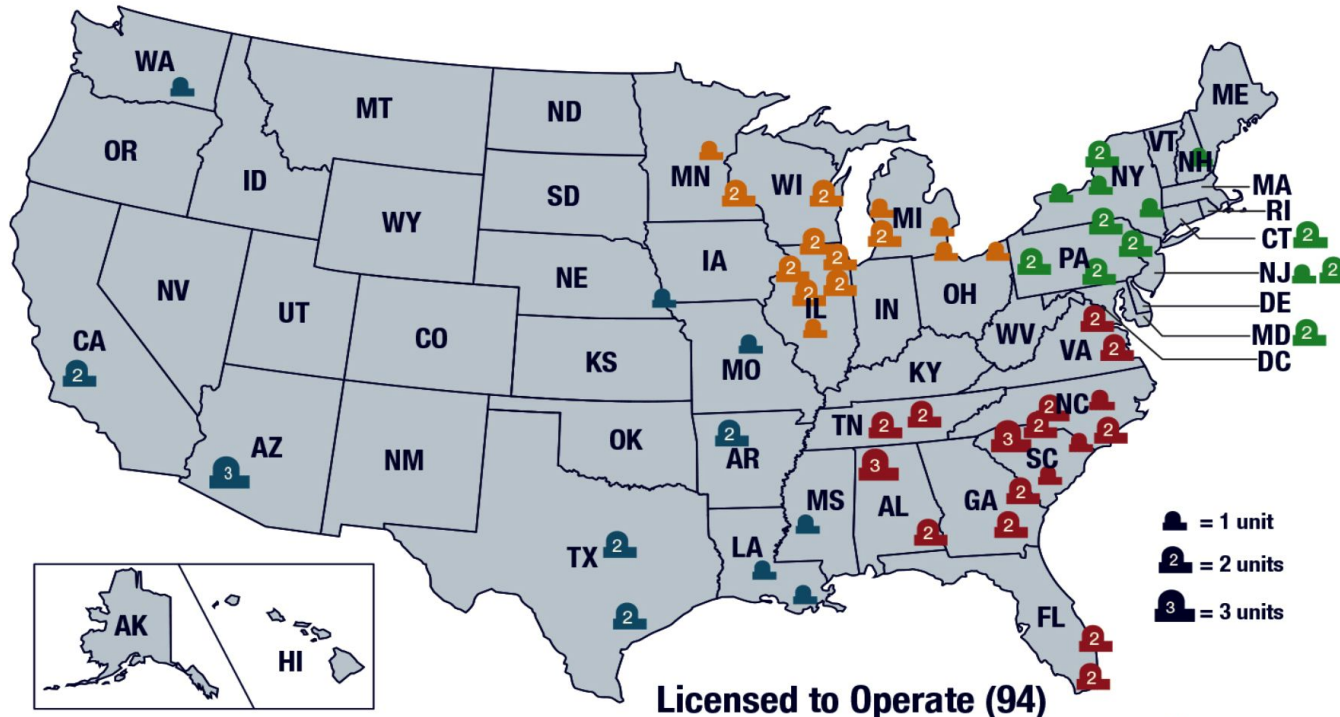
million megawatthours



Source: U.S. Energy Information Administration

Current State of Nuclear Power Plants

Nuclear power plants are mainly concentrated in the Eastern parts of the US. There are 96 operating commercial nuclear reactors at 58 nuclear power plants in 29 states (2019).



Source: U.S. Nuclear Regulatory Commission (2018)

Closures of Nuclear Plants

As of 2019, 17 commercial nuclear power plants have been closed; often prematurely to be replaced by natural gas. Additional plants are expected to close in the near future.

U.S. nuclear power plants that have retired or announced retirement



Source: U.S. Energy Information Administration

A photograph of a nuclear power plant with several large cooling towers and high-voltage power lines. In the foreground, there is a green field with a herd of cows grazing. The sky is clear and blue.

Safety & New Reactor Designs

03

Strict Regulations

Shutdown Features

Extensive shutdown/ safety features to prevent large-scale accidents

Alerting Authorities

Mandatory 15-minute reporting of signals



Institute of Nuclear Power Operations (INPO) established, 2.38 in 1985 -> 0.1 in 1997 significant events/reactor

Regulation

National Academy for Nuclear Training, **simpler yes-no** procedure book

Training

The U.S. Dept. of Energy has provided substantial support to develop and diversify the range of advanced reactors that reduce manufacturing and capital costs.

Microreactors

Range: 1 MW to 20 MW

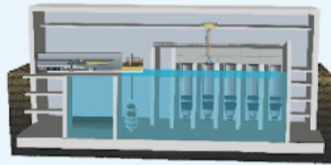
Can fit on a flatbed truck, and are mobile and deployable.



Small Modular Reactors

Range: 20 MW to 300 MW

Can be scaled up or down by adding more units.



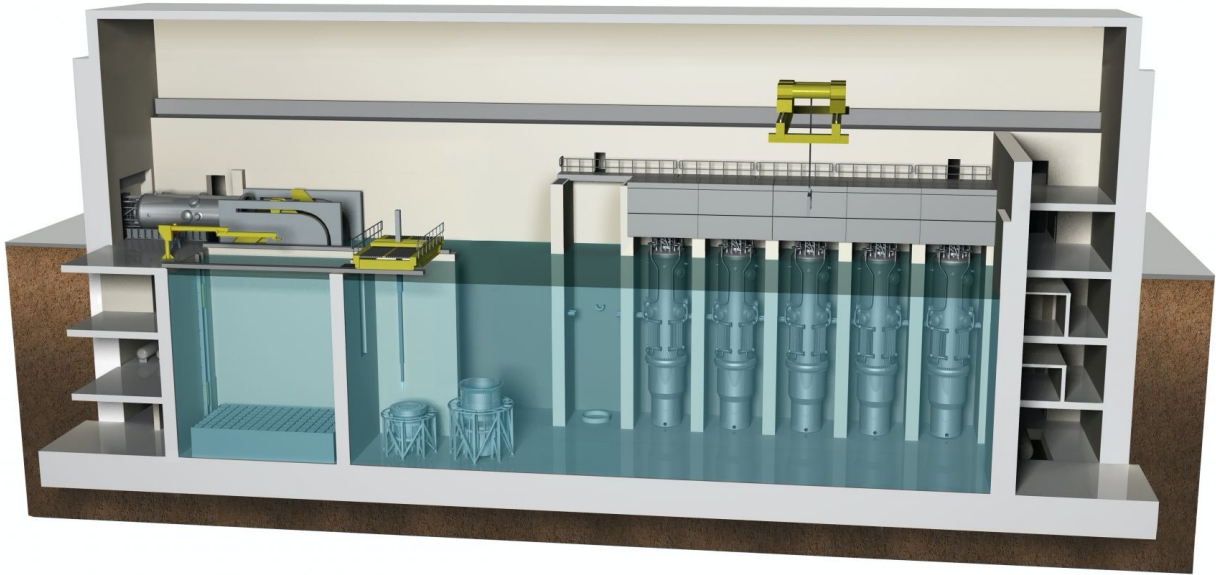
Full-Size Reactors Range:

300 MW to 1,000+MW

Can provide reliable, emissions-free baseload power.



New advanced reactor technologies are being built with features like walk-away safety, spent fuel reuse, and versatility of use in mind.

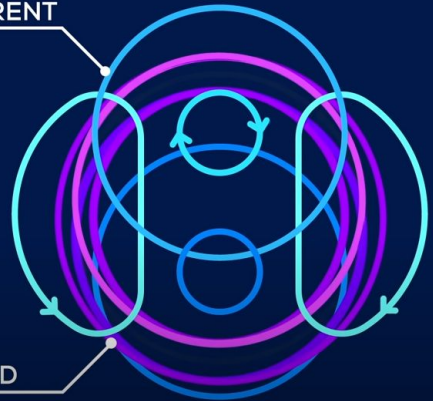


Concept drawing of an Advanced Small Modular Reactor (SMR)

Fusion Reactor

MAGNETIC CONFINEMENT REACTOR

ELECTRIC CURRENT



MAGNETIC FIELD

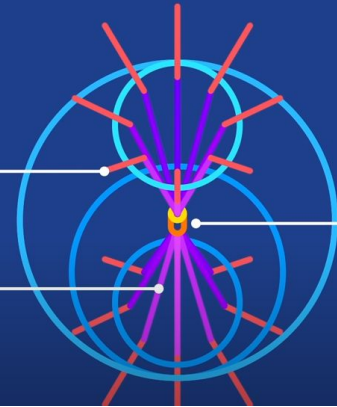
Incredibly safe
No emissions
4g of tritium at a time
Only requires water, moon dust

Con:
COST \$\$\$

INERTIAL CONFINEMENT REACTOR

INFRARED LASER

ULTRAVIOLET LASER



HOHLRAUM

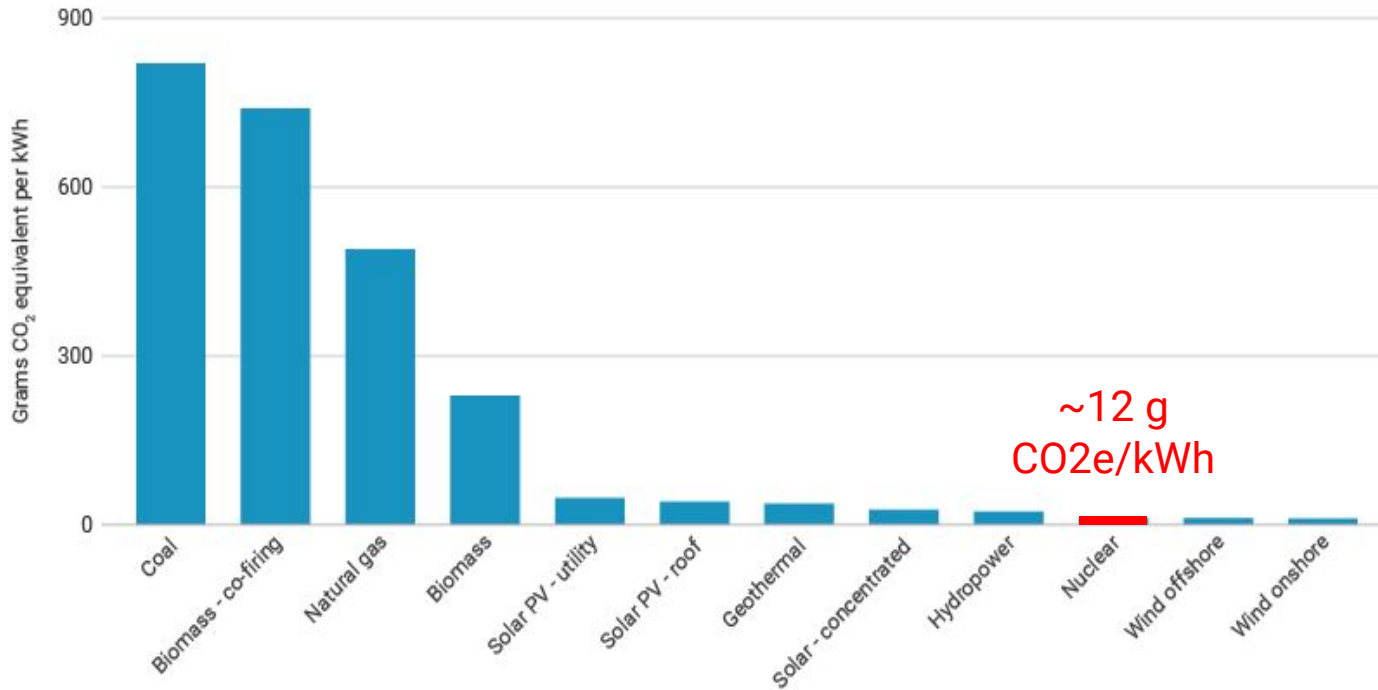


Environmental Impact

04

Low-Carbon Power Source

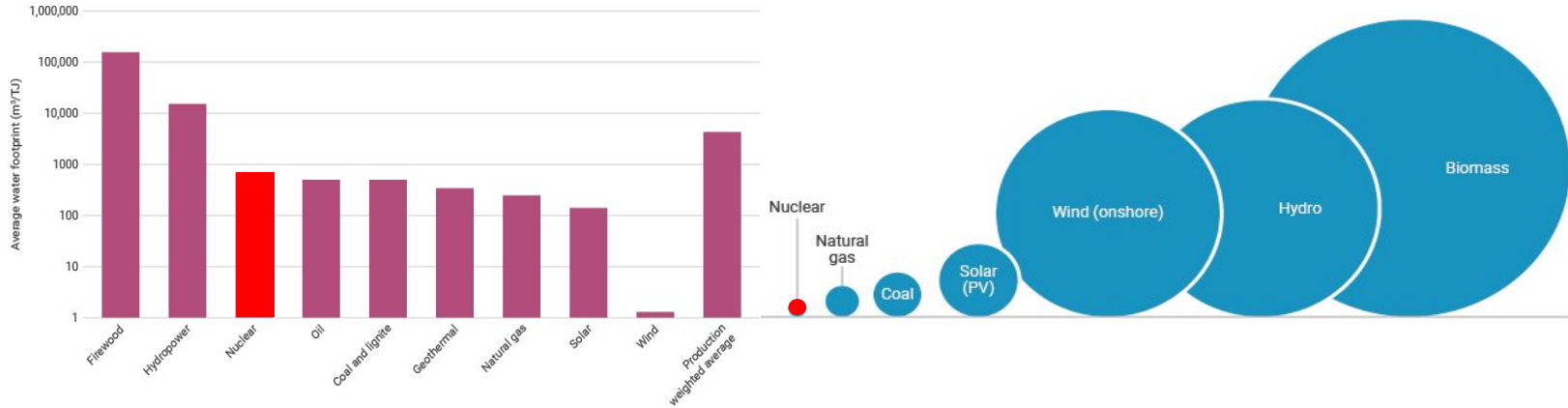
Nuclear power has one of the lowest average life-cycle CO₂ equivalent emissions compared to most other energy sources.



Average life-cycle CO₂ equivalent emissions (source: IPCC)

Water & Land Use

Nuclear power has the smallest relative land use footprint of all power sources, but plants consume significant quantities of water during operational cooling.

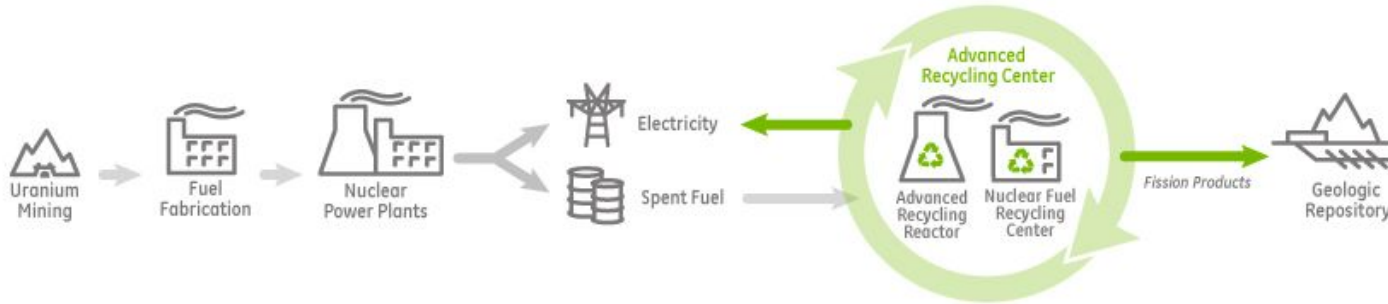


Water consumption per unit of electricity and heat produced 2008-2012 (source: Mekonnen et al., 2015)

Relative land use (fuel mining and generating footprint) of electricity generation options per unit of electricity (source: Brook & Bradshaw, 2015)

Mining & Radioactive Waste

There is no energy technology that is fully without risk to people or the environment. Uranium mining and spent fuel can pose health risks to humans and the environment if not properly managed.



“All of the used nuclear fuel produced by the U.S. nuclear energy industry over the last 60 years could fit on a football field at a depth of less than 10 yards.”

- Nuclear Energy Institute





Policy and Regulation

05

Change in policy and regulations

GOVERNMENT SUBSIDIES

Contracts-for-differences with performance-improvement requirements for specific operating facilities

CONSOLIDATE WASTE STORAGE

Deep geological repositories for nuclear waste like the WIPP in New Mexico

DESIGN AND CONSTRUCTION STANDARDIZATION

Standardization addresses the primary cause of cost overruns in previous projects.

GOVERNMENT LOANS

Loans with performance incentives should aid in the construction of new nuclear plants or uprates

Change in policy and regulations

GOVERNMENT SUBSIDIES

Contracts-for-differences with performance-improvement requirements for specific operating facilities

LONG-TERM WASTE STORAGE


Deep geological repositories for nuclear waste like the WIPP in New Mexico

DESIGN AND CONSTRUCTION STANDARDIZATION

Standardization addresses the primary cause of cost overruns in previous projects.

GOVERNMENT LOANS

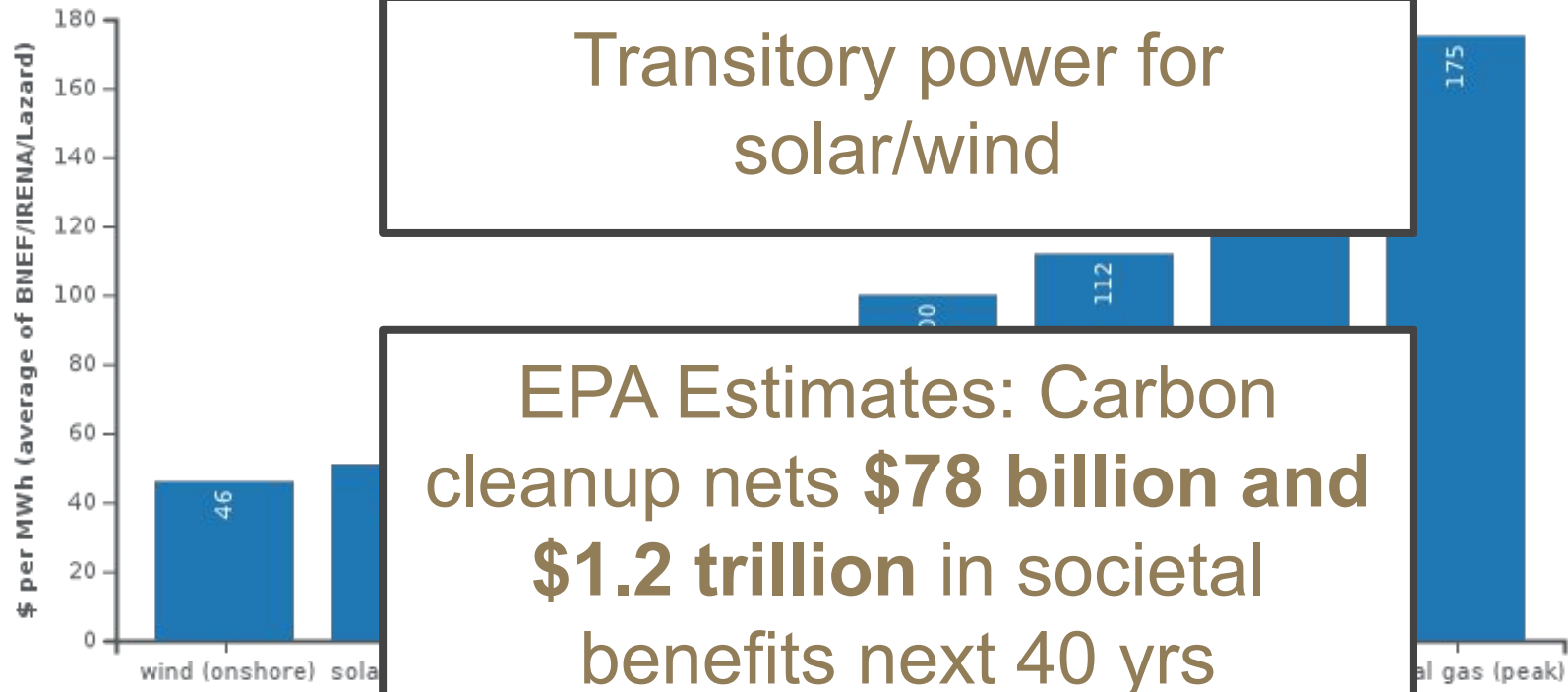
Loans with performance incentives should aid in the construction of new nuclear plants or uprates



Why nuclear as a transitory power?

06

Supporting Nucelar



Transitory power for solar/wind

EPA Estimates: Carbon cleanup nets **\$78 billion** and **\$1.2 trillion** in societal benefits next 40 yrs

Effectively Communicating Nuclear

Trust & Local Communities

The government needs to disseminate nuclear disaster information but changing opinions needs to come from tight-knit associated groups.

Extensive Knowledge

Proponents must be very knowledgeable on the subject and ready to address numerous arguments



Positive Attitude

Really, it works. Speaking about nuclear using a positive tone impacted the way students viewed nuclear in middle / elementary schools in experiment





**THANK YOU
FOR LISTENING**

Who supports nuclear?

“The Intergovernmental Panel on Climate Change, the International Energy Agency, the UN Sustainable Solutions Network and the Global Commission on the Economy and Climate argue for a tripling of nuclear energy, requiring over 1,000 new reactors (10,000 SMRs) to stabilize global carbon emissions.”

Does the Green New Deal include nuclear energy?

In 2019, the GND called for the phasing out all nuclear plants and not building any new ones; however, it now defines future energy sources as clean, renewable, and zero-emission, including nuclear.

Would you recommend subsidizing unprofitable, existing nuclear plants?

These subsidies could distort markets and reduce the incentive to innovate; however, subsidizing these plants might be favorable in the short run if it is less costly than replacing plants with renewable energies or constructing a new nuclear plant facility. It is definitely a case-by-case based decision.

Figure I. Nuclear Waste Storage Sites in the United States

