

2017 FIT Price Review

Background Information

August 31, 2016

2017 Price Schedule

Feed-in-Tariff Program Pricing (¢/kWh)				
Renewable Fuel	Project Size Tranches	Current Pricing (June 21, 2016)	January 1, 2017 Pricing	Percentage Change
Solar (PV) (Rooftop)	≤ 6 kW	31.3	31.1	0.5%
	> 6 kW ≤ 10 kW	29.4	28.8	2%
	> 10 kW ≤ 100 kW	24.2	22.3	8%
	> 100 kW ≤ 500 kW	22.5	20.7	8%
Solar (PV) (Non-Rooftop)	≤ 10 kW	21.4	21.0	2%
	> 10 kW ≤ 500 kW	20.9	19.2	8%
On-Farm Biogas	≤ 100 kW	26.3	25.8	2%
	> 100 kW ≤ 250 kW	20.4	20.0	2%
Biogas	> 250 kW ≤ 500 kW	16.8	16.5	2%
Renewable Biomass	≤ 500 kW	17.5	17.2	2%
Landfill gas	≤ 500 kW	17.1	16.8	2%
On-Shore Wind	≤ 500 kW	12.8	12.5	2%
Waterpower	≤ 500 kW	24.6	24.1	2%

Overview

- The April 5, 2012, June 12, 2013, August 29, 2014, and April 5, 2016, Minister of Energy's Directions require the IESO to conduct an annual price review for the FIT Program (including microFIT)
- The April 5, 2016, Direction requires the IESO to consult on and publish an updated price schedule by September 1, 2016, which will take effect on January 1, 2017
- On June 21, 2016, an updated price schedule was posted, including the new ≤ 6 kW size tranche
- On July 8, 2016, the IESO commenced the annual price review with the posting of the 2017 price review questionnaire
- In addition to the submitted questionnaires, the IESO examined internal as well as publicly available international forecasts on project development and operational cost data, and considered FIT 4 price reduction data

Context: Cost-Based Analysis

- FIT prices reflect a cost-based assessment of the investment required to implement a given technology
- This contrasts with a value-based assessment that would reflect the benefits and costs incurred by electricity consumers as a result of implementing that technology (e.g., in terms of avoided electricity capacity and energy costs or environmental benefits)
- Costs reflect development, equipment, construction and financing related costs incurred by the project proponent (e.g., developer or homeowner)
 - Costs are informed by current industry experience and recent cost trends

Context: When will the 2017 prices apply?

- The 2017 FIT and microFIT prices will be effective January 1, 2017, however, major project purchasing decisions are often made later in the project development cycle
- The 2017 FIT prices will apply to the FIT 5 procurement
- 2017 prices will apply to projects installed as late as:
 - Mid-2018: microFIT
 - Early 2019: FIT rooftop solar
 - 2020: FIT bioenergy and non-rooftop solar
 - 2021: FIT on-shore wind
 - 2025: FIT waterpower
- FIT and microFIT prices are intended to be forward looking
- As a result, commentary relevant to costs in mid-2016 (e.g., exchange rates and duties) may no longer be relevant at the time purchasing decisions are made

Stakeholder Engagement

- The 2017 price review questionnaire was publicly posted and its availability was communicated to all (over 9,500) FIT and microFIT subscribers
- In response, the IESO received six submissions:
 - 3 industry associations (Canadian Biogas Association, Canadian Solar Industries Association (CanSIA) and Ontario Waterpower Association (OWA))
 - Of the non-association submissions, one pertained to solar, and two pertained to waterpower (with one of the waterpower submissions not entirely related to pricing)
- All submissions, except one, recommended that current (2016) prices remain the same or be raised for 2017
 - One submission recommended that microFIT solar prices remain the same and FIT solar prices be reduced by no more than 5%

Stakeholder Feedback and Responses

- The IESO received less pricing feedback this year compared to previous years
- A few submissions provided additional evidence/information to support their recommendations
 - Of these, capital costs and assumptions were in line with international forecasts but on the high end
- Some submissions advocated for the introduction of new size tranches (for specific technologies) or the increase in the number of FIT price reduction tiers
 - These proposed program changes are not consistent with the government's directed policies
- Leasing costs were again included in some costing assumptions, but at notably reduced rates from those in 2016 submissions
 - The IESO addressed leasing costs during the 2016 price review and continues to exclude them from its pricing modelling for the same rationale

IESO Analysis of Third-Party Data

Data from external consultant

- IESO received project cost and pricing data from its external consultant
- Component costs were generally lower than those provided in questionnaire responses, with some outliers present

Data from key international reports and research papers

- US wind turbine costs continue an incremental downward trend; mostly at economies of scale larger than 500 kW
- Continued limited external reporting on bioenergy and waterpower cost changes; both industries remain relatively small and site specific considerations continue to influence project costs, especially at FIT project sizes (≤ 500 kW)
- US solar costs (which are generally lower than Ontario) continue to decline; cost reductions are increasingly focused on non-module costs, including labour and installer margins

Exchange rates

- Canadian dollar is currently slightly higher than last year at CDN1.30/USD1; forecast to continue to decrease relative to the US dollar over next few years
- Asian currencies: CNY6.65/USD1 (lower than 2016), MYR4.02/USD1 (higher than 2016); both still lower than 2015

FIT 4 Price Reduction Observations

- FIT 4 was oversubscribed above the larger 241 MW procurement target by a ratio of 2:1
- Applications from all renewable fuels elected for price reduction points
 - Other than wind and solar (non-rooftop), 50% of applications from each renewable fuel elected for price reductions
- Among those that chose price reductions, with the exception of wind and renewable biomass, there was an even split between Tier 1 (-4% and 1 point) and Tier 3 (-12% and 3 points)
 - Little to no uptake of Tier 2 (-8% and 2 points)

Price Reduction Tier	Price Reduction
Tier One	4%
Tier Two	8%
Tier Three	12%

FIT 4 Price Reductions – Amounts

Applications

	No Price Reduction	Applications with Price Reductions				Total
		Tier 1	Tier 2	Tier 3	Number with Price Reduction	
Solar (Rooftop)	476	215	16	260	491	967
Solar (Non-Rooftop)	366	123	18	107	248	614
Waterpower	12	9	2	7	18	30
Wind (On-shore)	22	5	0	1	6	28
Renewable Biomass	7	6	0	2	8	15
Biogas	2	1	0	1	2	4
Biogas (On-Farm)	20	18	3	3	24	44
Total	905	377	39	381	797	1702

Contract Offers

	No Price Reduction	Contract Offers with Price Reductions				Total**
		Tier 1	Tier 2	Tier 3	Some Price Reduction	
Solar (Rooftop)	264	155	6	237	398	662
Solar (Non-Rooftop)	173	32	9	31	72	245
Waterpower	4	1	2	2	5	9
Wind (On-shore)	5	0	0	1	1	6
Renewable Biomass*	--	--	--	--	--	--
Biogas*	--	--	--	--	--	--
Biogas (On-Farm)	7	0	2	3	5	12
Total**	453	188	19	274	481	934

*Price Reduction data cannot be provided as doing so would identify the Price Reduction of individual applicants.

** Totals do not include Renewable Biomass or Biogas.

FIT 4 Price Reductions – Percentages

Applications

	No Price Reduction	Tier 1	Tier 2	Tier 3	Some Price Reduction
Solar (Rooftop)	49.2%	22.2%	1.7%	26.9%	50.8%
Solar (Non-Rooftop)	59.6%	20.0%	2.9%	17.4%	40.4%
Waterpower	40.0%	30.0%	6.7%	23.3%	60.0%
Wind (On-shore)	78.6%	17.9%	0.0%	3.6%	21.4%
Renewable Biomass	46.7%	40.0%	0.0%	13.3%	53.3%
Biogas	50.0%	25.0%	0.0%	25.0%	50.0%
Biogas (On-Farm)	45.5%	40.9%	6.8%	6.8%	54.5%

Contract Offers

	No Price Reduction	Tier 1	Tier 2	Tier 3	Some Price Reduction
Solar (Rooftop)	39.9%	23.4%	0.9%	35.8%	60.1%
Solar (Non-Rooftop)	70.6%	13.1%	3.7%	12.7%	29.4%
Waterpower	44.4%	11.1%	22.2%	22.2%	55.6%
Wind (On-shore)	83.3%	0.0%	0.0%	16.7%	16.7%
Renewable Biomass*	--	--	--	--	--
Biogas*	--	--	--	--	--
Biogas (On-Farm)	58.3%	0.0%	16.7%	25.0%	41.7%

* Price Reduction data cannot be provided as doing so would identify the Price Reduction of individual applicants.

FIT 5 Price Reduction Considerations

- There was considerable interest in the FIT 4 price reduction priority points
- It is desirable that FIT 5 applicants that have cost advantages continue to elect for price reduction priority points
- High interest in Tier 3 and low interest in Tier 2 were unexpected FIT 4 observations
- The same FIT 4 price reduction tiers will be available in FIT 5
- The FIT 5 price reduction tiers have been published on the 2017 price schedule

Non-Solar Price Considerations



- The 2015 FIT price increases for biogas, renewable biomass, landfill gas, on-shore wind and waterpower resulted in marginally increased application volumes in FIT 4
- Similarly, there was a marginal increase in on-farm biogas FIT 4 applications
- Industry feedback continues to highlight challenges with lower prices and there are no publicly available data that indicate recent cost reductions
- Almost 48% of FIT 4 applications from these fuels elected for at least one price reduction priority point (-4%) and almost 12% elected for the highest Tier 3 points (-12%)
- Therefore, prices for on-farm biogas, biogas, renewable biomass, landfill gas, on-shore wind and waterpower have been reduced by 2% for 2017

Solar PV Price Considerations

- Application volumes for solar PV continue to exceed the FIT procurement target by a wide margin
- High interest in price reduction priority points with over 50% of rooftop and 40% of non-rooftop FIT 4 solar applications electing for at least one price reduction priority point (-4%); for rooftop solar, out of applications electing for a price reduction, most elected for the highest reduction (-12%)
- US solar costs continue their downward trend
- Based on stakeholder cost estimate data, the 2016 price decreases may be helping to further the reduction of Ontario solar 'soft costs'
- Cost reductions for microFIT sized projects have not been as rapid as those for larger system sizes, and microFIT application volumes have slowed in the past year
- Therefore, prices for solar have been further decreased for 2017, with lower decreases at microFIT sizes

Solar PV Price Elements – What’s Included

- 2017 solar PV pricing will continue to shift Ontario FIT solar PV pricing towards global trends
- 2017 solar PV pricing will continue to reflect higher Ontario costs
 - Module and inverter costs have been inflated above forecast US costs to reflect observed historical higher costs in Ontario
 - CanSIA balance of system costs have been used
 - CanSIA recommended capacity factors and module degradation rates have been used with exception of microFIT non-rooftop solar, where the IESO has continued to model the capacity factor based on a dual-axis system
 - CanSIA recommended FIT interconnection costs have been used
 - CanSIA FIT O&M costs have been used

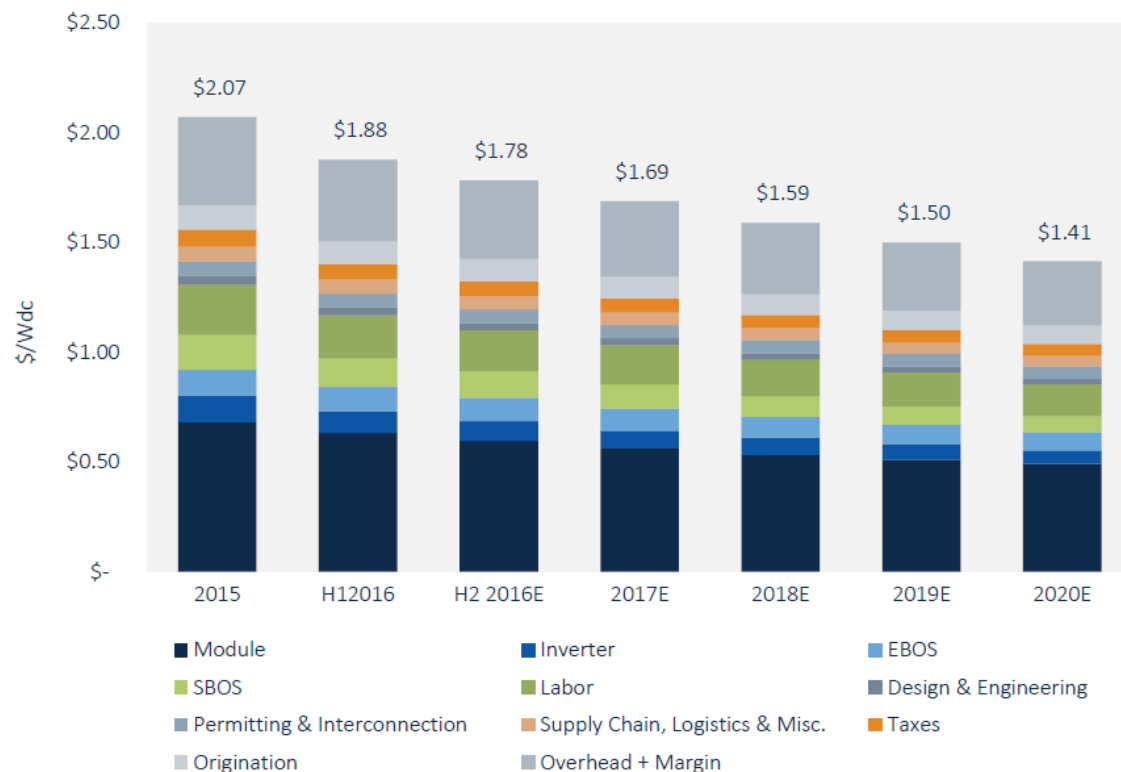
Solar PV Price Elements – What's Excluded

- Solar roof/land leasing costs continue to be excluded from IESO modelling
 - If lease structure is to be employed, the lease payment stream is expected to be deducted from the rate of return (return is expected to be shared, as required), or made up through other cost savings
 - The FIT and microFIT programs are not designed to fund every project deployment scheme that is utilized for a particular renewable fuel

Solar PV – Near-Term US Forecasting

- US solar installation costs continue to decline
- US module prices:
 - ~US\$0.68/W_{DC} in 2015
 - ~US\$0.66/W_{DC} in 2017
 - ~US\$0.53/W_{DC} in 2018
- US inverter prices:
 - ~US\$0.12/W_{DC} in 2015
 - ~US\$0.08/W_{DC} in 2017
 - ~US\$0.08/W_{DC} in 2018

Commercial PV System Pricing, 2015-2020E (\$/Wdc)



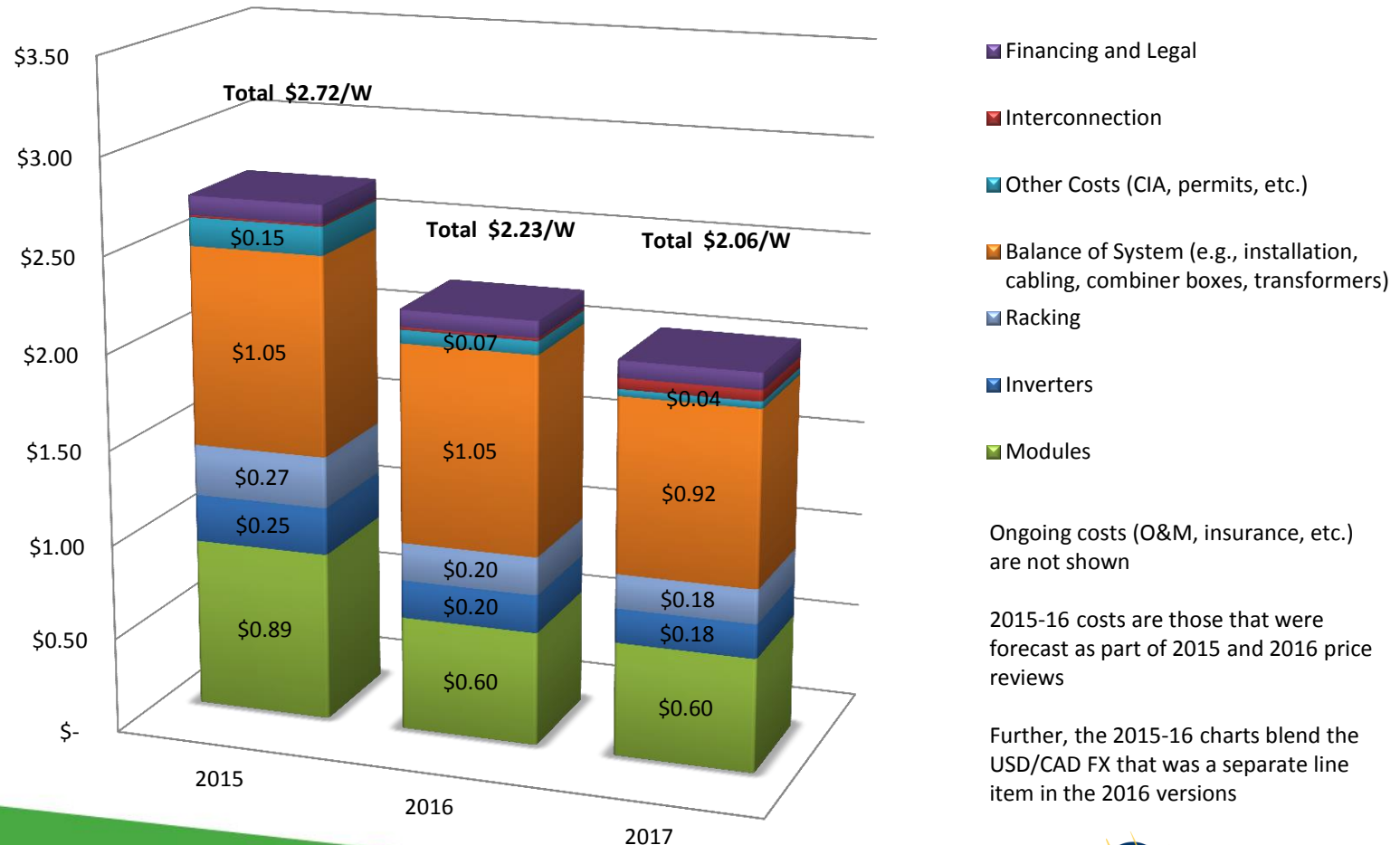
Source: GTM Research

H1 2016: First half of 2016
 H2 2016E: Second half of 2016 (estimated)

SBOS: Structural Balance of System
 EBOS: Electrical Balance of System

Solar PV Cost Elements – 2015–2017 Pricing

500 kW Solar PV Rooftop Installation Costs 2015 to 2017 FIT Price Assumptions ($\$/W_{AC}$)



APPENDIX

Assumptions

- Assumed debt/equity ratios
 - 80/20 for FIT
 - 85/15 for microFIT
- Assumed debt interest rate: 7%
- Average solar capacity factors
 - FIT: 15.6%
 - microFIT: 13% for rooftop and 22.8% for non-rooftop

Key Public Reports

- Energy Information Administration. 2016. *Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2016*. Washington D.C.: Energy Information Administration.
- Feldman, D. and M. Bolinger. 2016. *On the Path to SunShot: Emerging Opportunities and Challenges in Financing Solar*. Golden, CO: National Renewable Energy Laboratory.
- IRENA. 2016. *The Power to Change: Solar and Wind Cost Reduction Potential to 2025*. Bonn, Germany: IRENA.
- Lazard. 2015. *Lazard's Levelized Cost of Energy Analysis – Version 9.0*. November 2015.
- Wisser, R., K. Jenni, et al. 2016. *Forecasting Wind Energy Costs and Cost Drivers – The Views of the World's Leading Experts*. Washington, D.C.: U.S. Department of Energy.

Historic FIT Prices

Feed-in-Tariff Program Pricing (¢/kWh)									
Renewable Fuel	Size tranches	Sept 24, 2009	Aug 13, 2010	Apr 5, 2012	Aug 26, 2013	Jan 1, 2014	Sept 30, 2014/ Jan 1, 2015	Jan 1/ Jul 21, 2016	Jan 1, 2017
Solar PV									
Rooftop	≤ 6 kW	80.2	80.2	54.9	39.6	39.6	38.4	31.3	31.1
	> 6 kW ≤ 10 kW							29.4	28.8
	> 10 ≤ 100 kW	71.3	71.3	54.8	34.5	34.5	34.3	24.2	22.3
	> 100 ≤ 250 kW			53.9	32.9	32.9	31.6	22.5	20.7
	> 250 ≤ 500 kW	63.5	63.5	48.7	N/A	N/A	N/A	N/A	N/A
	> 500 kW	53.9	53.9						
Solar PV									
Non-Rooftop	≤ 10 kW	80.2	64.2	44.5	29.1	29.1	28.9	21.4	21.0
	> 10 kW ≤ 500 kW	44.3	44.3	38.8	28.8	28.8	27.5	20.9	19.2
	> 500 kW ≤ 5 MW			35.0	N/A	N/A	N/A	N/A	N/A
	> 5 MW			34.7					
Biogas									
On-Farm Biogas	≤ 100 kW	19.5	19.5	19.5	26.5	26.5	26.3	26.3	25.8
	> 100 kW ≤ 250 kW	18.5	18.5	18.5	21.0	21.0	20.4	20.4	20.0
Biogas	≤ 500 kW	16.0	16.0	16.0	16.4	16.4	16.8	16.8	16.5
	>500 kW ≤ 5 MW	14.7	14.7	14.7	N/A	N/A	N/A	N/A	N/A
	> 5 MW	10.4	10.4	10.4					
Renewable Biomass									
	≤ 500 kW	13.8	13.8	13.8	15.6	15.6	17.5	17.5	17.2
	> 500 kW ≤ 10 MW				N/A	N/A	N/A	N/A	N/A
	> 10 MW	13.0	13.0	13.0					
Landfill gas									
	≤ 500 kW	11.1	11.1	11.1	7.7	7.7	17.1	17.1	16.8
	> 500 kW ≤ 10 MW				N/A	N/A	N/A	N/A	N/A
	> 10 MW	10.3	10.3	10.3					
Wind									
On-shore	≤ 500 kW	N/A	N/A	N/A	11.5	11.5	12.8	12.8	12.5
	All sizes	13.5	13.5	11.5	N/A	N/A	N/A	N/A	N/A
Waterpower									
	≤ 500 kW	13.1	13.1	13.1	14.8	14.8	24.6	24.6	24.1
	> 500 kW ≤ 10 MW				N/A	N/A	N/A	N/A	N/A
	> 10 MW ≤ 50 MW	12.2	12.2	12.2					