Darlington New Nuclear Project: Research Report on Financing New Utility Investments

for
The Ontario Energy Board

Docket EB-2025-0297

By

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1 INTRODUCTION

1.1 Summary of Report

The Ontario Energy Board (OEB) staff has asked Christensen Associates Energy Consulting (CA Energy Consulting) to provide a research report that investigates the methods used by utilities and power generators to finance major capital projects. Specifically, the report investigates the extent to which debt issuances have been used to finance new utility capital investments and assets employing first-of-a-kind (FOAK) technology.

This research report provides information to test the statements contained in a report by Polar Star Advisory Services, Inc. (Polar Star) on behalf of Ontario Power Generation Inc. (OPG or "the Company") in Docket EB-2025-0297 regarding the financing options available to the Darlington New Nuclear Program (DNNP). The principle thesis of the Polar Report is that "there is a low to very low probability of a successful offering of investment grade non-recourse bonds within 12-18 months following the in-service date of the first SMR unit for the DNNP Limited Partnership (DNNP LP)" expected to be October 2030.[1] The Polar Star Report supports a request for DNNP LP payment amounts to be set based on a 100% equity funded capital structure. Our research has not found examples of viable nuclear projects (including FOAK nuclear projects) financed with debt, except where debt has been explicitly or implicitly backed by a government entity.

CA Energy Consulting was not asked to provide an opinion on the proposed equity structure for DNNP LP or on any of the matters on which Polar Star opined; rather, the purpose is to provide factual information about historical bond offerings across the industry to provide context for this aspect of the application.

The remainder of the report will be organized as follows:

- Section 2 describes the DNNP.
- Section 3 reviews the statements in the Polar Star report.
- Section 4 explains the research methodology used to assess how utilities finance new capital investments.
- Section 5 presents the research findings.
- Section 6 summarizes our key conclusions and findings.

1.2 Author Background

The primary author of this report is Mr. Nicholas Crowley. Mr. Crowley is a Vice President with CA Energy Consulting. He has provided expert evidence on cost of capital in numerous rate cases both in the United States and internationally. He has also provided expert testimony on incentive regulation and cost allocation in various jurisdictions throughout North America. In Ontario, he

[1] Attachment 3 of Exhibit C-1-1-1, p. 34.

has assisted the OEB with a review of the existing incentive regulation framework for distribution utilities[2] and reviewed Hydro Ottawa's most recent Custom Incentive Regulation proposal.[3]

Prior to joining CA Energy Consulting, Mr. Crowley was an Economist in the Office of Energy Market Regulation at the Federal Energy Regulatory Commission ("FERC"), where he supported updates to the price cap regulation of oil pipelines and the review and evaluation of natural gas pipeline rate cases. In these roles, he worked extensively with utility energy data and financial accounting data used for the development of cost of capital studies. Mr. Crowley has a Bachelor of Science in economics and a Master of Science in economics from the University of Wisconsin-Madison. He is a CFA charterholder and a Certified Rate of Return Analyst. His curriculum vitae can be found in the OEB's Staff Letter dated March 6, 2026.[4]

[2] "Advancing Performance-based Rate Regulation," Ontario Energy Board, EB-2024-0129.

[3] "Evaluation of Hydro Ottawa's Proposed Custom Incentive Regulation Framework," for the Ontario Energy Board, EB-2024-0115, October 14, 2025.

[4] Staff Letter Regarding Expert Evidence, Ontario Energy Board, March 6, 2026.

2 DESCRIPTION OF THE DNNP

2.1 The DNNP Project Summary

DNNP LP is a separate legal entity from OPG in the form of a Special Purpose Vehicle ("SPV"), which exists for the purpose of constructing four new nuclear generating units at the existing Darlington nuclear site, using small modular reactor ("SMR") technology. The project is intended to help meet Ontario's forecast growth in electricity demand using reliable, cost effective and clean energy.[5]

An SMR is a nuclear fission reactor with a smaller generating capacity than traditional large nuclear units and a design intended to be standardized and replicated across multiple installations. SMRs are generally characterized by modular construction techniques that allow for significant off-site fabrications, and simplified plant designs.[6] OPG has selected GE-Hitachi's BWRX-300 Boiling Water Reactor for the DNNP.[7] The BRWX-300 is a 300 MW water-cooled natural circulation SMR, and is an evolution of GE-Hitachi's Economic Simplified Boiling Water Reactor design that incorporates components and fuel designs with prior regulatory and operating experience. The overall plant configuration has not previously been constructed or operated on a commercial scale.[8] As a result, the first DNNP unit is considered a FOAK project.[9] For this reason, our investigation specifically focused on projects using FOAK technology.

2.2 Proposed Financing for the DNNP

Financing for the DNNP has been obtained from multiple sources. In 2022, OPG entered into a $970 million non-revolving term credit facility with the Canadian Infrastructure Bank to fund part of the expenditures required for the first phase of the project, including project design, site preparation, and procurement of long-lead equipment.[10]

Since that time, OPG has created a SPV under the legal name DNNP LP, which is expected to be fully funded with equity financing until at least 12-18 months after the first SMR enters commercial service, expected to be October 2030. In September 2025, OPG entered into an equity commitment agreement with Canada Growth Fund Inc. (CGF) and Building Ontario Fund (BOF), pursuant to which CGF and BOF will acquire minority ownership interests of 15% and 7.5%, respectively, in the DNNP LP.[11] OPG will own the remaining portion of the business. As of

[5] Exhibit A1, Tab 3, Schedule 1, Page 10.

[6] "What are Small Modular Reactors (SMRs)?" International Atomic Energy Agency. https://www.iaea.org/newscenter/news/what-are-small-modular-reactors-smrs

[7] Exhibit A1, Tab 3, Schedule 1, Page 11.

[8] GE Vernova Hitachi. *BWRX-300 General Description. Revision H.* October 2025*.* Also see: https://www.cnsc-ccsn.gc.ca/eng/reactors/new-reactor-power-plant-projects/new-reactor-power-plant-facilities/darlington-new-nuclear-project/.

[9] Exhibit A1, Tab 3, Schedule 1, p. 9.

[10] Exhibit C1, Tab 1, Schedule 2, p. 9.

[11] The applicant stated: "Under the [Equity Commitment Agreements], the Government Agencies will subscribe for partnership equity units of DNNP LP and common shares of DNNP GP, as non-controlling investors. It is anticipated that, during the business plan period, OPG will hold 77.5%, CGF will hold 15.0% and BOF will hold 7.5% of the partnership units of DNNP LP and common shares of DNNP GP, which is

October 2025, the CGF has provided $2 billion and the BOF has provided $1 billion in equity financing subject to the satisfaction of certain conditions. Consistent with the planned financing approach, DNNP has proposed a 100% equity-funded capital structure for DNNP LP.[12]

Ontario Regulation 53/05 provides the statutory framework for recovery of DNNP financing costs during construction. Under section 14(2)5, the DNNP LP revenue requirement includes an amount calculated by multiplying forecast cumulative capital costs incurred in respect of the DNNP by OPG's long-term debt rate.[13] This approach provides a limited but credit-supportive form of concurrent cost recovery (CCR) by allowing recovery of interest costs on Construction Work in Progress (CWIP). The CCR does not provide full recovery of the utility's weighted average cost of capital (WACC), as it allows for cost recovery at a debt rate only, which is generally lower than the cost of equity. While the addition of CWIP to rate base would provide the utility with a revenue component equal to the WACC, the OEB generally does not allow the inclusion of CWIP in rate base.[14]

In addition, Ontario Regulation 53/05 establishes a suite of DNNP-specific variance accounts to manage development, capital cost, and financing differences over time.[15] Section 13 establishes a DNNP Generator Capital Structure Variance Account, which records the difference between the revenue requirement impact of the actual financing and the 100% equity funded capital structure underpinning payment amounts. In particular:

> "Under section 13, the DNNP generator capital structure variance account is established to record differences between the revenue requirement impacts arising from a capital structure and cost of debt reflecting the amount of borrowing incurred by DNNP LP and the amount of the revenue requirement impacts arising from the capital structure and the cost of debt that were included in OEB-approved payment amounts."[16]

reflected in the OEB Application." Exhibit A2-1-1, Attachment 1, p. 2. Also see: Exhibit A1, Tab 4, Schedule 4, December 12, 2025*.* p. 1-3.

[12] Exhibit A1, Tab 4, Schedule 4, p. 7.

[13] Exhibit I1, Tab 1, Schedule 3, Page 3.

[14] "Filing Requirements for Electricity Distribution Cost of Service Rate Applications - 2026 Edition for 2027 Rate Applications," Chapter 2, Ontario Energy Board, December 16, 2025, p. 20.

[15] Exhibit H1 Tab 1 Schedule 1 Page 5

[16] Exhibit A1, Tab 4, Schedule 4, Page 6.

3 SUMMARY OF POLAR STAR EVIDENCE

The Polar Star report provides a description of the DNNP—the technology involved and the project timeline, a summary of the DNNP's proposed ownership structure and financing and regulatory approaches, and a discussion of relevant risk considerations perceived by potential purchasers of bonds issued by DNNP LP during the period between 2027 and 2031. The report concludes that the project poses sufficiently high risk that the DNNP has a "low to very low probability of a successful offering of investment grade non-recourse bonds within 12-18 months following the in-service date of the first SMR unit for the DNNP."[17]

The report states that "inherently unknown FOAK nuclear technology risk is the SPV's biggest risk to raising debt following the Unit 1 in-service date."[18] According to the report, bondholders believe technology risk should be allocated to equity holders, especially during the initial years of operation.[19] This is the primary reason, according to Polar Star, that the SPV will not be able to issue bonds during the construction phase or within 12-18 months after placement into service of the first SMR unit.

Polar Star also lists other risks associated with the DNNP, as follows:

- **Diversification Risk** - The report states that initially, the SPV will operate a single SMR and therefore lack revenue diversity. The report states that "all revenue may be foregone for a period since revenue is based on production."[20]

- **Safety and Security Risk** – The report states that safety risks are unlikely to be a significant area of focus for potential bond investors, though some investors may perceive risks of "cascading failure."[21]

- **Regulatory Risk** - The report states that regulatory risk is not expected to be a significant concern as the OEB is an established regulator with an "acceptable" regulatory track record.[22]

- **Operator Risk** The SPV will contract with OPG to carry out operations of the facilities and OPG has a "lengthy satisfactory track record" of operating nuclear facilities.[23] As such, Polar Star does not expect "potential bond investors to have material concerns about the ability of OPG to carry out its obligations under such contracts from a technical or organizational perspective."[24]

- **Financial Risks** – The report states that the SPV will lose cash flow if the SMRs experience unplanned outages, during which no revenue would be generated.[25]

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[17] Attachment 3 of Exhibit C-1-1-1, p. 34.
[18] Attachment 3 of Exhibit C-1-1-1, p. 16.
[19] Attachment 3 of Exhibit C-1-1-1, p. 15.
[20] Attachment 3 of Exhibit C-1-1-1, p. 18.
[21] Attachment 3 of Exhibit C-1-1-1, p. 18.
[22] Attachment 3 of Exhibit C-1-1-1, p. 20-21.
[23] Attachment 3 of Exhibit C-1-1-1, p. 21.
[24] Attachment 3 of Exhibit C-1-1-1, p. 21.
[25] Attachment 3 of Exhibit C-1-1-1, p. 22.

- **Fuel Supply and other Supply Chain Risk** - The report states that components of the SMRs (e.g., fuel and non-fuel) are sourced globally, introducing some supply chain risk.[26]

Polar Star also provides information on the amount of time required for the SPV to obtain credit ratings and a summary of the bond issuance process. The implication of the Polar Star report is that only a capital structure with 100% equity is feasible for the DNNP until late 2031, at the soonest.

In Exhibit L, C1-Staff-043, however, Polar Star indicates that debt financing could be obtained at an earlier date if credit support mechanisms existed, like government guarantees of the debt issuances:

> "If credit enhancements of the types referred to in part a) of this question were available, debt financing could very likely be raised sooner than "investment grade non-recourse debt." The terms would be based, in part, on the creditworthiness of the counterparty backing the debt (i.e., the external guarantor, off-take support provider, asset pool or corporation/guarantor with a wholly owned asset).
>
> […]
>
> "[A]n example of where the outcome could be determined as more favourable is where a government or government agency (e.g., Federal Government Guarantee of debt of Muskrat Falls project in NL) provides a loan guarantee that permits the issuance of debt at below the rates that would apply to debt financed on the strength of the project alone."[27]

[26] Attachment 3 of Exhibit C-1-1-1, p. 23 & 27
[27] Exhibit L, C1-Staff-043.

4 RESEARCH METHODOLOGY

This study assesses the degree to which utilities and Independent Power Producers (IPPs) leverage debt to fund capital expenditures, with a specific focus on assets employing FOAK technologies. Although IPPs are not directly comparable to DNNP LP for cost of capital purposes,[28] as they generally operate in competitive markets for generation services (whereas DNNP LP will have a regulated payment amount designated by the OEB),[29] such companies generally share the characteristic of owning power generation plant.

Our approach entailed a jurisdictional review of major capital projects within the energy sector. Initially, we focused on major projects in electricity generation projects in North America and Europe. To expand on this research, we subsequently included a review of projects in the Middle East and Asia, as well as two major pipeline projects in North America. We reviewed press releases, news reports, public records, and academic papers to record information related to:

- The type, size (measured in project cost), location, and construction dates of capital projects.
- Whether debt issuances were earmarked for these specific capital projects. We sought to understand whether any form of debt has been used to finance major power generation projects:
    - Secured Debt – e.g., Asset-Backed Securities, which generally carry the lowest risk.
    - Senior Unsecured Debt – e.g., investment grade corporate bonds.
    - Subordinated Debt – e.g., mezzanine tranche debt.
    - "Junk bonds" – generally high yield, speculative debt.
- Whether a government entity provided support for the debt issuances.
- Whether the capital investment was initiated by a stand-alone entity—like a SPV—or as part of the asset portfolio of a larger company—like a utility.
- The relevant company's actual capital structure, if available. A company's actual capital structure reflects the combination of long-term debt and equity used to finance operations and growth. (Whereas authorized capital structure is a regulatory construct used to calculate a company's allowed return.)

We focused on projects completed in the past twenty years (i.e., since 2006). However, we include additional historical information for context, as investors evaluate risk to some extent on the basis of history.

In many cases, we were unable to find complete public information detailing exactly how major capital projects were funded. In the case of utilities, it is often not possible to parse the financing sources for each project, as utilities finance projects with internal capital that is not clearly defined as a certain percentage of debt or a certain percentage of equity. In the case of other energy companies, like IPPs, financial statement information may not be publicly available.

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[28] Exhibit L, C1-SEC-032.

[29] "…IPP companies do not have key regulatory items such as adjustment clauses and cost recovery mechanisms that allow utilities to recover prudently incurred costs in a timely manner and reduce regulatory risk to investors..." Ibid.

5 RESEARCH FINDINGS

5.1 Major Nuclear Projects

Our review of major electricity generation projects did not find any nuclear plant construction projects that were financed partially by any form of debt unless that debt was guaranteed by a separate entity. However, we also did not find many examples of nuclear projects funded solely by equity. In general, government agencies explicitly or implicitly guarantee debt issuances to fund a portion of nuclear construction projects.

Table 1 presents a summary of findings from our research. We present seven attempted nuclear generation construction projects from the past two decades spanning North America, Europe, and the Middle East. The table lists the owner of each project, the kind of nuclear generation technology used, whether the generating units are currently in operation, the years of initial funding and placement into service, whether the project was held as part of a utility's balance sheet—or whether the project was financed as a separate legal entity like a SPV, the total cost of the project, whether it contained FOAK technology, and additional relevant notes.

5.1.1 NuScale SMR: An Abandoned Project

One of these projects, the NuScale SMR "Carbon Free Power Project," was halted after failing to receive sufficient subscriptions from power purchasers.[30] To move forward to construction, the project required local utilities to commit to buying a specific amount of the plant's capacity. NuScale failed to reach the 80% subscription target required to secure debt financing required to continue the project.

Subscriptions for power were abandoned after the cost of the project increased, driven by input price inflation and a rising cost of capital. These cost increases resulted in substantially higher, less competitive forecasted prices for power,[31] despite a subsidy of $30/MWh from the US Inflation Reduction Act incorporated into the contract price.[32]

5.1.2 Special Purpose Vehicles

Two of the projects were developed as SPVs. One, the Barakah Nuclear Energy Plant in Abu Dahbi, was financed under a capital structure of nearly 80% debt. The majority of this debt was issued by the Abu Dhabi Department of Finance.[33]

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[30] *NuScale Power Corporation, SEC Form 8-K*, Filed Nov 8, 2023.

[31] "NuScale Reaches Key Milestone in the Development of the Carbon Free Power Project," January 9, 2023. https://www.nuscalepower.com/press-releases/2023/nuscale-reaches-key-milestone-in-the-development-of-the-carbon-free-power-project.

[32] "Eye-popping new cost estimates released for NuScale small modular reactor," Institute for Energy Economics and Financial Analysis, January 11, 2023. https://ieefa.org/resources/eye-popping-new-cost-estimates-released-nuscale-small-modular-reactor

[33] "Enec Announces 'Formal Closing' Of $24.4Bn Financial Package For Barakah," NUCNET, October 20, 2016. https://www.nucnet.org/news/enec-announces-formal-closing-of-24-4bn-financial-package-for-barakah.

The other, Hinkley Point C in Somerset, England, was financed without any government debt guarantees. Instead, Hinkley Point C was funded entirely by the balance sheets of the corporate owners,[34] Électricité de France (EDF Energy) and China General Nuclear Power Group (known by its subsidiary General Nuclear International, GNI). EDF Energy raised funds for the Hinkley Point C project, in part, by issuing Green Bonds as part of its financing policy.[35] In contrast, GNI, a corporate entity owned by the nation China, relied on state-backed equity for its contribution to the project.[36]

A risk-reducing feature of the Hinkley Point C project was a United Kingdom government-backed contract for differences for the price of electricity sold by the generator. The contract allows for payments to generators to provide increased certainty around revenue levels. Mechanically, the contract established a strike price for electricity (£92.50/MWh in 2012 prices, indexed annually to the Consumer Price Index) such that if the market price falls below the strike price, a private company owned by the UK government (the Low Carbon Contracts Company, LCCC) pays the difference to the generator. If the market price exceeds the strike price, the generator pays the LCCC this difference.[37] The contract for differences reduces risk for the owners by offering an assurance that the relatively high cost, must-run nuclear power will be sold.

5.1.3 Nuclear Projects Financed on Utility Balance Sheets

Four nuclear projects were financed directly by utilities rather than as separate SPVs. Of these, the one U.S. project and one European project issued project-specific debt.

1. **Vogtle Units 3 and 4**, located in Georgia, was a joint venture of four utilities, and the U.S. federal government provided $12 billion in debt guarantees for debt issuances earmarked for construction on these units.[38] These debt guarantees reflect taxpayer liabilities: if the generation plants experience an inability to pay the interest expense on its debt (i.e., default), U.S. taxpayers will be required to provide payment to bondholders. To date, however, no such default has occurred.

2. **Olkiluoto 3**, owned by Teollisuuden Voima Oyj (TVO) and located in Finland, issued approximately €5.4 billion of debt securities and has an equity ratio of 33%.[39] The funding approach for this project followed a Finnish corporate structure called the

[34] That is, the owners financed the projects with parent company cash and debt issuances. The project does not have external creditors.
[35] "EDF announces the success of its senior green multi tranche bond issue for a nominal amount of 2.75 billion euros," EDF, February 26, 2026. https://www.edf.fr/en/the-edf-group/dedicated-sections/journalists/all-press-releases/edf-announces-the-success-of-its-senior-green-multi-tranche-bond-issue-for-a-nominal-amount-of-275-billion-euros, and https://www.edf.fr/en/the-edf-group/dedicated-sections/investors/debt/sustainable-finance.
[36] "Regulation (EC) No. 139/2004 Merger Procedure," European Commission, Case M7850-EDF/CGN/NNB Group of Companies, October 3, 2016.
[37] Department for Energy Security and Net Zero and Department for Business, Energy & Industrial Strategy, September 29, 2016. https://www.gov.uk/government/collections/hinkley-point-c
[38] "DOE Loan Guarantee Program: Vogtle Reactors 3 & 4," Taxpayers for Common Sense, March 21, 2019. https://www.taxpayer.net/energy-natural-resources/doe-loan-guarantee-program-vogtle-reactors-3-4-2/.
[39] Liddle, Brantley, and Peter Sadorsky. 2025. "The Economic and Financial Value of Small Modular Reactors in the Transition to Net Zero." *Energy Policy* 196 (January): 114402. https://www.sciencedirect.com/science/article/pii/S0301421524004026

"Mankala Model," in which shareholders are required to pay the total costs of operations in proportion to their ownership stake.[40] As part of the initial project funding, the French export credit agency Coface provided a credit guarantee for a portion of the debt issuances for this project on the condition that TVO purchased French-manufactured components for the plant.[41] In addition, the Swedish Export Credit Corporation provided a credit guarantee for a portion of the debt.[42] This is the only example of a nuclear project we found that issued debt as part of initial financing with a credit guarantee by an entity other than a national government.

The other two nuclear projects, financed through corporate balance sheet funding, relied on internal cash reserves and general credit facilities rather than project-level debt.

1. The Tennessee Valley Authority ("TVA") financed the **Watts Bar Unit 2** with a combination of internal revenue and debt issuances. TVA is a corporate agency of the U.S. government, which means its bonds have implicit support from the federal government. As explained in Exhibit L C1-EP-016, Concentric Energy Advisors notes that "TVA does not have an authorized equity ratio and does not earn a regulated return on equity […] Instead of setting rates on a rate base/rate of return methodology, TVA's states that it derives its rates from a debt-service coverage rate methodology."[43]

2. Electricite de France's ("EDF") financed the **Flamanville Unit 3** project. This company, EDF, is 100% owned by the government of France, which provides bond investors with a reasonable assurance of support, similar to TVA's implicit support from the U.S. government.

5.2 First-of-a-Kind Nuclear Technology

The review found three projects that employed FOAK technology. We provide a brief summary of the FOAK technology used in each project, as follows:

1. **Olkiluoto 3** –In 2005, TVO began construction on the first European Pressurized Reactor (EPR), a 1650 MWe Pressurized Water Reactor.[44] The EPR provided novel safety systems including a "Core Catcher", in which the units core can cool in an emergency scenario.

2. **Flamanville 3** - EDF started in 2007 to build the first EPR reactor in France (also a 1650 MWe Pressurized Water Reactor).[45] Although construction on this project continued in parallel to Olkiuoto 3, they are both considered FOAK.

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[40] https://www.tvo.fi/en/index/company/finances.html

[41] "EC Olkiluoto Ruling," Nuclear Engineering International, September 28, 2007. https://www.neimagazine.com/news/ec-olkiluoto-ruling/?cf-view.

[42] "The World Nuclear Industry Status Report," World Nuclear Industry Nuclear Status Report, June 11, 2002. https://www.worldnuclearreport.org/The-World-Nuclear-Industry-Status-Report-2009-HTML.

[43] Exhibit L, C1-EP-016.

[44] G. Locatelli, M. Mancini - Looking back to see the future: Building Nuclear Power Plants in Europe, Construction Management and Economics. Vol. 30, No, 2012, pp. 623-637.

[45] Ibid.

3. **Carbon Free Power Project** – This would have been NuScale's first SMR powerplant in the United States. The model promised passive safety systems and modular construction that allowed for most components to be constructed in a factory and installed separately.[46]

In addition, Vogtle Units 3 and 4 were the first and only U.S. deployments of the AP1000 Generation III+ reactor.[47]

[46] "SMR Carbon Free Power Project," Kaysville City. https://www.kaysville.gov/785/SMR-Carbon-Free-Power-Project.
[47] "Plant Vogtle Unit 4 begins commercial operation," US Energy Information Administration, https://www.eia.gov/todayinenergy/detail.php?id=61963.

Table 1: Financing Notes of Recent Nuclear Generation Facilities[48]

PROJECT NAME	UTILITY OWNER	TECHNOLOGY NAME	STATUS	INITIAL FUNDING YEAR	IN SERVICE YEAR	STAND ALONE PROJECT? (E.G., SPV)	CONSTRUCTION COST	FOAK STATUS	FUNDING NOTES
VOGTLE 3 & 4	Georgia Power (45.7%) Oglethorpe Power (30.0%) MEAG Power (22.7%) Dalton Utilities (1.6%)	Westinghouse AP1000	In operation	2009	Unit 3: 2023 Unit 4: 2024	No. But, owned by 4 different utilities.	$36.8 billion	First in U.S.	Financed with: ~$12 billion in federally guaranteed debt, utility equity contributions, and ratepayer funding via CWIP.
HINKLEY POINT C	Électricité de France (66.5%) China General Nuclear Power Group (33.5%)	Areva/Framatome UK European Pressurised Reactor	In progress	2016	Unit 1: 2030 Unit 2: 2031	Yes. Held by NNB Generation Company Ltd.	$46 billion	No.	Funded through EDF and CGN equity. UK Treasury guarantee offered, but equity financing chosen instead.
WATTS BAR UNIT 2	Tennessee Valley Authority	Westinghouse 4-loop PWR with ice condenser containment	In operation	Originally in 1973, resumed in 2007	2016	No. Held on TVA's balance sheet.	$6.1-6.4 billion	No.	TVA debt issued under TVA Act and sold in public capital markets. Not formally federally guaranteed, but implicit support.
OLKILUOTO 3	Teollisuuden Voima Oyj	Areva/Framatome European Pressurised Reactor	In operation	2003	2023	No. Owned directly by TVO.	€11 billion	Yes.	Partially backed debt by French credit agency. Cooperative model for TVO: non-profit where shareholders cover costs and receive electricity at cost.
FLAMANVILLE 3	Electricite de France	Areva/Framatome European Pressurised Reactor	In operation	2007	2024	No. Held directly on EDF balance sheet.	€13.2 billion	Yes.	Fully funded from EDF balance sheet. EDF is nationalized and fully federally owned by France. All debt and equity backed by/from the government.
BARAKAH NUCLEAR ENERGY PLANT	Emirates Nuclear Energy Corporation (82%) Korea Electric Power Corporation (18%)	KEPCO APR-1400	In operation	2009	Unit 1: 2021 Unit 2: 2022 Unit 3: 2023 Unit 4: 2024	Yes. Barakah One PJSC SPV jointly owned by ENEC and KEPCO.	$32 billion	No.	Equity in 82%/18% split from ENEC and KEPCO. Debt backed by Abu Dhabi government.
CARBON FREE POWER PROJECT	Utah Associated Municipal Power Systems (UAMPS)	NuScale VOYGR/NuScale Power Module	FAILED	n/a	Cancelled 11/23, targeted for 2029-2030	Yes. UAMPS owns UACFPP LLC subsidiary at DOE's Idaho National Lab.	$9-10 billion	Yes.	Subscription-based model where UAMPS members subscribed to plant capacity. Did not secure private financing due to insufficient subscriptions. DOE support but no federal debt guarantee.

48 Citations for this table can be found in Appendix 1.

5.3 Other Major Generation Projects

In addition to recent nuclear generation projects, we reviewed several major generation projects, including several projects that contained FOAK technology. Table 2 provides a summary of the findings.

5.3.1 Major Hydroelectric Projects

Three major hydroelectric dams were constructed in Canada in the past decade, two of which (Keeyask Generating Station in Manitoba and Muskrat Falls in Newfoundland and Labrador) were created under SPVs that issued federally backed debt. In the case of Keeyask Generating Station, the SPV is owned in part by Manitoba Hydro and in part by four Manitoba First Nations.[49] The original Muskrat Falls project was owned by Nalcor Energy but is now wholly owned by Newfoundland and Labrador Hydro. Site C, owned by BC Hydro, was entirely funded by debt issuances made by the province of British Columbia.[50] One major hydroelectric dam in China, the Three Gorges Dam, received support from the Chinese government in the form of government-backed debt.

Although none of these projects relied on FOAK technology (the Three Gorges Dam relied on well-established hydroelectric technology,[51] as did the Canadian dams), the projects relied on government guarantees as part of bond issuances. Of these projects, the smallest in terms of total cost was the Keeyask Generating Station, at $8.7 billion.

5.3.2 Projects with FOAK Technology

Of the four projects utilizing FOAK technology, two (Kemper County Energy Facility and Coastal Virginia Offshore Wind) relied on balance sheet funding by the utilities. The Kemper County Energy Facility also obtained funding through the U.S. Department of Energy as part of a clean coal initiative. The Kemper County Energy Facility was ultimately abandoned after cost overruns and technology failures, leading the state regulator to disallow cost recovery for a large portion of the investment.[52] In the case of the offshore wind project, the project owner, Dominion Energy, obtained a specific cost recovery mechanism in the form of a rate rider to recover the costs from ratepayers, which reduced the company's risk.[53]

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[49] Fox Lake Cree Nation, https://foxlakecreenation.com/partnerships/manitoba-hydro-keeyask-limited-partnership.

[50] "Fitch Assigns AA+" IDR to BC Hydro, Stable Outlook," Fitch Ratings, December 19, 2024. https://www.fitchratings.com/research/international-public-finance/fitch-assigns-aa-idr-to-bc-hydro-outlook-stable-19-12-2024.

[51] "Three Gorges Dam and the electric power systems in China," Blekinge Institute of Technology, Ze Fu Yujie Wang, May 25, 2015.

[52] "The Three Factors That Doomed Kemper County IGCC," IEEE Spectrum, June 30, 2017. https://spectrum.ieee.org/the-three-factors-that-doomed-kemper-county-igcc.

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One SPV, SunZia Wind, relied on FOAK technology and issued non-recourse debt. This project mitigated risk through several mechanisms.[54] For example, the project included a 550-mile high voltage direct current line that would ensure the wind farm would be connected to major markets for power. In addition, the company was eligible for substantial tax credits under the Inflation Reduction Act.[55]

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Table 2: Financing Notes of Major Non-Nuclear Generation Projects[56]

Project Name	Utility Owner	Project Type	Technology Name	Status	Initial Funding Year	In Service Year	Stand Alone Project? (e.g., SPV)	Construction Cost	FOAK Status	Funding Notes
Site C	BC Hydro	Hydro-electric	Voith Hydro Francis Turbines	In operation	2014	2025	No.	$16 billion (Canadian)	No.	Debt financed by BC Hydro (No equity).
Keeyask Generating Station	Manitoba Hydro and Four Manitoba First Nations	Hydro-electric	Voith Hydro fixed-blade propeller	In operation	2014	2021	Yes- Manitoba Hydro owns Keeyask Hydropower Limited Partnership	$8.7 billion (Canadian)	No.	KCN partners own 25% equity, 75% financed by provincially backed debt. No federal guarantee.
Muskrat Falls (Lower Churchill)	Nalcor Energy	Hydro-electric	Andritz Francis turbines	In operation	2013	2020	Yes- Muskrat Falls Corporation wholly owns Nalcor SPV	$13.5 billion (Canadian)	No.	Federally guaranteed debt, some equity from Nalcor SPV.
Kemper County Energy Facility	Mississippi Power	Lignite Gasification	Transport Integrated Gasification	FAILED	2006	n/a	No.	$7.5 billion	Yes.	Project funded by utility balance sheet. Included Department of Energy grants.
SunZia Wind	Pattern Energy Group LP via SunZia Transmission, LLC SVP	Onshore Wind	GE Vernova / Hitachi VSC	In progress	2023	2026 (projected)	Yes.	$11 billion	Yes, partially.	Issued $8.8 billion non-recourse debt.
Traverse Wind	Public Service Company of Oklahoma Southwestern Electric Power Company	Onshore Wind	GE 2.X MW	In operation	2019	2022	No.	$1.3 billion	No.	Funded by utility balance sheet.
Coastal Virginia Offshore Wind	Dominion Energy Company (50%) Stonepeak (50%)	Off-Shore Wind	Siemens Gamesa 14MW	In progress	2020	2026	No.	$11.5 billion	Yes, partially.	Funded by utility balance sheet; recovered in a specific rate rider.
Three Gorges Dam	China Three Gorges Corporation (state-owned)	Hydro-electric	700 MW Francis Turbines	In operation	1994	2003	No.	$29 billion	No.	Debt-financed through China Development Bank loans and Three Gorges-specific construction bonds.
Crescent Dunes Solar Energy Project	Tonopah Solar Energy LLC	Solar	Molten salt power tower CSP with thermal storage	FAILED	2011	2015	Yes.	$1 billion	Yes.	Federal loans guaranteed under DOE.
Mountain Valley Pipeline	Equitrans Midstream NextEra Capital Con Edison Transmission WGL Midstream RGC Resources	Natural Gas Pipeline	303-mile natural gas pipeline	Existing	2014	2024	Yes.	$7.85 billion	No.	Debt financed but not federally guaranteed.
Atlantic Coast Pipeline	Dominion Energy (53%) Duke Energy (47%)	Natural Gas Pipeline	600-mile natural gas pipeline	FAILED	2014	n/a	Yes.	$8 billion	No.	Debt financed by SPV. No federal guarantee on debt.

[56] Citations for this table can be found in Appendix 1.

6 CONCLUSION

Our review of major electricity generation projects did not find any nuclear plant construction projects that were financed partially by debt unless that debt was guaranteed, either explicitly or implicitly, by a separate entity. Two nuclear projects were owned by non-government corporate entities but received government debt guarantees (Vogtle and Barakah); three were at least partially owned by government-owned entities (Hinkley Point, Watts Bar Unit 2, and Flamanville 3); one (Olkiluoto) was supported by external credit agencies—but the primary guarantor of the debt (Areva NP) was 90% owned by the French government. These findings indicate that recent nuclear projects generally obtained financial support in some capacity from national governments.

We did not find any examples of viable nuclear projects funded solely by equity. All nuclear generation facilities, except the NuScale SMR Carbon Free Power Project (which was discontinued), funded part of the project with debt. In general, government agencies explicitly or implicitly guarantee debt issuances to fund a portion of nuclear construction projects.

Among non-nuclear power generation projects, only one, SunZia Wind, incorporated FOAK technology and issued non-recourse debt. This project differs from DNNP LP in that it was a wind project with more limited exposure to FOAK technology. Other projects with FOAK technology were funded by utility company balance sheets. Major hydroelectric projects in Newfoundland and Labrador, British Columbia, and Manitoba were financed at least partially with debt backed by provincial governments.

Among the six recent viable nuclear projects surveyed, DNNP LP's proposed capital structure is unique in that it does not propose to finance initial construction or operations with any debt, targeting an equity ratio of 100%. Even nuclear projects incorporating FOAK technology in other jurisdictions issued debt, although certain guarantees accompanied this debt. DNNP LP's proposed capital structure could also be considered unique among major utility infrastructure projects in Canada more generally, as major hydroelectric generation projects constructed in the past decade have employed debt financing.

APPENDIX 1: SOURCES FROM TABLES

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