NICE Future
Nuclear Innovation: Clean Energy Future
An Initiative of the Clean Energy Ministerial

CLEAN ENERGY MINISTERIAL
Advancing Clean Energy Together

FleXible Nuclear Energy for Clean Energy Systems

FLEXIBLE NUCLEAR CAMPAIGN
FOR NUCLEAR-RENEWABLES INTEGRATION
A CAMPAIGN OF THE CLEAN ENERGY MINISTERIAL

CLEAN ENERGY MINISTERIAL
Advancing Clean Energy Together

CEM: The Clean Energy Ministerial (CEM) is a high-level global forum that promotes policies and programs that advance clean energy technology, share lessons learned and best practices, and encourage the transitions to a global clean energy economy. Initiatives are based on areas of common interest among participating governments and other stakeholders at: http://www.cleanenergyministerial.org/

NICE Future
Nuclear Innovation: Clean Energy Future
An Initiative of the Clean Energy Ministerial

NICE Future: The Nuclear Innovation: Clean Energy Future initiative is an international collaboration that envisions a world where nuclear energy innovation advances clean energy goals. Rather than focus on specific technologies or issues, we aim to address nuclear energy holistically within the context of broader clean energy systems and understand market structures for advanced nuclear technologies. Find out more at: http://www.nice-future.org/

FNC FLEXIBLE NUCLEAR CAMPAIGN
FOR NUCLEAR-RENEWABLES INTEGRATION
A CAMPAIGN OF THE CLEAN ENERGY MINISTERIAL

FNC: The "Flexible Nuclear Campaign: Nuclear-Renewable Integration for Advanced Clean Energy Systems" is a campaign within the NICE Future initiative that brings together governments, research institutions, non-government organizations, and industry to focus on flexible, integrated systems that use both nuclear and renewable energy. The campaign is helping to expand an understanding of how coordinated use of these technologies can reliably and affordably accelerate contributions to clean energy systems of the future.

Lake Kawaguchiko, Japan

Inside...

Excerpts

from forewords of the Flexible Nuclear Energy for Clean Energy Systems Technical Report

"We must find ways to reduce emissions of our energy systems... Many of us recognize nuclear's indispensable role in solving this equation.

Canadian Nuclear Association
Japan Atomic Industrial Forum
Nuclear Energy Institute (U.S.A)
UK Nuclear Industry Association
World Nuclear Association

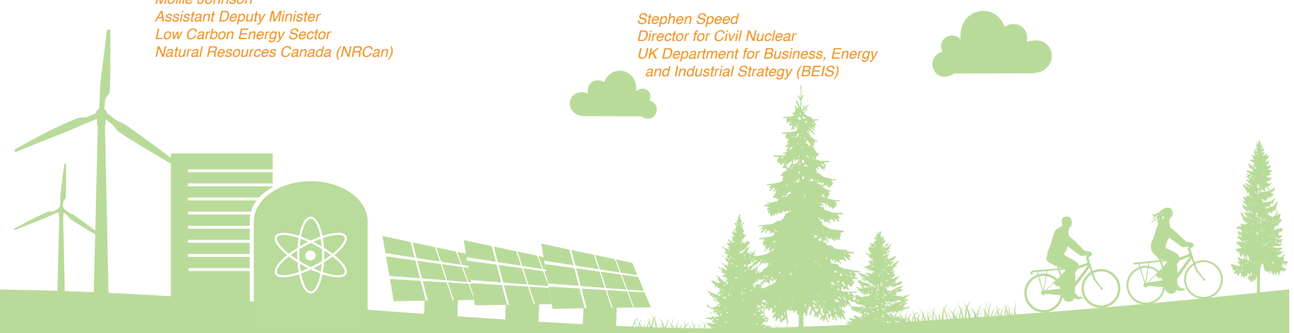
"We are excited about the innovative systems that are being explored to power our future. By harnessing nuclear energy innovation through closer global co-operation, the world will be cleaner, healthier, and more prosperous.

Dr. Rita Baranwal
Assistant Secretary for Nuclear Energy
U.S. Department of Energy (DOE)

Mollie Johnson
Assistant Deputy Minister
Low Carbon Energy Sector
Natural Resources Canada (NRCan)

Kihara Shinichi
Deputy Commissioner for International Affairs
Agency for Natural Resources and Energy (ANRE)
Ministry of Economy, Trade and Industry (METI), Japan

Stephen Speed
Director for Civil Nuclear
UK Department for Business, Energy and Industrial Strategy (BEIS)



Nuclear energy is an important part of the global clean energy supply, providing nearly one-third of the world's low-emitting electricity and complementing and enabling other clean energy sources, including renewables.

Globally, we are more connected today than ever in history. Our fates are tied; we share the opportunities and the consequences of the best and worst of the conditions in inter-connected eco-systems and economies.

It is within our ability to harness innovation to gain the benefits of abundant power for clean urban systems without harmful emissions and smog. We can provide energy self-sufficiency to communities and remote work sites at the farthest reaches of the world to give all people equal chance for prosperity.

We can achieve this by working together to build integrated low-emitting energy systems and infrastructure.

Already, there are hopeful signs. The last decade has seen advancement in wind and solar generation resulting in affordable technologies that can make a major contribution to clean energy. Existing and new designs in flexible, advanced nuclear technology can complement variable renewables.

This booklet accompanies a technical report that summarizes the work of scientists, engineers and power operators worldwide, each committed to development of clean energy. This is further captured in the Flexible Nuclear Energy for Clean Energy Systems technical report released at CEM11.

What is still needed are the policies that will put the change in full motion in the short timing remaining. We invite you to learn more and to join us as we work to reinvent the global energy supply.

"The scale of our ambition must be commensurate with the scale and urgency required by our combined economic, environmental, and energy challenges.

ClearPath and Energy for Humanity

Acknowledgement
of technical report contributors

Contributing Organizations

Agency for Natural Resources and Energy, Ministry of Economy, Trade, and Industry of Japan
American Nuclear Society
Canadian Nuclear Association
Canadian Nuclear Laboratories
ClearPath
Électricité de France
Energy for Humanity
Exelon
Generation IV International Forum
Idaho National Laboratory
International Atomic Energy Agency
International Energy Agency
International Framework for Nuclear Energy Cooperation
International Youth Nuclear Congress
Japan Atomic Energy Agency
Japan Atomic Industrial Forum
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Massachusetts Institute of Technology
National Renewable Energy Laboratory
Natural Resources Canada
Nuclear Energy Institute
Organization for Economic Co-operation and Development Nuclear Energy Agency
Tokyo Institute of Technology
U.K. Nuclear Industry Association
U.K. Nuclear Innovation and Research Office
U.K. Department of Business, Energy and Industrial Strategy
U.S. Department of Energy and Department of State
World Nuclear Association

Overview

Building a clean energy future

This booklet is a companion to the Flexible Nuclear Energy for Clean Energy Systems report, published as part of the Nuclear Innovation: Clean Energy Future (NICE Future) initiative under the Clean Energy Ministerial (CEM).

This year CEM11 is being held virtually from Saudi Arabia; a country that is actively pursuing a cleaner energy system through a mix of technologies, including renewables and nuclear. Its neighbour, United Arab Emirates, is home to the Arabian Peninsula's first nuclear power plant at Barakah, which began operation in August 2020.

A decade ago, energy ministers from around the world gathered to launch CEM, a global forum where major economies and forward-leaning countries work together to share best practices and promote policies and programs that encourage and facilitate the transitions to a global clean energy economy. The 25 countries and the European Commission taking part in CEM today account for about 90 percent of global clean energy investment and about 75 percent of global greenhouse gas emissions (GHG).

The clean energy focus of these countries is indicative of the growing interest in diversifying global energy supply and using energy sources that are both low-emitting and abundant. A key CEM aim is to ensure affordable access to reliable power and to meet the energy needs of all of the world's citizens while ensuring the long-term health of the planet.

The CEM's ambitions are commensurate to the scale and urgency required by our combined economic, energy and environmental challenges. With increased urgency to reduce GHGs, there has been increasing recognition of the roles nuclear energy and nuclear innovation can play, through both traditional nuclear plants and through the development and commercialization of small modular reactors (SMR) and other advanced reactor technologies.

To bring this opportunity to the forefront, in May 2018 at the Ninth Clean Energy Ministerial in Copenhagen, the NICE Future initiative was introduced by the United States, Canada and Japan. Argentina, Poland, Romania, Russia, the United Arab Emirates and the United Kingdom quickly signed on to identify and share opportunities for nuclear to play an integral and enabling role within low-emitting energy systems. Kenya and Jordan have also more recently joined the initiative.

Within the NICE Future initiative, the Flexible Nuclear Campaign (FNC) was initiated by the United Kingdom, United States, Canada and Japan, alongside environmental NGOs ClearPath, Energy for Humanity and Energy Options Network, to provide an understanding of how advanced technologies could work alongside variable renewables in flexible, reliable and safe energy systems. This includes nuclear reactors with highly-flexible power output across a range of energy applications.

FNC highlights how nuclear energy can effectively integrate into the energy systems of the largest cities, the most remote communities and project sites, bringing with it the benefits of reliable, low-emitting energy.

This booklet and the FNC technical report provide a window into the work of thousands of scientists, researchers, engineers, operators and policy makers. Collectively, they are exploring the expanded use of current and advanced nuclear technologies as enablers for low cost, clean energy systems.

The report also contributes to the evidence base for the deployment of these technologies in urban and remote areas to deliver flexible, abundant, low-emitting energy for the world's 7.8 billion people, wherever they may live.

Peak fall colours, New England, U.S.A.

Key report highlights

Technical report provides a comprehensive evidence base for integrating nuclear into a clean energy system

The Flexible Nuclear Campaign technical report that accompanies this booklet is a comprehensive resource on the roles of flexible nuclear power to advance clean energy systems. The report offers evidence-based findings to support policy makers, energy system planners, designers, and investors to consider all the ways nuclear power can operate to enable a modern clean energy system.

The report finds:

There is already a body of knowledge surrounding flexible operation of existing nuclear plants to compensate for the variability of supply from renewables. This means power stations built today can continue to play a significant role in the flexible supply of energy, even as renewables are more widely deployed.

Concept of a remote data centre powered by a mix of nuclear small modular reactors (SMRs) and variable renewable energy. With years of fuel on site, SMRs offer energy autonomy, wherever the location.

Innovation can increase the flexibility of existing nuclear reactors to produce both clean electricity and beneficial non-electric products. This includes the opportunity to deliver heat in support of hydrogen production, desalination, and industrial applications.

Advanced reactors will present even more opportunities for flexibility in nuclear systems. The advent of these technologies enables energy system planners and policymakers to consider nuclear energy in news ways.

The technical report can help pave the way for more flexibility, greater nuclear-renewables integration, and more clean energy in the future:

1. See how the report fills a key gap in advanced system analyses. Diverse modelling tools and different national circumstances may show variations, but all converge on a single point: there are promising roles for flexible nuclear.
2. Learn about the latest research by esteemed experts around the world, for the first time presented in one document. There are many years of experience in flexibly-operating nuclear plants. The report confirms there exists a robust body of research on nuclear flexibility opportunities and constraints.

   The report also confirms that nuclear energy is already more flexible than many of us thought.
3. Find out how innovation and advanced reactors, including micro-reactors and SMRs, will present even more opportunities for flexibility in nuclear systems.
4. Learn how 24/7 nuclear energy and variable renewable energy can be mutually enabling in clean energy systems.
5. Share with your networks how new products in flexible systems could bring benefits to society and create new revenue streams that could transform nuclear energy investments and clean energy systems design.
6. Consider incorporating this nuclear flexibility data into real work amongst reactor developers, investors, researchers, and governments on the economic and technical roles nuclear can play in future energy markets.

We require a lot from our energy systems: Reliable power that is abundant and affordable for all of us, wherever we may live while, at the same time, low-emission and gentler on our planet. Today, nuclear contributes about a third of the world's clean energy. In the future, it can be a source for clean electrification of our infrastructure, including transportation and buildings. It can provide heat, clean water and fuel for mobile energy. And, it can enable a clean energy system by responding to both demand and the variable output of other low-emission energy sources like wind and solar.

Empowering lives

The evolving needs of energy systems

In a single generation, through wireless telecommunications, the world became connected. People in even the most remote areas can now participate in e-commerce in ways not thought possible even a decade or two ago. With great clarity, family and friends can see, hear and almost touch loved ones, continents away.

And yet, many still rely on antiquated, emissions-intensive, smog-producing energy systems and fuels to power their most basic needs. Some even do without essentials, including clean water, heat, space cooling and electricity, due to the lack of access to affordable or reliable power.

In the past decade, catastrophic natural events and life-threatening levels of air-pollution have impressed upon us the urgency to make our energy systems and related infrastructure cleaner and more resilient.

There are positive signs that the transformation of our energy systems can be achieved through new and innovative technologies. These innovations protect our planet's health while also improving people's lives, ensuring they have clean air, as well as affordable and reliable access to energy services where they live.

Investment in wind and solar has resulted in great advances in these clean technologies. Yet, the emission reductions earned through renewables have been offset by the decline in the use of nuclear energy, thus halting the world's advances towards clean energy goals. Without increased investment in nuclear, achieving a sustainable energy system will be much harder and far more costly. (IEA, 2019)

Today, nuclear energy provides about one-third of the world's emissions-free electricity and contributes significantly to the global clean energy supply, both as a primary source of clean energy and by enabling other clean energy sources.

Nuclear technologies have continued to evolve and offer more benefits to energy systems than ever before. Through continuous improvement and innovation, existing nuclear plants are reaching new levels of performance in safety, affordability and longevity.

Some existing nuclear plants offer load-following capability to match varying grid demand, and new nuclear designs can be purpose-built as ideal partners to variable renewable energy in low-emitting systems that easily respond to energy demand.

Advanced nuclear reactors are being designed today that combine electricity generation with other energy applications, such as heating and water desalination. They are deployable both in urban and remote locations providing heat and electricity to a wide range of communities and work locations, such as industrial centres, mines and project sites.

By taking a whole system view of energy production and consumption and considering all the potential products and services that nuclear can provide, we can create integrated, responsive clean energy systems and infrastructure including cleaner transportation and buildings.

We can develop and deliver new energy delivery modes, such as hydrogen, and together power the world's most vibrant urban centres and its most remote communities while accelerating progress towards our clean energy goals.

Read more about evolving energy systems in Chapters 3, 4 and 17 of the FNC report.

Above from top: Electric bus charging, the bustling core of Tokyo, Japan, and a concept of a remote industrial hub powered by clean energy including small modular reactor.

As energy systems are changing to meet new expectations, so too is nuclear power, offering greater flexibility to meet changing demands.

And it can operate flexibly in three main ways:

Operational flexibility *by changing power output to follow the demand for energy;*

Deployment flexibility *to deliver reactors that meet size, location, schedule and budget; and*

Product flexibility *to support a variety of uses and markets.*

flex•i•ble

Capable of bending easily or to ably respond to altered circumstances.

flex•i•ble nu•cle•ar

The ability of nuclear energy to economically provide energy services at the time and location they are needed by end-users.

These energy services can be electric and non-electric applications, using traditional and advanced nuclear power plants and integrated systems. (FNC, 2020)

flexible nuclear

Many people already know that nuclear can deliver a large, steady supply of low-emitting electricity, 24-7, 365 days a year. What is less well known is nuclear energy's more flexible side.

It can partner with renewables to provide energy that matches the ebb and flow of people's requirement for electricity throughout the day. It can also ramp up output when the sun doesn't shine or the wind doesn't blow. In doing so, nuclear allows populations to gain the benefits of large scale renewables while providing added reliability.

In many countries, operating nuclear plants use different strategies to inject flexibility into their regional grids. Many new reactor designs further extend the range of flexibility in these plants.

When we think about nuclear, we tend to think BIG – big nuclear plants that provide lots of low-emitting power as part of large centralized systems. Certainly, these powerhouses are of huge benefit, especially as the world moves to reduce emissions, not just electricity systems but also transportation, buildings and other infrastructure.

While big is beautiful, small may be the right-sized package for many applications. Transportable micro and small modular reactors can provide a source of clean energy even for the most remote communities, providing electricity and other energy needs like district and industrial facility heating, hydrogen production and water desalination. Advanced nuclear designs are simple to operate with automatic safety systems and capital costs that are smaller, just like the scale of power they deliver. And, as communities prosper, the design allows for additional reactors to be added to serve growing needs.

Today's nuclear power is a multi-faceted energy source that will be there when you need it, where you need it.

Read more about flexible nuclear in Chapters 5, 6, 9, 10 and 16 of the FNC report.

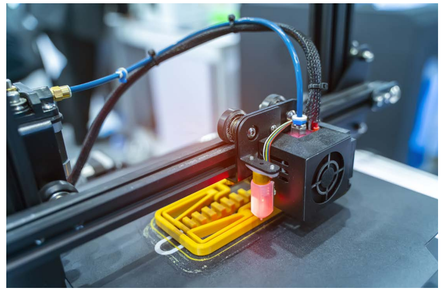
The same clean energy

For decades, nuclear operators have been fine-tuning their processes, procedures and human performance in nuclear plants; learning and improving their performance, year over year.

Today's nuclear plants are modern and powerful producers of reliable, affordable, clean power that provide a steady supply of low-emitting electricity for our largest cities, as well as the towns and homes that populate our country-sides.

Nuclear energy is also the largest contributor to low-emitting electricity in advanced economies. In 2018, it totaled 18 percent of generation in these countries (IEA, 2020).

But, just as the world is seeking to escalate the use of low-emitting energy sources, there is a risk looming. As nuclear plants built decades ago come to the end of their planned operation or are pushed out by low-cost sources with higher emissions, the world could see a reduced benefit from this large source of reliable, low-emitting electricity.



New technologies such as digital on-line maintenance monitoring for on-going equipment health assessment, drones to inspect areas difficult to access and 3-D printers (as in photo above) to manufacturer hard to procure parts are just a few of the new technologies that are making today's nuclear plants more effective and cost-efficient.

Fortunately, many countries recognize the opportunity to refurbish existing nuclear plants with modern technologies and updated systems, extending their years of operation for decades to get more clean energy from them and gain greater return on investment.

Just as a century-old home can be revitalized with new plumbing, wiring and the most modern appliances, traditional nuclear power plants are achieving new records in performance through investment in innovative technologies, advances in equipment, process innovations and training.

They are delivering on changing expectations and earning their place in the energy systems of the future.

Read more about advances and flexibility in existing nuclear plants in Chapters 3, 11, 12 and 15

new powers

From the outside, nuclear plants might look as they always did. But inside, with advances in nuclear technologies, scientific discoveries and advanced training and education, today's nuclear plant is often filled with the most current technology and the people who possess the knowledge to bring it to life.

Your hometown hero

Today's nuclear plants use cutting-edge technology to create a better, clean-energy future

People may not associate innovation with their hometown nuclear plant, possibly built before they were even born. From the outside these plants may look the same. But on the inside, they have been transformed into modern facilities equipped with robotics, 3-D printing, digital inspection programs and artificial intelligence, capable of higher performance and responding to a changing overall environment.

Today, we are asking nuclear plants to be more responsive to grid demands. In part, this responsiveness fills some gaps for clean but variable renewable energy sources like wind and solar.

While new nuclear designs are being purpose-built to this requirement, nuclear plants in France have been using power ramping to manage their supply-demand balance for years. Across North America, some nuclear plants make seasonal adjustments to their nuclear units to accommodate water flow rates from hydro sources. And there are many other examples of successful operational flexibility in nuclear plants around the world.

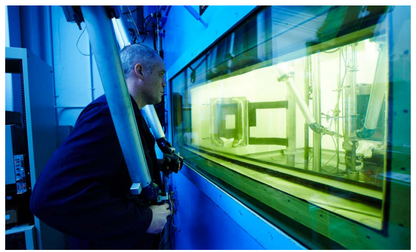
Some operators have already found uses for excess power. In the UK, excess nuclear energy was paired with pumped storage and district heating systems. Researchers and operators are looking for additional opportunities. That hometown nuclear plant could soon supply low-emitting hydrogen to power local transit, or be used as feedstock in nearby industrial complexes.

Some reactor designs, including CANDU plants, produce raw materials for life-saving nuclear medicine, treatments and diagnostics. With added uses come greater benefits. Today, nuclear plants contribute even more to quality of life and the economy, locally and on a global scale, while at the same time improving their cost competitiveness through introduction of new revenue streams.

Existing and new large-scale plants are integrating many of the same innovations as the new small modular reactors. Whatever the scale of the plant, large or small, nuclear remains safe, reliable and with great versatility to support cleaner electricity and integrated energy systems around the world.

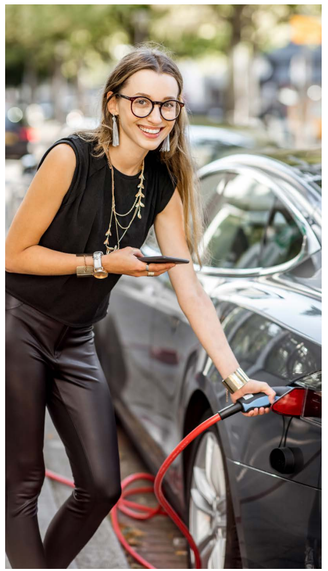
As engineers and scientists brought nuclear power to the world more than a half century ago, today its operators and research communities are finding ways to adapt it to 21st Century needs.

Read more about advances and flexibility in existing nuclear plants in Chapters 3, 11, 12 and 15.



Above: Robotics, artificial intelligence and digital systems are just a few of the reasons today's nuclear plants are reaching new heights in performance. A commitment to innovation is improving plant operation. It is also opening up opportunities for new ways to use this low-emission power for electricity, and for other uses like hydrogen production for clean, mobile uses.

Small Modular Reactors

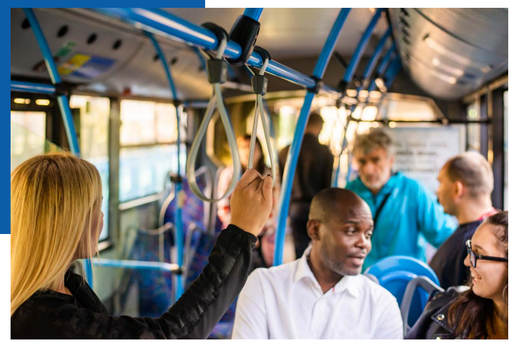


Above: A remote village, a Saskatchewan potash mine, and street charging an electric vehicle in Rotterdam.

An energy source for everyone

The simplicity, mobility, and safety of small modular reactors inherent in designs tailored to many power applications makes them ideal as a main power source in remote locations for communities and industry or in a supporting role to meet urban clean energy goals including electrification of transit, vehicles and buildings.

Read more about advanced nuclear technologies and their role as enablers in integrated systems and as single-source energy providers in Chapters 3, 4, 5, 13 and 16 of the FNC report.



The enabler

Small modular reactors: An energy source for everyone

Several decades ago, only the largest companies could afford computers, monoliths that filled a warehouse.

Today, we hold more computing power in our watches. In the same way personal computers democratized access to information, advanced and small reactors can bring clean energy autonomy to all countries and communities around the world.

For small, remote communities, access to low-emitting, reliable and affordable electricity can be a game-changer.

For countries heavily reliant on energy imports, a nuclear energy source can help meet security of supply and clean energy goals.

In the first half of the 20th Century, electric-powered appliances like vacuums, electric stoves and washing machines changed the trajectory of the lives of millions of women who, freed from domestic chores, could pursue higher education and enter the workforce.

Perhaps the most compelling example of how electricity can change lives is the power to purify and transport water to homes.

Advanced nuclear including SMRs can provide the world's most remote communities with electricity to power their households, medical centres, schools, and the computers that connect them to the global economy. The same SMRs could provide district heating for homes, industry and institutions; water purification to provide fresh drinking water; and clean hydrogen production for use in transportation and industry. Depending on the needs of the community, an SMR can provide power for a multitude of uses.

Of course, it isn't only small communities that can benefit from this small but mighty powerhouse. Equally, advanced nuclear technology has much to offer urban energy systems given their small footprint and diversity of applications. With advancements, nuclear power will soon bring the same clean, reliable power to all communities, wherever they are.

Powerful Partners

Advanced nuclear integrated with traditional nuclear and renewables

Advanced nuclear technologies designed for modular construction are not only for easy transport to far-off lands. As innovators consider how to tailor new reactors to 21st Century needs, design modifications help jurisdictions better manage the costs and demands of their large and evolving energy systems.

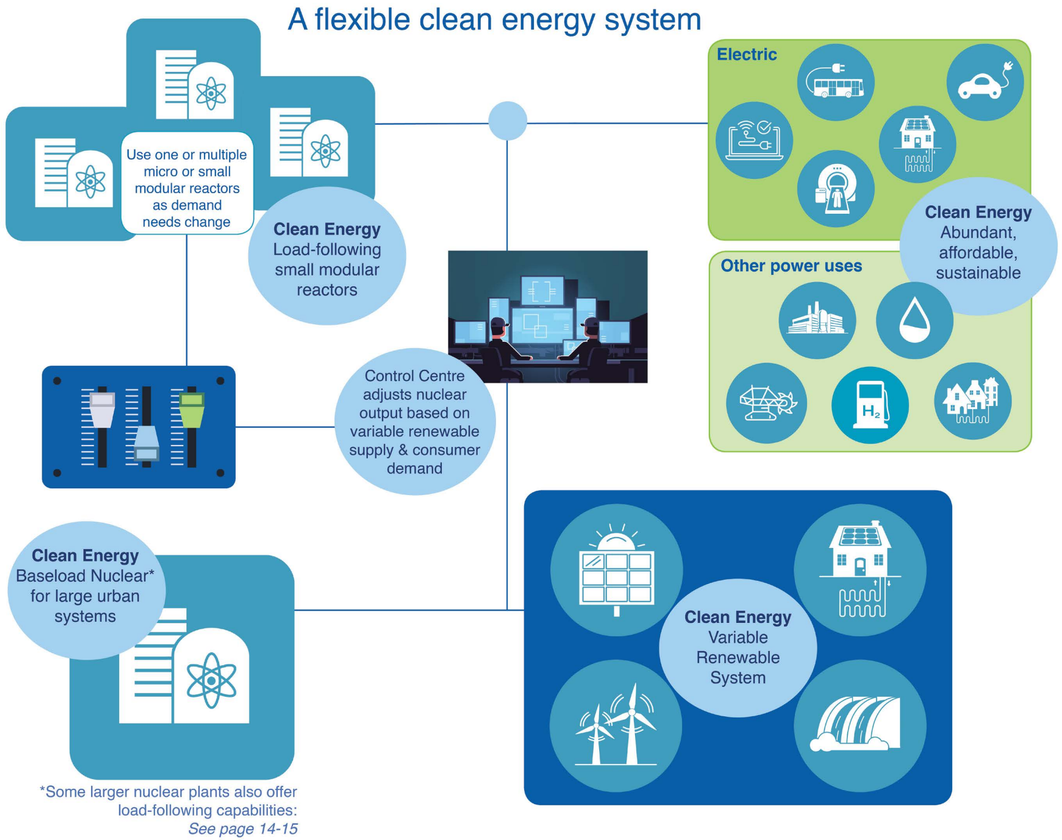
Modular construction in factories establishes a secure supply chain and provides system operators the flexibility to start with a single, small reactor and then build onto the plant with additional modules over time, as demand requires and funding allows.

Manufacturing of nuclear reactor components in factories provides the opportunity to manufacture a larger quantity of reactor components in multiple locations, further reducing the capital cost challenge.

These new reactors are specifically designed to load-follow demand, by varying power output or redirecting energy to produce non-electric products, making them a reliable partner for variable renewables for many decades.

When integrated into big energy systems that may include base-load nuclear and variable renewables, advanced nuclear technologies can be the collaborator that adds needed system flexibility and enhanced reliability. The result is affordable low-emitting grids that offer abundant clean electricity as well as fuel for heating and transportation.

Together, these energy sources will power a future of clean, vibrant communities free of smog and full of potential.



*Some larger nuclear plants also offer load-following capabilities:
See page 14-15

Solutions to fit all sizes

When it comes to the best way to build a clean energy system, the answer is often, "It depends."

With clean energy innovation, we can ensure that a variety of options are available to keep our planet's ecology in balance while also ensuring that every person has clean air, access to clean water and the tools for prosperity.

But there are many recipes to bring the right mix of ingredients together to meet the specific needs of the vast geographies, cultures and economies across thousands of jurisdictions around the world.

Clean energy systems that are low-emitting and accessible to all are foundational to the CEM approach.

Each country and jurisdiction will consider variables including their unique socio-economic circumstances, population size and demographics, climate suitability, national objectives, grid inter-connectivity, industrial operations, and existing and future transit and building infrastructure.

Advanced nuclear technologies coupled with wind and solar, as well as other low-emitting energy sources including geothermal, tidal power and hydro, will present even more opportunities for flexibility in clean energy systems. Nuclear energy and renewable energy can work together in clean energy systems.

Complementing innovation in energy sources is the rapid evolution of storage and energy mobilization including batteries, pumped storage, thermal storage, and chemical storage using energy carriers such as hydrogen.

System operators are also innovating their approach to grid management, integrating these new technologies and greater interconnectivity across jurisdictions.

There is no panacea to meet the world's energy and environmental goals. Rather, there are many good ingredients which, when combined, can deliver energy equity, clean air and water, and enable a sustainable future.

At left: Meeting the energy need A flexible clean energy system can combine many low-emission sources including variable renewable generation, hydro and base-load nuclear. Flexible nuclear reactors, including small modular reactors, can be ramped up and down quickly to respond to increases and declines in consumer demand and real-time output of intermittent generation sources.

The way forward

A leading purpose of the NICE Future initiative and Flexible Nuclear Campaign is to pool international experience on the continued advances and diverse uses of nuclear technologies and to share this experience with the broader CEM community.

Within this is a call to action to expand the potential for nuclear to fit into an energy system to create a clean energy future that will sustain the planet and allow its citizens to thrive.

Whether its providing heat, cooling and electricity to a remote village school, providing power and technologies for clean water and safe food production or powering cosmopolitan cities, like London, England, today's nuclear technologies can play an integral role in a clean energy future.

Our future energy systems will need to be low-emitting, reliable, affordable and flexible.

They should provide social, economic, and environmental benefits by reducing air pollution, protecting habitats and biodiversity both on land and in the oceans. They should drive jobs and economic prosperity, improve quality of life and access to opportunities, including for women and children throughout the world. And this must be achieved while also providing increased energy supply in the form of both electricity and non-electric fuels.

Today, rapid innovation in nuclear energy technologies is making it simpler, safer and more affordable to plan integrated low-emitting, flexible systems that provide electricity to reliably meet variable demand, while also providing power for other applications.

These applications include water purification, district and industrial complex heating and clean hydrogen production—just to name a few.

SMRs that will soon be commercially available can also decarbonize resource extraction projects at the work site and provide energy autonomy to remote communities.

With the coincident development of energy storage and mobilization technologies, system operators and planners can take better advantage of large baseload nuclear alongside new size options and with enhanced flexibility to effectively manage system supply and demand.

Nuclear power can contribute as both a low-emitting energy source and as a flexible enabler of other clean sources. 21st Century nuclear energy can be a powerful agent for change.

But nuclear alone is not the answer. We must continue to educate ourselves on all technology advancements and consider how they can work collaboratively across sectors and jurisdictions.

Through knowledge sharing, each country and jurisdiction will be in the best position to develop energy systems that work for their own citizens while also meeting our common goal of planet sustainability and equitable access to power for all.

Whether we are government officials, analysts, policy makers, climate or energy modellers, investors or business leaders, we have an essential role to play.

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Page 8
Page 11 (bottom)

Booklet writing and design

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With thanks to NICE Future contributors for review and input.

Disclaimer on report contents

The Flexible Energy for Clean Energy Systems report, that was the basis for this booklet, was authored by experts from around the world and many different organizations.

The views expressed in the report are the views of the authors and do not necessarily represent a statement of the views of the Clean Energy Ministerial (CEM) or its members countries, the Nuclear Innovation: Clean Energy Future (NICE Future) initiative, its participants or any of their sponsoring governments or organizations, the Joint Institute for Strategic Energy Analysis, or NREL.

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