

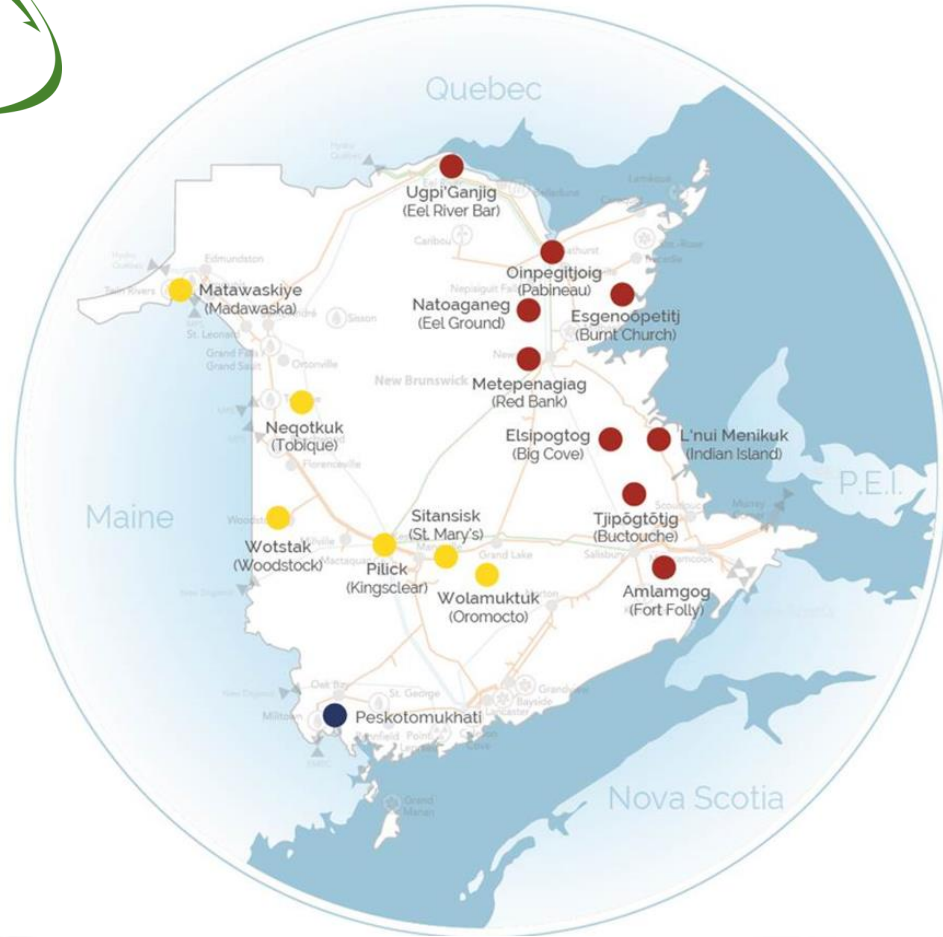
# Reactivating the Underutilized New Brunswick Supply Chain

Canadian Manufacturers & Exporters  
November 24<sup>th</sup>, 2020

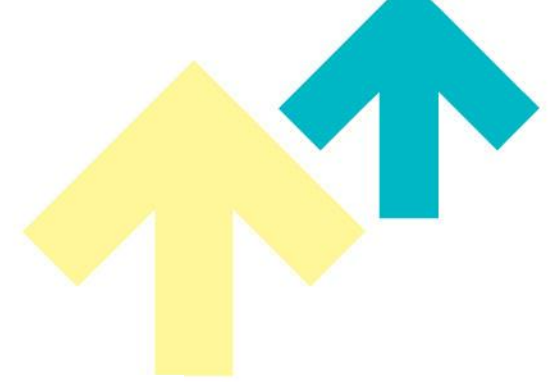


Norman JD Sawyer  
President & Chief Executive Officer  
ARC Nuclear Canada Inc.





-  Wolastoqey
-  Mi'kmaq
-  Peskotomukhati



*“ARC Nuclear Canada Inc. recognizes that New Brunswick covers the traditional territories of the Wolastoqey, Mi'kmaq and Peskotomukhati peoples and the region, part of the Wabanaki.”*

-Norman JD Sawyer  
President & CEO ARC Nuclear Canada Inc.

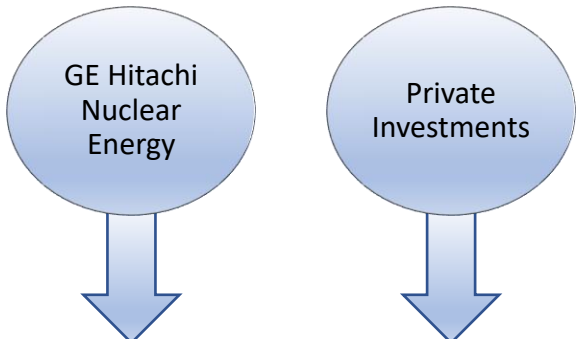
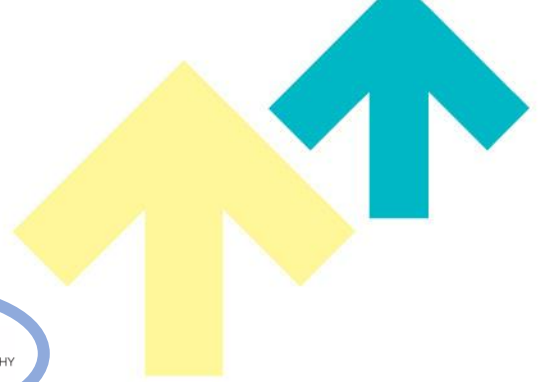


ARC Nuclear Canada Inc.

Technology Company

# ARC Nuclear Canada Inc.

TECHNOLOGY COMPANY



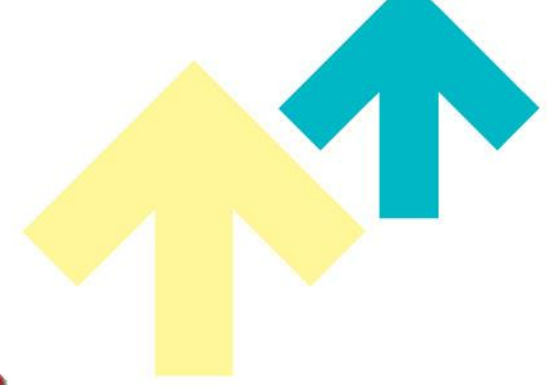
Partnerships Continue to Grow in New Brunswick, Canada and Internationally

# ARC Nuclear Canada Inc.

## TECHNOLOGY COMPANY

ARC Canada has as one of its core objectives to foster local economic growth opportunities

- Promoting equal economic opportunity for Indigenous Peoples & New Brunswicker's
- Providing opportunities for equity partnerships
- Hiring plan reflective of the New Brunswick region:
  - First Nations representation
  - Diversity and inclusivity
  - Bilingualism
  - Focus on local and Canadian talent

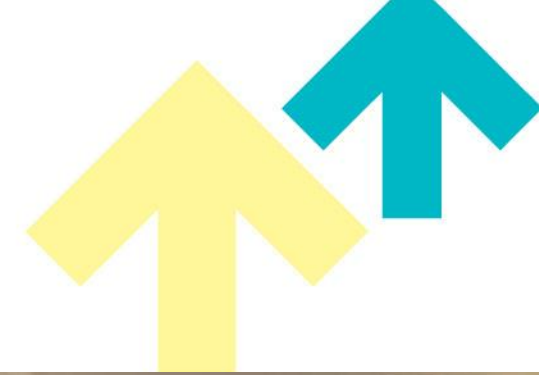


***"As a New Brunswicker, I am proud to say that our company is promoting environmentally friendly solutions, economic growth and opportunities for our beautiful province."***

-Norman JD Sawyer  
President & CEO ARC Nuclear Canada Inc.

# ARC Nuclear Canada Inc.

TECHNOLOGY COMPANY

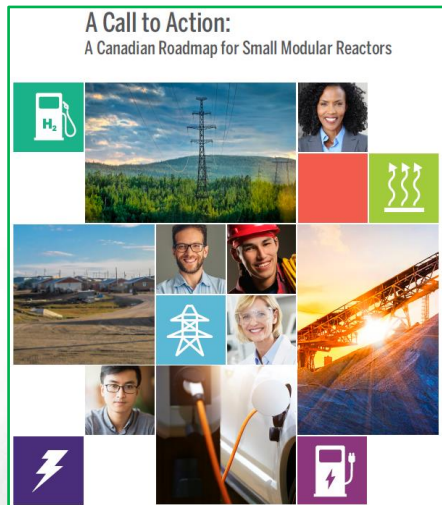


## Memorandum of Understanding Collaboration

- ❑ Executed by the Premiers of the Provinces of New Brunswick, Ontario & Saskatchewan
  - Developed to gain Federal & Public support
  - Engaged other Provinces & Territories
  
- ❑ Provided a pathway for the development of a Pan-Canadian “STREAM” approach



MOU Collaboration, December 1<sup>st</sup>, 2019  
 From left to right: New Brunswick Premier Blaine Higgs, Norman JD Sawyer President & CEO ARC Nuclear Canada Inc., Ontario Premier Doug Ford, and Saskatchewan Premier Scott Moe.



Stream #1	On-Grid “ready deployable” SMR by late 2020’s
Stream #2	On-Grid “Advanced SMRs” being developed for early to mid 2030s that bring additional benefits
Stream #3	SMR for resource extraction and remote communities



***New Brunswick Technology Differentiator: Dealing with past, current & future waste***



# ARC Nuclear Canada Inc.

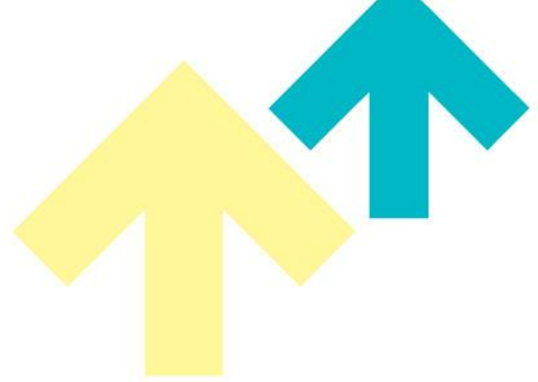


*Proven Technology Ready for Market*

A grayscale landscape photograph showing a rocky mountain peak in the foreground with a few people standing on it. The background features a dense forest of evergreen trees and rolling hills under a hazy sky.

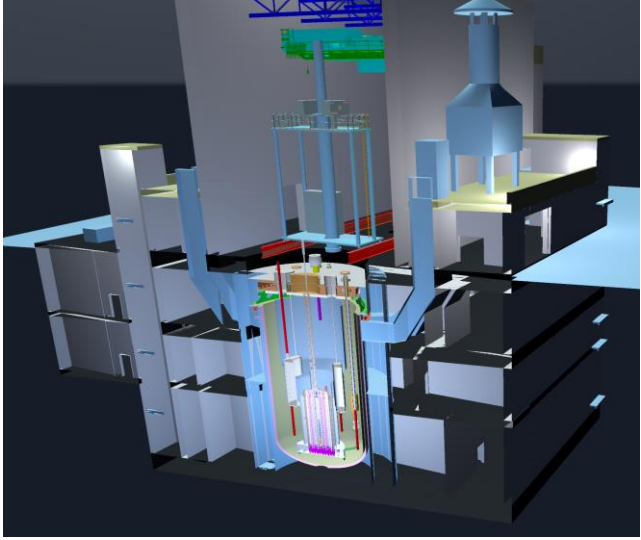
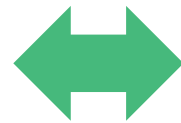
# ARC Nuclear Canada Inc.

PROVEN TECHNOLOGY READY FOR MARKET

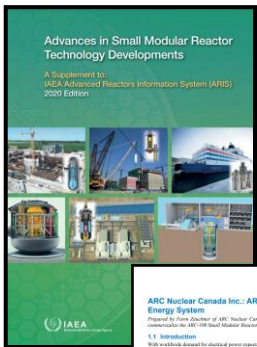


EBR-II

ARC-100



Technology to Address Climate Change



IAEA Advances in SMR Technology Developments 2020 edition



2020 CEM NICE Future Campaign International Report on Flexible Nuclear Energy for Clean Systems

1963 to 1994

2028 to 2088 - 100 MW (e)

62 Megawatts thermal – 20 MW electrical

286 Megawatts thermal – 100 MW electrical net output

- Technology evolution of a proven advanced nuclear reactor prototype
- IP protected with multiple patents, including metallic fuel and core design
- Addresses the key technical, economic, and geo-political barriers to nuclear power

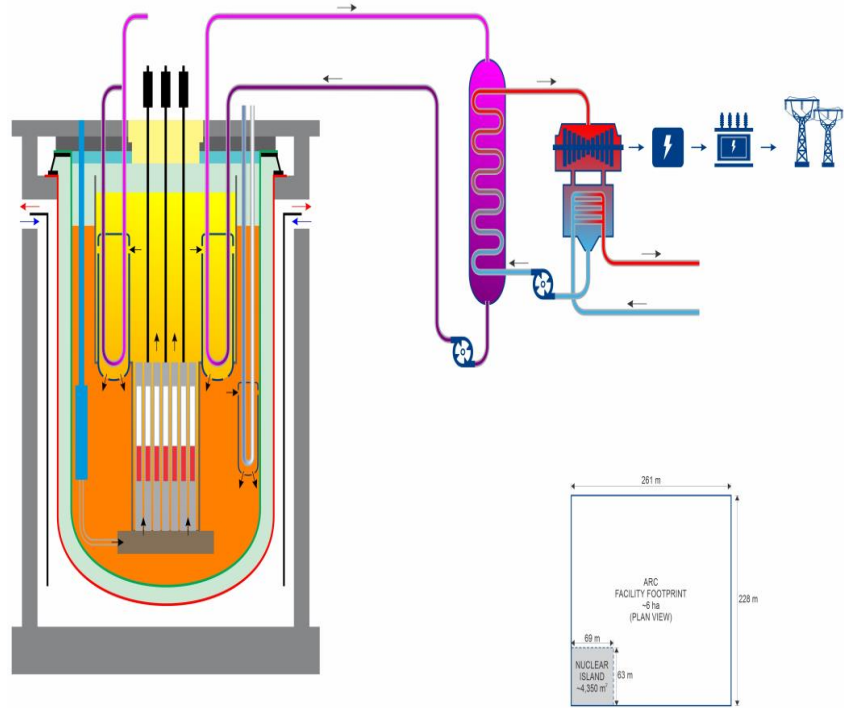
**30 years of operating experience leading to our evolutionary patented technology**





# ARC Nuclear Canada Inc.

PROVEN TECHNOLOGY READY FOR MARKET

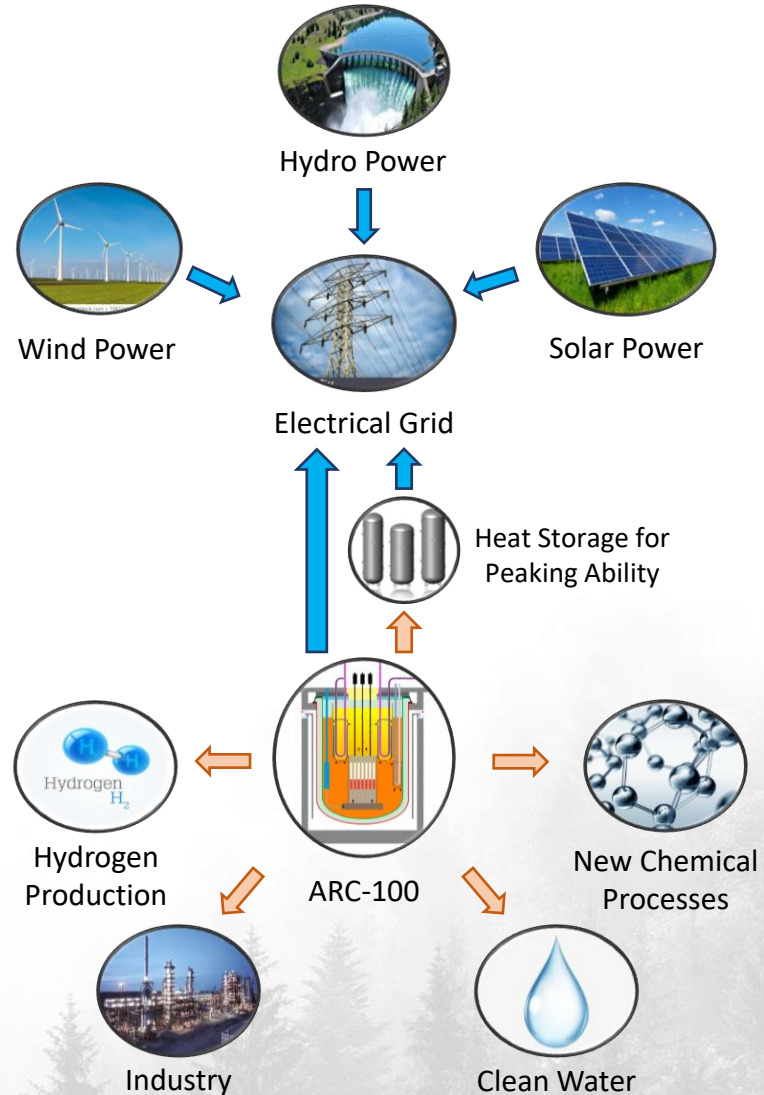


## Paradigm Shift in Reactor Manufacturing

- ❑ Operates at essentially atmospheric pressure
- ❑ Non-corrosive coolant
- ❑ No expensive exotic metal alloys
- ❑ No massive traditional containment structure
- ❑ No need for permanent on-site refueling equipment

**Lowering cost is essential to industry survival**

## Future Energy System

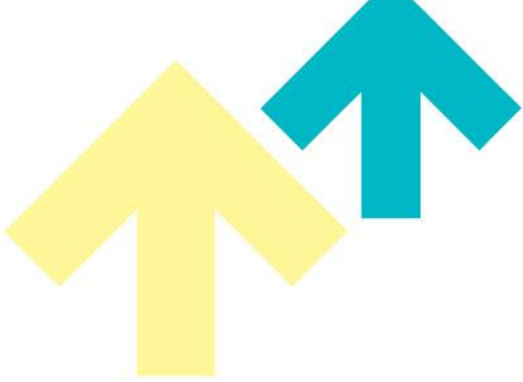


### Inherent Safety

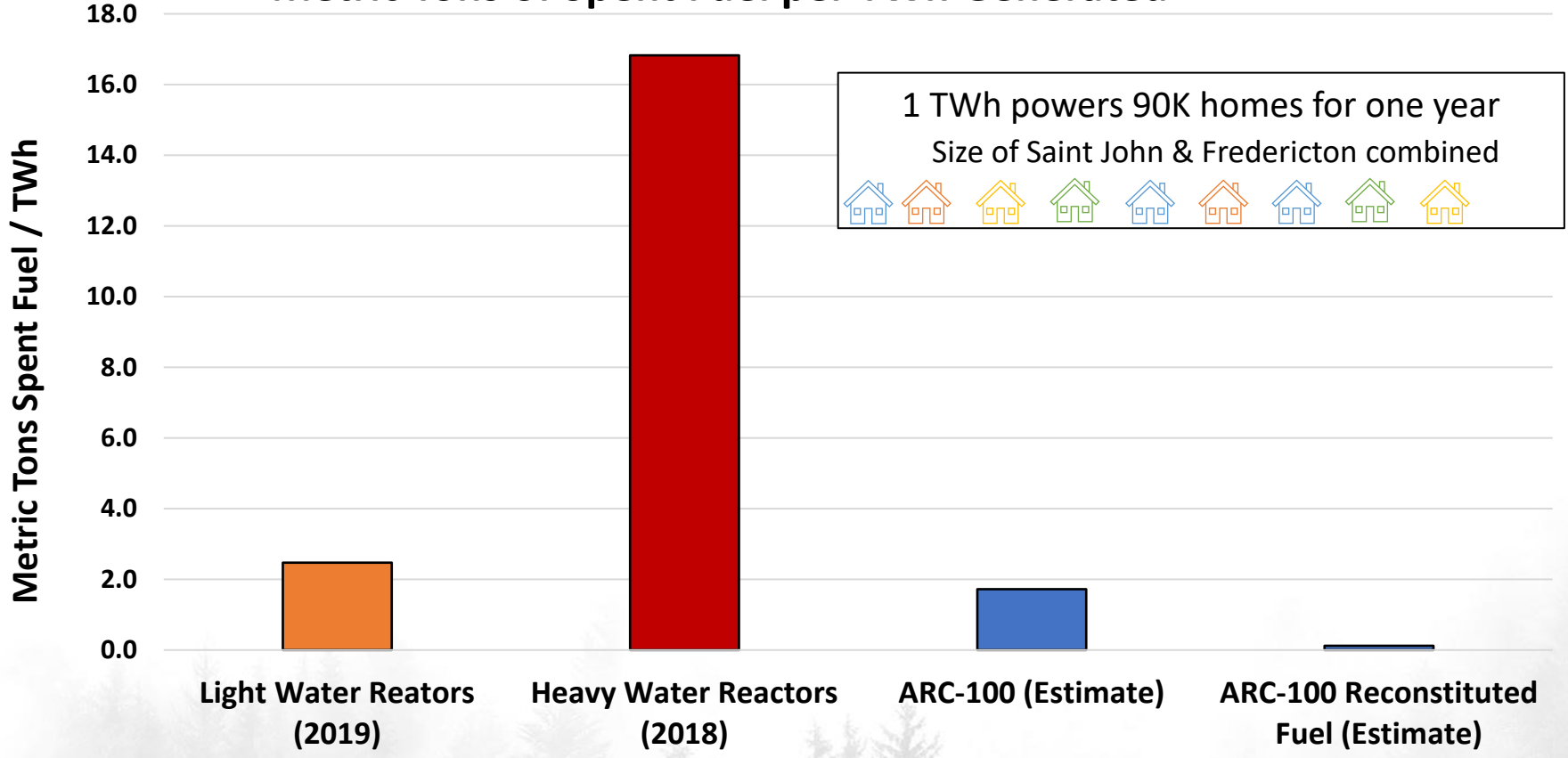
- ✓ Naturally controls its power without Human Intervention
- ✓ Provides exceptional load following characteristics
- ✓ Offering energy flexibility and versatility to partner with renewables

# ARC Nuclear Canada Inc.

PROVEN TECHNOLOGY READY FOR MARKET



### Metric Tons of Spent Fuel per TWh Generated



The ARC-100 generates less waste as compared to other technologies

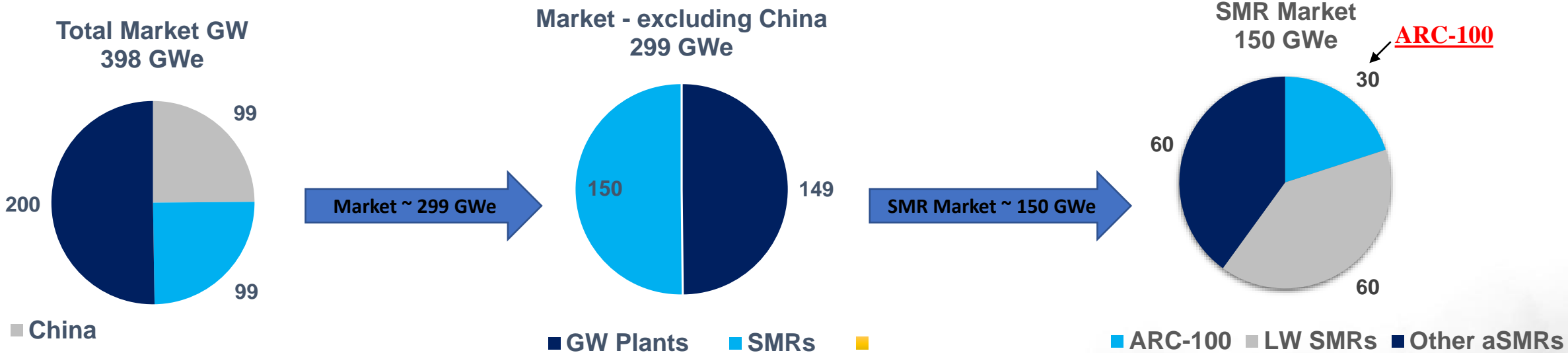


Data obtained from:  
<https://www.energy.gov/ne/articles/5-fast-facts-about-spent-nuclear-fuel>  
<https://www.eia.gov/tools/faqs/faq.php?id=427&t=3#:~:text=In%202019%2C%20about%204%2C%2011%20billion%20kilowatthours%20%28kWh%29%20%28or,an&d%20about%2018%25%20was%20from%20renewable%20energy%20sources.>  
<https://www.nwmo.ca/en/Canadas-Plan/Canadas-Used-Nuclear-Fuel/How-Much-Is-There>  
<https://world-nuclear.org/information-library/country-profiles/countries-a-f/canada-nuclear-power.aspx>  
<https://www.nap.edu/read/11320/chapter/11>  
<https://knoema.com/atlas/Japan/topics/Energy/Electricity/Nuclear-electricity-net-generation>  
<https://www.iaea.org/newscenter/news/under-one-roof-russias-integrated-strategy-for-spent-fuel-management#:~:text=In%202018%2C%20nuclear%20power%20accounted,plants%2C%20research%20reactors%20and%20submarines.>  
<https://sputniknews.com/russia/202001011077916654-russian-nuclear-plants-break-2018-energy-generation-record/>  
<https://journals.sagepub.com/doi/pdf/10.1177/0096340211407146>  
<https://world-nuclear.org/information-library/country-profiles/countries-o-s/south-korea.aspx#:~:text=In%202017%20Electricity%20production%20was%20567%20TWh%20gross%2C,wind%20and%20solar%2C%20and%207%20TWh%20from%20hydro.>  
<https://www.oecd-nea.org/rwm/profiles/France.pdf>  
<https://knoema.com/atlas/France/topics/Energy/Electricity/Nuclear-electricity-net-generation>  
[https://www-pub.iaea.org/MTCD/Publications/PDF/te\\_1591\\_web.pdf](https://www-pub.iaea.org/MTCD/Publications/PDF/te_1591_web.pdf)

# ARC Nuclear Canada Inc.

PROVEN TECHNOLOGY READY FOR MARKET

## ARC-100 Worldwide Market Share - 30 GW(e)



- ❑ Total plant new build due to obsolete fleets will be 200GWe through 2040, with none in China
- ❑ Total new build nuclear market will be 198 GWe through 2040, with half of new capacity in China

- ❑ One-half of new build will be Gigawatt size Light Water Reactors, and one-half will be SMRs

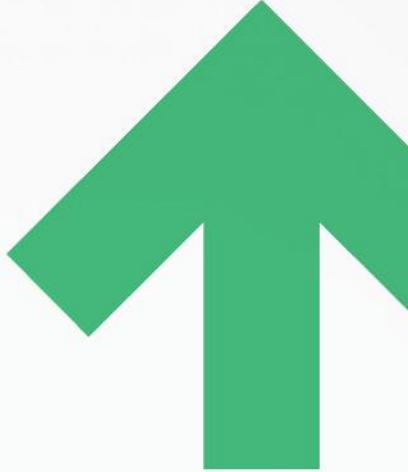
- ❑ ARC-100 captures **20% of SMR market** (30GWe), remainder will be split 50/50 between LWR SMRs and other aSMRs

**\$160 Billion Market Opportunity**

# ARC Nuclear Canada Inc.

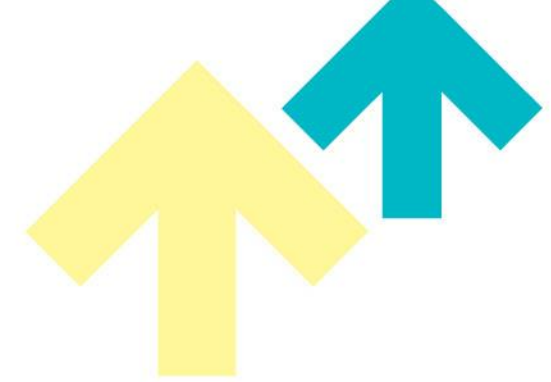


*Supply Chain Design & Development  
(Phase II)*

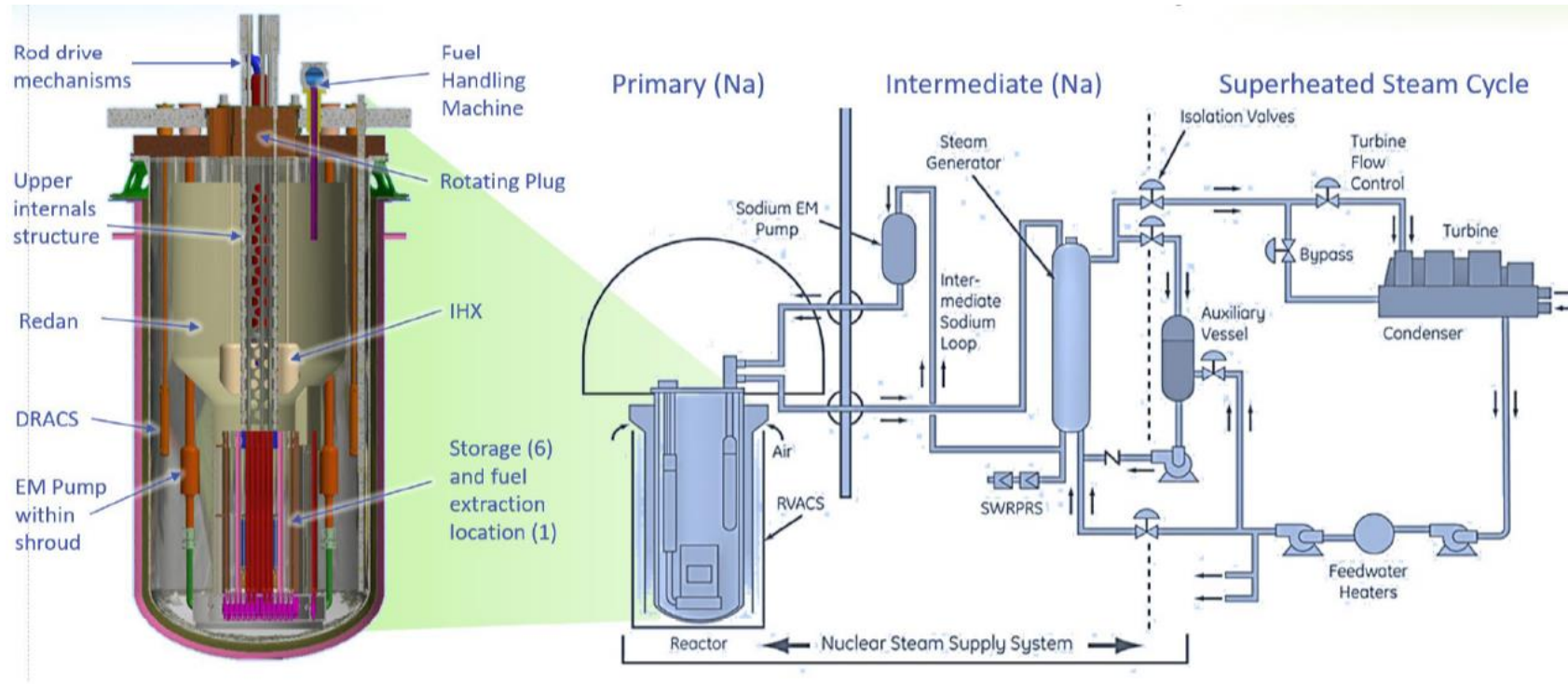


# ARC Nuclear Canada Inc.

## SUPPLY CHAIN DESIGN & DEVELOPMENT



### ARC-100 and Power Extraction Cycle

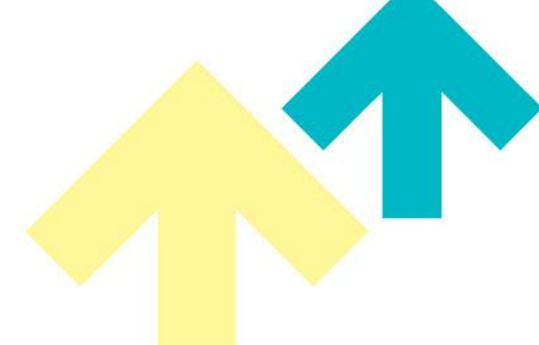


*In the next step of commercialization, ARC Canada begins its second phase of Supply Chain analysis to understand the New Brunswick capabilities and the support required from other provinces*

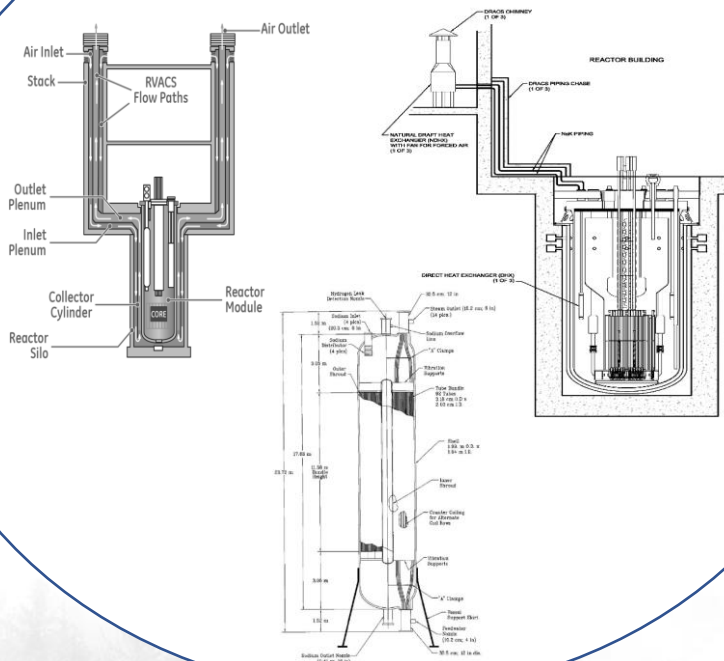


# ARC Nuclear Canada Inc.

## SUPPLY CHAIN DESIGN & DEVELOPMENT



**ARC-100 Simplified Diagrams**



Estimates of Fabricated Tubes, Ducts & Pipes	One Unit	Over 25 years
Fuel cladding: tubes of HT-9, 1.298 cm OD, thickness 0.5 mm Approximately 6 meters long	11,557 Tubes	4,044,950 Tubes
Reflector cladding: tubes of HT-9, 1.63 cm OD, thickness 0.5 mm, 6 meters long	714 Tubes	249,900 Tubes
Shield cladding: tubes of HT-9, 3.6 cm OD, thickness 0.5mm, 6 meters long	336 Tubes	117,600 Tubes
Hexagonal ducts: ducts of HT-9, 16.15 cm flat to flat, thickness -0.35mm, 6 meters long	191 Ducts	66,850 Ducts
Hexagonal ducts: ducts of HT-9, 14.95 cm flat to flat, thickness -0.35 mm, 6 meters long	7 Ducts	2,450 Ducts
Heat Exchangers tubes: 9Cr-1Mo tubes, 1.59 cm OD, thickness -0.889 mm, 4.5 meters long	6600 Tubes	2,310,000 Tubes
DRACS tubes: 9Cr-1Mo, 2.22 cm OD, 0.90 mm thickness, 3 meters long	75 Tubes	26,250 Tubes
Major SS 316 double pipes/pipes:	2 sets	700 sets
(a) Two sets, each consisting of outer pipe 55.9 cm OD, 1.27 cm thickness; inner pipe 40.6 cm OD, 1.27 cm thickness, 12 meters long.	2 sets	700 sets
(b) Two sets, each consisting of 55 cm OD outer pipe, 1.27 cm thickness, 15 meter long; inner pipe 50 cm OD, 1.27 cm thickness, 45m long (note: double pipe stops after 15 meters and continues as single pipe)	2 sets	700 sets
(c) Two sets, each consisting of 45 cm OD outer pipe, 1.27 thickness, 15 meters; inner pipe 40 cm OD, 1.27 cm thickness, 45 meters long (same note as above)		

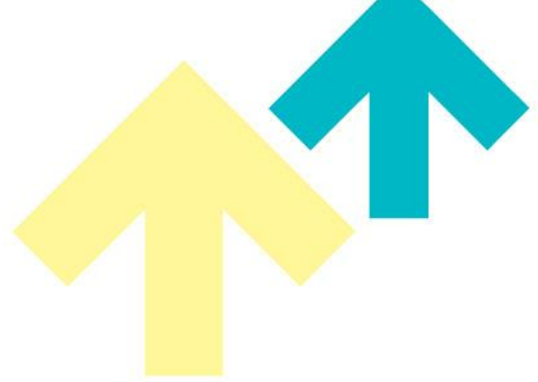
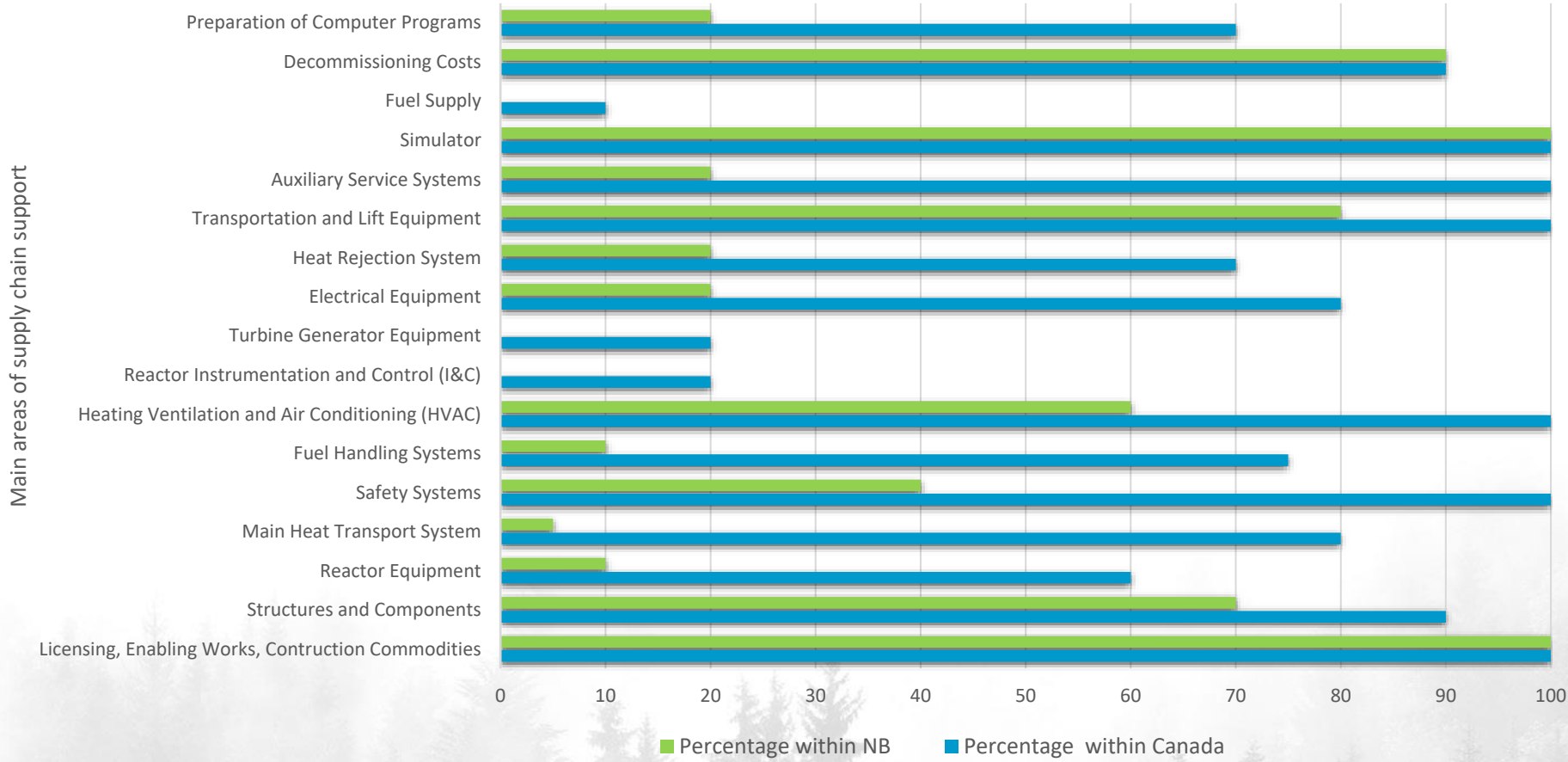


***As system components are more precisely defined, ARC Canada will compare requirements to the New Brunswick & Atlantic Provinces capabilities, as a priority, to manufacture at cost competitive pricing***

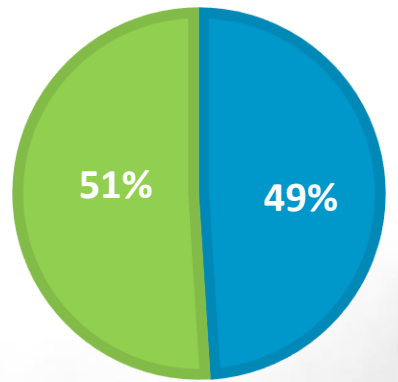
# ARC Nuclear Canada Inc.

## SUPPLY CHAIN DESIGN & DEVELOPMENT

Analysis of Canadian Supply Chain Capabilities



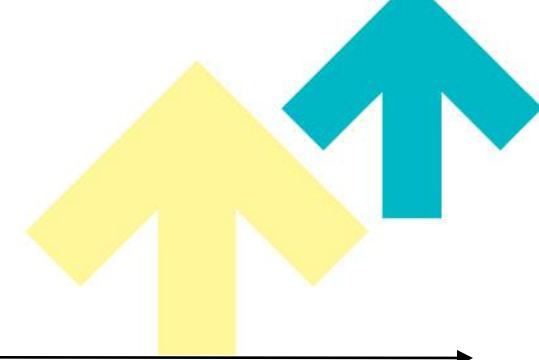
■ Canada ■ New Brunswick



***Our current estimates predict 74% of all components and systems could be supplied in Canada***

# ARC Nuclear Canada Inc.

## SUPPLY CHAIN DESIGN & DEVELOPMENT



### Components, Equipment & Systems Require Many Considerations:

- Safety Grade & Quality Requirements
- Codes Requirements
- Capabilities & Expertise
- Competition
- Quantity
- Cost Competitiveness
- Risk Appetite
- Attractiveness

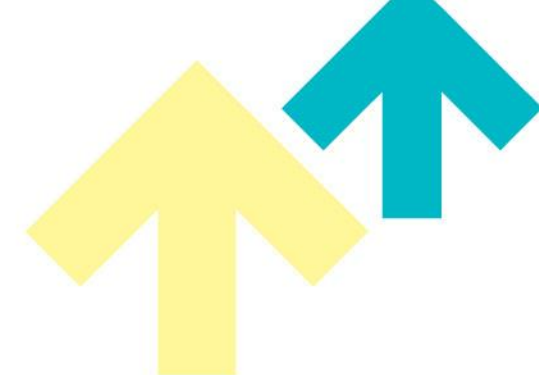
- ❑ Services
    - Engineering
    - Licensing
    - Training
    - Procurement
    - Outage Services
  - ❑ Nuclear
    - Reactor Vessel
    - Top Plate
    - Rotatable Plug
    - Guard Vessel
    - Reactor Internals
    - In-vessel Fuel Transfer Machine
    - Control Rod Drive Mechanisms
    - Intermediate Heat Exchanger
    - Electro-Magnetic Pumps
  - ❑ Mechanical (Nuclear & Non-Nuclear)
    - Steam Generator
    - Steam Turbine
    - Condenser
    - Heat Exchangers
    - Pumps
    - Valves
  - ❑ Electrical/ I&C (Nuclear & Non-Nuclear)
    - Generator
    - Diesel Generator
    - I&C Hardware/Software
    - Transformers
    - Switchgear
  - ❑ Structural (Nuclear & Non-Nuclear)
    - Modules – Mechanical, Civil, Hybrid
  - ❑ Civil / Construction
    - Concrete
    - Rebar
    - Buildings
    - Tanks
    - Piping
    - Fencing
    - Sand & Gravel
  - ❑ Chemical
    - Argon, Nitrogen & CO2 Storage
  - ❑ Other
    - Stimulator
    - Non-Sodium Fire Protection Systems
    - Sodium Fire Protection Systems
    - HVAC Systems
    - Cranes & Hoists
    - Elevators



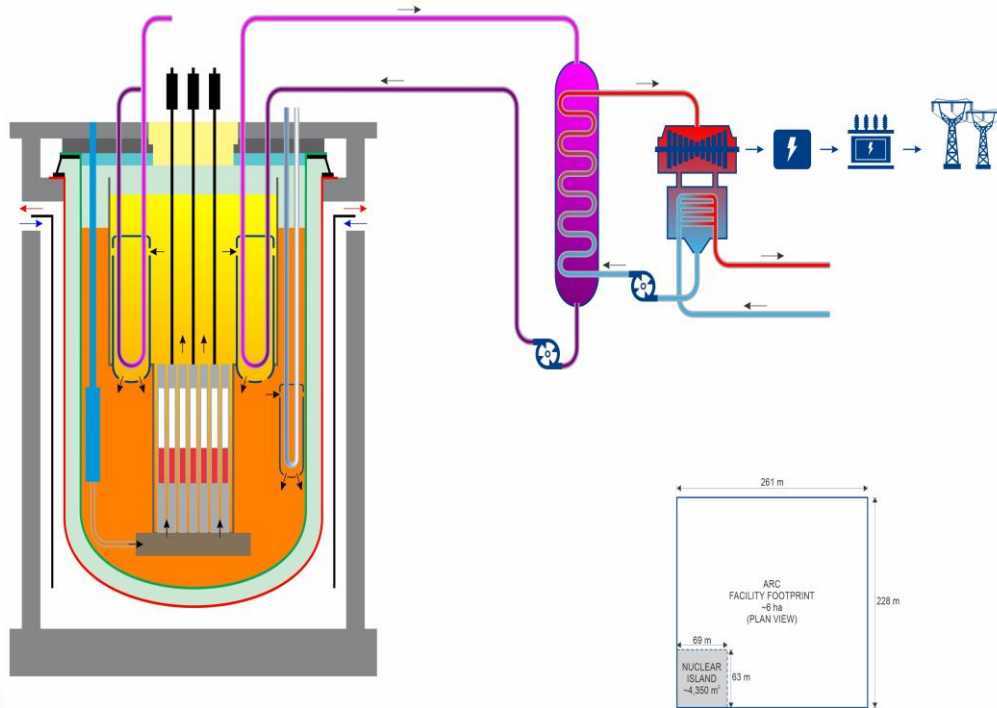


# ARC Nuclear Canada Inc.

## SUPPLY CHAIN DESIGN & DEVELOPMENT



### Increasing Requirements Closer to Reactor Components



### Qualification

- Ability to meet product requirements capability
- Production rigor and control of key process
- Audits to ensure programmatic compliance

### Requirements

- Clear and detailed procurement documentation
- Notification of defects for approval
- Product certificate

### Performance

- Monitoring execution and programmatic controls
- Improvement plan if necessary

### Generally, 3 areas for Supplier Participation:

- Nuclear Island
- Turbine Island
- Balance of Plant

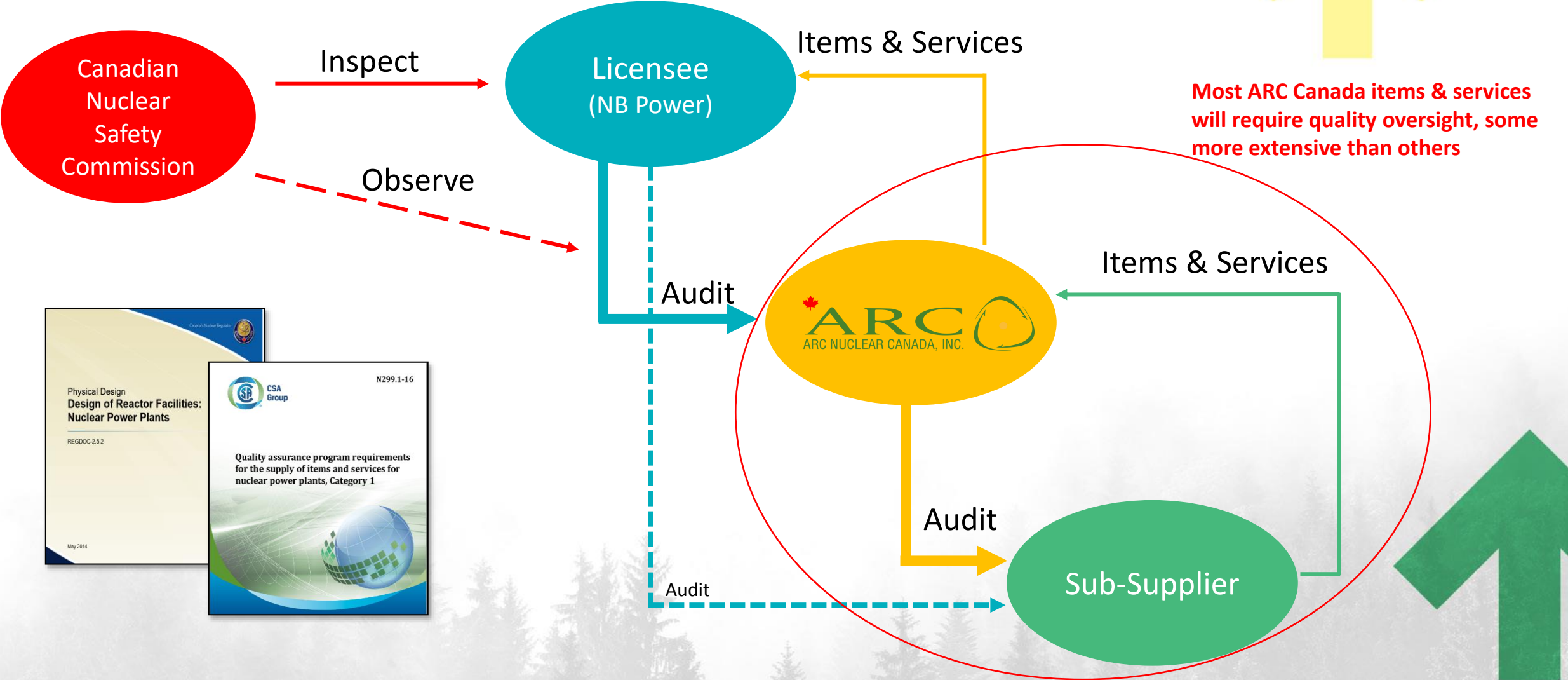
### Various Qualifications Required:

- Nuclear Grade
- Code Standard (e.g. ASME)
- Industrial Standards



# ARC Nuclear Canada Inc.

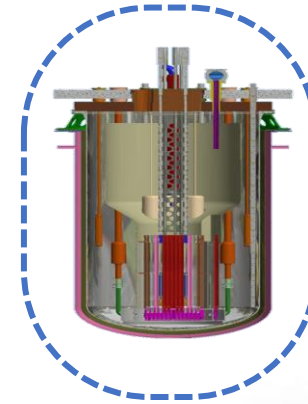
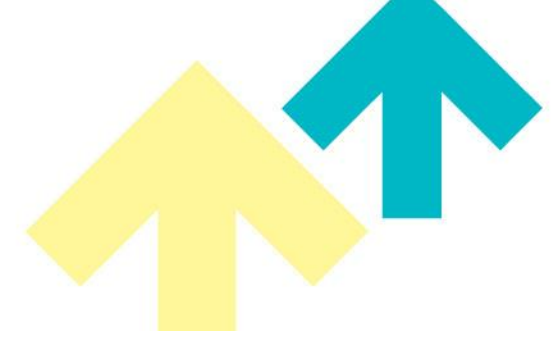
## SUPPLY CHAIN DESIGN & DEVELOPMENT



*The Nuclear Industry is highly regulated*

# ARC Nuclear Canada Inc.

## SUPPLY CHAIN DESIGN & DEVELOPMENT



**Various ownership options being considered:**


- Major Partner
- Specific Manufacturer
- ARC Nuclear Canada Inc.



(Example only)

**Requirements include :**

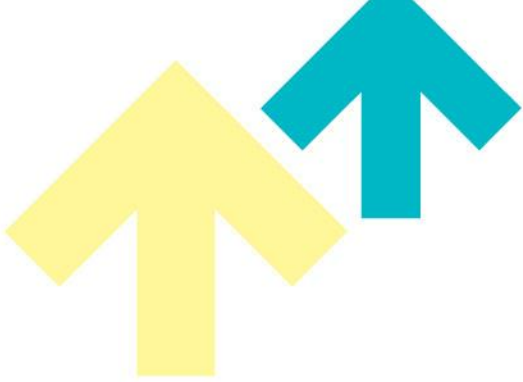
- Ability for transportation by road, rail or sea
- Supporting infrastructure such as port, airport, offices, and housing
- Other potential areas of impact

 Possible locations for the Manufacturing Facility

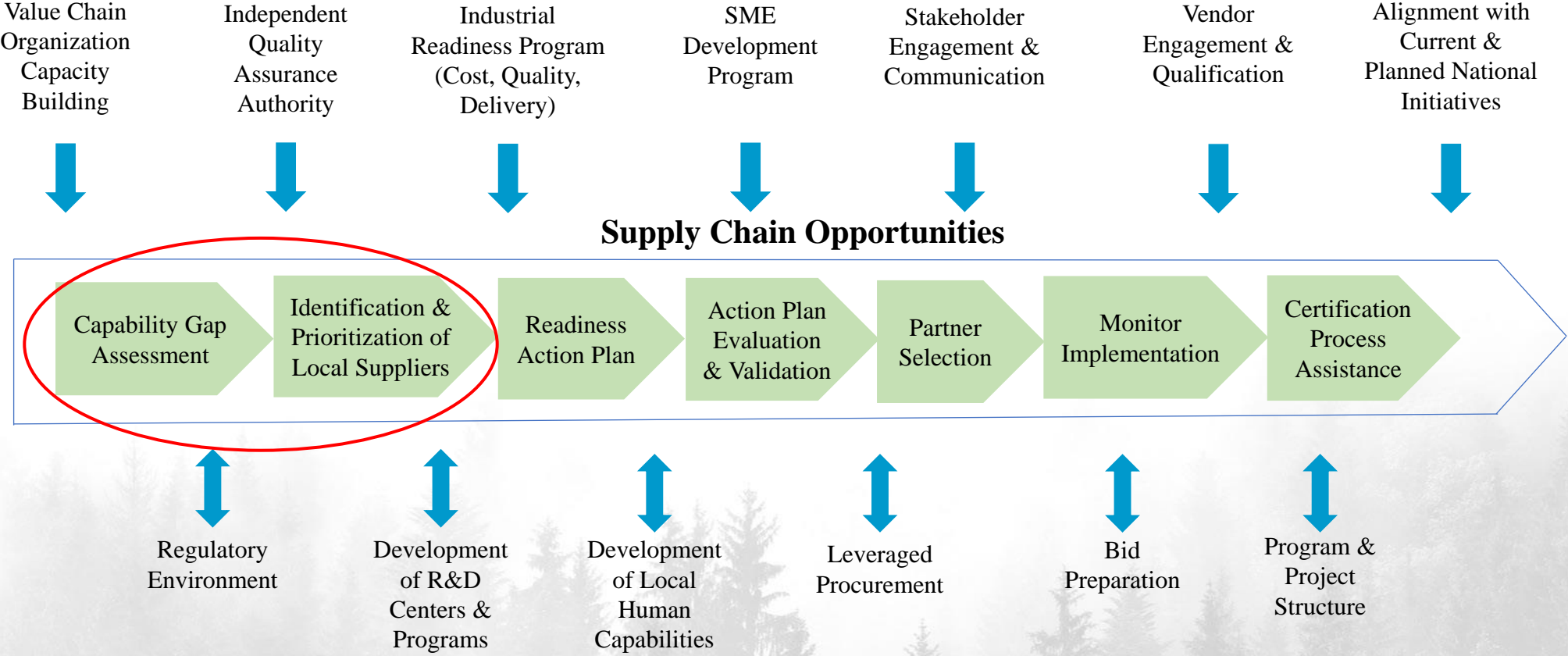


# ARC Nuclear Canada Inc.

## SUPPLY CHAIN DESIGN & DEVELOPMENT

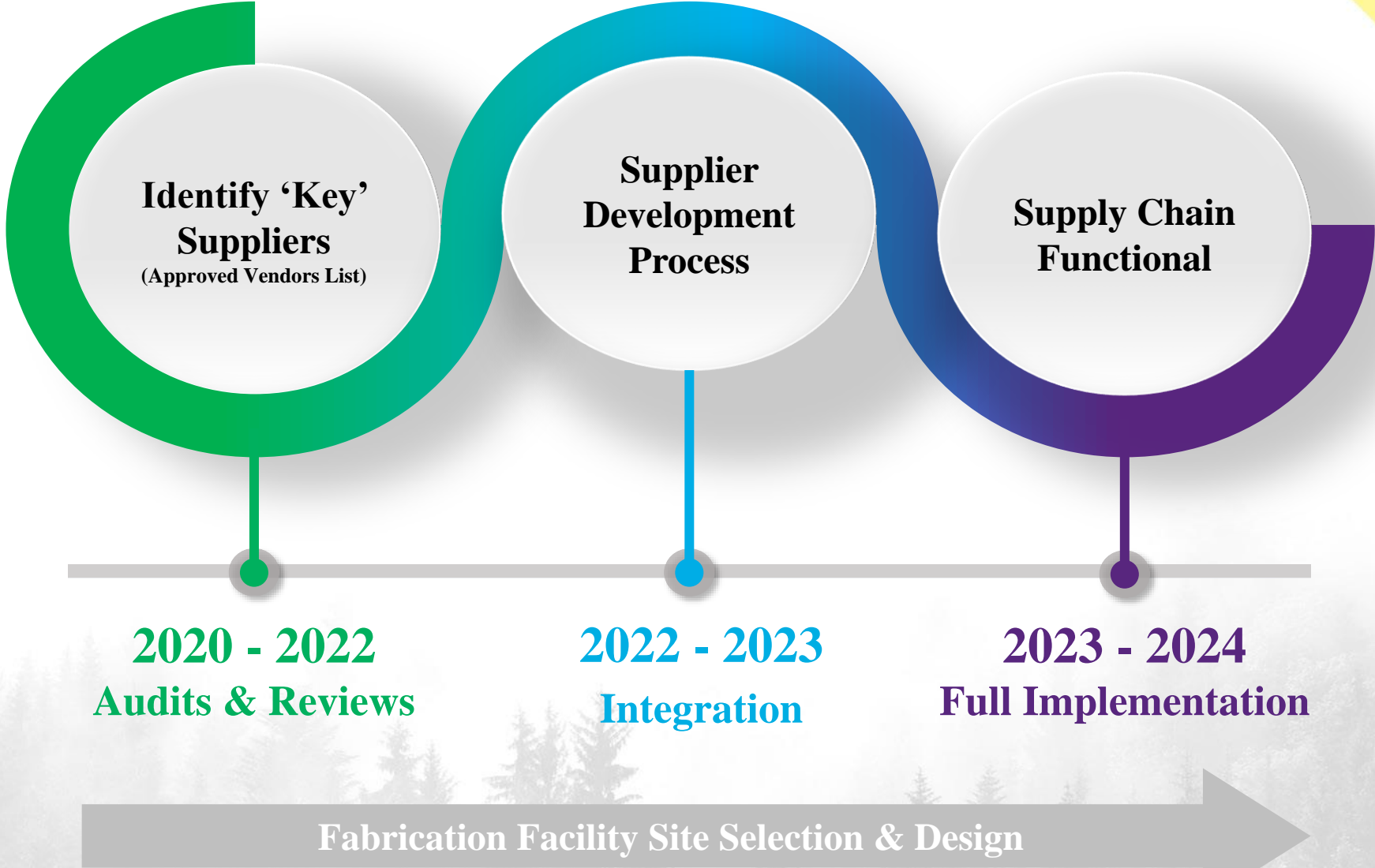


### Major Phases & Inputs



# ARC Nuclear Canada Inc.

## SUPPLY CHAIN DESIGN & DEVELOPMENT

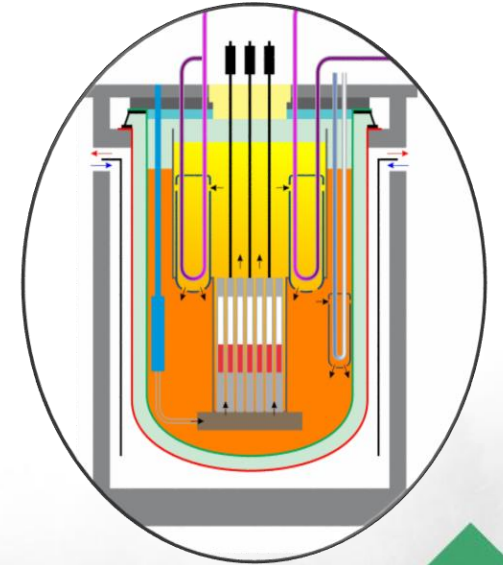
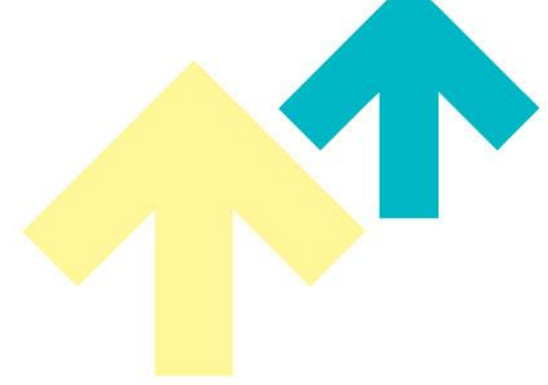


# ARC Nuclear Canada Inc.

## SUPPLY CHAIN DESIGN & DEVELOPMENT

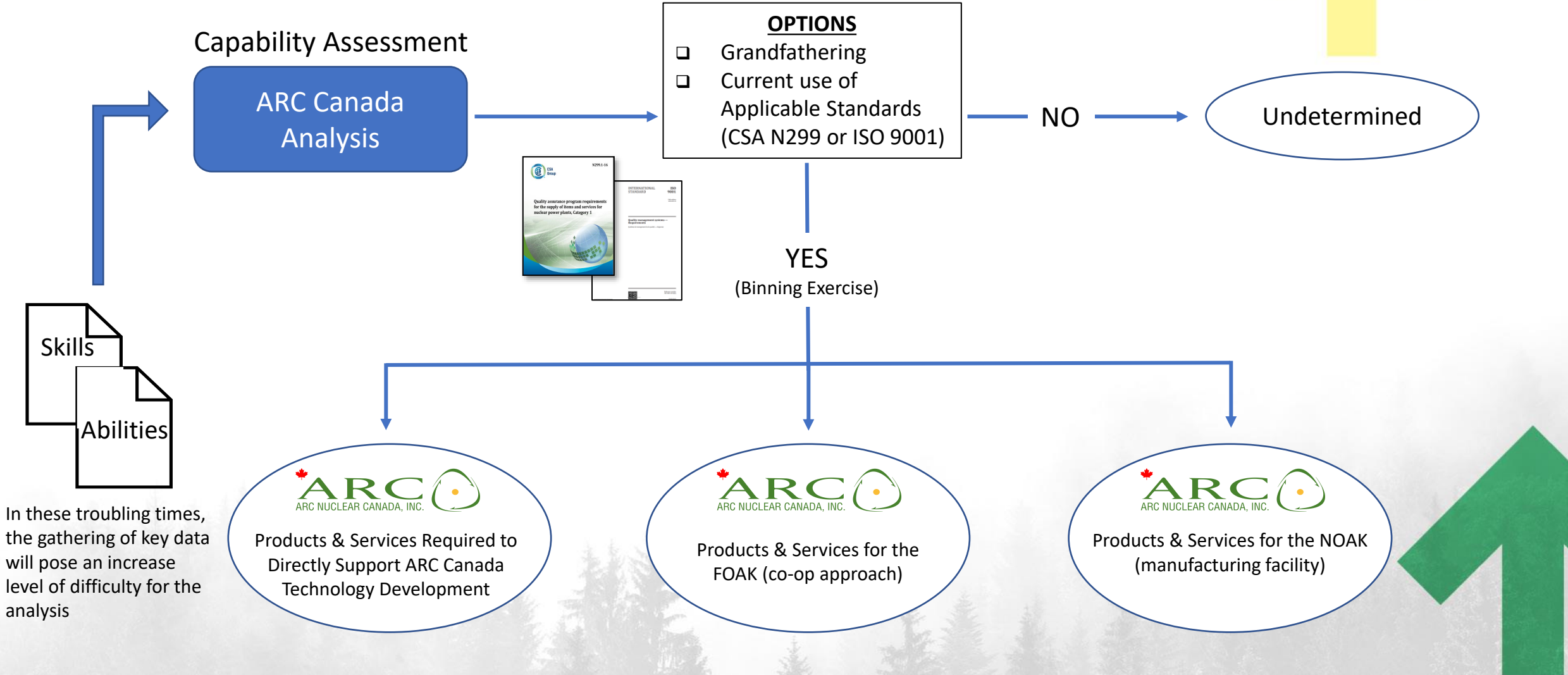
### Company Capability Assessments

- ❑ Ability to provide technically adequate and economical products or services
- ❑ Ability to meet milestones & dates
- ❑ Adequate Quality Management Programs that deliver quality products consistently
- ❑ Adequate supply history & oversight of supply chain
- ❑ Control and implementation of non-conformances & corrective actions
- ❑ Safety Culture and Social Responsibilities



# ARC Nuclear Canada Inc.

## SUPPLY CHAIN DESIGN & DEVELOPMENT



In these troubling times, the gathering of key data will pose an increase level of difficulty for the analysis

**ARC Canada postulates to have this study done by mid to late 2022**



# ARC Nuclear Canada Inc.



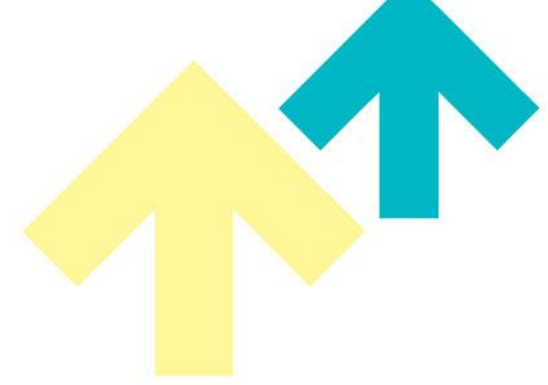
*“Reactivating the Underutilized New Brunswick Supply Chain”*





# ARC Nuclear Canada Inc.

## REACTIVATING THE UNDERUTILIZED SUPPLY CHAIN



Statistic Canada Latest Estimates

### **New Brunswick Economy**

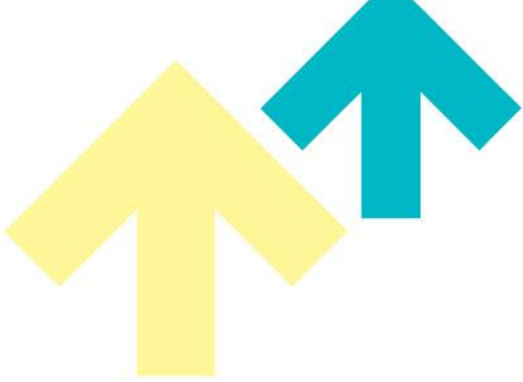
(November 2020)

- Grew by 1.2 per cent in 2019
- Slowest growth in any province east of Manitoba
- 10<sup>th</sup> year in a row economy has expanded at a rate below the national average
- In those 10 years, Canada's economy has grown by 24.5 per cent
  - Compared to just 6.8 per cent in NB, which had the least growth in the country
- The only province not to reach double digits

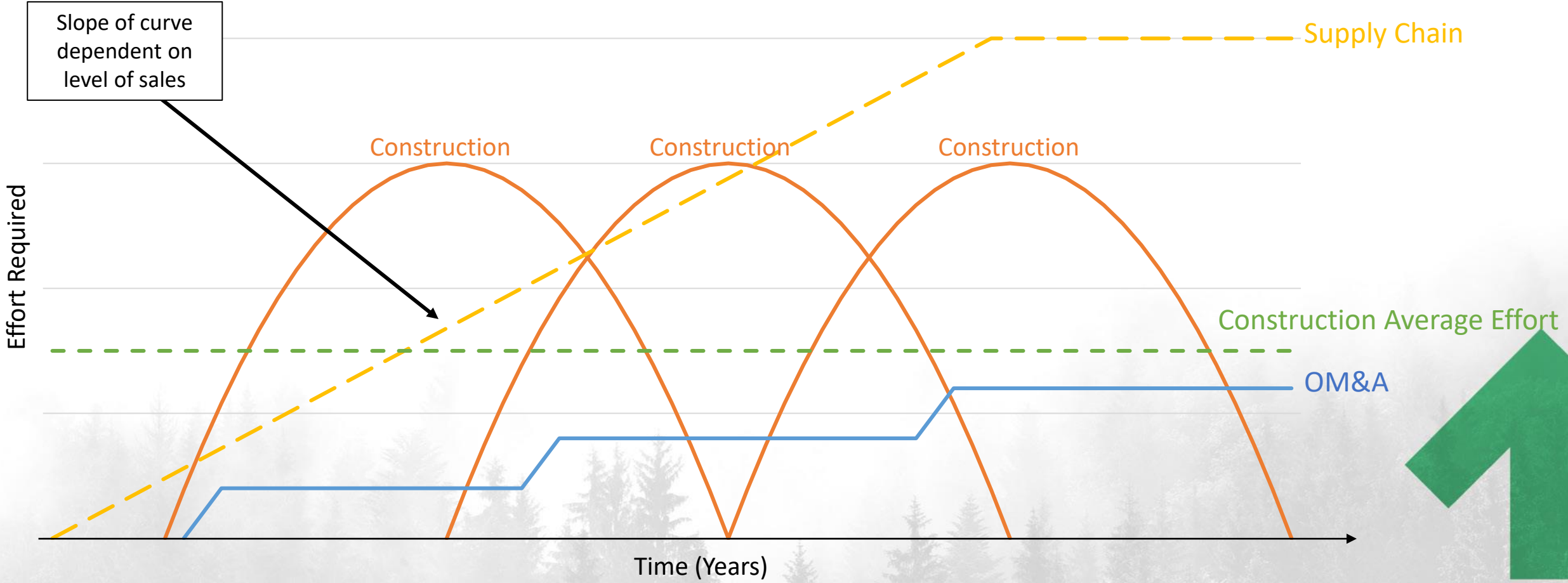


# ARC Nuclear Canada Inc.

## REACTIVATING THE UNDERUTILIZED SUPPLY CHAIN

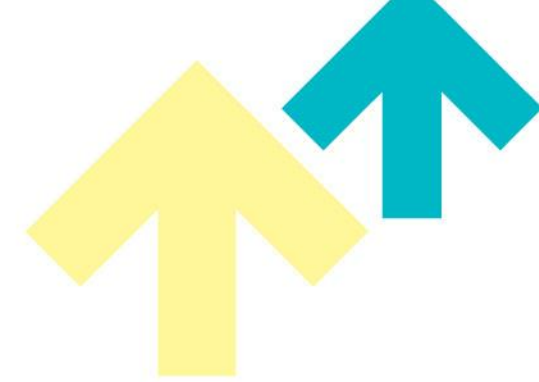


### Manufacturing & Supply Chain Effort



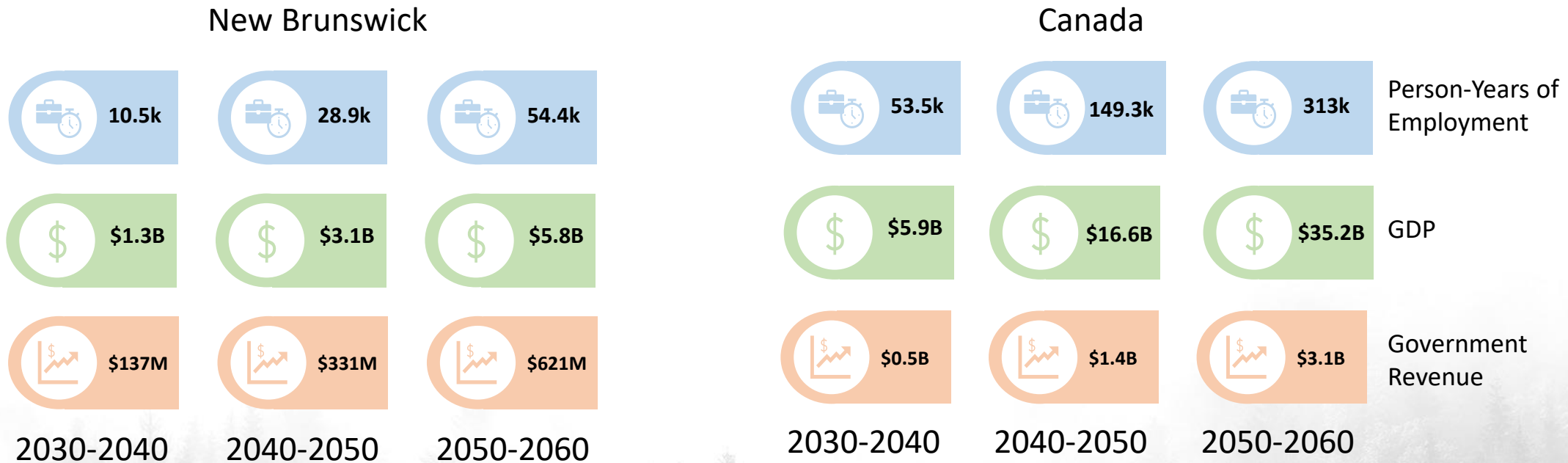
# ARC Nuclear Canada Inc.

REACTIVATING THE UNDERUTILIZED SUPPLY CHAIN



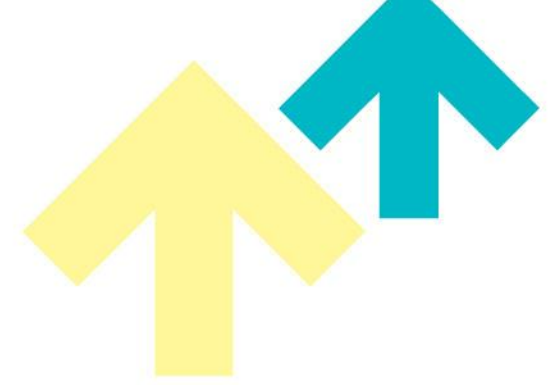
## Nuclear Innovation Cluster Economic Impact

(New Brunswick Outlook for Both Technologies)



Source: NB Small Modular Reactors Pamphlet, 2020





**We look forward to hearing from you!**

Please forward your Contact information and your Company's skill & ability profile to:

Fawn Zeuchner  
Program Manager  
ARC Nuclear Canada Inc.  
Brunswick Square, Suite 1206  
1 Germain Street  
Saint John, NB  
E2L 4V1

**[fzeuchner@arcnuclear.com](mailto:fzeuchner@arcnuclear.com)**

