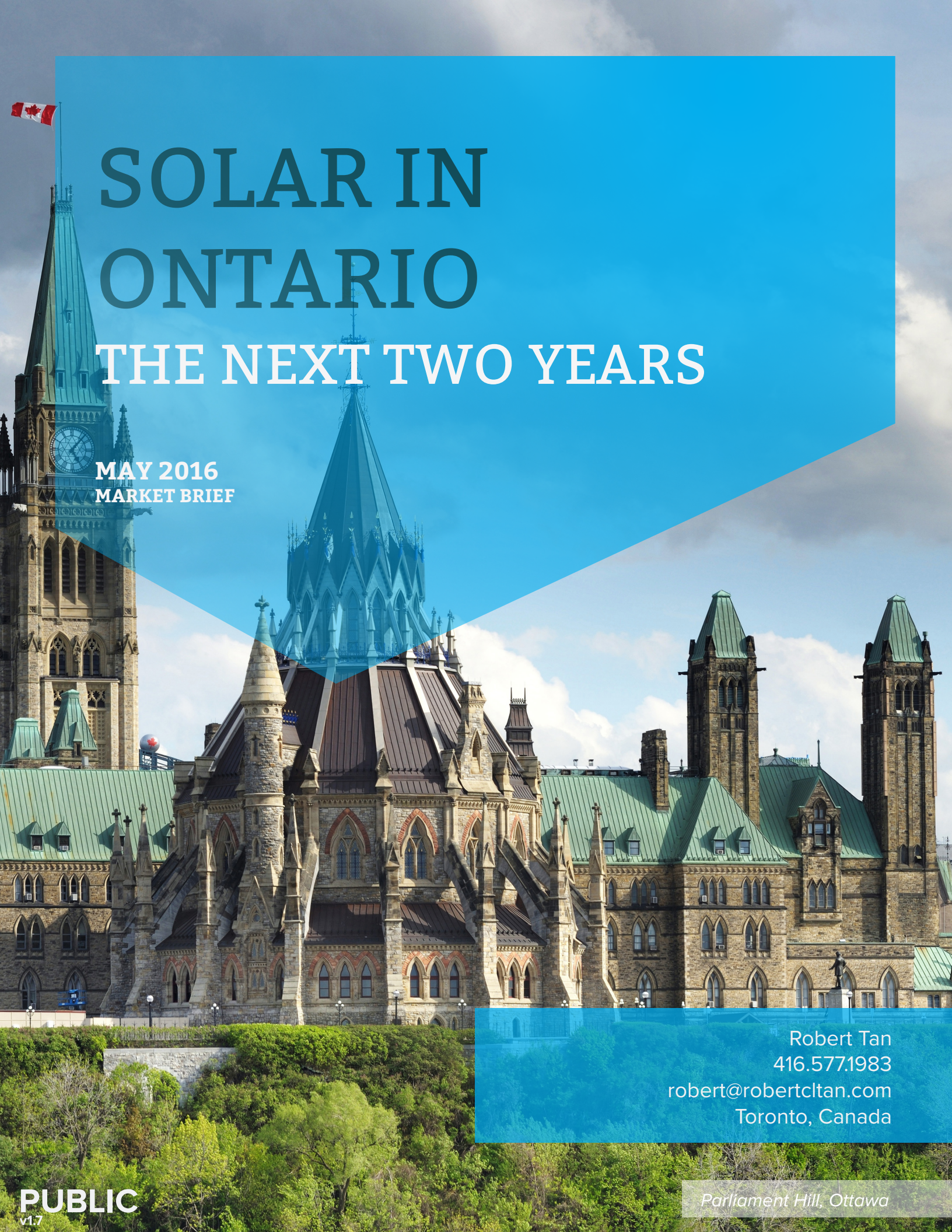

SOLAR IN ONTARIO

THE NEXT TWO YEARS

MAY 2016
MARKET BRIEF

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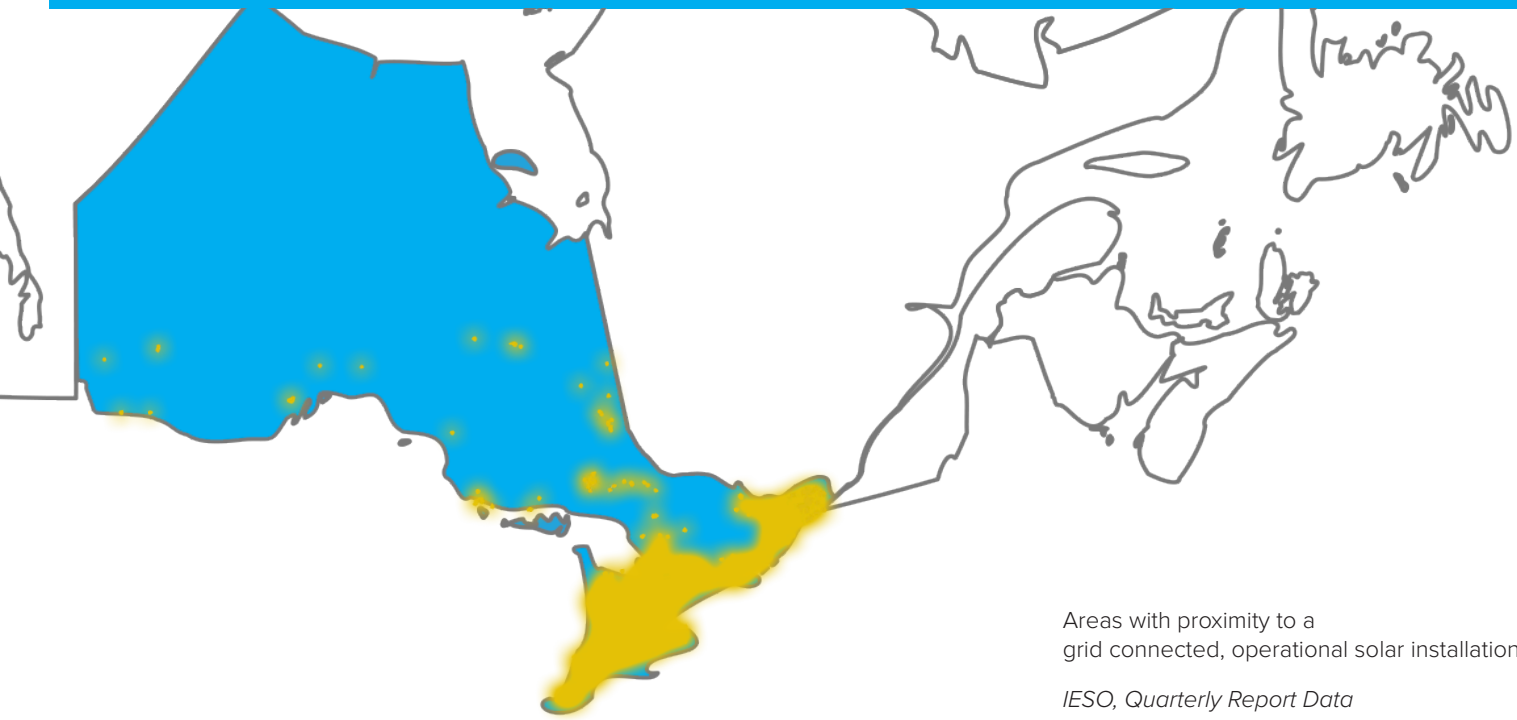
Acknowledgments

The data within the report was sourced with the help of the passionate people from CanSIA and their partners, the IESO, NRCan, as well as other important intelligence organizations such as IEA, GTM, and Bloomberg. The report would not have been possible without their contributions.

Simon Solar, Georgia



Areas with proximity to a
grid connected, operational solar installation

IESO, Quarterly Report Data

INTRO

The solar industry in Ontario has experienced record-breaking growth from 2010 to 2015. In fact, Ontario alone has driven a predominant (99.2%) share of the Canadian solar capacity and as a result placed Canada in the top 15 countries with the most PV capacity[1].

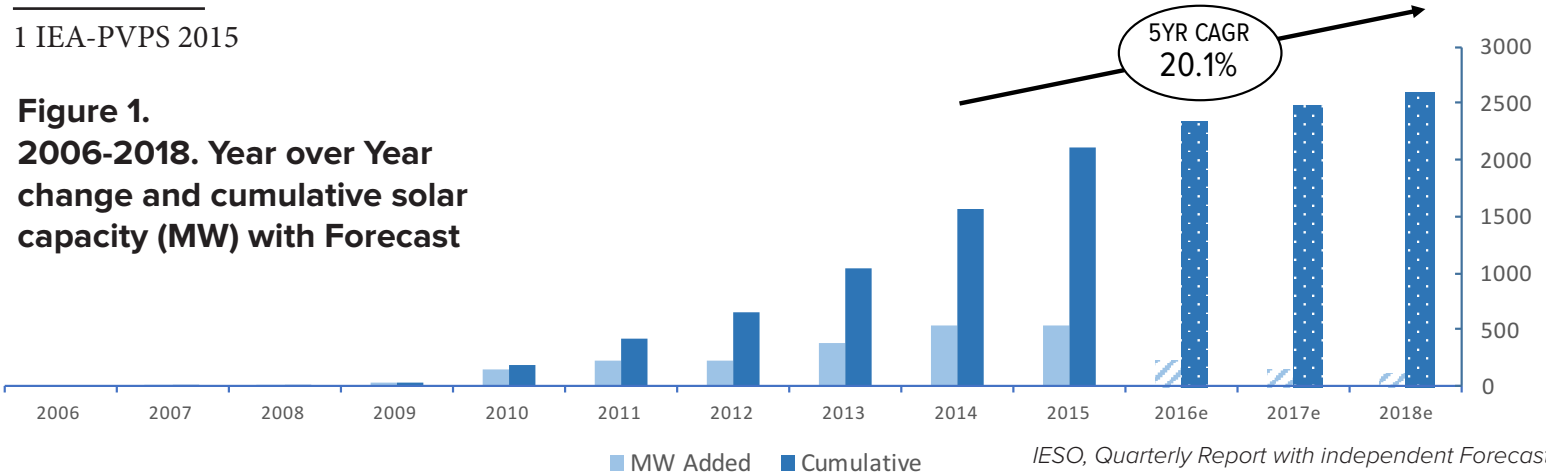
The success is attributed to Ontario's Feed-In Tariff (FIT) program. The program is a 20-year contract that enables the sale of self generated clean energy at a fixed price. Initial prices were set at more than 80 cents per kilowatt-hour (kWh) and spurred a booM in solar development.

New contract offerings have slowed in recent years, but are expected to pick up pace within the next 3 years with the introduction of the Large Renewable Procurement (LRP) program.

Installations costs have continued to drop and are expected to drop for both Utility and Residential solar PV. Commercial and Industrial electricity price is expected to rise. Both trends indicate Solar PV reaching Grid Parity between 2020 and 2026.

1 IEA-PVPS 2015

Figure 1.
2006-2018. Year over Year change and cumulative solar capacity (MW) with Forecast



IESO, Quarterly Report with independent Forecast

*of Ontario's installed capacity is **solar****

and generates 1.5% of Ontario's energy

***87%** of solar comes from distributed generation*

IESO, Quarterly Report with independent analysis

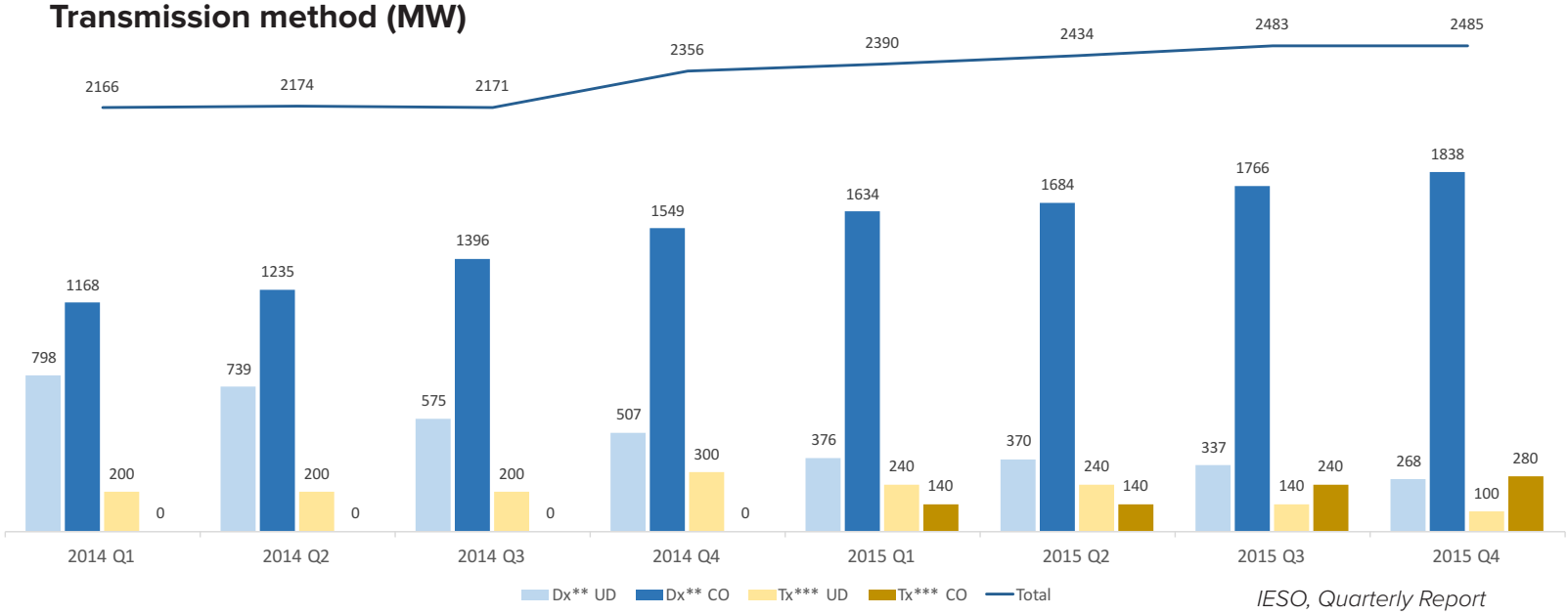
QUICK STATS

But how does the near future look like? In this report I hope to shed some light on the current prospects and challenges that the industry faces and how much growth we can expect in the coming years.

Historical Growth Trends

A view in the future necessitates a brief review of recent trends.

Figure 2.
2014-2015 Capacity - CO & UD by Transmission method (MW)



IESO, Quarterly Report

In Figures 1 and 2, we are able to see that the fastest growth in Commercially Operational (CO) capacity peaked in 2014, just over 3 years after the first and most rewarding FIT contracts were rolled out around 2010.

On the surface, the growth illustrated in Figure 1 appears to be fast-paced and consistent. However, new developments have slowed down significantly and we are just observing the conversion of the existing Under Development (UD) capacity in the past 2 years. The slowdown is illustrated in Figure 3 on the following page.

*This figure accounts for distributed generation. IESO Supply Mix.
**Dx stands for Distribution, generation is sent by local distribution (distributed generation)
***Tx stands for Transmission, generation is sent by high voltage lines (central generation)

GROWTH

We will begin by taking a look at the general outlook - how quickly will we see solar growth in the next coming years?

Developmental Slump

New Commercially Operational (CO) solar developments will see a slowdown in the next 3 years. The majority of developments were spurred by the early, highly attractive FIT prices (starting from 80c+/kWh, which then diminished to the 20c -30c range as of January 1st, 2016[1]). The decline in tariffs was proportionally faster than the decline in installed costs, resulting in an overall slowdown in development.

Figure 5 shows the MicroFIT price levels over the last 5 years. The prices correlate tightly and are therefore indicative of the decline in more powerful FIT systems.

More Contracts Offered

However, the flatline will not continue beyond the next 3 years. Carefully planned additions of renewables will be facilitated under more FIT and MicroFIT program series along with the new Large Renewable Procurement program which will work with large solar projects (above 500kW or enough to power about 370 homes at peak production).

It is estimated that approximately ~375MW of solar capacity contracts will be offered annually in the 2016-2018 period (Figure 4). Based on private discussions with recent LRP signees, the contracts are expected to be physically operational 3 years following the signing of contracts.

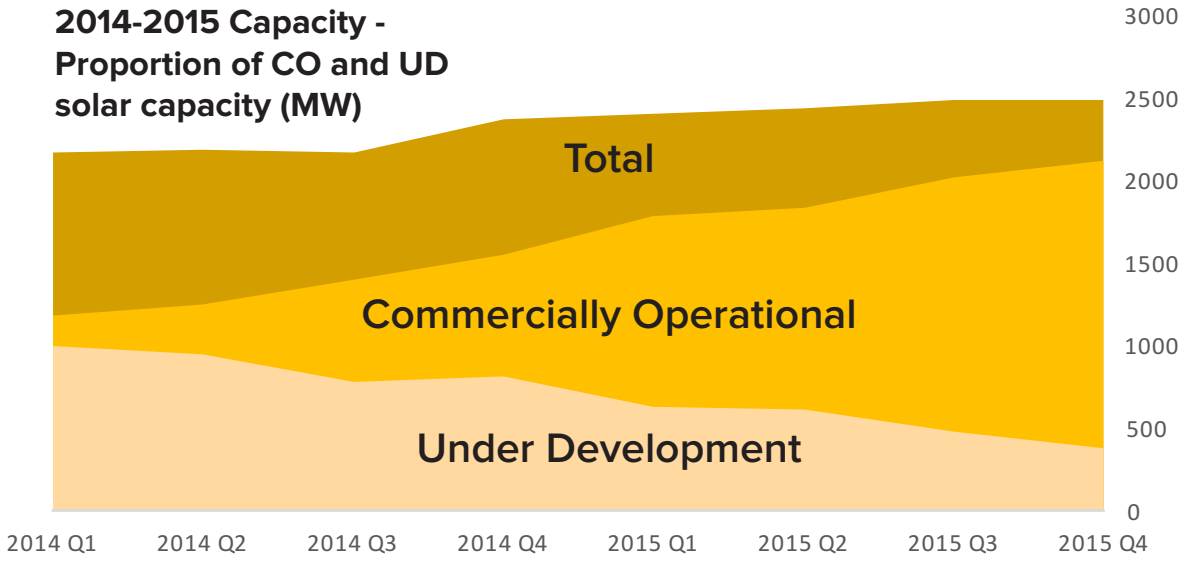
Demand for Large Programs High

Solar applicants for the LRP program saw a below 20% acceptance rate[2]. Demand for the most recent FIT4 program will likely yield a rate of above 40%. However, MicroFIT procurement has slowed down, with only 20MW added in 2015, and recently was forced to carryover a 82% surplus into the FIT4 procurement target due to lack of applicants[3].

Our analysis assumes that most of the available MicroFIT capacity will be transferred towards the FIT program, as was done in the recent FIT4 series.

2 IESO LRP 1 Selected Proponents
3 IESO Quarterly Report

Figure 3.
2014-2015 Capacity - Proportion of CO and UD solar capacity (MW)



1 IESO FIT price schedule 2016

IESO, Quarterly Report

Participative Communities

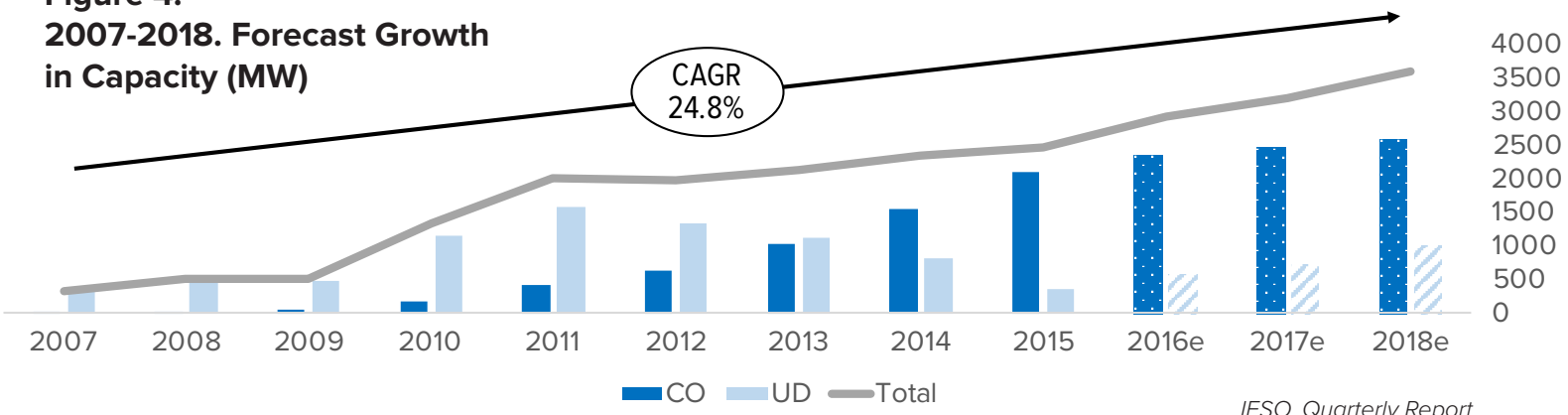
A component of the subsidy programs involves a financial incentive for Aboriginal or Community led projects (in whole or in part where the minimum is generally more than 10-15% of capital ownership). Most recently, LRP saw around 75%[1] of its projects being supported by the community and 80% of the projects being led in whole or in part by Aboriginal communities.

The incentive specifically involves a 'Price Adder' which contributes extra tariff per energy produced. This is becoming especially attractive as base tariffs are expected to continue to fall and financial instruments such as the Aboriginal Loan Guarantee Program being available to potentially boost the financial returns of a project[2].

1 IESO LRP 1 Selected Proponents

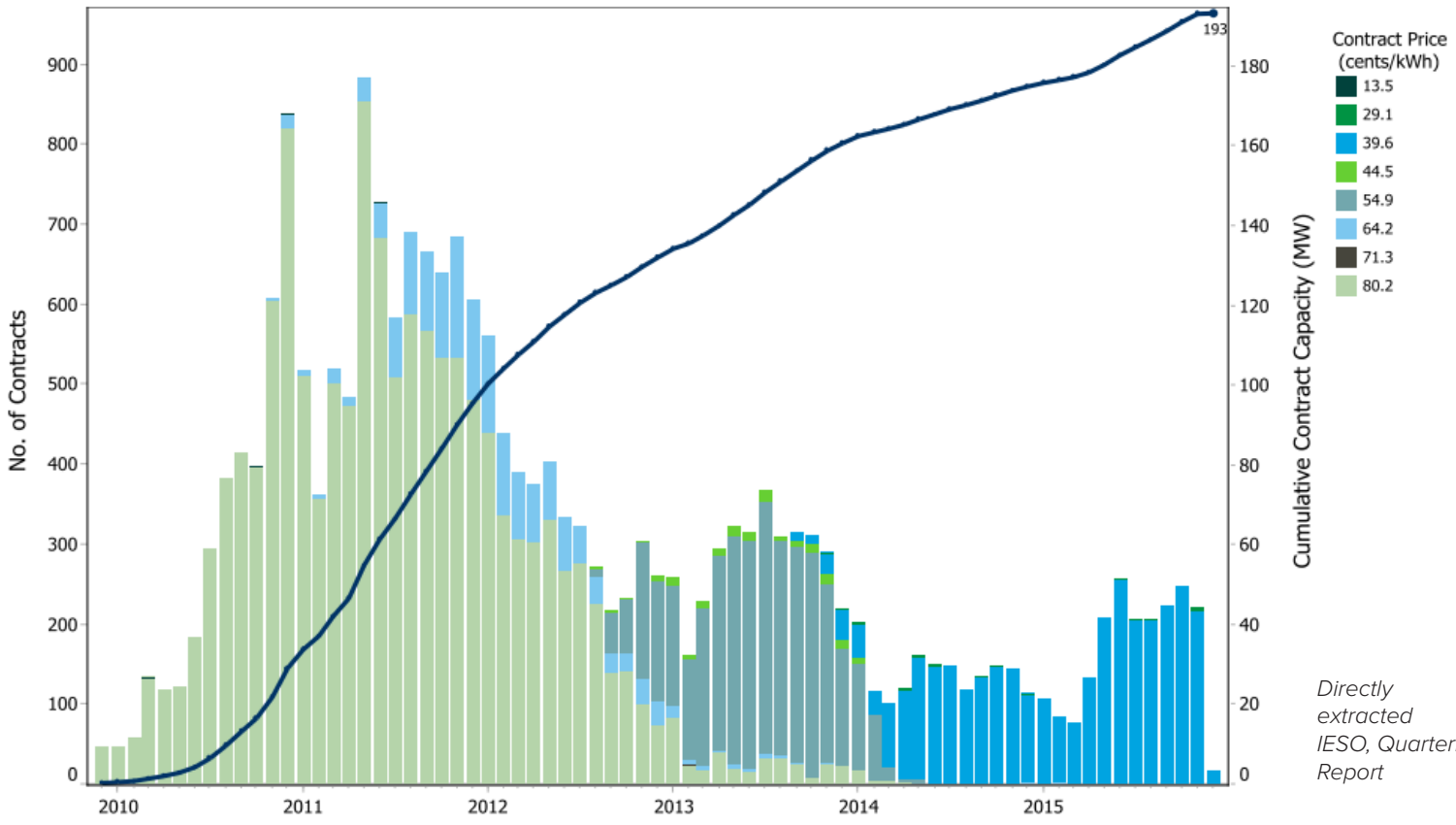
2 Mondaq - Unlocking Value of Aboriginal Participation

Figure 4.
2007-2018. Forecast Growth in Capacity (MW)



IESO, Quarterly Report

Figure 5.
2011-2015 MicroFIT Capacity and Contracts Executed (MW)



Directly extracted IESO, Quarterly Report

SUBSIDIES

As beneficial and stimulating as the Feed-In Tariff programs have been for solar adoption, it is expected that the Ontario government will phase out the program completely in the 2018 timeframe.

Transition to Net Metering

In a recent ministerial directive written by the Minister of Energy, it is stated that the MicroFIT program be terminated on Dec. 31, 2017 while the Ministry plans to post the net metering transition documents for public comment in 2016[1].

The phase out of MicroFIT into a Net Metering scheme has been exhibited more frequently in official public announcements. The future of both FIT and LRP projects are more uncertain in the 2018 timeframe. However, it is highly anticipated that a new Net Metering scheme be implemented at some time after the FIT program ends[2].

The Canadian Solar Industries Association (CanSIA), has collaborated with intelligence and industry partners to create a Distributed Generation Task Force, which produced a report in March of 2016 recommending an execution plan conducive to a carefully maintained phase out of the FIT programs.

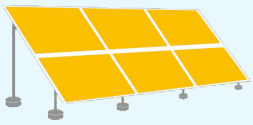
Among the recommendations in the report, CanSIA has recommended a capital incentive program whereby the initial capex is subsidized. CanSIA intends for this program to serve as a stepping stone from the current tariff based subsidy to a Net Metering scheme.

1 Ministerial Directive 2016
2 Compass - Solar Canada 2015

FIT, MicroFIT, LRP - The Differences

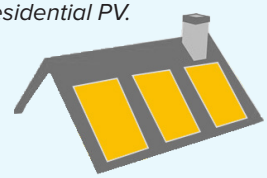
FIT + LRP

These programs are geared towards large scale projects. FIT projects must exceed 10kW and LRP projects must exceed 500kW.



MicroFIT

MicroFITs are under 10kW and must be primarily for self consumption. The rates are higher to reflect the costs of deploying residential PV.



Notes: FIT also accepts energy from biowaste, wind, and hydro. Rooftop installations are also used for large systems.

Shifts in Policymaking

Bill 135[3] was introduced in late 2015, proposing some restructuring of a number of decade old processes[4,5]. Among the stipulations in the Bill included a repeal of Section 25.35 in the *Electricity Act of 1998* which led to the existence of the FIT program. As per stipulations within the proposed Bill, the changes will not affect existing or announced programs; but sparks uncertainty towards the existence of a FIT6 in 2017/2018 if enacted.

The other group of changes relate to the regulations within the *Electricity Act of 1998*, whereby the policymaking and planning power is shifted from the IESO to the Ministry of Energy. Such a relationship reflects a traditional corporate agency relationship where the Ministry directs the IESO to execute its plans and where the IESO provides performance/ technical reports for the making of such plans.

3 Bill 135 - Energy Statute Law Amendment Act, 2016
4 George Vegh - The Bill 135 Governance Model
5 Lexology - A brief look at Bill 135

TECHNOLOGY

Consistent Cost Cuts

Costs have continued and will continue to drop in a systematic and consistent manner. It may come as a surprise, but the costs of the modules (or panels) have dropped to encompass less than half of the total installed cost in just the past few years. That means soft costs (e.g. labour, permits, and marketing) alone are greatly exceeding the cost of the panels.

It is worthy to note that there are different ways to generate energy from PV, some not even coming in the familiar panel-like form that we commonly see on rooftops.

However, those types of solar technologies (such as thin-film solar pictured below) represent a small part of the overall market (Appendix 1) and therefore do not usually receive the predominant focus from the broader solar industry.

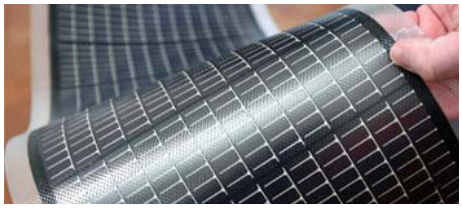
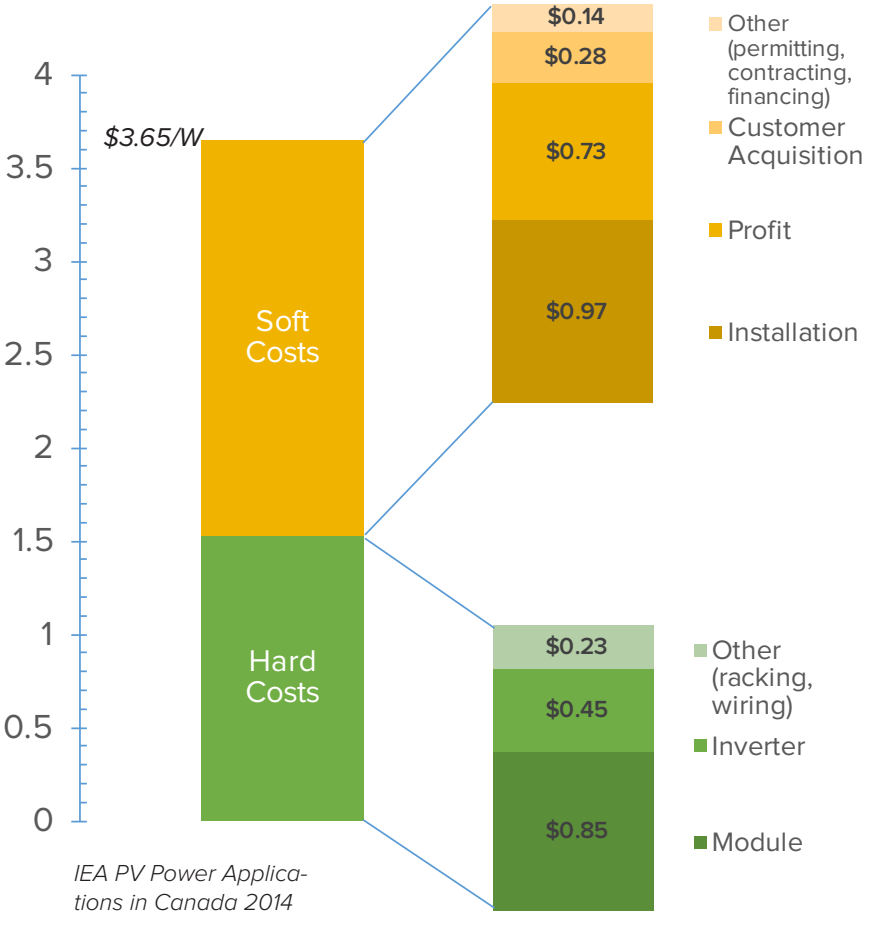


Figure 7. 2015. A sheet of Thin Film solar cells

Figure 6. 2014. Average $/Watt installed for a <10kW Residential system in Canada



IEA PV Power Applications in Canada 2014

For a breakdown of an Commercial system please see Appendix 4.

Module Costs Drop

Module costs have continued their downward trend.

Reasons stem from: decreasing cost of input materials (Figure 9) from rising global demand, manufacturing efficiencies, increasing cell efficiency, and economies of scale (Appendix 2).

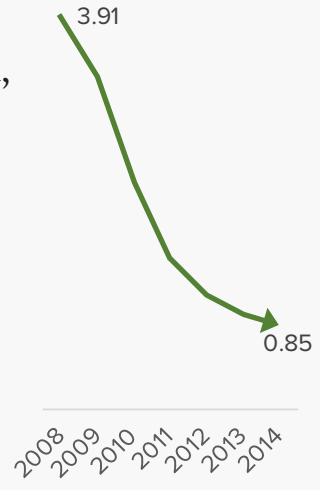


Figure 8. 2008-2014. Canadian module costs. IEA PV Power Applications in Canada 2014

	2014 Q4	2015 Q1	2015 Q2	2015 Q3	2015 Q4
Polysilicon ($/kg)	21.04	18.94	15.53	15.06	14.46
Wafer ($/W)	0.22	0.21	0.2	0.2	0.21
Cell ($/W)	0.32	0.31	0.29	0.3	0.33
Module ($/W)	0.73	0.72	0.68	0.67	0.65

Figure 9. 2014 Q4-2015. Global resource costs. GTM SEIA U.S. Solar Market Insight

Consistent Cost Cuts (cont.)

The most predictable cost decreases are expected to come from modules. Cost forecasts vary widely even from reputable sources but all sources suggest that modules will continue their long term downward trend.

In addition, according to CanSIA, 'many components are priced in US dollars and [are] sourced from international markets'[1]. This may exert double digit percentage upward pressures on installed costs in the time the exchange rate continue to be elevated. A chart that encompasses the exchange rate effects can be found in Appendix 3.

As the market grows provincially and nationally, we can expect a more competitive landscape, which will increase purchasing power of consumers, lower costs to entry, and thus lowering the overall installed costs. The accompanied decrease in profit margins, installation costs due to industry learning, lower marketing (customer acquisition) costs due to increased awareness of solar as a viable option, and economies of scale with respect to other components, will likely drive the costs to unprecedented levels.

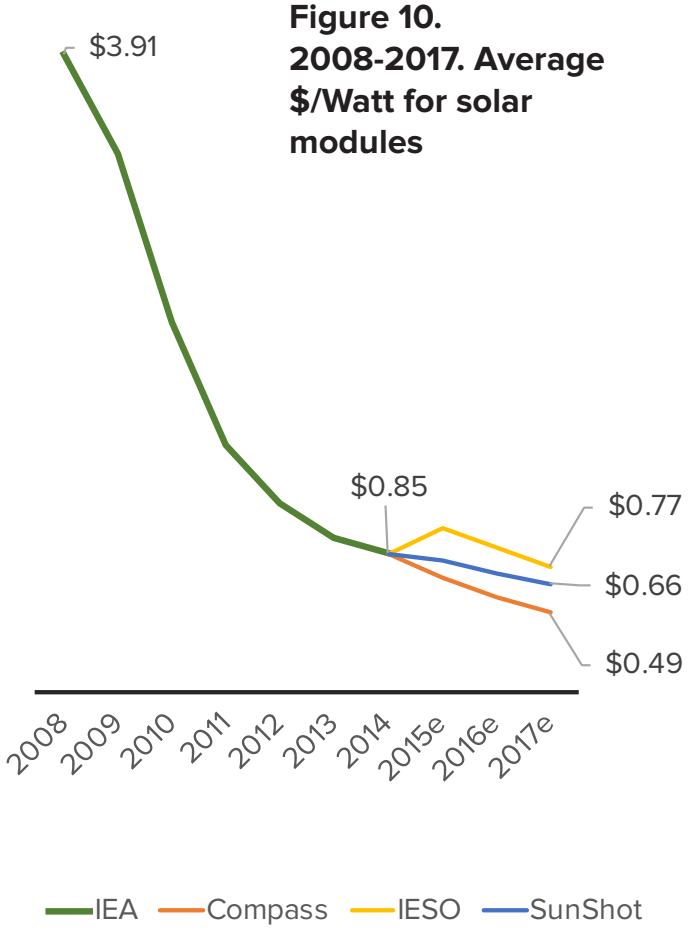
1 CanSIA DGTF Recommendation Report

Cell Efficiency

The decreasing module cost comes in part from the ever consistent innovations in cell efficiency. Most recent FIT projects require minimum 15.3-16% efficiency ratings[1]. Today's leading edge commercially produced cells (i.e. not used in laboratory/experimental settings) break 24%[2]. It is common today to come across online news and articles about newfound cells breaking new efficiency records. While the commercial viability of those cells may be debated, the general trend of efficiency is an upward one, as exhibited by a chart from the National Renewable Energy Laboratory (Appendix 5), a widely respected scientific institution within the solar industry.

1 IESO LRP 1 Contract
2 GTM Sunpower article

Figure 10. 2008-2017. Average $/Watt for solar modules



IEA - 2014 PVPS PV Power Applications in Canada
Compass Renewable Energy Consulting - 2015 Solar Capital Costs
IESO - 2016 FIT Price Review
SunShot U.S. DoE - 2015 Photovoltaic System Pricing Trends

GRID PARITY

With electricity prices in Ontario expected to increase year over year (Appendix 6) and costs of solar installations dropping in tandem (page 8), we can begin to analyze the point at which they cross. This crossover point marks a critical moment where solar PV power reaches the so called Grid Parity, a moment where solar PV becomes an unsubsidized, competitive offering.

Crossover Years

Considering the two trends, CanSIA and its partner, Compass Renewable Energy Consulting, are forecasting grid parity to occur between 2020 and 2026 (Figure 11). The wide range is attributed to "a variety of factors such as; strong customer uptake, reduction of soft-costs and favourable federal tax policy" (CanSIA DGTF Recommendation Report).

Appendix 7 illustrates a chart that suggests a general timeline for subsidies necessary to support the transition.

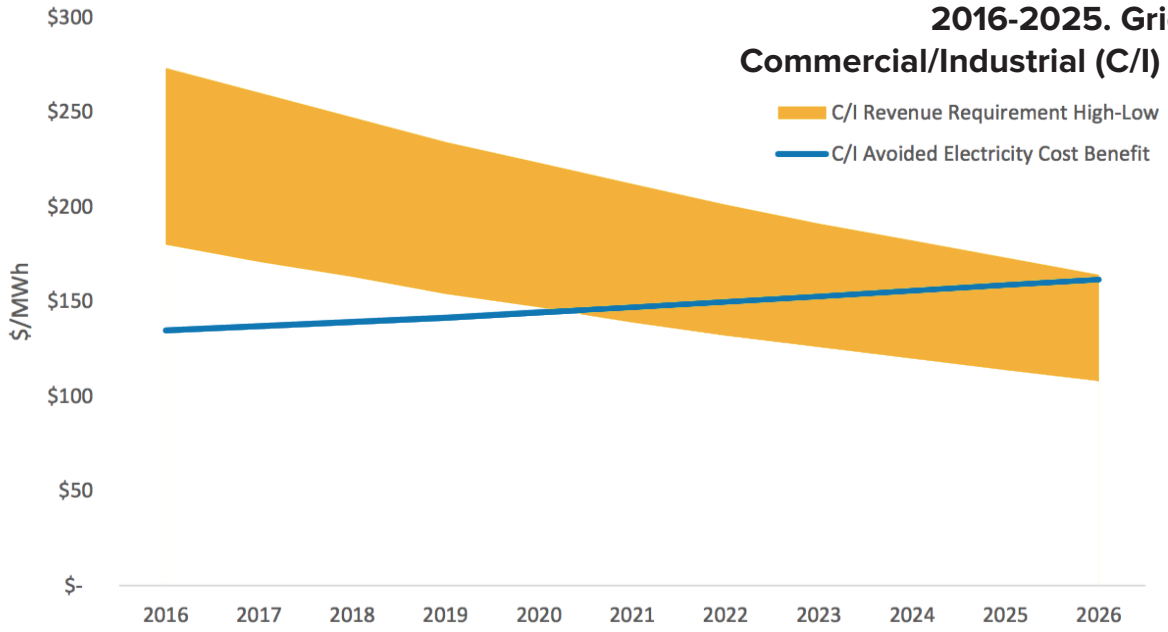
A Global Trend

Deutsche Bank completed an analysis of grid parity progress worldwide. They had found that countries with naturally low high electricity prices or unnaturally low costs are already experiencing grid parity (Appendix 8).

Deutsche Bank's (DB) analysis of the Canadian market ultimately corroborates CanSIA's analysis[1]. In a global perspective, Canada and Ontario may lag behind other countries due to our low electricity prices[2] - requiring greater cost reductions until the economics work for us.

1 Deutsche Bank - Markets Research 2015
2 Statista - Global Electricity Prices 2015

Figure 11.
2016-2025. Grid Parity for Commercial/Industrial (C/I) Customers



As the electricity price rises, the benefit of avoiding traditional electricity increases. As the installations cost per Watt decreases, the revenue required to break even decreases.

Directly extracted CanSIA DGTF Report

REFERENCES

Bill 135, Energy Statute Law Amendment Act, 2016	http://www.ontla.on.ca/web/bills/bills_detail.do?locale=en&BillID=3539
CanSIA DGTF Recommendation Report	Privately procured from CanSIA
Compass - Solar Canada 2015	http://solarcanadaconference.ca/wp-content/uploads/2015/12/20151207_SolarCanada_OntarioMarket_FINAL.pdf
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George Vegh - The Bill 135 Governance Model	http://www.canadianenergylawblog.com/2015/11/05/the-bill-135-governance-model-all-roads-lead-to-the-government/
GTM SEIA U.S. Solar Market Insight	http://www.seia.org/research-resources/solar-market-insight-report-2015-q1
GTM Sunpower Article	http://www.greentechmedia.com/articles/read/SunPower-Breaks-Solar-Panel-Efficiency-Record-Again
IEA - 2014 PV Power Applications in Canada	http://www.iea-pvps.org/index.php?id=93&eID=dam_frontend_push&docID=2731
IESO FIT price schedule 2016	http://fit.powerauthority.on.ca/sites/default/files/version4/FIT-Price-Schedule-2016-01-01.pdf
IESO LRP 1 Contract	pg. 12 - http://www.ieso.ca/Documents/generation-procurement/lrp/LRP-I-Contract-20150731.pdf
IESO LRP 1 Selected Proponents	http://www.ieso.ca/Documents/generation-procurement/lrp/lrp-1-final/LRPI-Selected-Proponent-List-20160412.pdf
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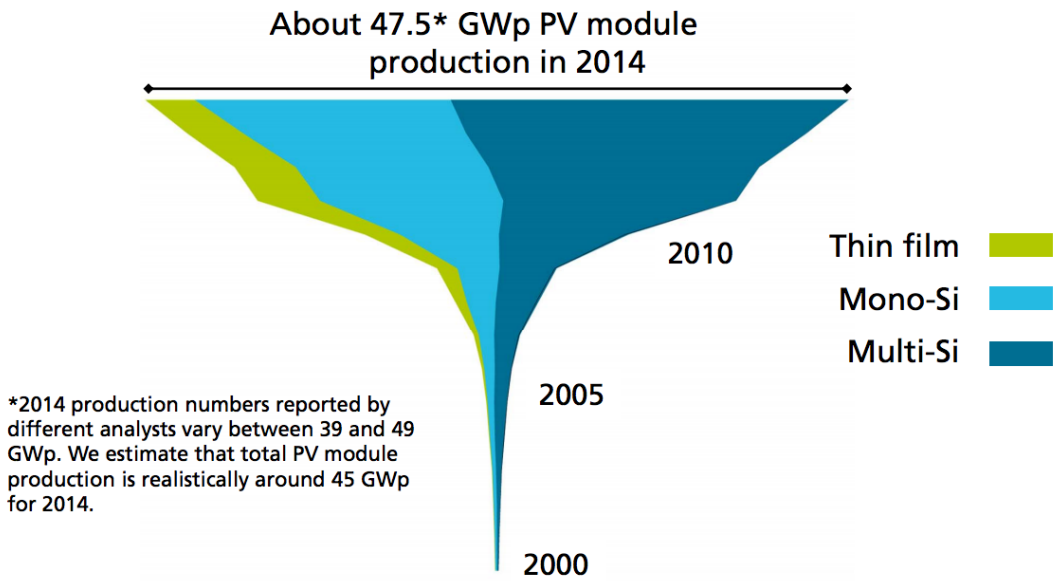
Back Cover	https://insights.abnamro.nl/app/uploads/2016/04/shutterstock_72551659.jpg

APPENDIX FIGURES

Appendix 1. 2000-2014. Global production share by PV technology (GW)

This plot is courtesy of Fraunhofer, Germany

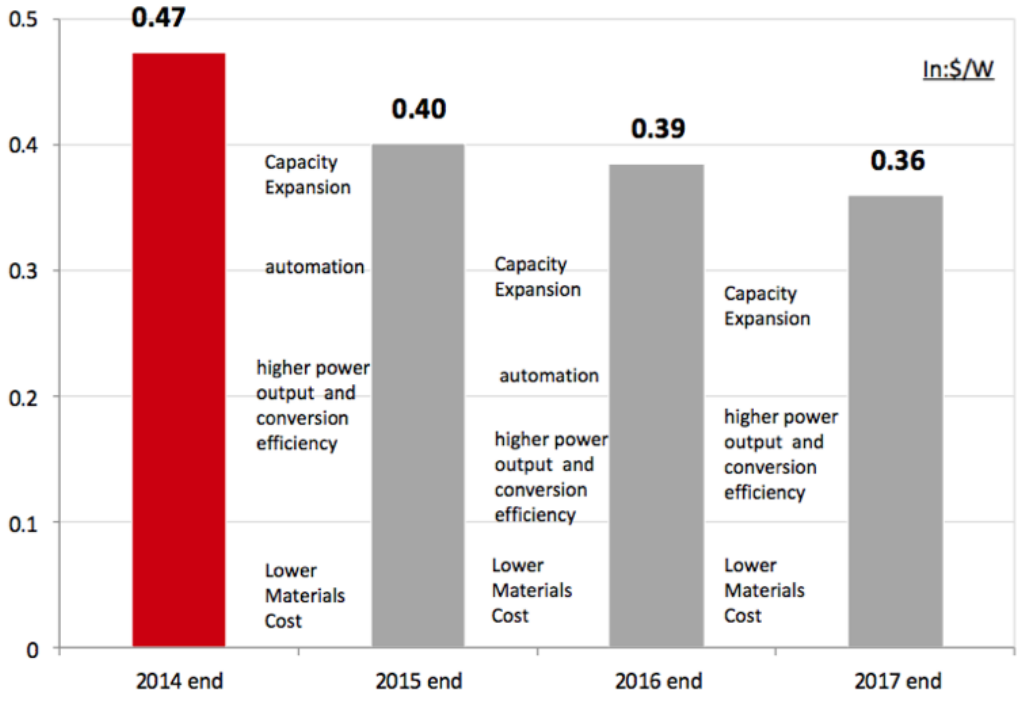
https://www.ise.fraunhofer.de/de/downloads/pdf-files/aktuelles/photovoltaics-report-in-englischer-sprache.pdf



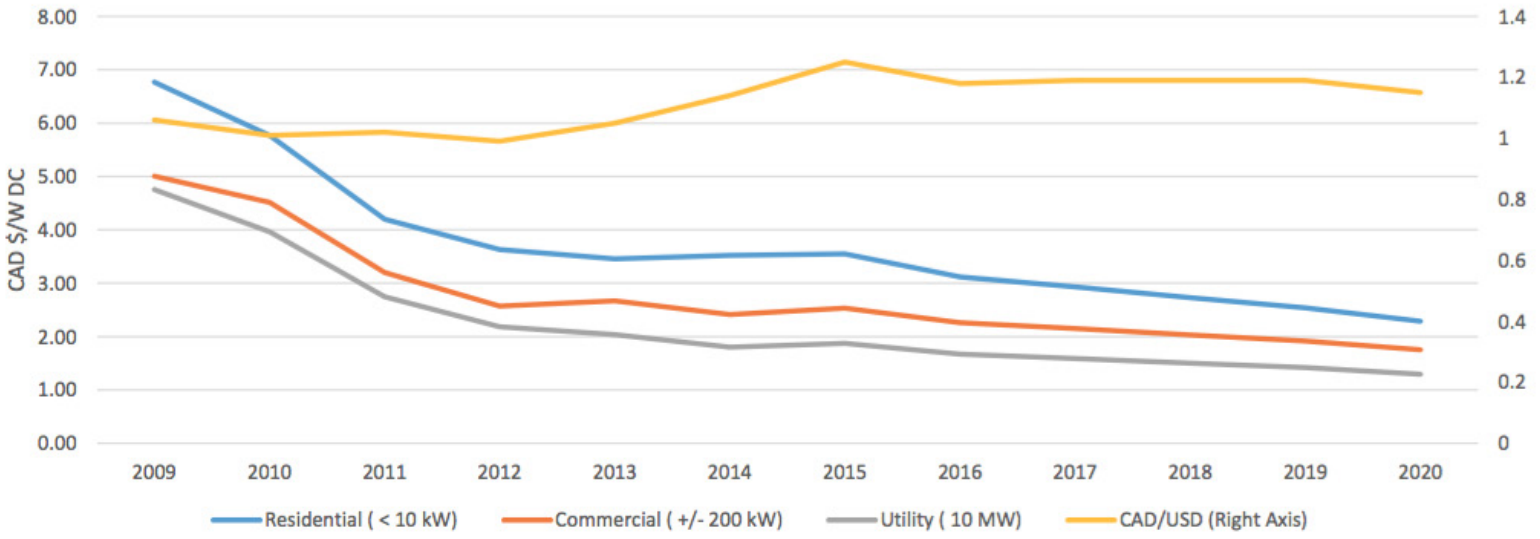
Appendix 2. 2014-2017. Module production cost decline by cost cutting methods

This plot is courtesy of Canadian Solar

http://bit.ly/1WqFzvw



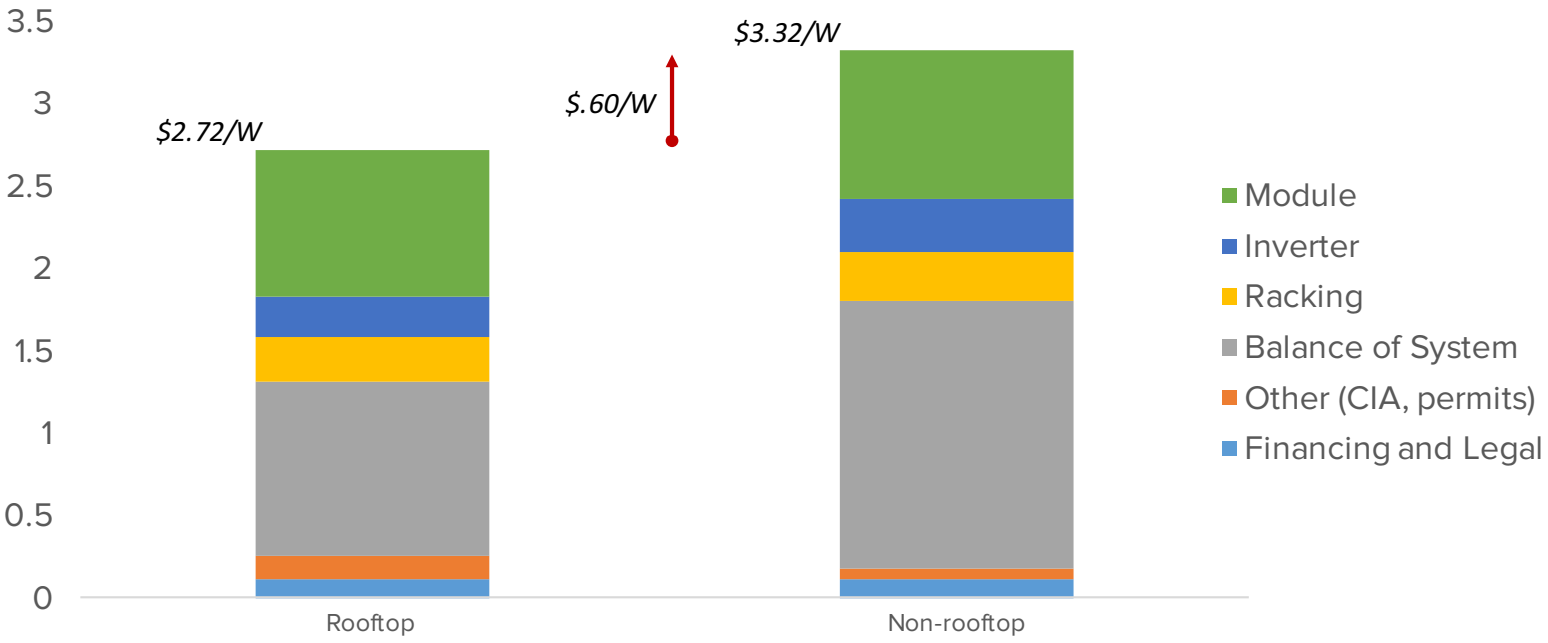
Appendix 3.
2009-2020. USD/CAD rate effect on installation costs by system size



This plot is courtesy of Compass Renewable Energy Consulting, ON

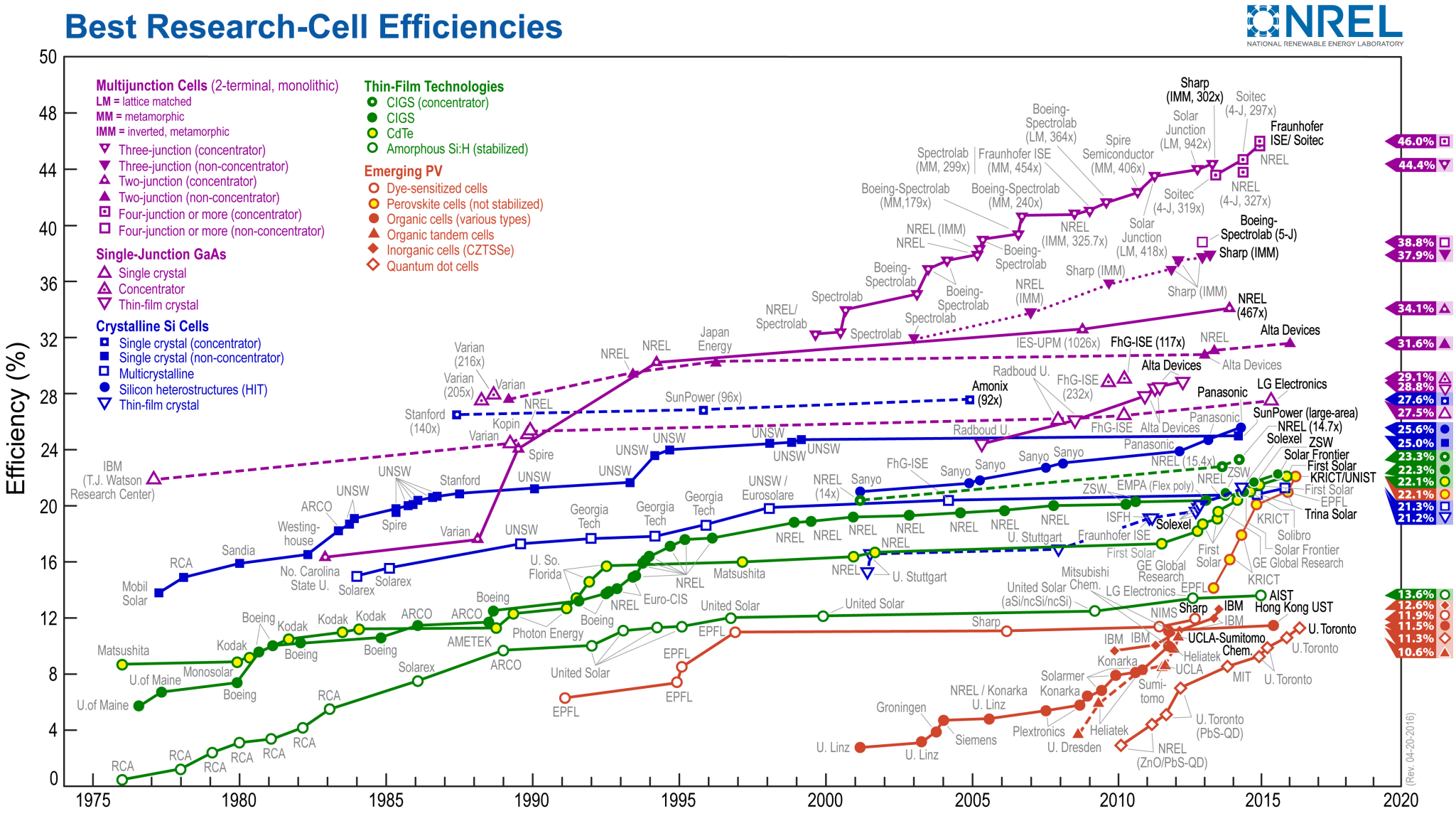
http://solarontarioconference.ca/wp-content/uploads/2015/12/Solar-Capital-Costs-Trends-and-Considerations.pdf

Appendix 4.
2015. IESO Cost breakdown for a 500kW PV system ($CAD)



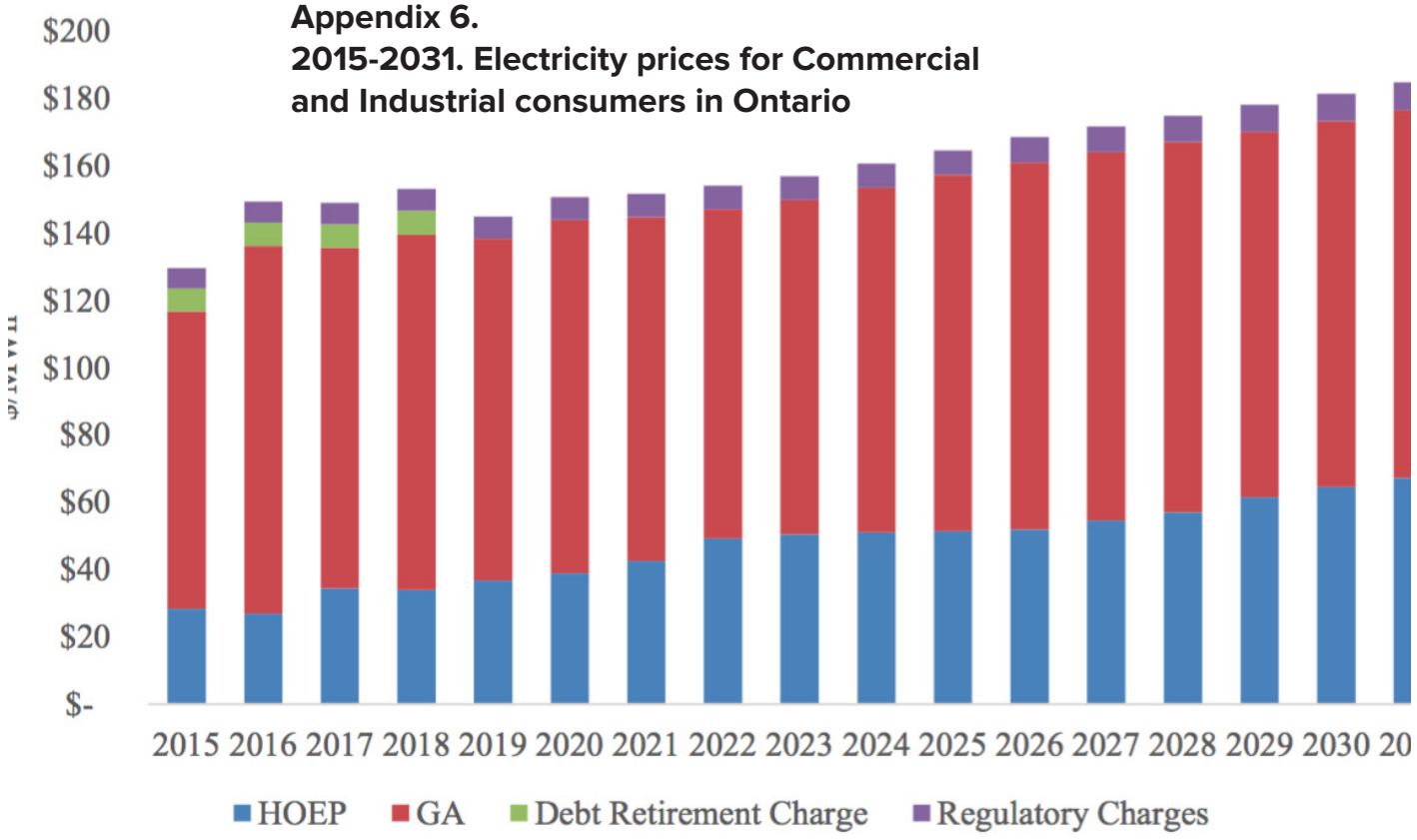
https://fit.powerauthority.on.ca/sites/default/files/2016-FIT-Price-Review-Public-Background-Deck_UPDATED_FINAL.PDF

Appendix 5.
Cell efficiency of various solar technologies and organizations



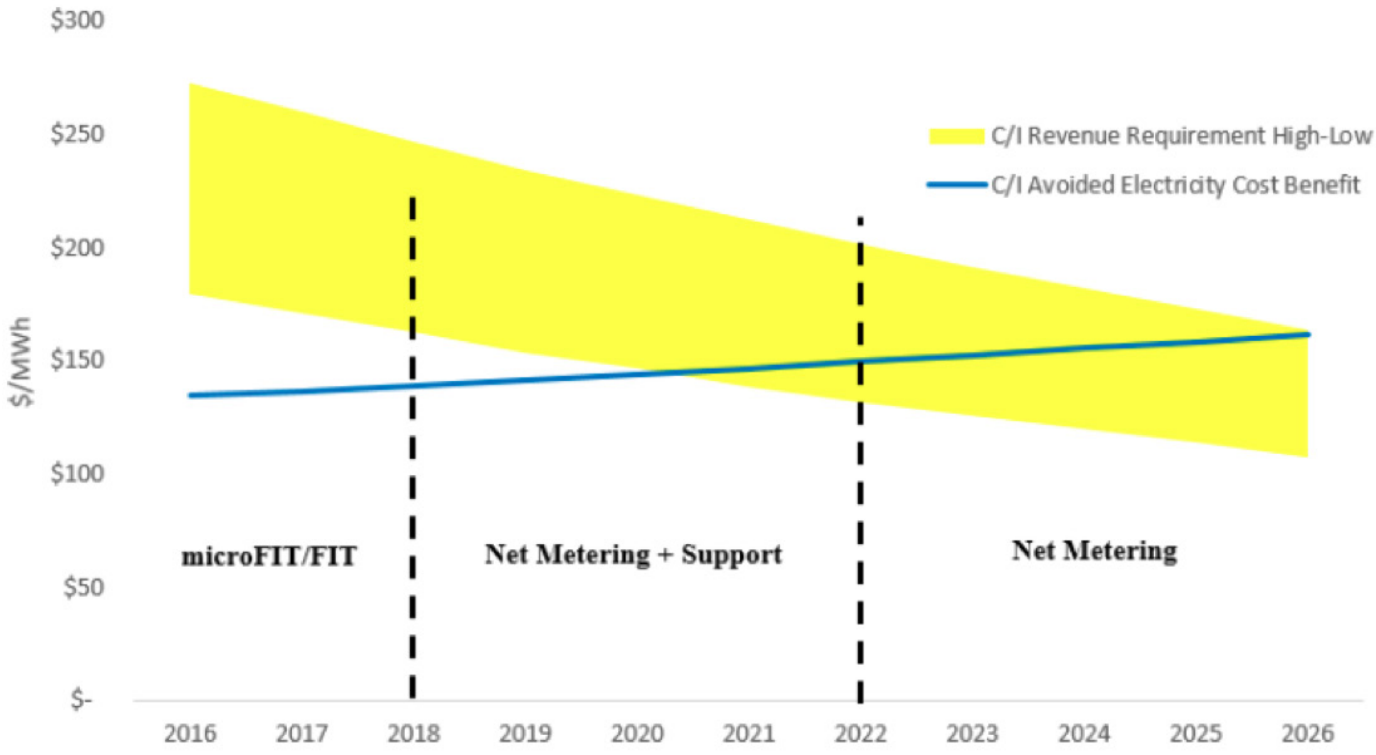
http://www.nrel.gov/ncpv

Appendix 6.
2015-2031. Electricity prices for Commercial and Industrial consumers in Ontario



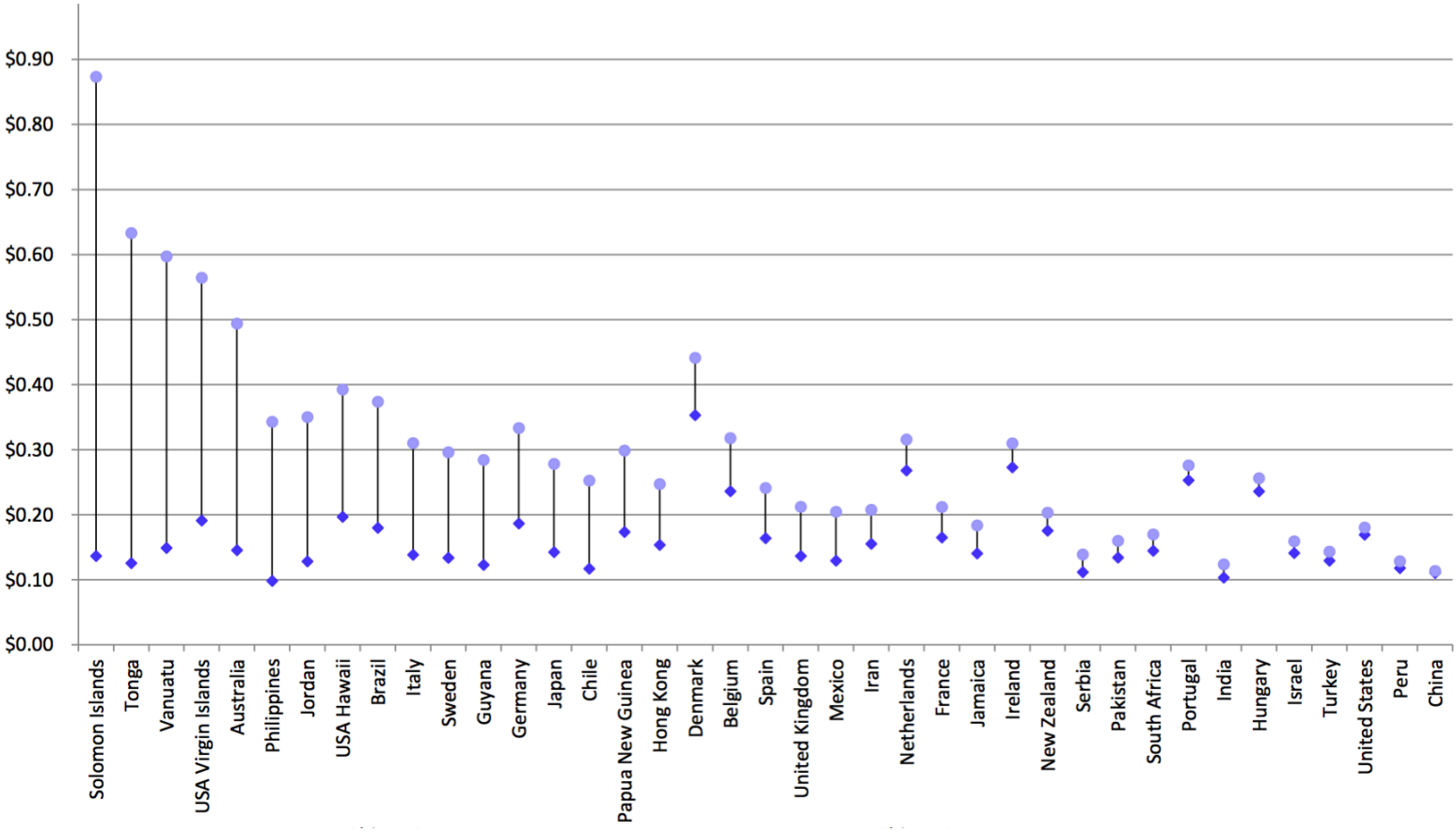
This plot is courtesy of CanSIA's DGTF Recommendation Report.

Appendix 7.
2016-2026. Suggested subsidy timeline for transition to Grid Parity



This plot is courtesy of CanSIA's DGTF Recommendation Report.

Appendix 8.
Countries with regions of Grid Parity



This plot is courtesy of Deutsche Bank - Markets Research.

Robert is a recent graduate from the Queen's Smith School of Business in Kingston where he earned a Bachelor of Commerce Honours degree with First Class Honours.

He is currently pursuing analytical roles within the energy sector in Canada.

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