Reimagining Nuclear Energy – an Update

Reflections of an Informed Observer

Presentation to
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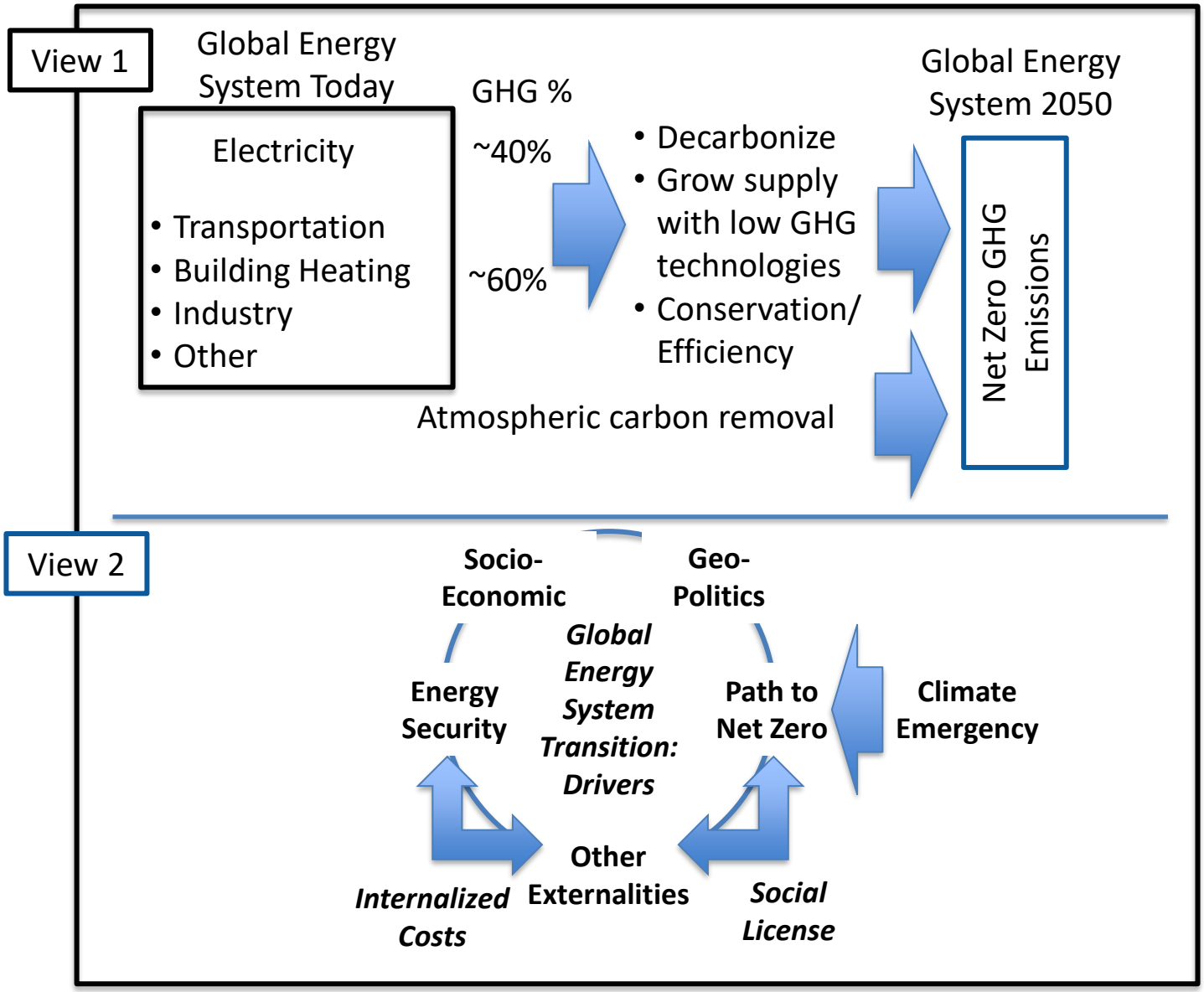
Land Acknowledgement

Outline

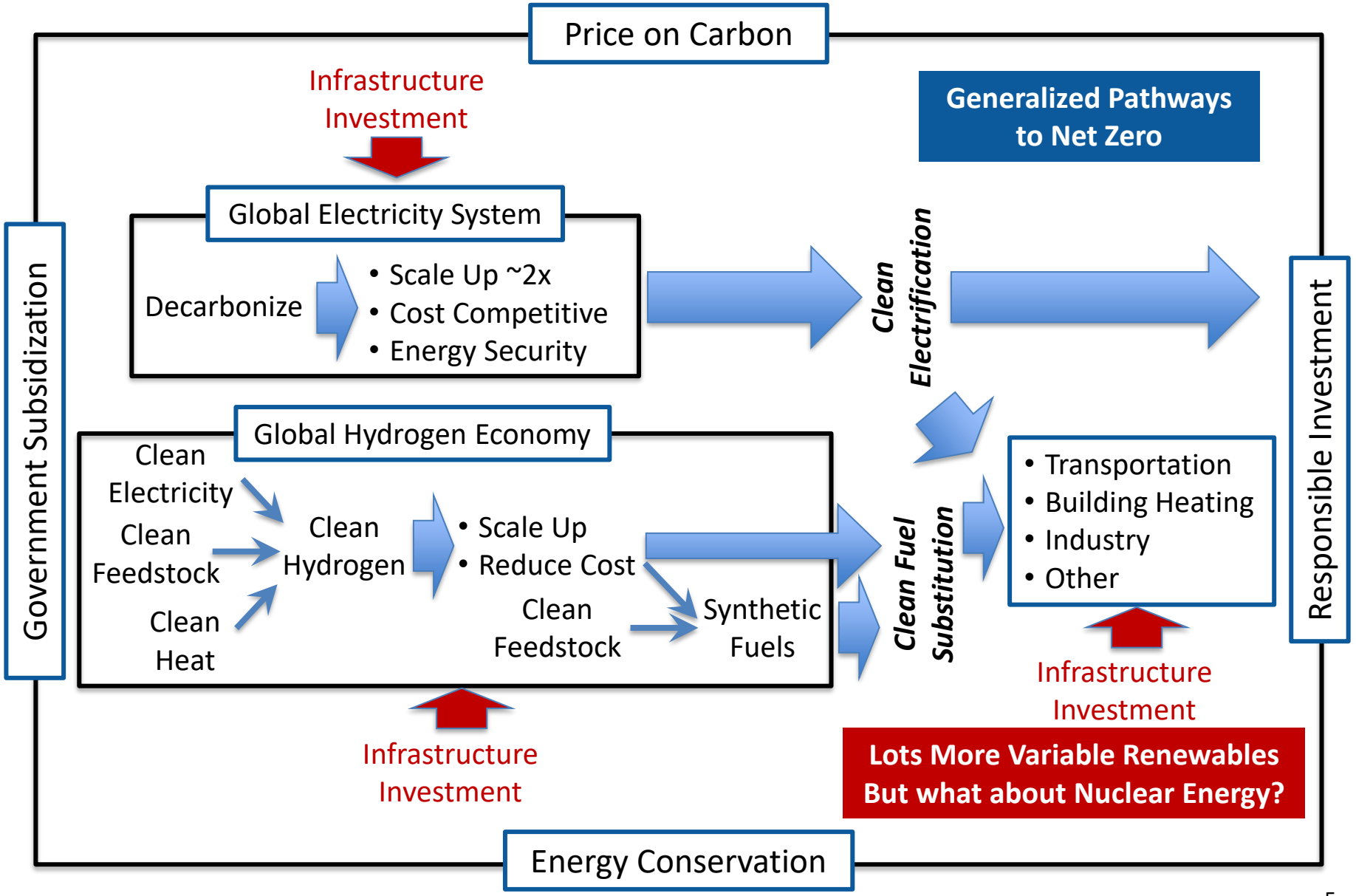
- The Global Path to Net Zero – Broad Strokes
- CACOR Presentation Dec 2, 2020 – A Refresher
- Canadian SMR Demonstration and Deployment - Status
- Electricity System Economics
- Ontario's Electricity System and the Path to Net Zero – A Brief Case Study

…. and what about the Public's nuclear hesitancy?

The Global Path to Net Zero – Broad Strokes (1 of 2)



The Global Path to Net Zero – Broad Strokes (2 of 2)



Europe's Green New Deal – Is Nuclear Power In?

- The European Commission is attempting to finish its **sustainable finance taxonomy**, which defines which economic activities can be labelled as a sustainable investment in the EU based on whether they meet strict environmental criteria.
- Whether or not to include nuclear energy in the EU taxonomy has been the subject of heated debate at the EU level. **Ten EU countries are pushing to recognise nuclear** as a low-carbon energy source. **Five EU countries are opposed**, pointing to concerns about safety and radioactive waste disposal.
- The European Commission consulted its in-house scientific body, the Joint Research Centre, to make up its mind. "***The analyses did not reveal any science-based evidence that nuclear energy does more harm to human health or to the environment than other electricity production technologies.***" These conclusions were later backed by two other scientific bodies.
- According to the 10 countries in favour, the ongoing surge in electricity prices provides another argument for doing so. "***Firstly, because it prevents European consumers to be exposed to the volatility of prices, as we currently face with gas prices. Secondly, because it contributes decisively to the independence of our energy and electricity supplies.***"
- They also recognised that renewables will be essential in the transition to clean energy. However, "***they cannot produce enough low-carbon electricity to meet our needs, at a sufficient and a constant level,***" saying nuclear energy already provides half of Europe's low-carbon electricity.

Source: EURATIV.com Oct 21, 2021

CACOR Presentation Dec 2, 2020
"Reimagining Nuclear Energy"

A Refresher (in 8 Parts)

1. Canada is a Tier 1 Nuclear Nation

Cigar Lake Uranium Mine

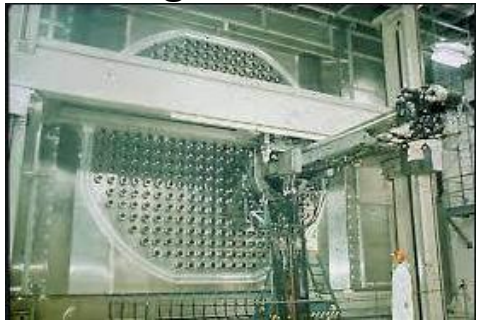
Bruce Power NGS

Point Lepreau NGS

Pickering NGS

Canadian Nuclear Safety Commission

Darlington NGS



CANDU Reactor

Canadian Nuclear Laboratories

2. Global Nuclear (Fission) Energy Today - a Mixed Track Record

- ~440 nuclear reactors worldwide in ~ 30 countries. ~10% of global electricity generation, ~400 GWe installed.
- Canada has 19 reactors providing ~17% of the country's electricity, ~ 60% in Ontario.
- ~50 Third Generation (passive safety) reactors under construction worldwide, primarily in Asia, led by China, India and Russia.
- New Builds in Asia are largely on budget and on schedule.
- The refurbishment of Ontario's CANDU fleet, at >$25B the largest clean-energy project in North America, on budget and on schedule.
- Data show that nuclear energy is among the lowest GHG emitting, most affordable, most scalable and safest (including accidents) energy source.

2. Global Nuclear (Fission) Energy Today - a Mixed Track Record

… but

- Some nuclear nations are exiting nuclear energy, e.g. Germany, Belgium, Spain, Switzerland, Taiwan.
- US has seen nuclear plants in unregulated markets shutting down before end of their operational life because they are no longer economical compared to Natural Gas.
- First-of-Kind Gen III/III+ New Builds in US and EU have been over budget and over schedule.
- TMI, Chernobyl and Fukushima accidents continue to shape public perceptions of risk.
- Public polling shows persistent significant levels of ***nuclear energy hesitancy***.

3. Why Nuclear Energy? (4x4)

Yesterday/Today

- Electricity Grid Reliability/Energy Security
- Cost to Ratepayers
- VERY low GHG Emissions
- Reduced Air Pollution

Tomorrow - Today + …

- Dispatchable – enabling variable renewables
- Fit for smaller grids
- Beyond electricity
- Clean energy security

4. Nuclear Energy and the Global Energy System Transition - Evolving Perspectives

- **2015 Paris Climate Agreement – A Commitment to Action**
  - Variable Renewables will lead the way.
  - No/little mention of the role of nuclear energy.
- **2018 Clean Energy Ministerial** launches its Nuclear Innovation for a Clean Energy (NICE) Future initiative
  - Focus placed on renewables and nuclear energy working together.
- **2018 Report of the Intergovernmental Panel on Climate Change**
  - All IPPC Scenarios require lots more variable renewables and more nuclear energy.
  - 1/2 of IPPC scenarios postulate growth in nuclear energy.
- **2020 World Energy Outlook of the International Energy Agency**
  - A sustainable energy future needs all low-carbon solutions, including lots more variable renewables and more nuclear energy.
  - The IEA's latest 2050 Net Zero scenario postulates a ~100% growth in nuclear energy.

"We have not seen a model where we can get to net-zero emissions by 2050 without nuclear," Seamus O'Regan, Federal Minister of Natural Resources, Sep 2020

5. Nuclear Energy Priorities in the Path to Net Zero

Nuclear Energy Priorities (IPCC, IEA)

- Extend the life of the conventional nuclear fleet where possible.
- Deliver planned conventional nuclear New Builds with Generation III/III+ (passive safety) designs.

… and

- Transition rapidly to ***New Nuclear Energy*** that
  - *greatly reduces construction costs and time,*
  - *uses simpler and safer designs,*
  - *provides a dispatchable solution to enable scale-up of Variable Renewable Energy,*
  - *looks beyond grid-level electricity markets, and*
  - *reduces nuclear waste streams.*

Canada's Priorities

Fleet Life Extension

- *Refurbish Bruce, Darlington, Point Lepreau (completed) NGSs*
- *But, shut down Pickering (2025)*

Canada and SMRs

- *Canadian SMR Roadmap (2018)*
- *Canadian SMR Action Plan (2020)*
- *SMR Demonstration and Deployment (next decade+)*
- *Mix of Gen III+, Gen IV designs*

6. Nuclear Energy is in the midst of a Technology Paradigm Shift

~ 70 companies worldwide are presently developing SMR solutions for market readiness within ~2-10 years

Advanced Reactor Technology

Competitive Energy Pricing	Competitive Time to Market	Reduced Capital Requirements	Access to Energy Markets Beyond Electricity
Improved Safety, Security, Safeguards Margins	Electricity/ Heat Co-Generation	(Near) Closed Fuel Cycles	Reduced Very Long-Term Radioactive Waste
Compatibility with Renewables	Dispatchable	Reduced Environmental Footprint	Enabler of the Hydrogen Economy

Et cetera …

Small Modular Reactors

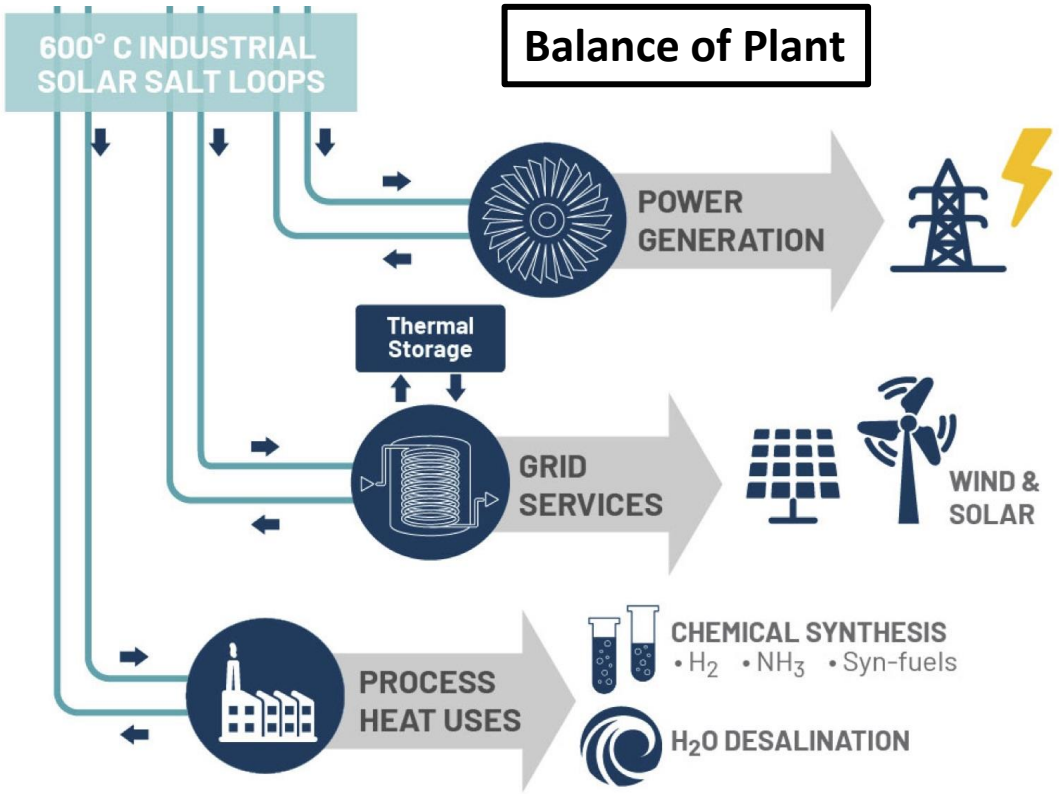
Almost all designs are based on designs prototyped decades ago, updated with novel engineering approaches

Balance of Plant (BoP) Innovations

7. The SMR Value Proposition - the Energy System's Multi-tool

Canada has the potential to develop all 3 markets

e.g. Terrestrial Energy's Integrated Molten Salt Reactor



On Grid Power (~150-300 MWe)

- Fossil fuels (on-site) replacement
- Electrification growth
- Dispatchable energy solution
- Variable Renewables enabler

Resource Extraction and Heavy Industry (~10-80 MWe)

- Combined heat & power
- On and Off Grid
- Synthetic fuels, clean chemicals
- Hydrogen economy

Remote Communities (~1-10 MWe)

- Electricity
- District heating
- Desalination, food production
- Energy security

Nuclear and the path to Net Zero

- ✓ *Clean electrification*
- ✓ *Clean fuel substitution*
- ✓ *Energy storage*
- ✓ *"Just" transition*

8. Canada's SMR Roadmap (2018) and Action Plan (2020)

Why Canada?

- Tier 1 Nuclear Nation
- Indicative SMR Markets
- Regulation of Nuclear Innovation

Action Plan

- Engagement is ramping up
- Partnerships are taking shape
- Demonstrations are moving forward

Key Milestones

- 2026 – first micro SMR demonstration at CNL, more being planned
- 2028 – first on-grid SMR built at Ontario Power Generation's Darlington NGS
- Early 2030's – announced plans for roll out of on-grid SMRs in New Brunswick, Saskatchewan

Canadian SMR Demonstration and Deployment

Status

The Evolution of Nuclear Power

Generation I

Early Prototype Reactors

- Shippingport
- Dresden, Fermi I
- Magnox

Generation II

Commercial Power Reactors

- LWR-PWR, BWR
- CANDU
- VVER/RBMK

Generation III

Advanced LWRs

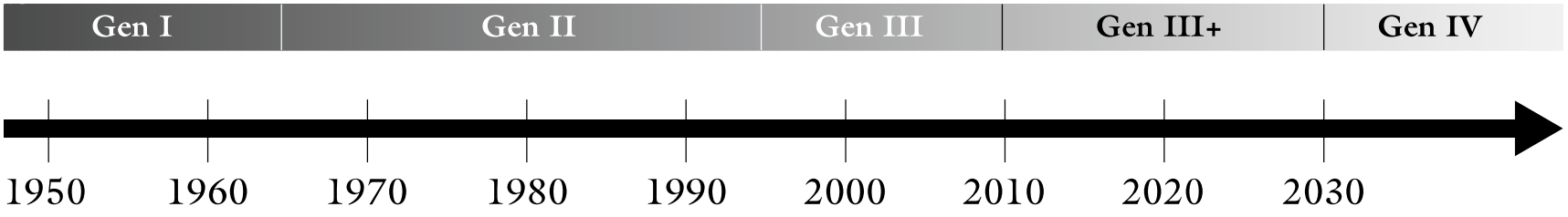
- ABWR
- System 80+
- AP600
- EPR

Near-Term Deployment

Generation III+ Evolutionary Designs Offering Improved Economics

Generation IV

- Highly Economical
- Enhanced Safety
- Minimal Waste
- Proliferation Resistant



SMR Demonstration and Deployment in Canada – the "Dance Card"

* Gen III
** Gen IV

Stream 1

- First grid-scale SMR project, 300 MW at Darlington in service by 2028.
- Up to 4 subsequent units in Saskatchewan, first in service by 2032.
- OPG, Bruce Power and SaskPower collaborating to select the technology and developer by end of 2021.
- **GE Hitachi (BWRX-300)***, **X-Energy (Xe-100)****, **Terrestrial Energy (IMSR)**** designs under consideration.

Stream 2

- Two Gen IV designs to be demonstrated at Point Lepreau NGS in early 2030s.
- **Moltex Energy (SSR-W)**** and **ARC Canada (ARC-100)**** partnered with NB Power.

Stream 3

- New class of micro SMRs (MMRs) designed primarily to replace diesel use in remote communities and mines.
- USNC/OPG partnership for **USNC MMR**** in service at CNL by 2026.
- Bruce Power and Westinghouse Canada partnership exploring opportunities for the **Westinghouse's eVinci Micro-Reactor**.**

Electricity System Economics

Electricity System Reliability

Some of the most important elements of a **reliable electricity system** are capacity, energy, other ancillary (or reliability) services, and transmission infrastructure. As a result, a supply mix must be able to provide for all these specific needs:

- **Capacity** is the ability of a supply resource to deliver energy – either a generator that increases its output or businesses, institutions or aggregated homeowners that can reduce consumption when needed. To plan a reliable electricity system, the system operator must ensure that adequate capacity is available to supply demand throughout the year, including during peak times.
- **Energy** refers to actual electricity output over a specific period of time.
- **Ancillary Services** – also known as reliability services – are critical to the reliable operation of the grid, and include things like frequency regulation and voltage control.
- **Transmission Infrastructure** delivers electricity from generators along high-voltage power lines to consumers – a key consideration as supply is often limited by where it can be located.

Electricity System Economics - Comparative Costs

Energy costs for electricity generating technologies are typically compared through three parameters:

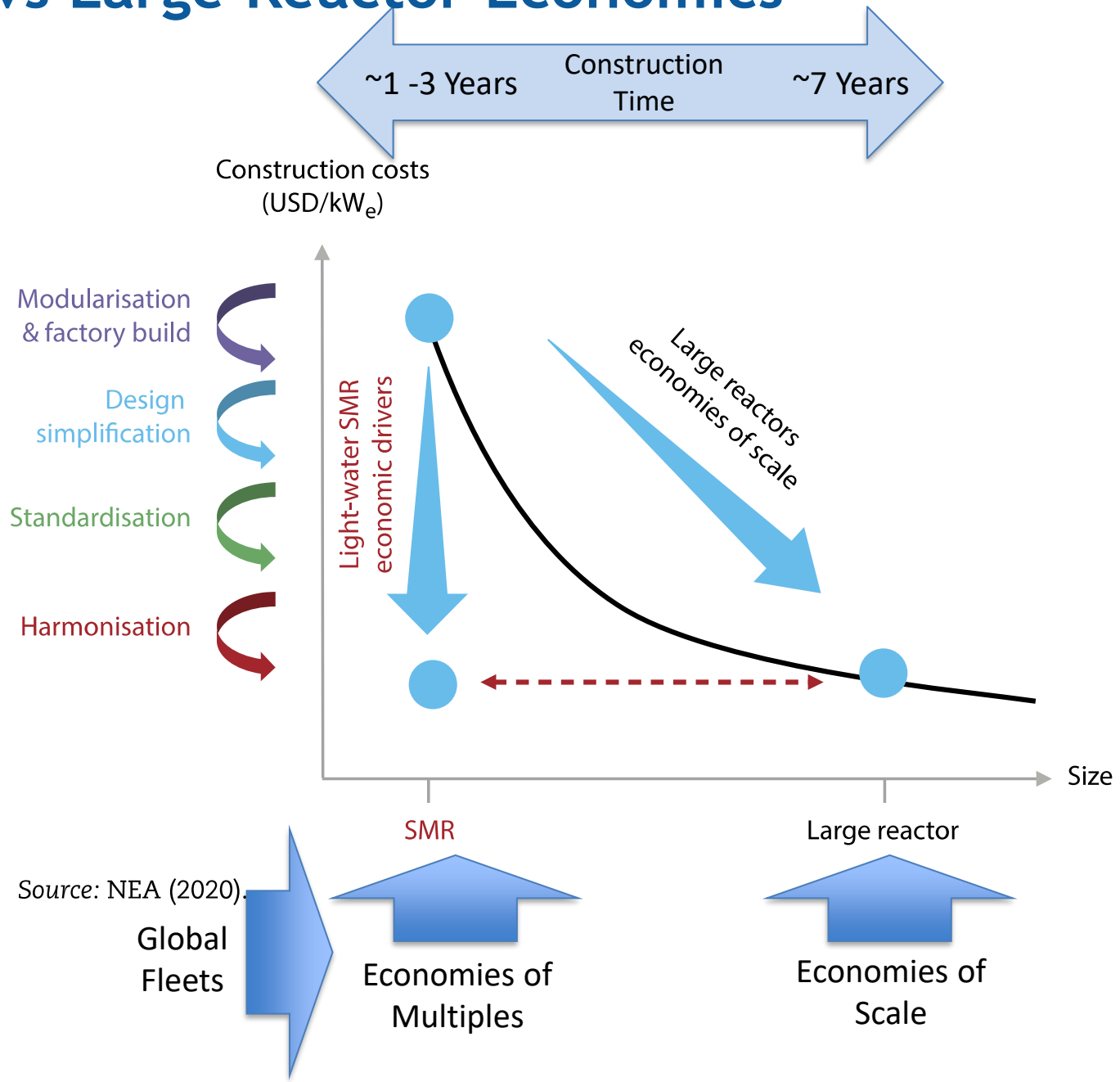
- *Overnight capital costs (USD/kW)*
- *Levelized Cost of Electricity – LCOE (USD/MWh)*
- *Load Factors*

Comparative costs for Nuclear with Variable Renewable Energy (VRE) require two additional perspectives:

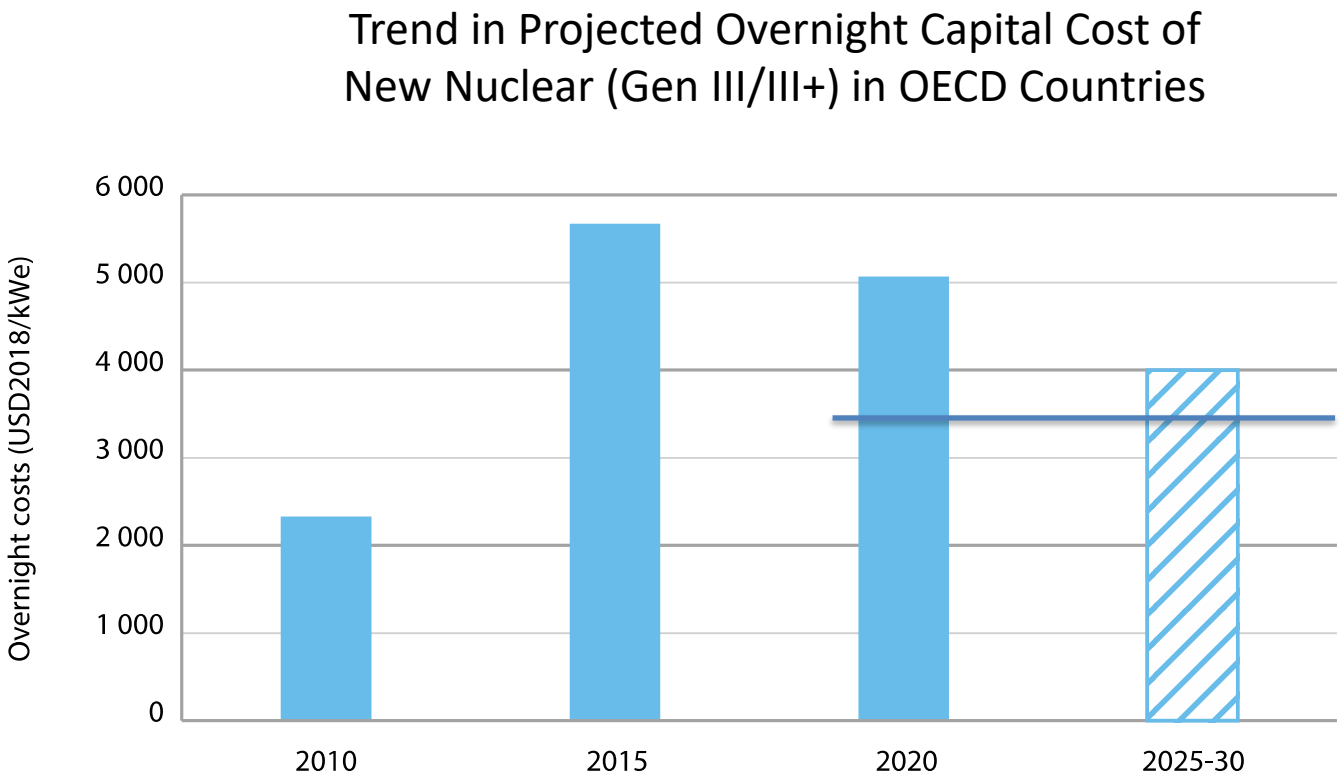
- *Electricity System Costs as % VRE penetration increases*
- *Costs of Electricity Storage*

SMR vendors are predicting target costs that are competitive with competing low carbon technologies. However, there is insufficient data from operating plants to validate predicted costs of SMRs. Costs of Large Nuclear provide a reasonable bounding scenario, at least for on-grid applications.

SMR vs Large Reactor Economics

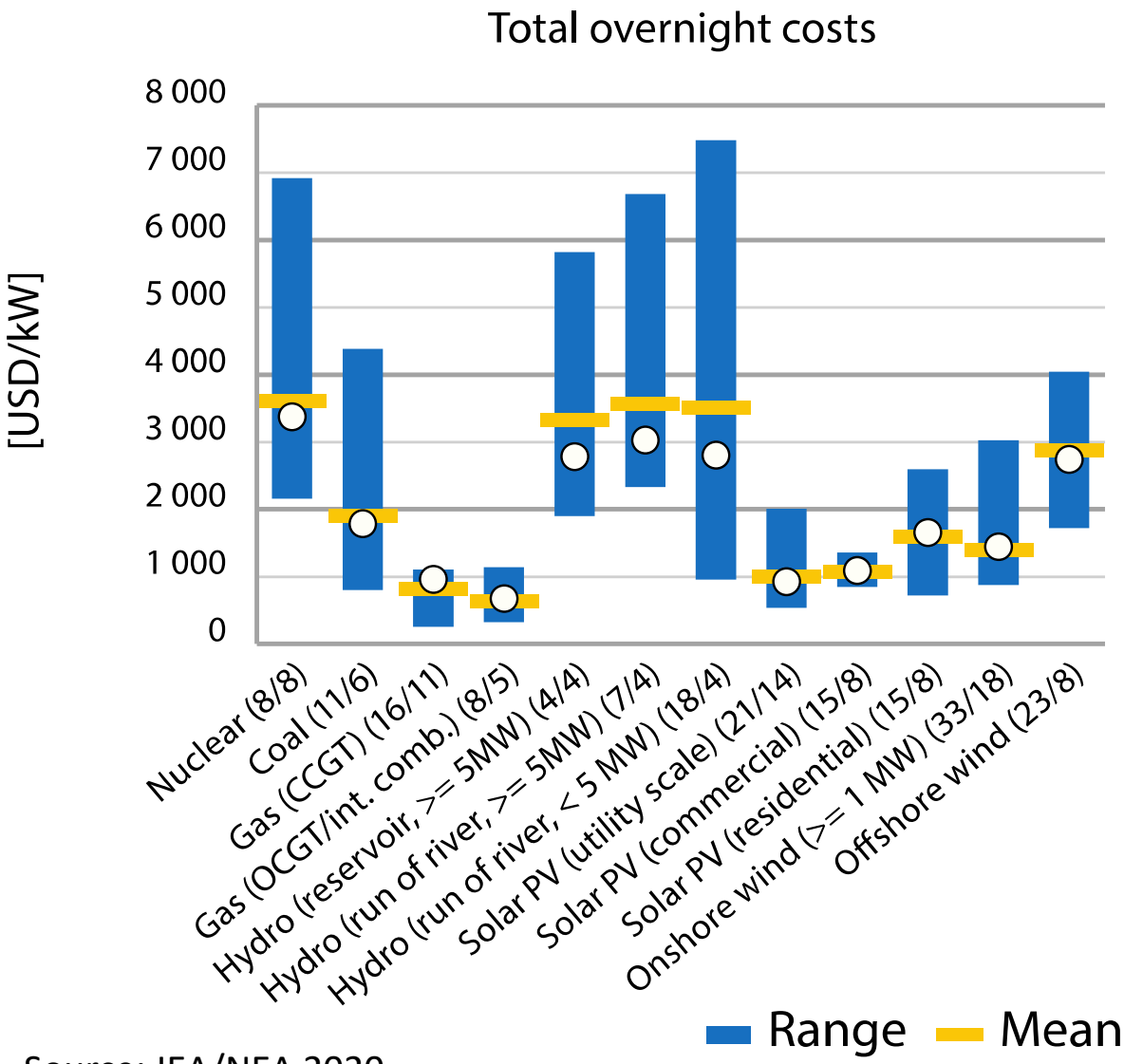


Overnight Capital Costs of New Nuclear



Source: IEA/NEA (2005, 2010, 2015, 2020).

Overnight Capital Costs of Electricity Generating Technologies - 2025 Outlook *(IEA/NEA 2020 Edition)*



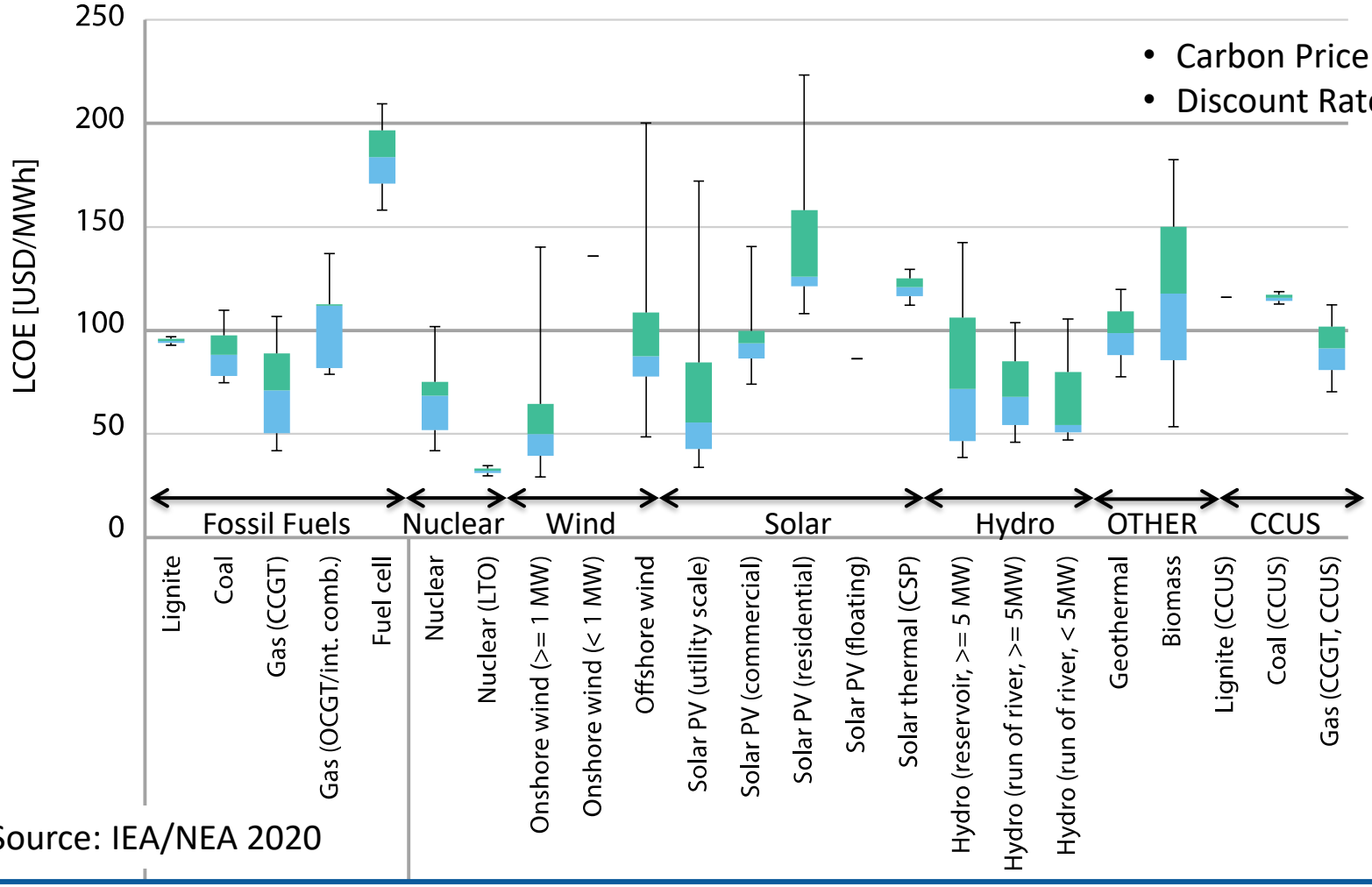
Key Messages:

- Capital costs vary greatly by technology.
- PV Solar and On-Shore Wind are projected to be cost competitive with Natural Gas and better than coal.
- Nuclear and Hydro are projected to have comparable capital costs.

Source: IEA/NEA 2020

Levelized Cost of Electricity -2025 Outlook

(*Projected Costs of Generating Electricity: IEA/NEA 2020 Edition*)

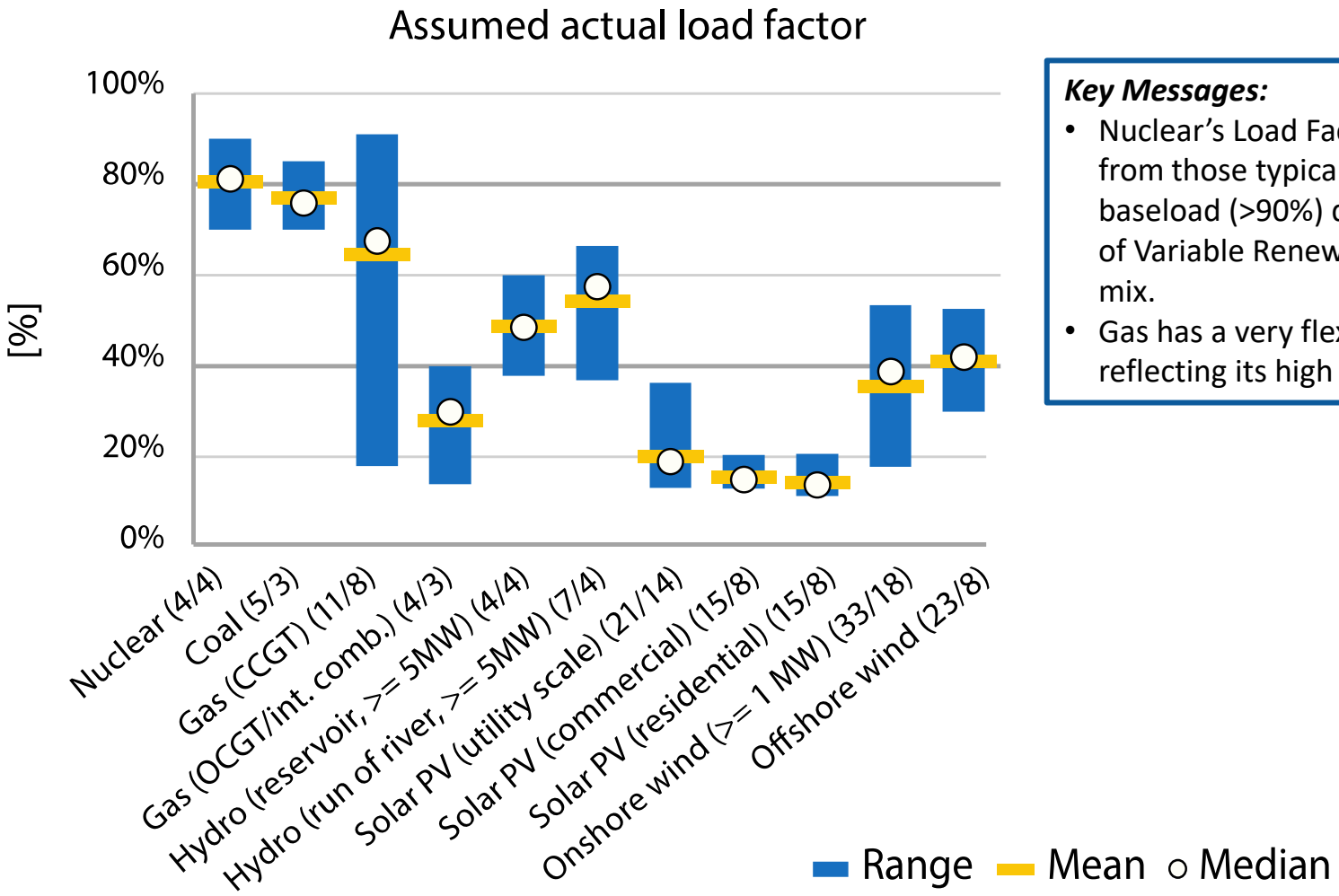


Source: IEA/NEA 2020

Key Messages:

- Several Low-Carbon Technologies, including Nuclear, are projected to be cost competitive with Fossil Fuel Technologies with modest carbon pricing.
- Nuclear, Hydro and utility-scale VREs are projected to be competitive in terms of LCOE.

Load Factors



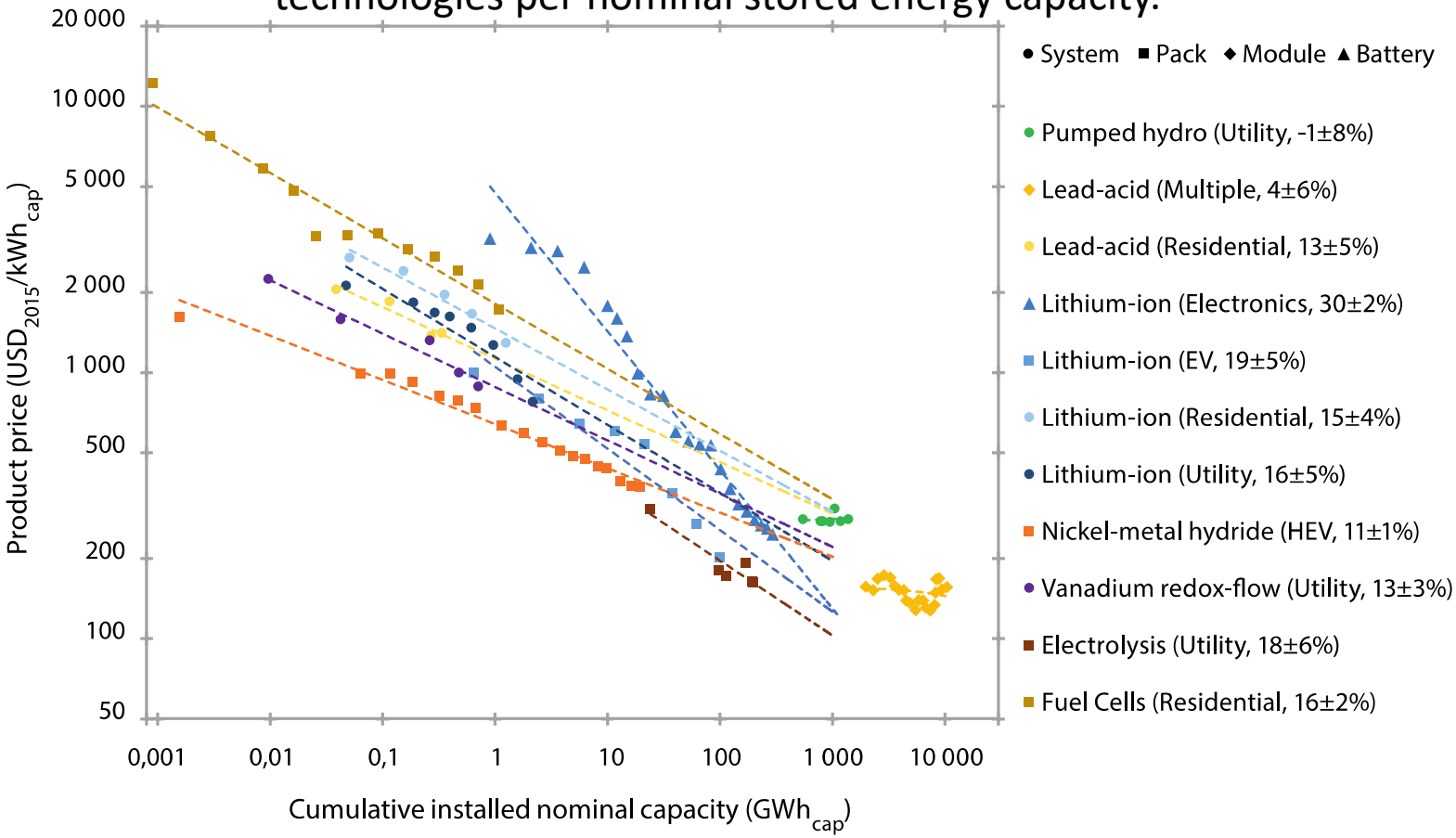
Key Messages:

- Nuclear's Load Factors are reduced from those typically achievable in baseload (>90%) due to the presence of Variable Renewables in the supply mix.
- Gas has a very flexible Load Factor reflecting its high dispatchability.

Source: IEA/NEA 2020

Levelized Cost of Electricity Storage

Expected future product price for electrical energy storage technologies per nominal stored energy capacity.

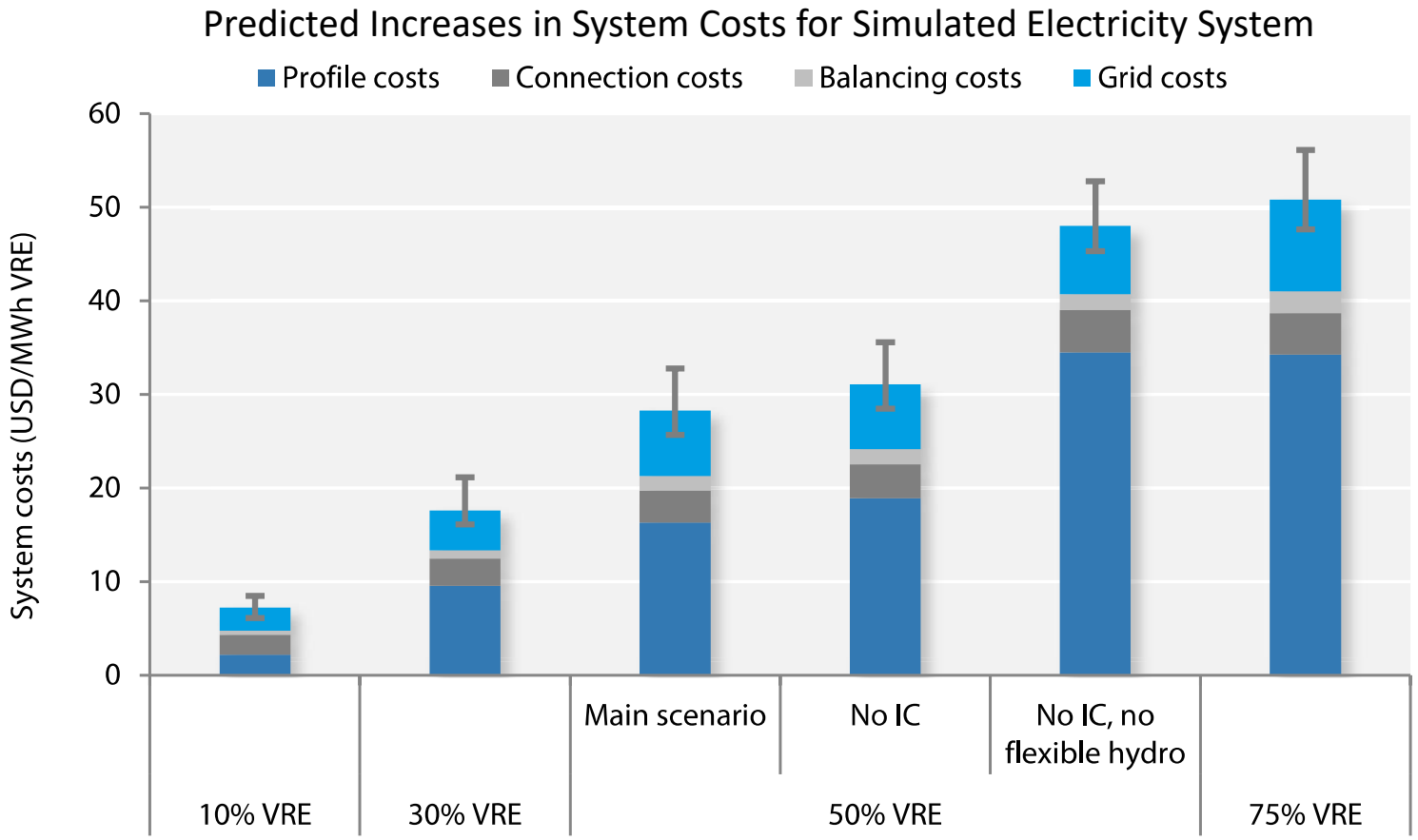


Source: IEA/NEA 2020

Key Messages:

- Targets for cost competitiveness of VRE + Storage with Nuclear require storage capital costs of ~20USD/kWh.
- Cost of electricity storage continues to decrease at impressive rates.

Impact of % Variable Renewable Energy (VRE) on Electricity System Costs



Source: NEA 2019

Key Messages:

- As % penetration of VREs increases, system costs also increase.
- These system costs are dependent of the specifics of each electricity system.

Ontario's Electricity System and the Path to Net Zero

A Brief Case Study

Ontario's Electricity System – A Brief Case Study

- Electricity System Reliability – a Reminder
- Ontario's Electricity System Today
- Ontario's Electricity System Outlook – IESO* Perspective
- IESO* Feasibility Study for Elimination of Natural Gas by 2030
- What the future may hold

* IESO – Independent Electricity System Operator

Electricity System Reliability – A Reminder

Some of the most important elements of a **reliable electricity system** are capacity, energy, other ancillary (or reliability) services, and transmission infrastructure. As a result, a supply mix must be able to provide for all these specific needs:

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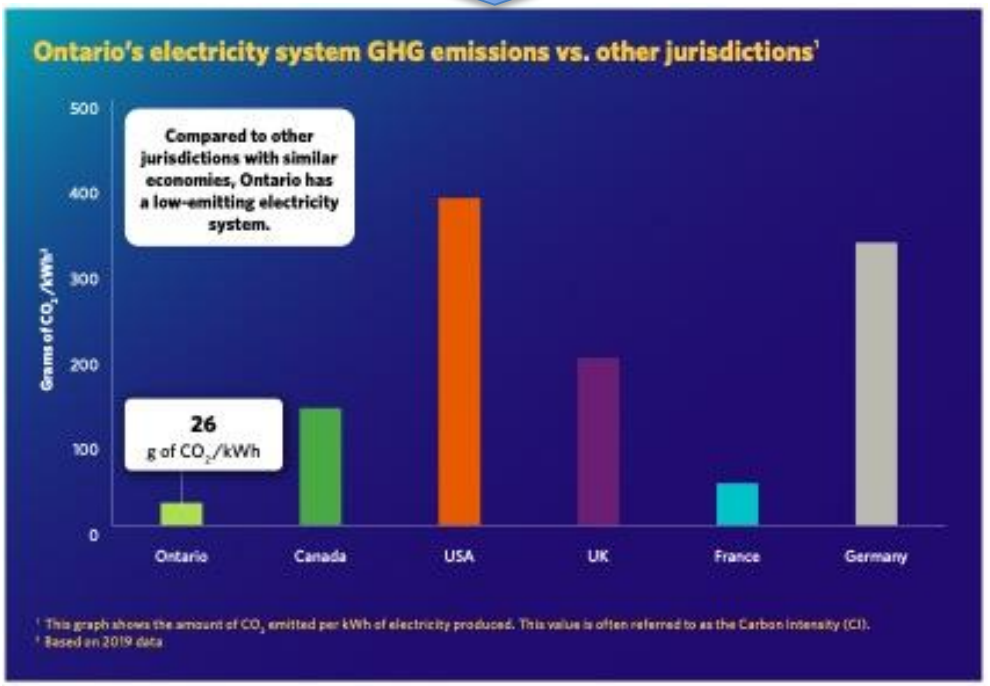
Ontario's Electricity System Today (1 of 3)

GHG emissions in Ontario by sector*

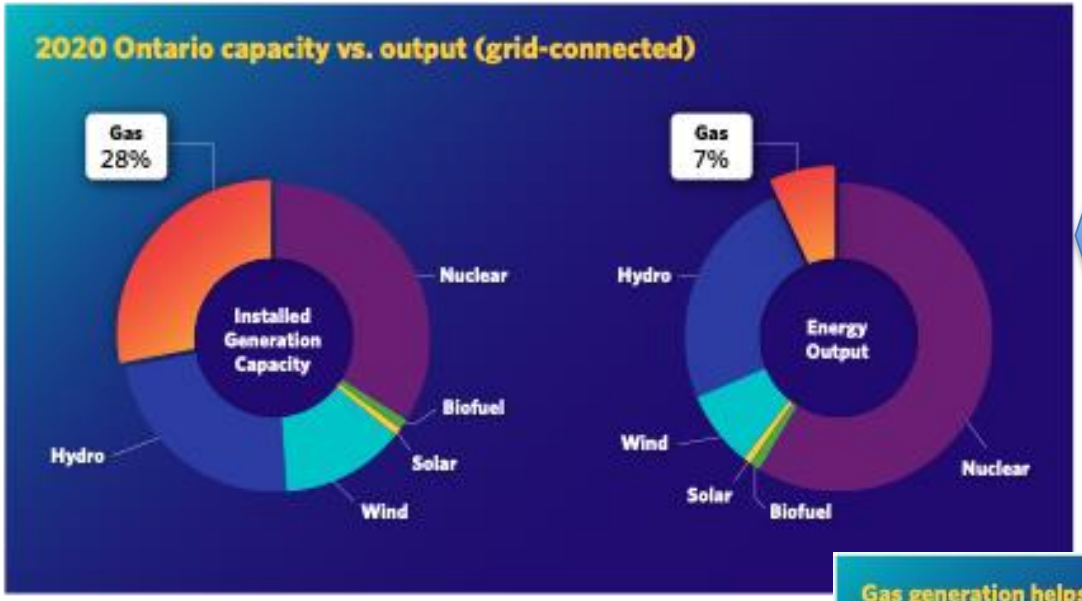
*Percentages have been rounded and as a result will not add to 100.

- Today, Ontario has one of the lowest GHG emitting grids in the world.
- Electricity generation accounts for a very small fraction of Ontario's GHG emissions.
- Ontario has successfully transitioned off of coal generation.



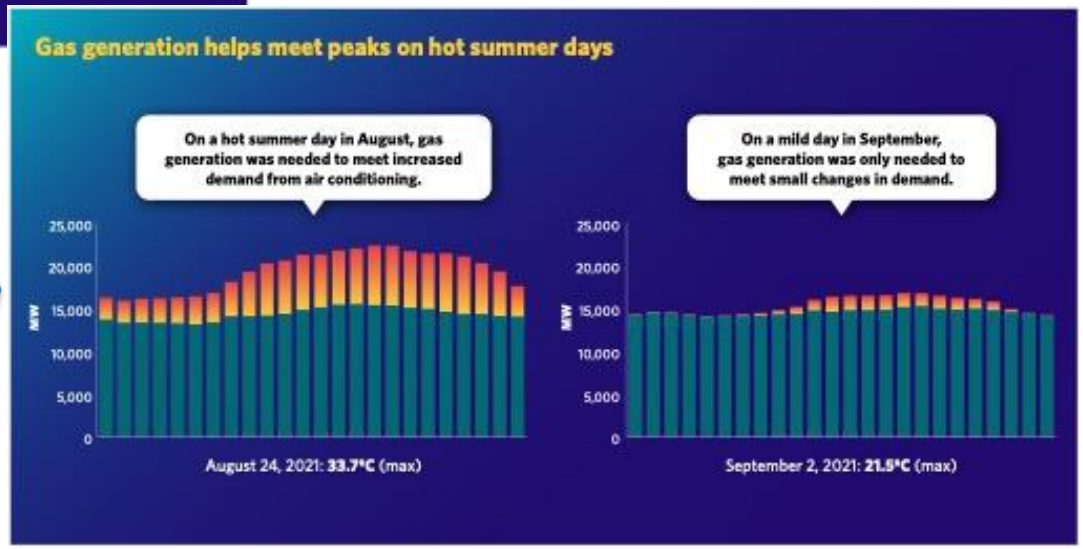
- But what does the future hold for Ontario's electricity sector?
- ***Can electrification of Ontario's big GHG emitting sectors help achieve the Net Zero goal?***
- ***How would the electricity sector evolve to support increased electrification and/or a hydrogen economy?***

Ontario's Electricity System Today (2 of 3)

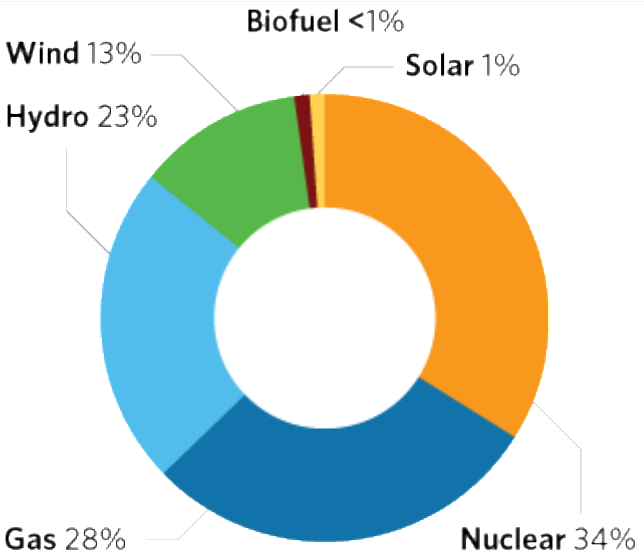


- Ontario has a highly diversified generation mix, including nuclear, hydro, variable renewables (wind and solar), natural gas and biofuel.
- Nuclear's high load factor (~95%) and low price account for its larger contribution to grid output.

- Natural Gas plays a critical role in providing dispatchable generation to ensure grid reliability and security of supply.



Ontario's Electricity System Today (3 of 3)

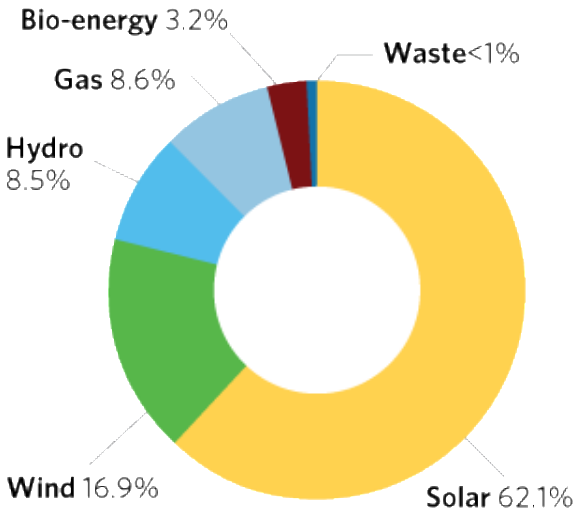


Nuclear	13,089 MW or 34%
Gas/Oil	10,515 MW or 28%
Hydro	8,918 MW or 23%
Wind	4,783 MW or 13%
Biofuel	296 MW or <1%
Solar	478 MW or 1%

Ontario's current installed energy capacity by fuel type on Ontario's transmission system.

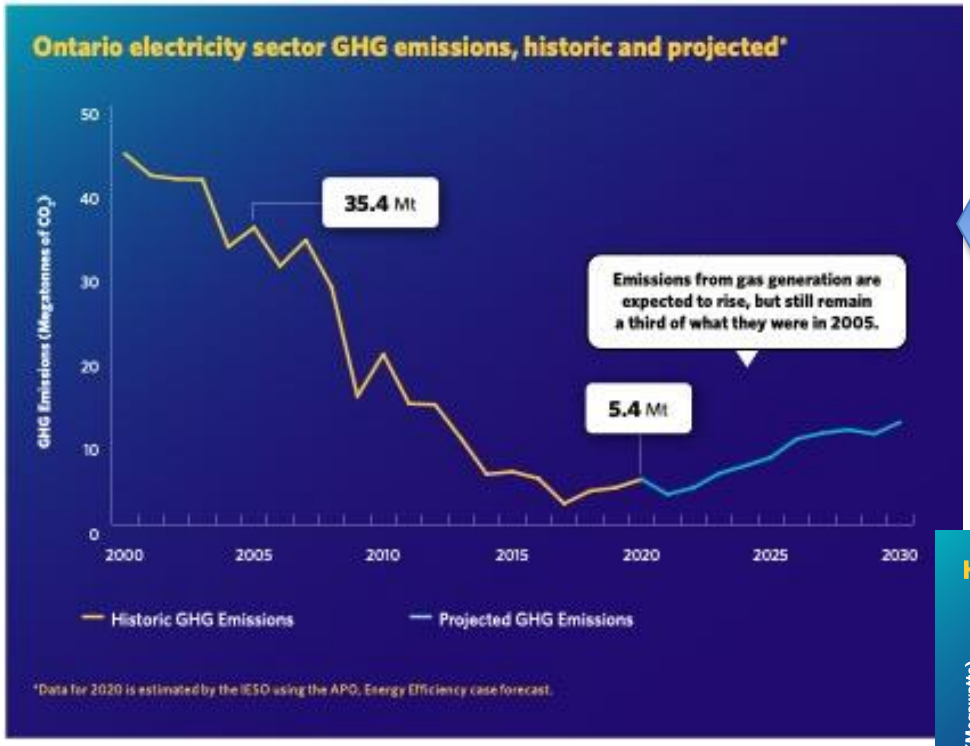
Amount of energy by fuel type that is in commercial operation on Ontario's distribution systems (also referred to as current installed embedded generation).

Also referred to as Distributed Energy Resources (DER) or micro-grids.



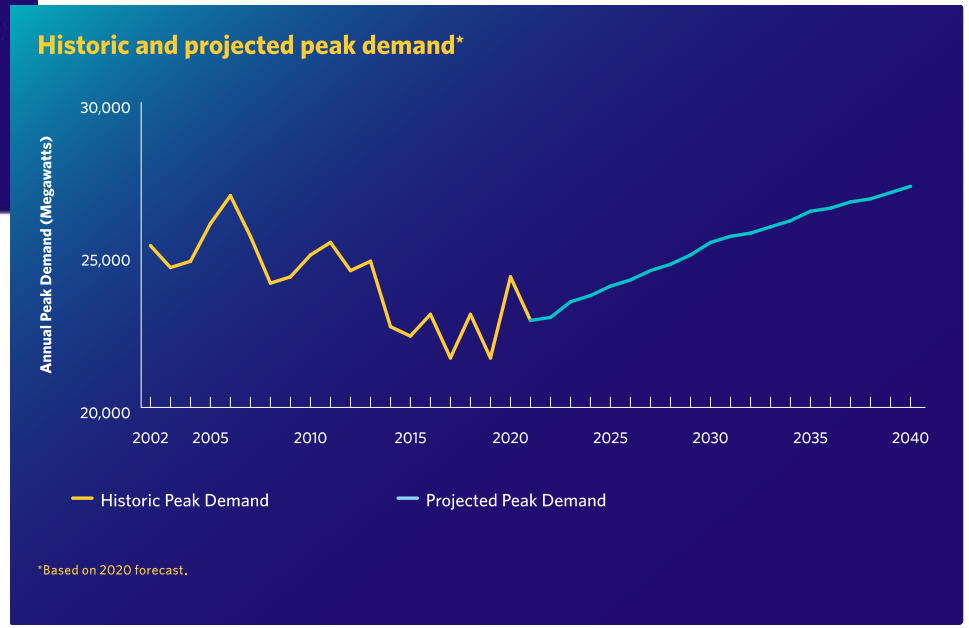
Solar	2,166 MW or 62.1%
Wind	590 MW or 16.9%
Hydro	297 MW or 8.5%
Gas	299 MW or 8.6%
Bio-energy	110 MW or 3.2%
Waste	24 MW or <1%

Ontario's Electricity System Outlook

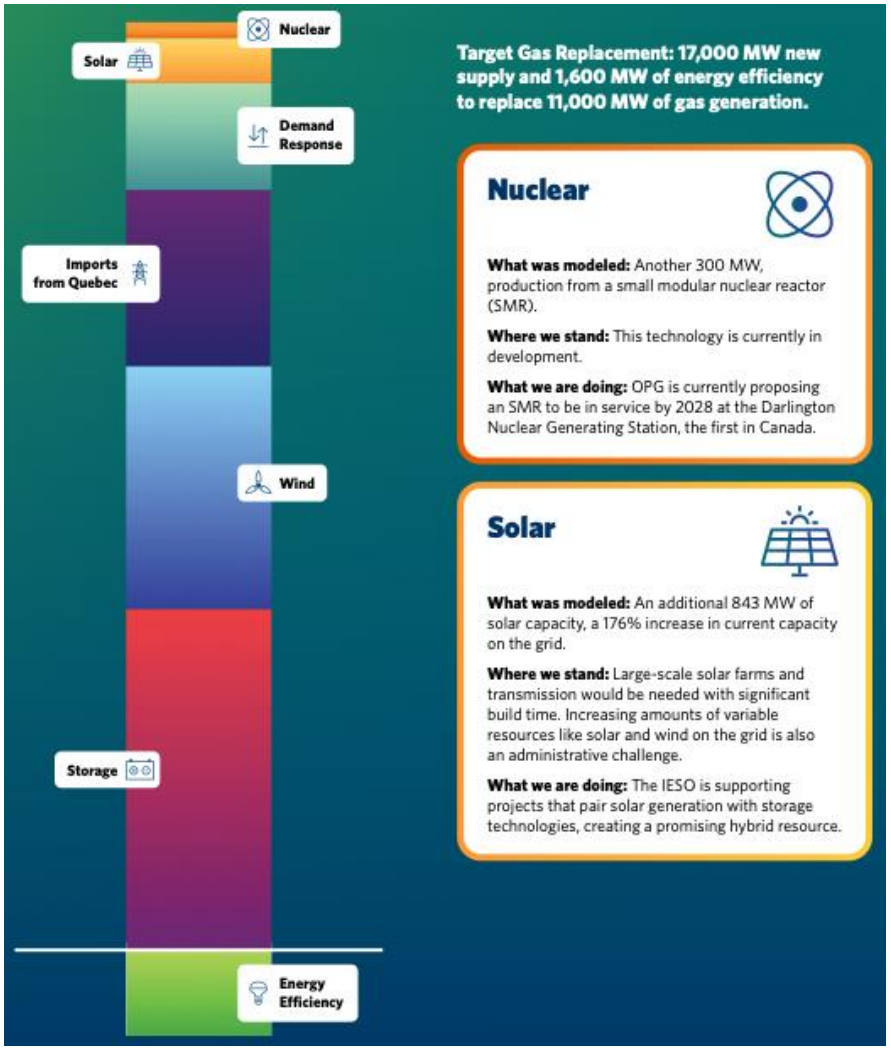


- Over the next decade, IESO is predicting that annual GHG emissions from Ontario's electricity grid will increase from ~4MT CO_2 to ~12MT.
- This is largely due to the retirement of the Pickering NGS and nuclear refurbishments, with Natural Gas expected by the IESO to make up much of the shortfall.

- IESO's latest 20-year outlook for electricity demand predicts a growth of ~ 20%.
- ***This would appear to be far short of that needed to support significant electrification of Ontario's major GHG emitting sectors.***



IESO Feasibility Study to Eliminate Gas by 2030 (1 of 2)



Target Gas Replacement: 17,000 MW new supply and 1,600 MW of energy efficiency to replace 11,000 MW of gas generation.

Nuclear

What was modeled: Another 300 MW, production from a small modular nuclear reactor (SMR).

Where we stand: This technology is currently in development.

What we are doing: OPG is currently proposing an SMR to be in service by 2028 at the Darlington Nuclear Generating Station, the first in Canada.

Solar

What was modeled: An additional 843 MW of solar capacity, a 176% increase in current capacity on the grid.

Where we stand: Large-scale solar farms and transmission would be needed with significant build time. Increasing amounts of variable resources like solar and wind on the grid is also an administrative challenge.

What we are doing: The IESO is supporting projects that pair solar generation with storage technologies, creating a promising hybrid resource.

Imports from Quebec

What was modeled: 3,300 MW of capacity and energy from Quebec all year round.

Where we stand: Quebec currently imports electricity in the winter for heating. It would also need to build new generation facilities specifically for Ontario above what would be required for Quebec itself.

What we are doing: Current infrastructure upgrades have the potential to increase imports.

Demand Response

What was modeled: 2,000 MW of additional demand response. Participating businesses would need to reduce energy use 200 times over a year, roughly four days a week.

Where we stand: Ontario currently benefits from up to 1,300 MW in voluntary demand response during peak hours, roughly five times a year.

What we are doing: Committed demand response of 680 MW is already counted for reliability and is growing through the Capacity Auction and pilot projects in local communities.

Storage

What was modeled: More than 6,000 MW of new storage capacity, capturing excess energy to be released when needed.

Where we stand: No storage technology has been tested at the scale required. It is unknown whether it can provide necessary capacity and flexibility during heatwaves and cold spells. Also, this amount of energy could only be provided by exceptionally large facilities – far beyond what could be available over the coming years.

What we are doing: Storage provides some reliability services to the grid today. The IESO is supporting storage technology testing and development and working to allow it to compete with traditional resources. This includes negotiating the contract for a new 250 MW battery facility – which would be one of the largest in the world.

Wind

What was modeled: An additional 4,545 MW of wind would be needed, doubling the amount of wind energy in Ontario and adding more than 1,300 new turbines.

Where we stand: Large-scale land use for turbines and transmission would be needed, and time to site and build them would be significant.

What we are doing: The IESO is supporting research into hybrid wind and energy storage technologies.

Energy Efficiency

What was modeled: Another 1,600 MW of energy savings, increased energy programs and policies.

Where we stand: Ontarians achieved 1.5 TWh in energy savings and 186 MW of demand savings through Save on Energy programs in 2019 and 2020.

What we are doing: IESO's 2021-2024 Conservation and Demand Management Framework is targeting 2.7 TWh of electricity savings and 440 MW of peak demand savings to help cost-effectively meet system needs.

Study requested by Ontario Minister of Energy in 2020.
Findings released Oct 2021.

IESO Feasibility Study to Eliminate Gas by 2030 (2 of 2)

The Bottom Line: IESO modelling and simulations show that a **reliable electricity service cannot be maintained, nor can the system support further electrification or accelerated economic growth** if gas generation is phased out by 2030. Even under the most optimistic scenario, the IESO would frequently need to resort to emergency actions such as rotating blackouts to manage energy shortfalls.

D**eveloping and building a mix of clean and cost-effective technologies at the scale needed to replace gas generation by 2030 would not be feasible.** This would **exclude using significant quantities of new hydro and nuclear capability** that require more time to build, something to be considered for longer-term zero-emission targets.

A 2030 phase out would require incorporating much larger amounts of established resources, such as wind, solar and demand response, onto the grid. **Higher amounts will present more risk, as solar and wind are variable and cannot always produce electricity when needed.**

It would mean assuming the availability of certain emerging resources that are not fully tested in the Ontario context, such as a fully operational small nuclear reactor and new storage technologies. **Once proven at a commercial level, these technologies can become integral components of the power system of the future.**

Ontario would also need to lock in far greater amounts of year-round imports from Quebec that the province currently cannot supply, requiring both Ontario and Quebec to undertake lengthy and expensive transmission expansions specifically to meet Ontario's needs.

There is also the challenge of managing multiple infrastructure projects at the same time. **Whether all these projects could be completed by 2030 would depend on the availability of capital, skilled workers, supplies and equipment.**

The minimum amount of investment required to accomplish this effort as it is currently laid out is estimated to be more than ***$27 billion, increasing residential bills by 60 per cent.***

What the Future may Hold

Ontario Minister of Energy letter to IESO, Oct 2021

- IESO to evaluate a **moratorium on the procurement of new natural gas generating stations in Ontario**.
- IESO to develop an **achievable pathway to phase-out natural gas generation and achieve zero emissions in the electricity system for consideration**. The pathway should consider:
  - first and foremost, the reliability of the electricity system
  - the cost to electricity ratepayers
  - the timeline on which this would be achievable
  - the positive or negative effect this would have on electrification of the broader Ontario economy (i.e. industry, transportation, etc) and reaching the province's overall climate goals
  - the possibility of maintaining the generating facilities but replacing natural gas with green fuels such as hydrogen and renewable natural gas, or the development of utility-scale carbon capture and storage, and
  - the role of technologies like pumped storage, battery storage combined with non-emitting resources, hydro, ***nuclear***, and demand response to eliminate emissions in the electricity system.

Report expected by Nov 2022

Politization

Anti/Pro Nuclear Activism

Polarization

Rationality

Indigenous Reconciliation

Public Trust

… and what about the Public's nuclear hesitancy?

Motivated Reasoning

Partisanship

NIMBY

Social Media

Democratization of Decision Making

Conspiracy Theories

Ten Myths about Nuclear Energy (Argonne National Lab) *[there are many such lists]*

1. Americans get most of their yearly radiation dose from nuclear power plants.
2. A nuclear reactor can explode like a nuclear bomb.
3. Nuclear energy is bad for the environment.
4. Nuclear energy is not safe.
5. There is no solution for the huge amounts of nuclear waste being generated.
6. Most Americans don't support nuclear power.
7. An American "Chernobyl" would kill thousands of people.
8. Nuclear waste cannot be safely transported.
9. Nuclear used fuel is deadly for 10,000 years.
10. Nuclear energy can't reduce our dependence on foreign oil.

Ten Myths about Nuclear Energy (World Nuclear Association)

1. The nuclear industry still has no solution to the 'waste problem'.
2. The transport of this waste poses an unacceptable risk to people and the environment.
3. Plutonium is the most dangerous material in the world.
4. Nuclear waste is hazardous for tens of thousands of years. This clearly is unprecedented and poses a huge threat to our future generations.
5. Even if put into a geological repository, the waste might emerge and threaten future generations.
6. Nobody knows the true costs of waste management. The costs are so high that nuclear power can never be economic.
7. The waste should be disposed of into space.
8. Nuclear waste should be transmuted into harmless materials.
9. There is a potential terrorist threat to the large volumes of radioactive waste currently being stored and the risk that this waste could leak or be dispersed as a result of terrorist action.
10. Man-made radiation differs from natural radiation.

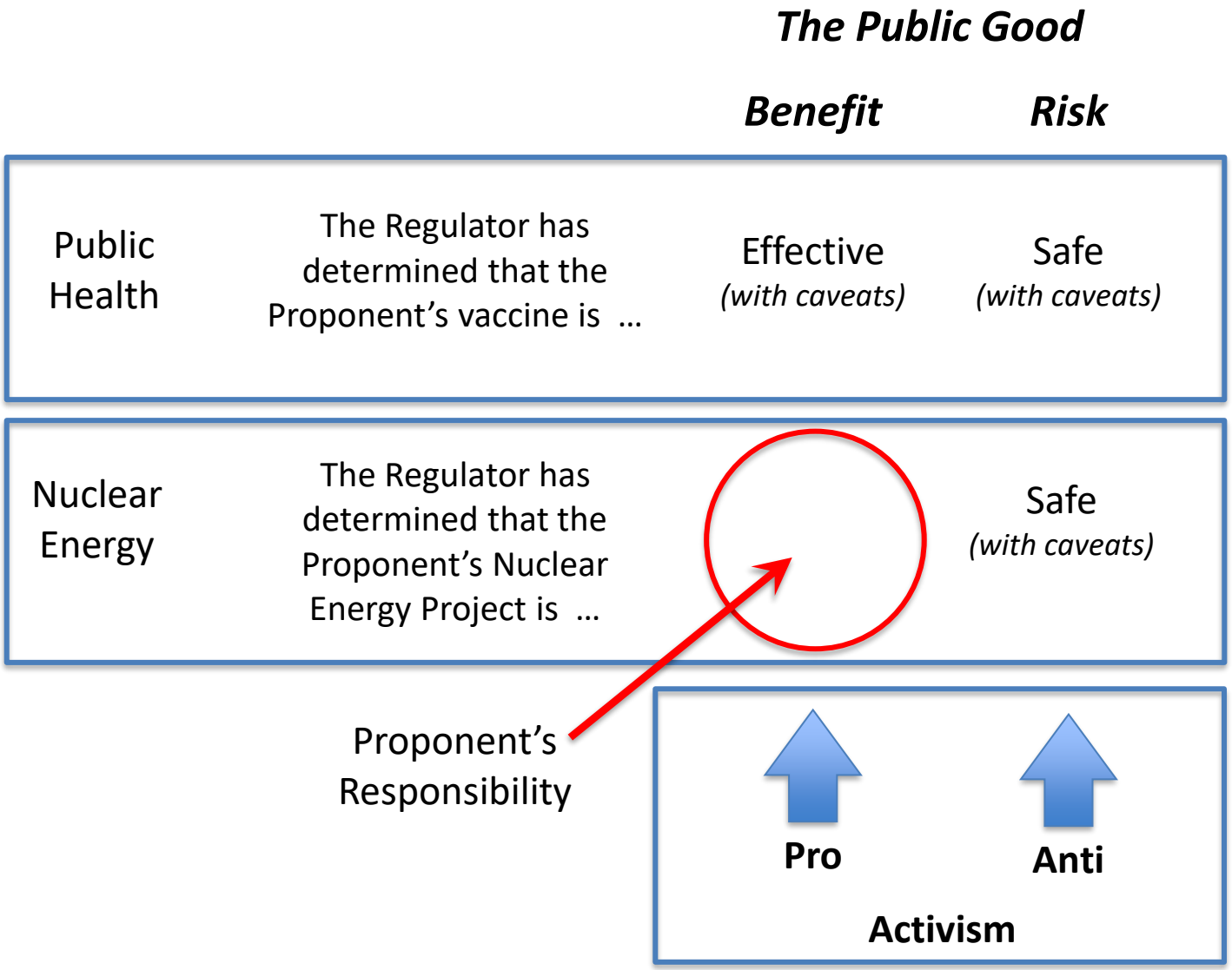
Ten Facts about Nuclear Energy *(… and so on)*

1. Nuclear energy's **life-cycle GHG emissions** per unit energy produced are **comparable to those from wind and better than those from PV solar**.
2. Over the course of 50+ years of nuclear power, it has **avoided millions of premature deaths** by eliminating air pollution from fossil fuels.
3. Nuclear energy's capital costs are high, but its low operating costs, low fuel costs and long plant lifetimes make it **one of the lowest cost electricity generating technologies**.
4. In terms of deaths incurred during a generating technology's life-cycle, data show that **nuclear energy (including accidents) is the safest of energy generating technologies**.
5. Nuclear energy is the only energy generating technology to have **internalized the cost of managing its waste**.
6. Nuclear energy generates the **least volume of toxic waste, by orders of magnitude**.
7. Compared to wind and PV solar over their full life-cycles, **nuclear energy uses the least amount of natural resources, by orders of magnitude**.
8. Compared to wind and PV solar, **nuclear energy has the smallest land usage, by orders of magnitude**.
9. Ionizing radiation occurs naturally. Ionizing radiation released from nuclear power plants is a **very small fraction of natural background radiation exposures to the public**.
10. The annual radiation dose to the public from nuclear power is about that **obtained by eating one banana per year.**

Source: IEA/NEA 2020

The evidence would suggest that Nuclear Energy is "Green".

The Role of Regulation



But perhaps addressing the Public's Nuclear Hesitancy is about (much) more than (more) facts and evidence …

Social Scientists point to the following:

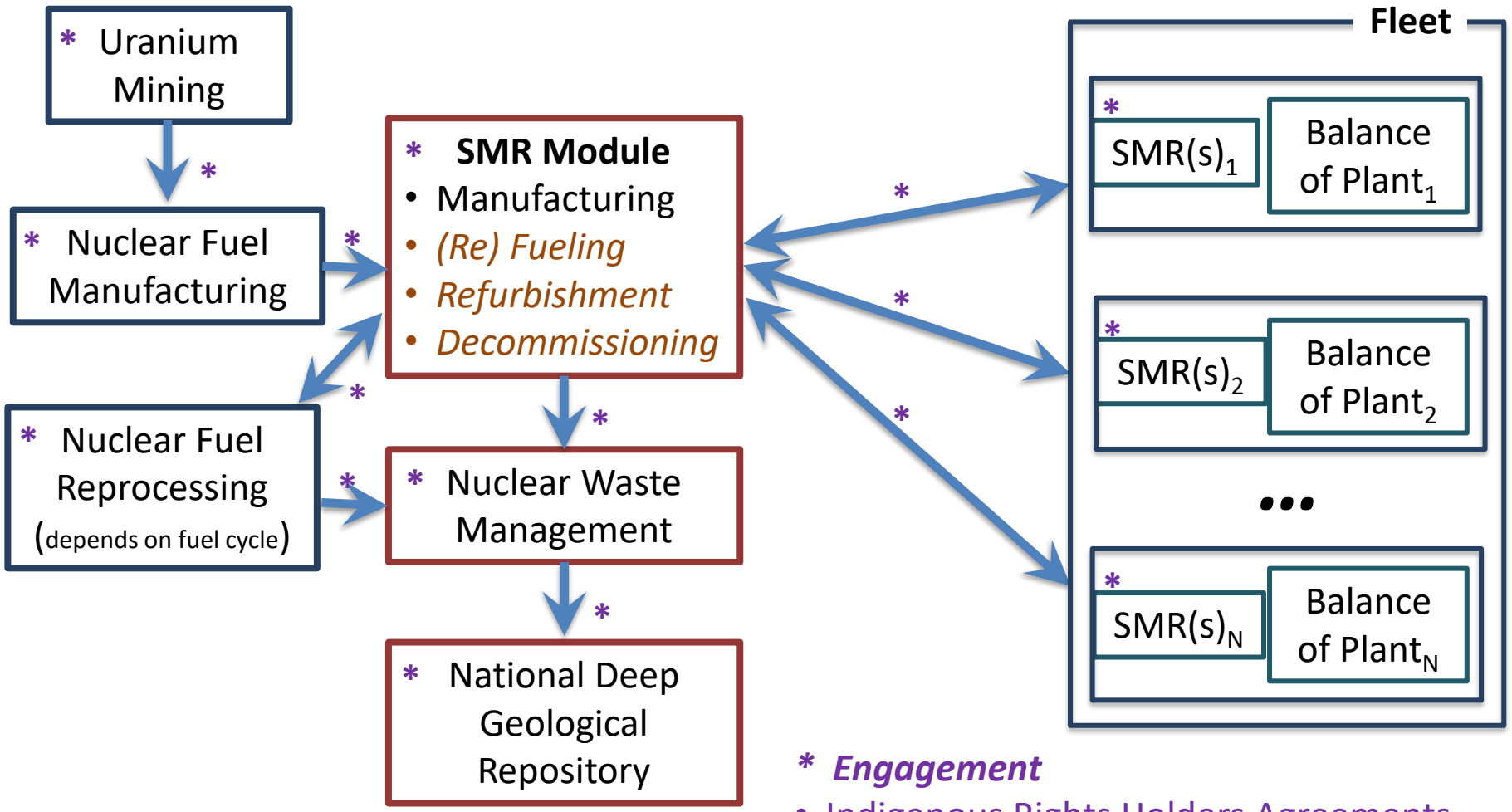
- A general erosion of public trust in experts
- The trend to politization, polarization and partisanship in politics in western democracies
- The increasing expectation in the public to be involved in decision making that directly impacts them individually and their communities
- The "echo chambers" of social media that help reinforce one's beliefs
- The tendency of all humans all engage in "motivated reasoning" - to accept/reject new evidence based on its consistency with their pre-existing world views
- Just who is being more rational in their decision making? - an industry that says "*Nuclear energy is safe, yet we must bury our waste a kilometer underground*", or a Public that says, "*This waste must be the most dangerous stuff there is.*"

These realities point to a compelling need to new approaches to "meaningful consultation"…

A Notional "SMR System": *The Case for a New Approach to Engagement*

Implicated Jurisdictions

International
Federal
Provincial
Territorial
Municipal
First Nations



* ***Engagement***

- Indigenous Rights Holders Agreements
- Host / Impacted Community Agreements
- Owner / Operator / Licensee Agreements
- Regulatory Licenses

Transportation of Nuclear Materials

Summary

- The Path to Net Zero is an unprecedented challenge. There is no silver bullet.
- Nuclear energy is in the midst of a technology paradigm shift that further helps position its role in the Path to Net Zero.
- This *Reimagined Nuclear Energy*, coupled with (lots of) Variable Renewables, can play a critical role in achieving the Net Zero goal.
- Meaningful engagement is an essential ingredient for this *Reimagined Nuclear Energy* to be an important contributor to the Net Zero goal.
- Canada is well positioned to help show the way in nuclear's role in the global Path to Net Zero.