Technology Collaboration Programme
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International Energy Agency
Photovoltaic Power Systems Programme

Task 1 Analysis & Outreach

PVPS

National Survey Report of PV Power Applications in Canada

2024

Natural Resources Canada | Ressources naturelles Canada

Canadian Renewable Energy Association | Association canadienne de l'énergie renouvelable
WIND. SOLAR. STORAGE. | ÉOLIEN. SOLAIRE. STOCKAGE.

What is IEA PVPS TCP?

The International Energy Agency (IEA), founded in 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD). The Technology Collaboration Programme (TCP) was created with a belief that the future of energy security and sustainability starts with global collaboration. The programme is made up of 6 000 experts across government, academia, and industry dedicated to advancing common research and the application of specific energy technologies.

The IEA Photovoltaic Power Systems Programme (IEA PVPS) is one of the TCP's within the IEA and was established in 1993. The mission of the programme is to "enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems." To achieve this, the Programme's participants have undertaken a variety of joint research projects in PV power systems applications. The overall programme is headed by an Executive Committee, comprised of one delegate from each country or organisation member, which designates distinct 'Tasks,' that may be research projects or activity areas.

The 28 IEA PVPS participating countries are Australia, Austria, Belgium, Canada, China, Denmark, Finland, France, Germany, India, Israel, Italy, Japan, Korea, Lithuania, Malaysia, Morocco, the Netherlands, Norway, Portugal, South Africa, Spain, Sweden, Switzerland, Thailand, Türkiye, the United Kingdom and the United States of America. The European Commission, Solar Power Europe and the Solar Energy Research Institute of Singapore are also members.

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What is IEA PVPS Task 1?

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of PV power systems. Task 1 activities support the broader PVPS objectives: to contribute to cost reduction of PV power applications, to increase awareness of the potential and value of PV power systems, to foster the removal of both technical and non-technical barriers and to enhance technology cooperation. An important deliverable of Task 1 is the annual "Trends in photovoltaic applications" report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the country National Survey Report for the year 2024. Information from this document will be used as input to the annual trends in photovoltaic applications report.

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COVER PICTURE

A 4.8 MW community-owned PV array in Mahone Bay, Nova Scotia, which is part of the province's Community Solar Program that facilitates shared ownership of PV projects. Partly funded by the Government of Canada and developed by AREA (photo credit: Goldbeck Solar).

INTERNATIONAL ENERGY AGENCY

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1 INSTALLATION DATA

The PV power systems market is defined as the market of all nationally installed PV applications with a PV capacity of 40 W or more. A PV system consists of modules, inverters, batteries and all their installation and control components. Other applications such as small mobile devices are not considered. In this report, PV installations are included in the 2024 statistics if the PV modules were installed and connected to the grid between January 1st and December 31st, 2024.

1.1 Applications for photovoltaics

This report examines grid-connected PV systems encompassing ground mounted utility-scale, rooftop residential, commercial and industrial arrays, and in some cases their combination with battery energy storage systems (BESS). By contrast, the amount of off-grid capacity is considered negligible and is not tracked. However, off-grid hybrid PV applications, combining PV with a small wind turbine or diesel generator, are becoming more common in remote northern communities. Installation capacity data for floating PV, agrivoltaic systems, building-integrated PV (BIPV), building-added PV (BAPV), and vehicle-integrated systems (VIPV) are not tracked.

Table 1. While the definition of what constitutes a small (distributed) or a large (centralized) PV system varies by province and territory, approximately 68% of Canada's PV capacity is centralized. Ontario and Alberta represented approximately 53% and 37% of Canada's total cumulative PV capacity in 2024, respectively. The remaining 10% capacity was located primarily in British Columbia, Nova Scotia, Saskatchewan, and Prince Edward Island.

1.2 Total PV power installed

The cumulative national installed PV capacity at the end of 2024 was 5.29 GW_{AC}. The PV capacity for 2023 was revised downwards, to 5.04 GW_{AC}, reflecting new net metering data from the Ontario Energy Board which was not available when the previous report was written. Comparing to the revised total for 2023, PV growth in 2024 was approximately 5%, corresponding to around 248 MW_{AC}.

Table 1 summarizes Canada's centralized and decentralized PV capacity. Centralized PV installations, by definition, have no self-consumption and only inject electricity to the grid. Distributed PV, by contrast, allows self-consumption. Centralized PV capacity was mostly located in Ontario (1811 MW_{AC}) and Alberta (1663 MW_{AC}). Data were collected by contacting local utilities or by accessing reports on contracted electricity supply. Respondents were requested to divide their installation data into centralized and decentralized systems. Data collection timelines, reporting methods (publicly available versus private), and the level of detail reported by utilities for PV capacity varies by province and territory. The uncertainty in the historical country-wide total is expected to be ±3% when reporting in megawatt-AC, whereas uncertainty will be greater for DC figures due to assumptions made for the AC/DC conversion coefficients. The uncertainty for provincial PV capacity figures is lowest in Alberta and Ontario which communicate aggregated renewable energy totals in monthly and quarterly reports that are publicly available. Uncertainty for PV data in other provinces and territories varies but may, in some cases, be above the 3% margin due to different reporting standards for 141 electric utilities in operation across the country.

Table 1: Annual PV power installed during calendar year 2024

Data rounded to the nearest MW		Installed PV capacity in 2024 [MW]	AC or DC
	Decentralized	223	AC
	Centralized	24	AC
	Off-grid	Not tracked	AC
	Total	248	AC

The data collection process is described in Table 2. Canada's PV capacity data are mostly reported by provincial utilities in AC format. For 2021, and all years prior, AC data were converted to DC using an AC/DC ratio of 0.85. Beginning in 2022, this was changed to 0.67 to better reflect utility-scale system performance. The coefficient is based on the 465 MW_{AC} / 692 MW_{DC} Travers PV array in Alberta, which is assumed to be a good representation of a typical commercial array. Beginning in 2024, a two-tiered approach was applied using 0.67 for centralized systems and 0.85 for distributed arrays.

Table 2: Data collection process

Data collection category	Data collection methodology
If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	PV capacity data in this report are in AC. To convert from AC to DC, conversion coefficients of 0.67 and 0.85 were used for centralized or distributed arrays, respectively.
Is the collection process done by an official body or a private company/Association?	Data were collected by the Government of Canada, the Canadian Renewable Energy Association, and Rematek Energy Inc.
Link to official statistics (if this exists)	Statistics Canada and see works cited

Table 3 summarizes the centralized versus distributed PV power capacity between 2010 and 2024. Centralized PV systems are typically ground-mounted, provide bulk power, and exist on the supply side of electricity meters. They inject electricity and do not allow self-consumption. In this report, centralized PV systems are defined as having power capacity greater than 500 kW_p and may be connected to either the distribution grid or transmission grid. By contrast, distributed PV systems are connected to the distribution network, are on the demand side of the electricity meter, and are often embedded on a customer's premises allowing for self-consumption. Distributed systems may be located on residential or commercial buildings and can be further categorized as BIPV or BAPV depending on whether or not the modules replace building cladding materials.

Table 3: Cumulative installed PV power in 3 sub-markets.

Year	Off-grid [MW_{AC}] (including large hybrids)	Grid-connected distributed [MW_{AC}]	Grid-connected centralized [MW_{AC}]	Total [MW_{AC}]	Total [MW_{DC}]
2010	51	23	164	238	281
2011	51	111	311	474	558
2012	-	185	465	651	765
2013	-	232	796	1 028	1 210
2014	-	459	1 106	1 566	1 843
2015	-	625	1 515	2 140	2 518
2016	-	673	1 590	2 264	2 664
2017	-	787	1 705	2 492	2 932
2018	-	924	1 706	2 630	3 094
2019	-	1 001	1 825	2 827	3 326
2020	-	1 114	1 953	3 067	3 609
2021	-	1 176	2 676	3 853	4 533
2022	-	1 303	3 019	4 323	6 040
2023	-	1 494	3 547	5 041	7 052
2024	-	1 718	3 572	5 290	7 351

Figure 1 shows the installed capacity by province and territory for grid-connected PV power and the number of utility-interconnected PV systems as of December 31, 2024.

Table 4 provides national figures on power generation and electricity demand as well as an estimate of total PV energy production. Total energy generation capacity for 2024 was calculated using Statistics Canada's annual electricity generation estimates [1]. Total electricity demand was estimated from the Canadian Energy Regulator's report on Energy Futures and Statistics Canada's supply and demand figures for primary and secondary energy [2]. To estimate PV energy production, the total power (MW_{DC}) was multiplied by the average yearly Canadian PV potential which was assumed to be 1 150 kWh/kW_p. The average PV potential was determined using satellite-based insolation data and a conservative performance ratio of 75% [3].

Figure 1: Map showing the PV power capacity (MW_{AC}) and number of installed systems for the provinces and territories. The total number of installed systems across the country is estimated to be 107 837.

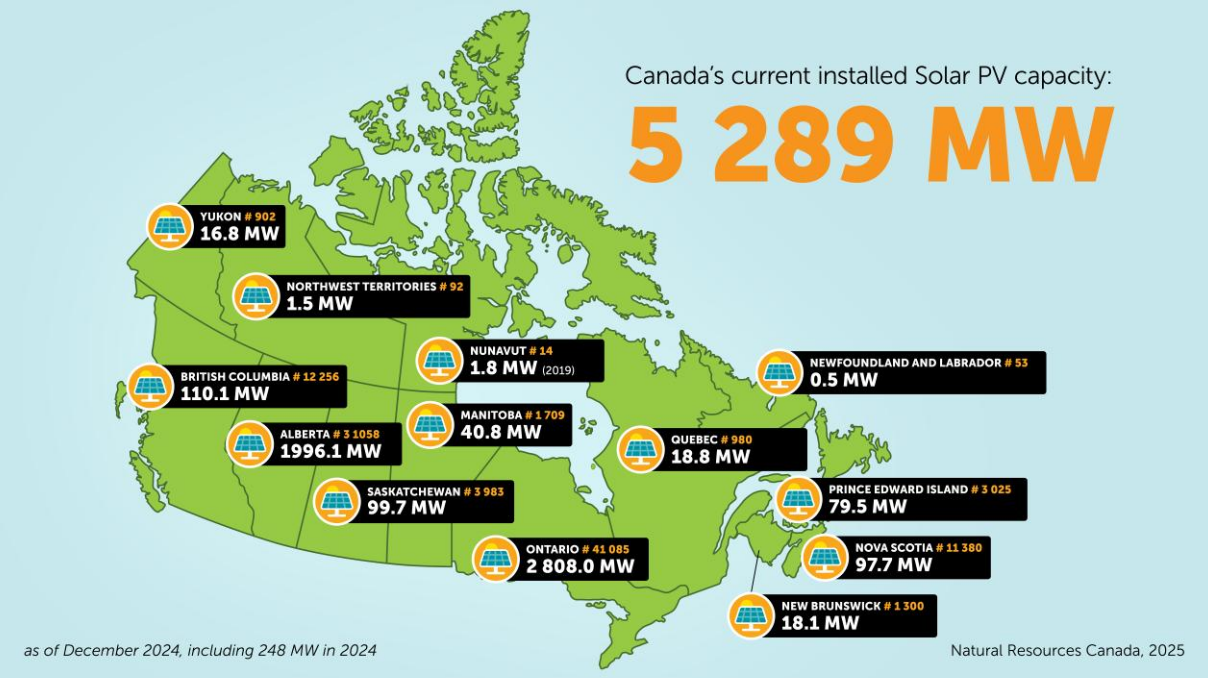

Table 4: PV power and the broader national energy market

	2024	2023
Total power generation capacities [TWh]	610	620
Total renewable power generation capacities (including hydropower) [TWh]	388	408
Total electricity demand [TWh]	597	594
Estimated total PV electricity production (including self-consumed PV electricity) [TWh]	8.45	8.11
Total PV electricity production as a percentage of total electricity consumption	1.42	1.37
Average yield of PV installations (kWh/kW_p)	1 150	1 150

1.3 Key enablers of PV development

Key enablers refer here to heat pumps and electric vehicles; technologies that are complementary to PV or which directly support its deployment. Other enabling technology, such as the deployment of home energy management systems, hybrid inverters, and stationary energy storage applications, are not tracked. Decentralized storage and electric cars, buses, and trucks can increase a grid's hosting capacity and provide storage. There were approximately 271 228 electric vehicles purchased in Canada in 2024, consisting of both battery-electric and plug-in hybrids [4]. In terms of centralized storage, although PV battery energy storage system data are not publicly available, work is underway to track these installations. Additional storage capacities are available as pumped hydro and compressed air. Most projects are utility-scale and behind-the-meter storage which are connected to the transmission or distribution grid [5].

Table 5: Information on key enablers

	Description	2024 Volume	Total Volume	Source
Residential heat pumps [# of units sold]	Linear growth assumption	21 200	923 800	Canada Energy Regulator [6]
Electric cars [# of units sold]	BEV + PHEV	271 228	833 680	Statistics Canada [4]

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

There was, in 2024, an overall excess of PV supply compared to demand which led to a continued decrease in module prices for most manufacturers. In some cases, module prices even fell below the cost of production, leading to consolidation among large manufacturers. Module prices vary by producer and technology type but can be divided into the following categories:

- Standard high efficiency modules using TOPCon (Tunnel Oxide Passivated Contact), SHJ (Silicon Heterojunction), or IBC (Interdigitated Back Contact) cell types with efficiencies exceeding 21%.
- Older module inventory, no longer in production, consisting of mono or multicrystalline silicon using PERC (Passivated Emitter Rear Contact) cell architecture with efficiency usually less than 21%.

The Canadian market mirrors global trends. The industry has entirely shifted from monofacial to bifacial, from PERC towards TOPCon and SHJ cells, and from full to half-cut cells. Table 6 shows wholesale price estimates with value-added taxes excluded.

Table 6: Typical module prices

Year	Lowest price of a standard module crystalline silicon [CAD/W]	Highest price of a standard module crystalline silicon [CAD/W]	Typical price of a standard module crystalline silicon [CAD/W]
2019	0.50	0.74	0.62
2020	0.40	0.74	0.44
2021	0.41	0.78	0.46
2022	0.45	0.80	0.63
2023	0.41	0.52	0.46
2024	0.30	0.50	0.40

2.2 System prices

Although module prices were reduced in 2024, overall system prices in Canada remained similar to the previous year due to an increase in the cost of aluminium/steel racking components. PV system prices, shown in Table 7 and

Table 8, incorporate the cost of modules, racking, inverters, other balance-of-system components, and installation. Prices do not include recurring charges after installations such as inverter replacement or other operation and maintenance activities. Additional costs incurred due to the remoteness of a site, or any specialized installation requirements, are not considered. Value-added taxes are excluded.

Table 7: Turnkey PV system prices for different PV systems sizes

Category/Size	Typical applications	Current prices [CAD/W]
Off-grid 1 – 5 kW	A stand-alone PV system that generates electricity for a device or a household and is not connected to the grid.	Not tracked
Residential BAPV 5 – 10 kW	A grid-connected, roof-mounted, or distributed PV system that produces electricity for grid-connected households. May include balcony solar.	2.30 – 3.90
Residential BIPV 5 – 10 kW	A grid-connected, roof-mounted, or distributed PV system that produces electricity for grid-connected households. The PV system replaces the building cladding material and may include PV roofing tiles or balcony solar.	Not tracked
Small commercial BAPV 10 – 100 kW	A grid-connected, roof-mounted, distributed PV system that produces electricity for grid-connected commercial buildings, such as public buildings, multi-family houses, agricultural buildings, grocery stores, etc.	2.00 – 3.20
Small commercial BIPV 10 – 100 kW	A grid-connected, building integrated, distributed PV system that produces electricity for grid-connected commercial buildings, such as public buildings, multi-family houses, agricultural buildings, grocery stores, etc.	Not tracked
Large commercial BAPV 100 – 250 kW	A grid-connected, roof-mounted, distributed PV system that produces electricity for grid-connected large commercial buildings, such as public buildings, multi-family houses, agricultural buildings, grocery stores, etc.	1.90 – 2.40
Large commercial BIPV 100 – 250 kW	A grid-connected, building integrated, distributed PV system that produces electricity for grid-connected commercial buildings, such as public buildings, multi-family houses, agricultural buildings, grocery stores, etc.	Not tracked
Industrial BAPV > 250 kW	A grid-connected, roof-mounted, distributed PV system that produces electricity for grid-connected industrial buildings, warehouses, etc.	1.68 – 2.22
Small centralized PV 1 – 20 MW	A grid-connected, ground-mounted, centralized PV system that works as a central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	1.65 – 1.90
Large centralized PV > 20 MW	A grid-connected, ground-mounted, centralized PV system that works as a central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	< 1.31

Table 8: National trends in system prices for different applications

Year	Residential BAPV Grid-connected, roof-mounted, distributed PV system 5 – 10 kW [CAD/W]	Small commercial BAPV Grid-connected, roof-mounted, distributed PV systems 10 – 100 kW [CAD/W]	Large commercial BAPV Grid-connected, roof-mounted, distributed PV systems 100 – 250 kW [CAD/W]	Centralized PV Grid-connected, ground-mounted, centralized PV systems 10 – 50 MW [CAD/W]
2019	2.50 – 2.75	1.80 – 2.50	1.80 – 2.00	1.25
2020	2.40 – 2.70	1.80 – 2.25	1.60 – 2.00	1.25
2021	2.50 – 2.83	1.89 – 2.36	1.68 – 2.10	1.31
2022	2.42 – 2.82	2.07 – 2.71	2.22 – 2.50	1.31
2023	2.30 – 3.90	2.00 – 3.20	1.90 – 2.40	1.31
2024	2.30 – 3.90	2.00 – 3.20	1.90 – 2.40	1.31

2.3 Cost breakdown of PV installations

The cost breakdown of a typical 5 – 10 kW roof-mounted, grid-connect, distributed PV system on a residential single-family house is presented in Table 9.

The cost structure presented does not rationalize for volume and is from the customer's point of view without reflecting the installer companies' overall costs and revenues. The “average” category in Table 9 represents the average cost for each cost category and is the average of the typical cost structure. The average cost is taking the whole system into account and summarizes the average end price to customers. The “low” and “high” categories are the lowest and highest cost reported in each segment. These costs are individual posts, i.e. summarizing these costs does not give an accurate system price.

Table 9: Cost breakdown for a grid-connected roof-mounted, distributed residential PV system of 5 – 10 kW

Cost category	Average [CAD/W]	Low [CAD/W]	High [CAD/W]
Hardware			
Module	0.40	0.30	0.50
Inverter	0.40	0.30	0.75
Mounting material	0.50	0.41	1.05
Other electronics (cables, etc.)	0.10	0.09	0.11
Subtotal Hardware	1.40	1.10	2.41
Soft costs			

Planning	-	-	-
Installation work	1.00	0.9	1.10
Shipping and travel expenses to customer	-	-	-
Permits and commissioning (i.e. cost for electricians, etc.)	0.13	0.1	0.15
Project margin	0.22	0.20	0.24
Subtotal Soft costs	1.35	1.20	1.49
Total (without VAT)	2.75	2.30	3.90

2.4 Financial parameters and specific financing programs

Financing from institutional lenders is available for projects, or portfolios of projects, that meet certain financial thresholds. There are fewer financing options for residential and small commercial projects, but the number of options for low-cost capital is growing.

To some degree, the financing of large utility-scale PV projects is specific to the power production paradigm of each province and territory encompassing the regional complexities of generation, distribution, supply, and demand. Some provincial grids may be operated by a single large vertically integrated utility, such as in the province of Quebec, whereas others may be partially publicly owned and privatized subject to varying degrees of deregulation and marketization, such as the province of Ontario. As marketization of a grid proceeds, the business of generation may become decoupled from the infrastructure of distribution and transmission. What this may mean for large-scale PV systems, in some scenarios, is volatility in electricity prices and difficulty in predicting the expected profits, or bankability, of a project selling into a wholesale market. Since uncertainty can be anathema to some institutional lenders and banks, and most PV projects are predominantly funded using a mix of debt and equity, the financing environment for large-scale PV projects may be particularly challenging in the absence of countervailing measures to hedge against risk.

2.5 Specific investment programs

As outlined in Section 3, there are a variety of investment mechanisms across the country to support PV development. Additional details are provided in Table 10.

Table 10: Summary of existing investment schemes

Investment Schemes	Additional Information
Third-party ownership (no investment)	Third-party ownership and leasing services were a common financing mechanism for residential PV under Ontario's feed-in tariff (FIT) program. Third-party ownership models for net metering

	are common in Alberta and Nova Scotia and were included as an option in Ontario in 2022.
Renting	Several companies offered rented systems in Canada in 2024. However, leasing is more common.
Financing through utilities	No utilities offered PV on-bill financing in 2024.
Community investment in PV plants	Several PV energy cooperatives have been incorporated to facilitate investment in and ownership of these systems. Nova Scotia's new community solar program, referred to as the "Solar Garden" pilot project, has been highly successful in democratizing PV investment.
International organization financing	The Green Energy Investment Agreement (GEIA), initiated in 2010, mandated investment and cooperation between the Government of Ontario, Samsung, and the Korea Electric Power Corporation.

2.6 Additional country information

Canada's electricity sector is provincially and territorially regulated and comprised primarily of vertically integrated crown corporations or investor-owned utilities with a deregulated energy-only market system. Electricity demand in Canada was estimated to be 594 TWh in 2024 with the largest producers of electricity being the provinces of Quebec, Ontario, British Columbia, and Alberta.

Table 11: Electricity prices in 2024 by sector, including taxes, averaged across Montreal, Calgary, Charlottetown, Edmonton, Halifax, Moncton, Ottawa, Regina, St. John's, Toronto, Vancouver, and Winnipeg. [7]

Retail electricity prices for a household (consumption: 1 000 kWh) [¢/kWh]	9.25 (lowest) 18.12 (average) 25.18 (highest)
Retail electricity prices for a commercial mid-power company (power demand: 1 000 kW, load factor: 56%) [¢/kWh]	9.29 (lowest) 14.89 (average) 19.37 (highest)
Retail electricity prices for an industrial large-power company (power demand: 5 000 kW, load factor: 85%) [¢/kWh]	6.59 (lowest) 11.20 (average) 14.60 (highest)

3 POLICY FRAMEWORK

This chapter describes the support policies aiming to drive the development of PV. As shown in table Table 12, PV policies may, for example, address the upfront capital costs to produce or install PV systems, provide a source of revenue from the energy generated, or alter the regulatory environment in which these systems operate.

Table 12: Summary of PV support measures. The FIT program, although cancelled, continues to function according to, in many cases, 20-year contractual obligations.

Category	Residential		Commercial + Industrial		Centralized	
Measures in 2024	**On-going**	**New**	**On-going**	**New**	**On-going**	**New**
Feed-in tariffs	yes	-	yes	-	yes	-
Feed-in premium (above market price)	-	-	-	-	-	-
Capital subsidies	yes	-	yes	-	-	-
Green certificates	-	-	-	-	-	-
Renewable portfolio standards with/without PV requirements	-	-	-	-	-	-
Income tax credits	-	-	-	-	-	-
Self-consumption	yes	yes	yes	yes	-	-
Net-metering	yes	yes	yes	yes	-	-
Net-billing	yes	yes	yes	yes	-	-
Collective self-consumption and delocalized net-metering	yes	yes	-	-	-	-
Sustainable building requirements	-	-	-	-	-	-
BIPV incentives	-	-	-	-	-	-
Merchant PV facilitating measures	-	-	-	-	-	-
Other (specify)	-	-	-	-	-	-

3.1 National targets for photovoltaics

There are currently no PV installation or manufacturing capacity targets set by the federal, provincial, or territorial governments.

3.2 Direct support policies for PV installations

3.2.1 Federal commitments

Launched in 2021, the Smart Renewables and Electrification Pathways Program provides $4.5 billion over fifteen years to support renewable capacity, energy storage, and grid modernization projects [8]. There is also the Accelerated Capital Cost Allowance (ACCA) and the Canadian Renewable and Conservation Expense (CRCE) tax incentive [9]. Beginning in 2023, two federal support mechanisms for PV and other low-carbon technologies were implemented: the Clean Technology Investment Tax Credit and the Clean Technology Manufacturing Investment Tax Credit. Both provide a corporate tax refund equivalent to 30% of the cost of capital investment for a PV system or the cost of machinery for PV manufacturing initiated between March 28, 2023, and December 31, 2034 [10].

3.2.2 Solar PV support measures by province and territory

Support measures for residential or small commercial and industrial PV systems can be divided into 1) solar incentives such as tax breaks and rebates, 2) utility policies such as electricity time-of-use pricing, net metering, interconnection fees, and 3) system financing options such as low-interest loans, the Property Assessed Clean Energy (PACE) programs, or on-bill financing. PACE programs allow the system cost to be repaid through property taxes. The average cost per installed watt for each jurisdiction is given in

Table 13. However, these prices are only an approximate guide and are dependent on system size, choice of installer, and additional market factors In some cases, rebates for PV are bundled with support measures for co-located BESS. For example, British Columbia's utility provides a maximum $5 000 rebate ($1 000/kW) for residential PV systems combined with a $5 000 rebate for battery storage ($500/kWh) [11]. One interesting PV option available in Ontario from the IESO is third-party ownership. This allows homeowners and other generators to benefit from net metering without having to cover the costs of installing or owning the PV asset. Another example of a helpful measure is the updated commercial net metering program in Nova Scotia which raised the self-generation capacity limit from 100 kW to 1 MW [12].

Table 13: Summary of support measures by province and territory. Average electricity cost is based on a consumption of 1000 kWh per month. Average system cost is based on a 7.5 kW array.

Province or territory	Solar incentives	Average electricity cost (¢/kWh)	System cost (CAD/W)
Alberta	City-specific support measures	25.8	2.60 – 3.27
British Columbia	7% Provincial tax exemption for all PV equipment, district and city-specific support measures	11.4	2.52 – 3.17
Manitoba	$0.5/W rebate up to $5 000, loan of up to $20 000 over 15-year term	10.2	2.72 – 3.42
New Brunswick	$0.2/W rebate	13.9	2.89 – 3.64

Newfoundland and Labrador	None	14.8	3.86 – 4.85
Northwest Territories	50% rebate (only for off-grid and non-hydro)	41.0	3.00 – 3.77
Nova Scotia	$0.3/W rebate up to $3 000, PACE loan with 10-year term	18.3	2.51 – 3.16
Nunavut	50% rebate up to $30 000	35.4	3.86 – 4.85
Ontario	PACE loan up to $125 000 repaid over 5 to 20 years	14.1	2.42 – 3.05
Prince Edward Island	$1.0/W rebate up to $10 000, PACE loan up to $40 000 repaid over 15 years	18.4	2.98 – 3.75
Quebec	None	7.8	2.65 – 3.33
Saskatchewan	PACE loan to $60 000 repaid over 20 years	19.9	2.88 – 3.63
Yukon	$0.8/W rebate up to $5 000 (only for off-grid)	18.7	3.02 – 3.80

3.2.3 BIPV development measures

There are currently no policies to support BIPV either provincially or federally.

3.3 Self-consumption measures

Table 14: Summary of self-consumption regulations for residential PV systems in 2024

Self-consumption regulations and characteristcs			Regional scope of regulation or policy
PV self-consumption	1	Right to self-consume	Throughout Canada
	2	Revenues from self-consumed PV	Applied as credits or monetarily depending on the jurisdiction
	3	Charges to finance Transmission, Distribution grids & Renewable Levies	Offset in some instances, paid in others depending on the jurisdiction
Excess PV electricity	4	Revenues from excess PV electricity injected into the grid	Applied as credits or monetarily depending on the jurisdiction
	5	Maximum timeframe for compensation of fluxes	Most typically one year

	6	Geographical compensation (virtual self-consumption or metering)	Typically uniform within a jurisdiction
Other characteristics	7	Regulatory scheme duration	Various, depending on jurisdiction
	8	Third-party ownership accepted	Various, depending on jurisdiction
	9	Grid codes and/or additional taxes/fees impacting the revenues of the prosumer	Various, depending on jurisdiction
	10	Regulations on enablers of self-consumption (storage, DSM…)	Various, depending on jurisdiction
	11	PV system size limitations	Various, depending on jurisdiction
	12	Electricity system limitations	Various, depending on jurisdiction

3.4 Collective self-consumption, community solar and similar measures

Measures for collective self-consumption (e.g. PV systems for several apartments in the same building), virtual net-metering (allowing consumption and production in different places), and community solar (investment by private or public organizations) are rare. There are, however, several community-owned PV systems in British Columbia and Nova Scotia, whereby members invest on a per-panel basis and may receive a proportional credit on their hydro bill or be paid an annual dividend [13] [14]. In Ontario, the IESO is developing several virtual net-metering demonstration projects [15].

3.5 Tenders, auctions & similar schemes

Procurement methodologies include standard offer, bilateral negotiations, and competitive bid. However, in the coming years, most jurisdictions will likely use competitive procurement. Solar PV contract periods are generally awarded for 20 years. The way in which incentives are paid in Canada varies by region. Programs are funded through revenues from carbon pricing programs or provincial and municipal taxes.

3.6 Other utility-scale measures including floating and agricultural PV systems

There are currently no support measures or policy framework for floating PV or agrivoltaics. However, the not-for-profit Agrivoltaics Canada association [16] provides a bridge between farmers, PV installers, academia, and provincial and federal funding organizations. Agrivoltaics Canada advocates for provincial policy support and changes in land-use designations to stimulate the deployment of PV systems on farmland. The first agrivoltaic projects are likely to receive public funding in Ontario and Alberta to de-risk demonstration arrays with different crops and provide confidence to farmers.

3.7 Social policies

In terms of PV policy, support measures are largely left to the provinces and territories to define. However, as stated previously, PV projects are eligible for several national support programs announced by the Federal Government, including the $500 million Low Carbon Economy Challenge Fund, the $100 million Smart Grid Program, the $520 million Clean Energy for Rural and Remote Communities program, the $4.5 billion Smart Renewables and Electrification Pathways program, and various tax incentive programs for industry [9]. For corporations, there is also the Clean Technology Investment Tax Credit and the clean Technology Manufacturing Investment Tax Credit described in subsection 3.2.1.

3.8 Indirect policy issues

3.8.1 Rural electrification measures

Canada has approximately 300 off-grid communities with a total population of around 200 000 people. There is a transition in these communities from diesel to renewable energy supported by the $520 million Clean Energy for Rural and Remote Communities Initiative. A Federal Government initiative studying PV system performance, cost, and durability north of the 60th parallel, also provides funding for the monitoring of PV arrays in remote communities.

3.8.2 Support for electricity storage and demand response measures

Ontario's Smart Grid Fund has resulted in several PV projects with electricity storage. The Federal Government's Smart Grid program, started in 2018, supports combined solar and BESS. Other measures were outlined in the 2020 federal policy update [17].

3.8.3 Support for encouraging social acceptance of PV systems

There are currently no programs at the national or regional level to study or encourage the social acceptance of PV systems.

3.9 Financing and cost of support measures

PV projects may be directly subsidized by reducing the upfront capital cost on the residential side using rebates and at the utility-scale side using investment tax credits, feed-in tariffs, or private or government-backed power purchase agreements (PPA) which may be an alternative to the merchant risk accrued by selling directly into the spot market. Over the past few years, governments in several countries have faced both financial and political pressures due to the cost of certain FIT programs. If the FIT is too low, project deployment is sluggish due to a lack of private capital. But if the FIT is too high, a glut of projects can quickly lead to overcapacity and expensive payouts to system owners. To control FIT costs, there has been a shift in some jurisdictions towards competitive bidding and auctions.

As a hedge against volatile electricity prices, some project owners favour PPAs to sell electricity at an agreed upon rate for a fixed period directly to a corporate entity. While a PPA can improve the bankability of a PV project, there are often many bidders interested in winning a small number of contracts. In the PV power supply sector, the barriers to entry are relatively small, compared to fossil-based generators, leading to fierce competition among project proponents. This intense competitive pressure from a variety of renewable energy bidders, while driving down electricity prices for the consumer, can also sometimes compete away potential profits that could be gained from a reduced LCOE. If the costs of building a PV project are reduced, due to economies of scale and improvements in module manufacturing, but the revenue from a PPA is also reduced by vigorous competition between bidders offering to sell electricity at lower prices, then profit margins can be eroded. Thus, although a PPA may offer greater security than selling into the spot market, the competitive pressures of auction-based purchasing may sometimes act as a hindrance to further PV deployment. The market for PPAs is also, in some cases, limited by the available pool for corporate proponents. Financial institutions will often favour PPA agreements involving large corporate entities with the stability to remain in business for the foreseeable lifetime of the PV array.

Other alternatives to insulate against risk that may be employed for PV projects include so-called special purpose vehicles or subsidiaries and contract-for-difference (CfD) mechanisms. The CfD approach provides a degree of revenue stabilization while also protecting consumers from increased prices when electricity costs are high. However, the CfD funding mechanism is currently not used in Canada. Lastly, PV arrays with a large BESS component may use arbitrage as an important revenue stream to partially mitigate electricity price fluctuations by charging the battery when rates are low or negative and selling when electricity prices are high.

3.10 Grid integration policies

3.10.1 Grid connection policies

Interconnection policies determine the size of PV system that can be connected to the grid and the financial compensation that such systems receive for the electricity that they produce. The grid interconnection process, array size limits, and electricity rates paid for renewable electricity vary substantially by jurisdiction. The waiting time for grid interconnection is currently not tracked in this report.

3.10.2 Grid access policies

Grid access costs are part of the soft costs in Table 9 and are linked to installation and commissioning expenditures. Grid access policies, procedures, and interconnection times vary by province and territory and their effects on market development are not tracked in this report. Particularly large PV arrays may require the construction of new electrical lines or substations.

4 INDUSTRY

4.1 Production of feedstocks, ingots and wafers (crystalline silicon or thin film industries)

Canada continues to produce feedstock for the global solar industry through 5N Plus: a producer of high-purity tellurium, cadmium, zinc and related compounds (Table 15). 5N Plus is a Canadian company with 14 manufacturing facilities located throughout Canada, the USA, Malaysia, England, China, Belgium, and Laos. They have 18 sales offices in Asia, Europe, North and South America. First Solar is their primary customer and is the largest thin film PV producer worldwide. There are currently no producers of polysilicon, silicon ingots, or silicon wafers in Canada.

Table 15: Silicon feedstock, ingot and wafer manufacturing information for 2024

Manufacturers	Process & technology	Total Production	PV-related product destination	Price
5N Plus	CdTe & CIGS high purity compounds	350 tonnes	First Solar	Unknown

4.2 Production of PV cells and modules (including thin film and CPV)

Module manufacturing is defined as the process of encapsulation for silicon cells but may include ancillary manufacturing such as the addition of module-level power electronics. If vertically integrated, a company may also produce silicon ingots, wafers, and cells. The manufacturing of modules may only be attributed to a country if the encapsulation process takes place there. Table 16 presents data from four Canadian PV companies with manufacturing in Canada and abroad. Together, these four companies produce an estimated 475 MW/year of crystalline silicon modules for the Canadian market.

Table 16: PV cell and module production and production capacity information for 2024. The quantity of ingot, wafer, and cell production for each company is unknown.

<table>
<tr><th rowspan="2">Cell/Module manufacturer</th><th rowspan="2">Technology</th><th colspan="2">Total Production [MW]</th><th colspan="2"><u>Maximum</u> production capacity [MW/yr]</th></tr>
<tr><th>Cell</th><th>Module</th><th>Cell</th><th>Module</th></tr>
<tr><td colspan="6">Wafer-based PV manufactures</td></tr>
<tr><td>Canadian Solar</td><td>c-Si</td><td>-</td><td rowspan="3">475</td><td>-</td><td rowspan="3">1 050</td></tr>
<tr><td>Heliene</td><td>c-Si</td><td>-</td><td>-</td></tr>
<tr><td>Silfab</td><td>c-Si</td><td>-</td><td>-</td></tr>
<tr><td>Totals</td><td></td><td>-</td><td>475</td><td>-</td><td>1 050</td></tr>
</table>

4.3 Manufacturers and suppliers of other components

The balance of the system technology market in Canada is mainly served by foreign companies with operations in Canada or production through contract manufacturing. However, domestic solar racking manufacturers including FastRack, Polar Racking, Terragen and hb Solar, and OpSun are prominent in the Canadian market. Other companies that have Canadian development and manufacturing facilities include Eaton, Hammond Power Solutions, and Nexans. Typical balance of system components manufactured or supplied in Canada include inverters (central/string, microinverter, power optimizer), racking and mounting (rooftop, ground-mount, dual/single axis trackers), and wiring (cabling and combiner box). Among these components, the manufacturing of central inverters has experienced the largest growth and is primarily used for commercial rooftops and utility-scale systems. A notable solar glass manufacturer in Canada is Canadian Premium Sand (CPS) which manufactures patterned cover glass, equivalent to around 6 GW of PV capacity, in the province of Manitoba with supply contracts with Heliene, Hanwha QCells, and Meyer Burger. There is also a 4 GW CPS solar glass factory in the United States.

5 PV IN THE ECONOMY

5.1 Labour places

The effects of PV in the economy were determined from the installed PV capacity in each province and territory. These data were analysed using the Economic Impacts of Electrification Initiatives (EI^2) model developed by the Trottier Energy Institute and Ecole Polytechnique [18]. The estimate of the total number of jobs is the sum of permanent operation and maintenance for the cumulative installed capacity of previous years plus the effects of temporary construction due to new installations in 2024. These estimates are conservative since they do not include PV system design and engineering, sales and marketing, project development and management, or legal/financial services and administration which collectively constitute a significant share of jobs.

Table 17: Estimated PV-related full-time labour places in 2024

Market category	Number of full-time labour places
Research and development (not including companies)	105
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	6 052
Distributors of PV products and installations	345
Other	-
Total	**6 502**

5.2 Business value

The value of PV business in Canada as it relates to the PV capacity installations for 2024 is estimated to be approximately $863 million. Calculations were performed at the provincial and territorial level using installed PV capacity estimates as input to the EI^2 model. The EI^2 model incorporates financial multipliers specific to each region. Economic impacts were the sum of operation and maintenance associated with previously installed capacity added to the construction impacts due to new PV capacity in 2024. Operation and maintenance encompassed onsite labour, local revenue, and supply chain effects. The construction phase related to modules and supply chain, project development, and onsite labour output.

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

Each Canadian province and territory operate their own electricity sector. As a result, the market structure and regulations in each jurisdiction are unique (although several inter-ties do exist). For example, Quebec, British Columbia, Manitoba, and Newfoundland and Labrador are hydropower-dominated provinces characterized by low production costs, a dynamic export orientation, and public ownership. Ontario, Alberta and New Brunswick moved away from the centrally managed model through the creation of independent system operators and wholesale markets. Wholesale markets are characterized unbundled assets, whereby the transmission infrastructure is publicly owned but the business of energy production occurs through a variety of public and/or private producers in competition.

6.2 Interest from electricity utility businesses

Given the diversity in market structures across Canada, the interest from electricity utility businesses is variable. Some utilities have established unregulated subsidiaries to act as generators while others simply interconnect projects and handle the settlement of payments. In other jurisdictions, utilities offer rebates, manage net-metering, and are considering solar financing products such as lease-to-own.

6.3 Interest from municipalities and local governments

There are over 3 500 urban and rural municipalities in Canada interested in environmental sustainability and continued exploration of PV throughout 2024.

7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

Canada's PV sector has reached 5.29 GW_{AC} of installed capacity, a growth of approximately 5% over the previous year. Achieving Canada's greenhouse gas emission reduction goals will require significantly more decarbonisation and electrification in the coming years.

7.2 Prospects

PV and wind generating assets continue to play a role in altering the composition of Canada's generating capacity. Renewables are needed to meet the growing demand for the electrification and decarbonization of fossil fuel-intensive sectors such as vehicular transport (battery charging), commercial and residential buildings (heat pumps), and steel production (blast furnace replacement by electric arc furnace).

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