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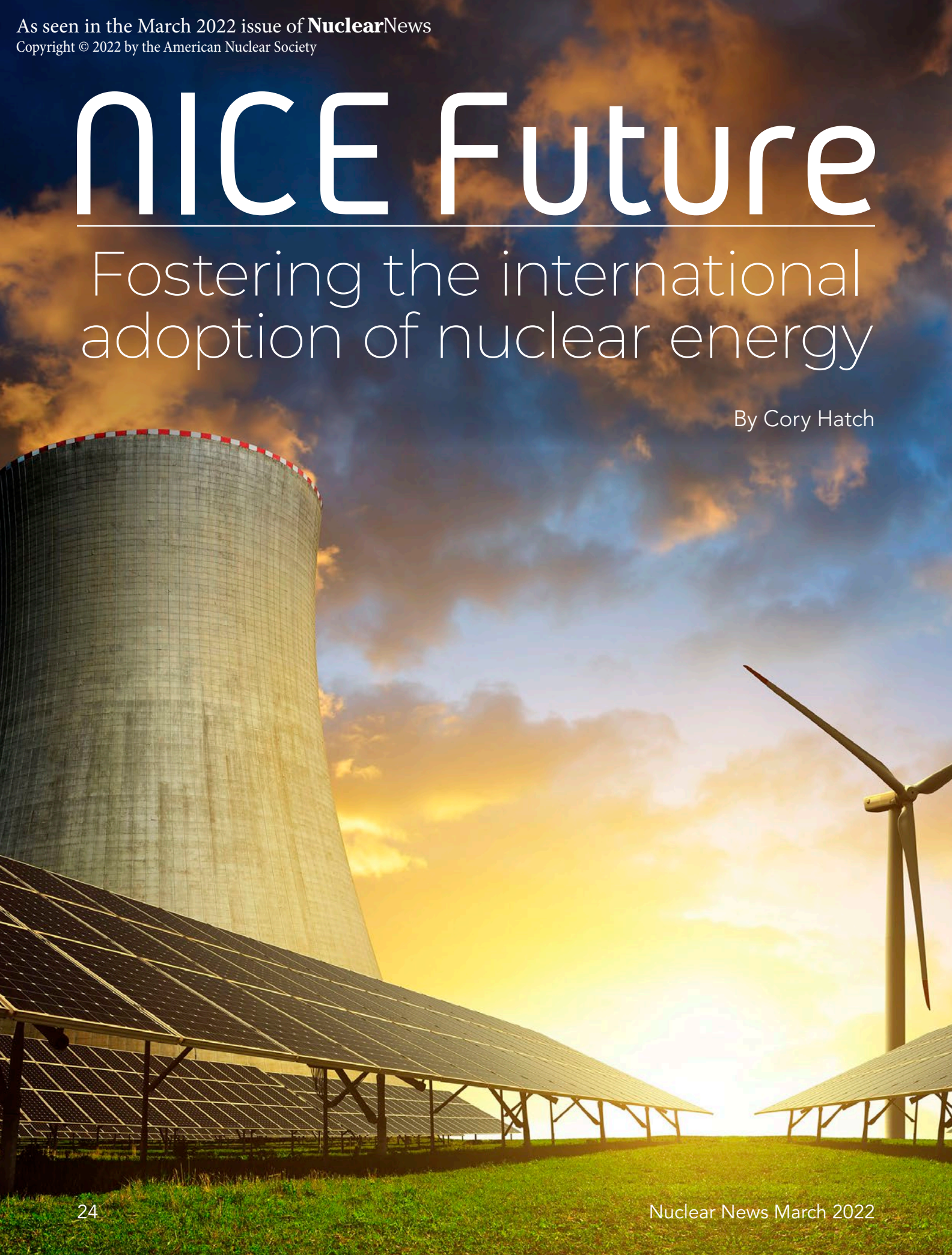
# NICE Future

## Fostering the international adoption of nuclear energy

By Cory Hatch



**Imagine life without refrigeration, television, clean cooking facilities, clean water, clothes washers, and electric lights. For the roughly 1 billion people around the world without access to electricity, energy poverty is a reality that drastically reduces their quality of life and economic opportunities.**

**At the same time, fossil fuels currently provide more than 60 percent of electricity and about 80 percent of energy worldwide, even as global carbon dioxide levels are higher than at any point in at least the past 800,000 years.**

The combination of energy poverty and the race to curb the impacts of climate change have many nations facing the same dilemma: How do you meet the needs of an energy-hungry population while also reducing emissions? How can you make clean energy widely available across the globe?

For some nations, nuclear energy could be part of the solution. Tomorrow's advanced nuclear reactors are diverse and flexible enough to overcome a wide range of challenges. At the same time, advanced nuclear energy solutions could provide nations with a carbon-free foundation for the expansion of renewables like wind and solar.

## *Exploring advanced nuclear technologies*

The Nuclear Innovation: Clean Energy Future (NICE Future) initiative helps countries explore how nuclear technologies can support economic growth, energy security, and energy access while enabling the expansion of renewable energy.

Established in 2018 at the 9th Clean Energy Ministerial, NICE Future was developed to raise awareness about the potential benefits of advanced nuclear energy technologies within the international community. The ministerial is a partnership among the world's key economies to accelerate the transition to clean energy worldwide.

Through NICE Future, the United States is joining forces with 13 nations, including Japan, France, and Canada, to incorporate nuclear in the global discussions about clean energy.

"While nuclear energy is not necessarily an option for every country and every location, it can be an important part of the clean energy mix," said Shannon Bragg-Sitton, director for Integrated Energy and Storage Systems at Idaho National Laboratory. "Nuclear energy can be the backbone of a reliable, resilient grid. It has low land use requirements. It already plays a significant role in clean energy production worldwide, and it can provide heat to support the decarbonization of industry and transportation."

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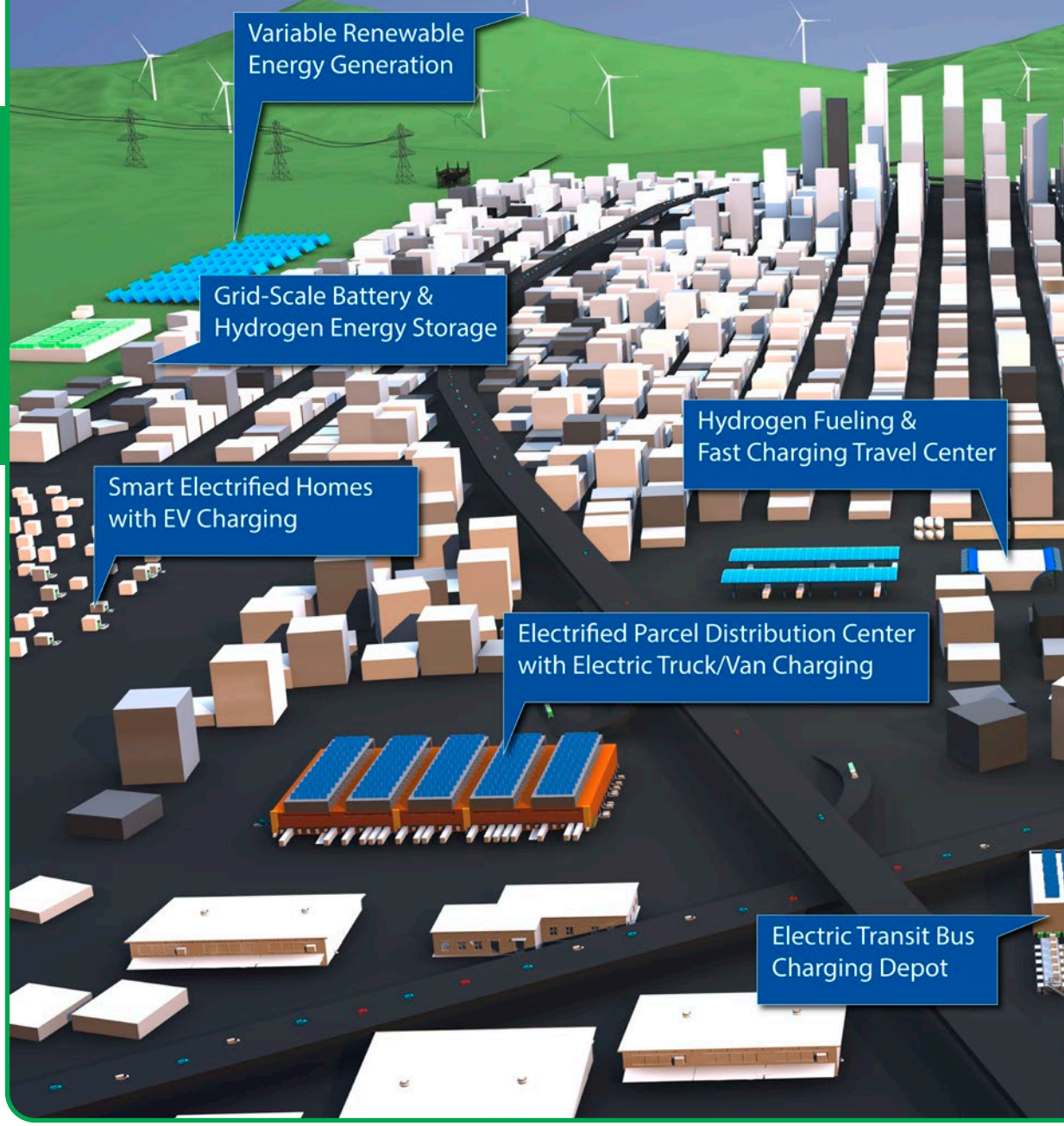
In the next few decades, cities could feature a variety of clean energy sources, including nuclear, to decarbonize not only the electric sector, but also transportation and industry.




## *Flexible nuclear*

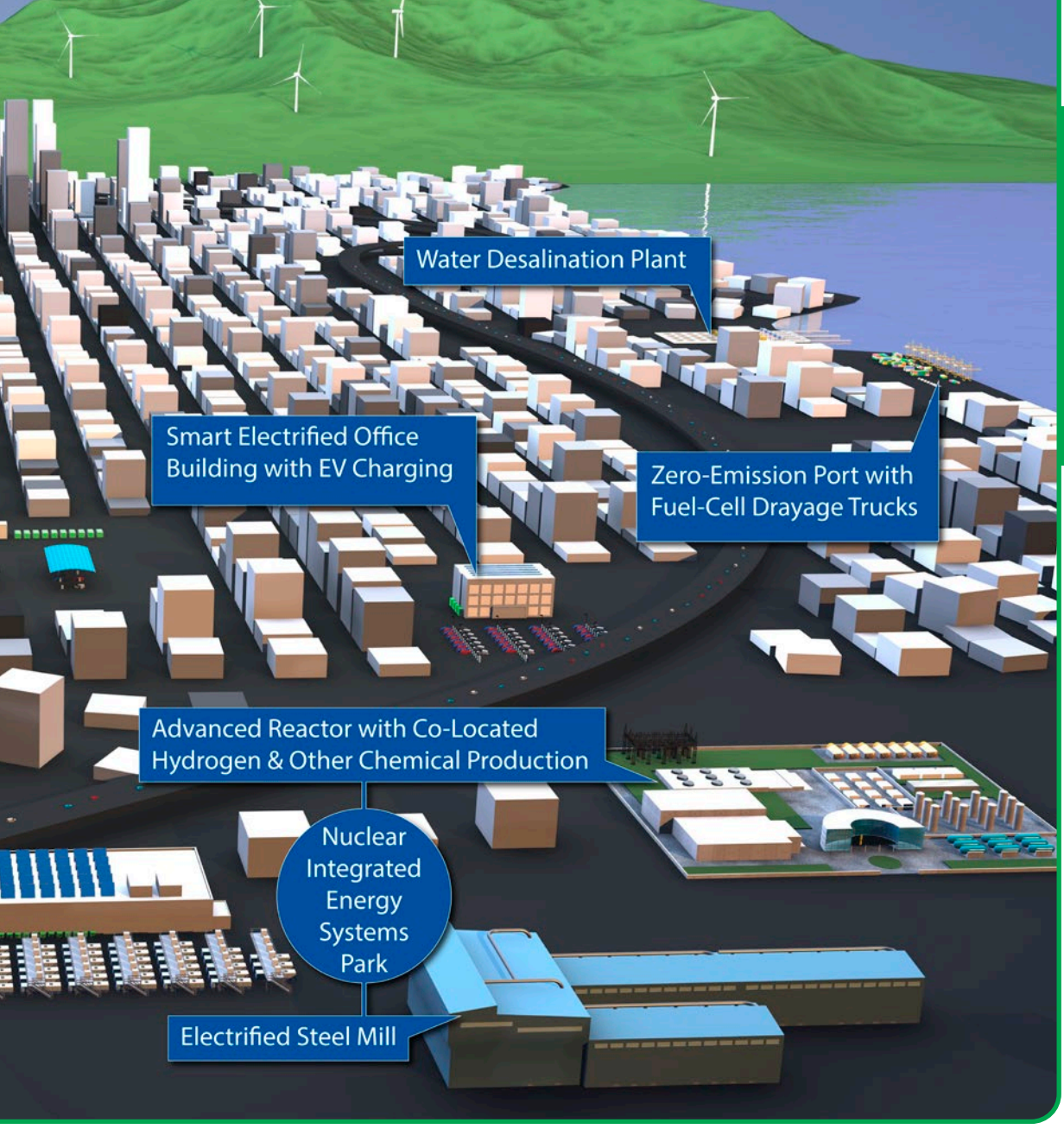
Within the global energy community, there's generally a high level of knowledge about conventional light water nuclear reactors, but not about the flexible, advanced nuclear options that will be available soon, Bragg-Sitton said.

Most of these advanced nuclear technologies offer many of the same benefits. They generate reliable, carbon-free heat and electricity; they are flexible when responding to grid demands, making them ideal companions for variable renewables like wind and solar; and they're designed with next-generation materials, fuels, and systems to enhance safety and performance.

From there, the diversity in size, design, coolant type, temperature, and other attributes of advanced reactors makes them suitable for a range of needs. Some designs will use coolants such as gas (e.g., helium), liquid salt, or liquid metal, allowing them to operate at high temperatures for industrial applications such as hydrogen production or metals manufacturing.

Some designs will be built in factories and shipped to the site for rapid assembly. Microreactors, for example, produce from a few to tens of megawatts of energy and are small enough to fit inside one or more cargo containers for easy transport to remote locations where they could replace generators that run on expensive diesel fuel.

Small modular reactors can also be built in a factory, but they're designed to produce a few hundred megawatts. Multiple small modular reactors would operate in tandem at the same power plant, and more modules could be added as the energy needs of a community grow.




## *Options for different energy markets*

These diverse advanced reactor types mean that tomorrow's nuclear can provide options for any number of different energy markets, from remote mining operations and commercial shipping to water desalination and large-scale power production.

Advanced nuclear technologies can play a key role even as more nations plan large investments in renewable technologies. First, advanced reactors can provide clean, 24/7 energy to support the grid demand that's needed for variable renewables such as wind and solar to expand. Second, smaller-scale systems can serve remote communities, or communities in developing nations, without major investments in expanding the electrical grid. Third, they can help reach segments of the energy market that are hard to decarbonize, such as industry and heavy-duty transportation.

"As you get a higher percentage of renewables on the grid, eliminating fossil fuel generation within the last 10 to 15 percent of total generation is extremely hard—and costly—without dispatchable resources," Bragg-Sitton said.

NICE Future's mission is to let people know that these options exist. Through various outreach efforts, including working with energy officials in nations where advanced nuclear could play a big role, the group has made strides in educating nations about advanced nuclear options.

Some countries participating in the initiative are not currently utilizing nuclear energy, but they are interested in nuclear as a potential option to expand energy availability and reliability. Without the work of NICE Future to communicate the diversity of clean energy options available, these countries might not find the best solution for their citizens.

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Kenya is one example. For two decades, the nation's economy and infrastructure have expanded rapidly, while its population grew at a healthy 2 percent per year. While Kenya does have access to renewable resources, officials fear that the nation's rapid growth could increase fossil fuel consumption and, consequently, carbon emissions.

"Kenya generates the majority of its energy from the large renewable resources available in the country," said Diana Musyoka, an environmental scientist at Kenya's Nuclear Power and Energy Agency (NuPEA). "The nation intends to follow this path in the long term in order to have a clean energy system. Nuclear has a greenhouse gas footprint comparable to renewables. It also generates stable and reliable energy.

"In developing the country's long-term strategy toward a zero-carbon development pathway and to meet obligations in the Paris Agreement," Musyoka added, "an energy system that integrates renewables with nuclear is proposed in this strategy. This integrated energy system will result in a clean, stable, and reliable energy supply. Through participation in the NICE initiative, the country intents to conduct analysis on how to achieve this objective with the least cost."

## *Energy for economic growth and a higher standard of living*

Kenya's government sees nuclear energy as a carbon-free power source that can support continued economic growth and provide a way to raise the standard of living for its citizens.

Kenyan energy officials have worked with the NICE Future initiative to explore options for an investment in nuclear energy that is sensitive to the nation's needs, economic resources, and relative inexperience with nuclear technologies.

Small modular reactors and microreactors might be good options because these advanced nuclear units are easy to operate, are economical, and could be deployed incrementally as Kenya continues to develop and expands its electric grid.

In addition to electricity for the grid, advanced nuclear technologies could provide Kenya with energy to produce clean water (desalination) and heat for industrial processes, hydrogen production, agriculture, and other applications.

Kenya's NuPEA contributed to NICE Future's inaugural

Thriving cities such as Nairobi, Kenya, are looking to clean energy sources, including nuclear, to support rapid growth while minimizing carbon emissions.

report in September 2020. Kenya continues to participate in NICE Future, including through planned collaborations between NuPEA, INL, and the National Renewable Energy Laboratory on modeling energy systems, estimating job creation and economic impact, arranging local stakeholder events, and connecting nuclear vendors with agency staff.

"We've been talking to countries about how nuclear is not just for electricity, which helps them think about nuclear in a broader context," Bragg-Sitton said.

Poland is another example. The country has been looking at nuclear energy for some time as a vital part of the future Polish energy mix. Nuclear power as a reliable source of electricity generation will help Poland replace its coal-fired power plants, which are going to be retired in the coming decades.

Krzysztof Szymański, head of the strategy and regulation unit in the Nuclear Energy Department of the Polish Ministry of Climate and Environment, states, "To achieve the goals of decarbonization, our country needs first of all a nuclear program based on large-scale reactors, ensuring production of a large volume of clean electricity. At the same time, we follow closely plans for deployment of SMRs in Poland, which are still at an early stage, depending on the successful licensing and deployment of SMRs in vendor countries. We see potential synergies between these technologies and their applications in the future. Large nuclear power plants will create the backbone of the Polish energy system as baseload units, while SMRs, once they are available, will serve the needs of the industry for heat processing and for local communities as a source of district heating. Both technologies from that perspective are needed and have their place in the energy system in Poland."

For other countries, the alternative to advanced nuclear technologies might be fossil fuels. While choosing fossil fuels might support growing energy demands in these developing nations, it doesn't align with global efforts to decarbonize the energy sector.

"If some of these countries can skip over a major investment in fossil fuels, then significant emissions can be avoided," Bragg-Sitton said. "If they consider the role of both nuclear energy and renewables in making future energy decisions, then I think we've done our job getting the word out."

The NICE Future initiative provides a global platform for communication with various stakeholders to ensure that all clean energy options—nuclear, renewables, carbon capture, and various combinations of these technologies—receive equal consideration as nations transition away from fossil fuels.

"Investing in clean energy is an investment in our environment and our communities," Bragg-Sitton said. "The transition to carbon-free energy sources such as nuclear, motivated by the need to mitigate climate change, will impact developed and developing countries, urban and rural communities, to differing degrees. Advanced nuclear technologies that can be right-sized to meet the energy demand, whether it's electricity or heat to drive local industrial processes, can turn the energy transition from a burden to an opportunity for growth."

*Cory Hatch is a science and medical writer under contract with Idaho National Laboratory.*