Price Responsive Loads

May, 2025

AN IESO MARKETPLACE TRAINING PUBLICATION

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1. Introduction – What is a Price Responsive Load?

A Price Responsive Load (PRL) is a resource participation type available to load resources which provides these market participants with another option for managing price risk. A PRL is defined in Market Rules, Chapter 11: Definitions as "a *load resource* for which the *registered market participant* is authorized to submit *bids* for *energy* into the *day-ahead market* but which the load resource is not *dispatchable* and whose [operational] level is not selective or set by the *IESO* based on the price of *energy* in the *real-time market*" (that is, it is not dispatchable).

A PRL can be thought of as occupying a middle ground between dispatchable and non-dispatchable loads. Like a dispatchable load, a PRL bids into the Day-Ahead Market (DAM). If it is economic, it will receive a financially binding DAM schedule, locking in its day-ahead locational marginal price (LMP) for its scheduled quantity. Post-DAM, a PRL is treated like a non-dispatchable load. Its bid is no longer considered, meaning that like a non-dispatchable load its real-time consumption is forecast by the IESO for pre-dispatch and real-time scheduling purposes. In real-time, it is free to consume as it wishes. However, like a dispatchable load, differences between its real-time operations and its day- ahead schedule are settled at its real-time locational marginal prices.

2. Market Registration

2.1 Who can and who must become a PRL?

Registration as a PRL resource is available to new load resource applicants and currently registered non-dispatchable loads and dispatchable loads. Please note that prior to registering their resource as a PRL, the organization must have a Registered Market Participant (RMP) participation type. An RMP is responsible for entering and revising dispatch data. An RMP must be in place prior to submission of an application for PRL status.

2.1.1 Hourly Demand Response

In order to satisfy an Hourly Demand Response (HDR) capacity obligation in the energy market, a resource registered in the energy market must be assigned to the capacity obligation. A PRL resource can be assigned for this purpose.

The HDR and its associated PRL are registered as two separate resources with separate delivery points. The resources allow for the PRL and HDR to be offered separately during the availability window; for scheduling of the resources to be done; and for HDR activations to occur. The delivery points support settlement: The PRL is settled for all energy market activity whereas the HDR is settled for all capacity market-related charge types.

In the example below, a physical load has a single connection point with the grid, which is also its Defined Meter Point. The entire load is registered as a PRL with its own delivery point, with a portion of the load assigned to the HDR capacity obligation which has its own, separate delivery point.
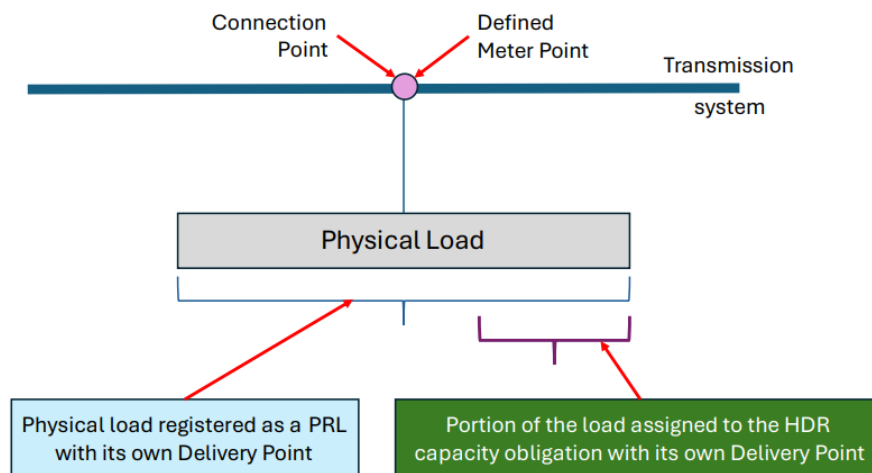

Figure 1: PRL and HDR

To be registered, a capacity market participant with a physical capacity obligation must be the registered owner of the resource associated with the capacity auction resource.

A PRL cannot be registered as a virtual contributor because a PRL's location-specific settlement pricing is incompatible with virtual HDR pricing (which is the Ontario Zonal Price plus the Load Forecast Deviation Adjustment[1]).

2.1.2 Self-Scheduling Electric Storage Resources

The load (or 'withdrawal') resource portion of a self-scheduling electricity storage resource (whether currently registered or a new applicant) must register as a PRL.[1] This is to align the settlement of the injection and withdrawal resources. Self-scheduling injection resources are settled at their locational marginal prices as are PRLs. If the withdrawal resource were registered as non-dispatchable, it would be settled on an entirely different basis; i.e., the Day-Ahead Ontario Zonal Price plus the Load Forecast Deviation Adjustment.

2.2 Equipment and Metering Requirements

Most facility equipment and metering requirements for PRLs are the same as for non-dispatchable loads – two exceptions:

- Since PRLs enter bids in the DAM, they must have a participant workstation. One or more Dispatch Data Submitter contacts must also be designated.

- PRLs enter a set of technical parameters in Online IESO regarding their equipment similar to those registered for dispatchable loads. For example, they must input their Total Peak Load – Active Power values. These are used by the IESO to determine the resource's Maximum Load – Active Power which is necessary for bid validation and scheduling purposes.

2.3 Market Control Entities

PRLs are required to register any Market Control Entities (MCEs). An MCE is any entity (an individual or organization) that has the ability to control or influence the participation of a market participant in the DAM and/or Real-Time Market (refer to Market Rules Chapter 7: System Operations and Physical Markets, section 22.9 for details). Submission of this information assists the IESO to conduct market monitoring activities.
MCE information must be submitted before registration as a PRL can be completed. MCE data can be submitted and updated as required through Online IESO.

2.4 PRL Registration of Part of a Load Resource

If only a portion of a load resource is to be registered as a PRL, the market participant may need to update their real-time data monitoring (i.e., telemetry point data) and revenue metering and ensure that the two portions of the loads are electrically separated. This can be discussed with the IESO during the registration process.

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[1] See Market Rules Chapter 7: System Operations and Physical Markets s.21.2.1 and Manual 1.5: Market Registration Procedures, s.3.5.1.1.

2.5 Prudential Support Obligations

The price basis for determining a PRL resource's prudential support obligation will be calculated by first determining the higher of its DAM LMPs and its average real-time LMPs for each hour over the last three years and then stacking these prices from lowest to highest. The value at the 50% percentile will then be used in prudential calculations.

For market participants that change their resource's participation type between non-dispatchable and price-responsive, the IESO will use the latest status to determine the energy price basis used.

More details on prudential support for all participant types can be found in the Guide to Prudentials at the IESO on the IESO website.

2.6 Changing Load Participation Types

If a market participant wishes to change their load resource from one participation type to another, it can do so by submitting a request in Online IESO. Participants are required to submit such a request at least a specified number of days prior to the intended effective date.[2]

Table 1: Participation Type Changes

Change Number	Current Resource Type	Changing to	Submit Request Prior to Effective Date by
1	Non-Dispatchable Load	Price Responsive Load	75 calendar days
2	Price Responsive Load	Non-Dispatchable Load	75 calendar days

The 75-calendar day requirement is to allow time for completion of all necessary processing steps. If a non-dispatchable load resource that has already been a PRL wishes to become a PRL again, the effective date of the change can be no sooner than 180 days from the end date of its previous PRL status. This not only allows time for the change to be processed, but it also supports fairness by limiting the ability of participants to take advantage of predictable short-term price differences between their locational marginal prices and the Ontario zonal price to the detriment of other participants.[3] If a dispatchable load is changing to a PRL, the request is to be submitted at least 75 days prior to the requested effective date. If a PRL (or a non-dispatchable load) is changing to a dispatchable load, the request is to be submitted at least 180 days before the requested effective date.

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[2] Please note, these timelines assume the organization has a Registered Market Participant participation type prior to applying for PRL status for their resource.

[3] This same restriction does not apply if the resource had switched from a PRL to a dispatchable load in change number 2 in the table. This is because the effective date of a new dispatchable load status can be no sooner than 180 days in the future (see Market Rules, Chapter 7: System Operations and Physical Markets, section 2.2.19). As such, the issue of switching back quickly to a PRL does not apply.

3. PRL Market Operations

3.1 DAM Energy Bids

Registered PRLs must enter bids into the DAM if they intend to consume energy the next day.[4] Bids consist of up to 20 price/quantity pairs (e.g, $125, 20 MW) for each hour of the dispatch day for which the market participant wishes to enter a bid. Submission can either be done daily from 6:00 to 10:00 Eastern Prevailing Time,[5] or a standing bid can be submitted. A standing bid will be automatically used every day until it is changed, expired, or withdrawn by the market participant.[6]

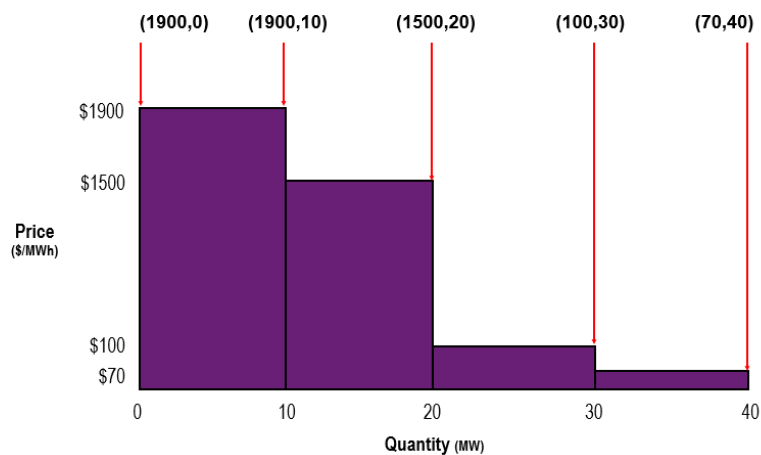Below is an illustrative example of a bid.[7]

Figure 2: Bid Price/Quantity Pair Example

Through this bid, the market participant is specifying that they are willing to pay:

- Up to $1,900/MWh to consume 10 MW;

- Up to $1,500/MWh to consume 20 MW;

- Up to $100/MWh to consume 30MW; and

- Up to $70/MWh to consume 40MW.

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[4] See Market Rules, Chapter 7: System Operations and Physical Markets, s, 3.11.

[5] Eastern Prevailing Time (EPT) means the current time applicable in Ontario, whether Eastern Standard Time or Eastern Daylight Savings Time.

[6] For more information on bid submission, see Market Rules, Chapter 7: System Operations and Physical Markets, s.3.

[7] More information on how to structure a set of price-quantity pairs, can be found in the "Introduction to Ontario's Physical Markets" training workbook, available on the IESO website.

[8] See Market Manual 4.1: Submitting Dispatch Data in the Physical Markets, s.2.5.

Bids can be entered manually by using the IESO's Energy Market Interface (EMI) tool. Participants can find detailed guidance and screenshots related to submitting energy bids through EMI in the [Submitting, Revising and Cancelling Energy Bids](#) training manual. Bids can also be submitted using an Application Programming Interface (API).

3.2 Energy Schedules and Reports following DAM completion

After close of the DAM, the 'Day-Ahead Schedule Report' and the 'Day-Ahead Hourly Energy LMP Report' will be published. The former report is private and will show the PRL's schedule while the latter public report will show all locational marginal prices including those of the PRL resource. The reports will typically be published around 13:30 EPT.

3.3 Pre-Dispatch and Real-Time

PRL bids will only be considered in the DAM. For pre-dispatch and real-time purposes, PRL consumption will be included in IESO demand forecasts. Pre-dispatch will project the resource's real- time LMP, which will be included in the Pre-dispatch Hourly Energy LMP public report. This can help market participants plan their real-time operations.

In real-time, a PRL is free to consume the same quantity of energy as their day-ahead schedule or can instead choose to consume some other amount. The difference between their actual quantity of energy consumed and their day-ahead schedule will be settled at their real-time locational marginal prices.

3.4 PRLs as Hourly Demand Response Contributors

As discussed in Section 2.1 above, an HDR and its associated PRL will be registered as two separate resources with separate delivery points at the same connection point to the IESO-controlled grid. As such, a separate bid will be entered for the HDR resource and for the PRL resource for any HDR obligation hours. The total quantity of the two bids must not exceed the registered maximum load of the PRL. If it did, it would imply a higher potential real-time consumption than the underlying physical load is registered for. For example, assume a 100 MW load registered as a PRL is also registered to fulfill a 40 MW HDR obligation. During the availability window, up to 60 MW can be bid for the PRL resource and 40 MW for the HDR resource. If the participant bid 70 MW from the PRL, it would imply that in real-time the PRL resource could consume 70 MW and the HDR resource another 40 MW, for a total of 110 MW – which is 10 MW more than the 100 MW registered for the physical load.

Outside of the availability window, only bids for the PRL resource need to be submitted. In these hours, the quantity bid for the PRL resource can be up to the resource's full registered maximum load (100 MW in the example).

Two DAM schedules, one for the PRL and one for the HDR resource, will be provided for hours when both submitted bids.

If the HDR is activated, the associated PRL can consume any amount up to its bid quantity in real-time; however, it would be considered an HDR activation failure if the PRL consumed more. Using the above example, assume the PRL bid for 60 MW and the HDR for 40 MW. If the HDR is activated for all 40 MW, for the underlying physical load to deliver the expected demand reduction at its metering point, the PRL cannot consume more than 60 MW. Although theoretically a PRL can consume in real- time whatever amount it wants up to its registered load capacity, if the PRL now consumed 70 MW, the actual reduction in demand overall at the meter point would only be 30 MW, not 40 MW.

4. Settlements

4.1 Overview of Settlements for PRLs

Settlement for PRLs is done under the two-settlement system, just as it is for suppliers and dispatchable loads. Statements and invoices contain amounts for both DAM and real-time activities.

Day-ahead market energy settlement is based on the quantity scheduled for each hour and the applicable hourly DAM locational marginal prices for that resource. A simplified formula for DAM settlement is:

$$\text{(Quantity Day-ahead x LMP Day-ahead)}$$

Charge Type 1104: Day-Ahead Market Energy Settlement Amount for Price Responsive Loads will appear on settlement statements as a separate line item for each hour of the trade date.

Real-time energy settlement occurs on a five-minute basis using the resource's real-time locational marginal prices. This settlement considers the difference between the quantity of energy actually withdrawn in real-time by the resource and its DAM schedule. A simplified formula for real-time settlement is:

$$\text{(Quantity Real-time – Quantity Day-ahead) x LMP Real-time}$$

Charge Type 1105: Real-Time Energy Settlement Amount for Price Responsive Loads will appear on settlement statements as a separate line item for each five-minute interval of the trade date.

The sum of day-ahead and real-time settlement for a given hour represents the resource's total settlement.

Below are simplified examples of energy settlement for a PRL and for a PRL with HDR obligations.

Example: Simplified Energy Charge Settlement for a PRL

Assume for Hour Ending 9 a PRL's:

- DAM Schedule: 80 MW
- DAM LMP: $25/MWh
- Real-time consumption (in all intervals[11]):   65 MW
- Real-time LMP (in all intervals): $30/MWh

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[9] Please note that real-time settlement is on a 5-minute basis. The example has been simplified for illustration purposes by assuming that all intervals have the same LMP and quantity consumed.

Table 2: Example 1 PRL Energy Charges Calculation

Line-Item Charge Type (Field 2)	Hour Ending (Field 4)	Interval (Field 5)	Effective Calculation (not on statement) ($)	Settlement Amount ($) (Field 6)[12]	Billable Quantity (MW) (Field 10)	Price ($) (Field 11)	PRL DAM Scheduled Quantity (MW) (Field 27)
1104	9	0	80 MW x $25	-2000.00	80	25	80
1105	9	1	(65-80) x $30 /12	+37.50	-15	30	80
1105	9	2	(65-80) x $30 /12	+37.50	-15	30	80
"	"	"	"	"	"	"	"
1105	9	…12	(65-80) x $30 /12	+37.50	-15	30	80

In the above example, the energy settlement for Hour Ending 9 would

be: Day-ahead Market CT 1104 = -$2,000

Real-time Market CT 1105 = $37.50 for each of twelve

intervals This would make the total settlement for the hour:

= -$2,000 + (37.50 x 12)

= -$2,000 + $450

= -$1,550

4.2 Settlements for PRLs with Hourly Demand Response Obligations

Day-ahead energy settlement for a PRL fulfilling an HDR obligation can be represented by the simplified formula:

(Day-ahead PRL Quantity + Day-ahead HDR Quantity) X Day-ahead LMP

The PRL and HDR resources bid and receive schedules separately. As such, their total scheduled day-ahead quantities must be added together to arrive at the total quantity to be billed.

The simplified formula for real-time settlement is:

(Real-time Quantity – Day-ahead PRL Quantity – Day-ahead HDR Quantity) X Real-time LMP

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[10] Note that on settlement statements, amounts owed by a market participant are shown as negatives while amounts owed to a market participant are shown as positive.

Since real-time is a balancing market intended to settle differences between day-ahead schedules and real-time actual consumption, the day-ahead PRL and HDR schedules need to be subtracted from the real-time measured quantity. This is then settled at the applicable real-time LMPs.

Example: Simplified Energy Charge Settlement for a PRL with an Hourly Demand Response Obligation

Assume the following:

Day-Ahead Market:

- Hour Ending 12
    - PRL Offered Quantity: 80 MW
    - PRL Schedule: 80 MW
    - HDR Offered Quantity: 0 MW[11]
    - HDR Schedule: 0 MW
    - LMP: $25
- For Hours Ending 13, 14 and 15
    - PRL Offered Quantity: 50 MW
    - PRL Schedule: 50 MW
    - HDR Offered Quantity: 30 MW
    - HDR Schedule: 0 MW
    - LMP Price: $25

The HDR was scheduled to consume 0 MW for hours ending 13-15 because it was activated for all 30 MW. As such, total PRL plus HDR real-time consumption should be no more than 50 MW.

Real-time Market:[12]

- Hour Ending 12
    - Consumption: 70 MW
    - RTM LMP (all intervals): $28
- Hour Ending 13
    - Consumption (all intervals):   56 MW (6 MW short of 30 MW HDR activation target)
    - RTM LMP (all intervals): $30
- Hour Ending 14
    - Consumption (all intervals):   50 MW (meets HDR activation)
    - RTM LMP (all intervals): $25
- Hour Ending 15
    - Consumption (all intervals):   45 MW (exceeds 30 MW HDR activation by 5 MW)
    - RTM LMP (all intervals): $21

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[11] The HDR was not offered since HE 12 is outside the summer availability window.

[12] Please note that real-time settlement is on a 5-minute basis. The example has been simplified for illustration purposes by assuming that all intervals have the same LMP and quantity consumed.

Table 3: Example 2 PRL With HDR Activation Energy Charges Calculation

Line-Item Charge Type (Field 2)	Hour Ending (Field 4)	Interval (Field 5)	Effective Calculation (not on statement)	Settlement Amount ($) (Field 6)	Billable Quantity (MW) (Field 10)	Price ($) (Field 11)	HDR Quantity Scheduled (MW) (Field 20)	PRL Quantity Scheduled (MW) (Field 27)
1104	12	0	(80+0) x $25	-2000.00	80	25	0	80
1104	13	0	(50+30) x $25	-2000.00	80	25	30	50
1104	14	0	(50+30) x $25	-2000.00	80	25	30	50
1104	15	0	(50+30) x $25	-2000.00	80	25	30	50
1105	12	1	(70-80-0) x $28 /12	23.33	-10	28	0	80
1105	12	2	(70-80-0) x $28 /12	23.33	-10	28	0	80
"	"	"	"	"	"	"	"	"
1105	12	…12	(70-80-0) x $28 /12	23.33	-10	28	0	80
1105	13	1	(56-50-30) x $30 /12	60.00	-24	30	30	50
1105	13	2	(56-50-30) x $30 /12	60.00	-24	30	30	50
"	"	"	"	"	"	"	"	"
1105	13	…12	(56-50-30) x $30 /12	60.00	-24	30	30	50
1105	14	1	(50-50-30) x $25 /12	62.50	-30	25	30	50
1105	14	2	(50-50-30) x $25 /12	62.50	-30	25	30	50
"	"	"	"	"	"	"	"	"
1105	14	…12	(50-50-30) x $25 /12	62.50	-30	25	30	50
1105	15	1	(45-50-30) x $21 /12	+61.25	-35	21	30	50
1105	15	2	(45-50-30) x $21 /12	61.25	-35	21	30	50
"	"	"	"	"	"	"	"	"
1105	15	…12	(45-50-30) x $21 /12	61.25	-35	21	30	50

In the above example, the net energy settlement (Day-ahead Market CT1104 + Real-time Market CT1105) would be:

- HE12: -$1,720.04;
- HE13: -$1,280;
- HE14: -$1,250;
- HE 15: -$1,265.

4.3 DAM Make-Whole Payments for PRLs

PRLs can receive DAM Make-Whole Payments. These compensate a participant if its resource was scheduled uneconomically day-ahead, typically in order to manage a reliability issue on the system.

There are different make-whole payment formulas depending on if the PRL is associated with an Hourly Demand Response resource (see Market Rules, Chapter 9: Settlements and Billing, section 3.4.10), or not (see Market Rules, Chapter 9: Settlements and Billing, section 3.4.9). In all cases, if a PRL resource had a bid below negative $15/MWh, the bid will be reset to the lower of the locational marginal price or negative $15/MWh before it is used in make-whole payment calculations.[13]

Below is an example of a DAM Make-Whole Payment calculation for a PRL without an associated HDR resource.

Example: DAM Make-Whole (Lost Cost) Calculation for a PRL

For a PRL, assume:

DAM Price/Quantity Pairs: (1900,0),(1900,10),(1000,20),(40,30)

DAM Schedule: 25 MW

DAM LMP: $90/MWh

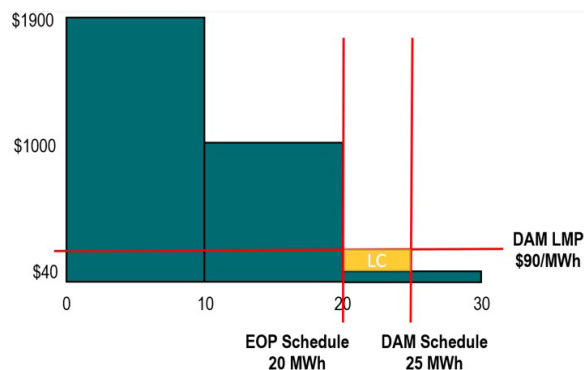Economic Operating Point (EOP):   20 MW (i.e., at an LMP of $90/MWh, it is economic for 20 MW)

Figure 3: DAM Make-Whole Payment Example

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[13] As PRLs bids are not considered in real-time, PRLs are not eligible for Real-Time Make-Whole Payments.

Table 4: DAM Make-Whole Payment (Lost Cost) Calculation

	Operating Profit for DAM Schedule		Operating Profit for DAM Economic Operating Point	
Cost at Market Price	25 MW x $90	= $2,250	20 MW x $90	= $ 1,800
Benefit Realized by Consuming Energy	10 MW x $1,900 + 10 MW x $1,000 + 5 MW x $40	= $29,200	10 MW x $1,900 + 10 MW x $1,000	= $29,000
Total	$2,250 - $29,200	=-$26,950	$1,800 - $29,000	=-$27,200

As a result, the DAM Make-Whole Payment is:

= [The maximum of ($0) or (-$26,950 +$27,200)]
= $250 paid to the PRL

4.4 Emergency Activation Payment

Emergency activation of HDR resources occurs as a result of actions taken by the IESO Control Room to avoid the declaration of an emergency operating state or to manage it after it has been declared. Emergency Activation Payment (EAP) calculations are found under charge type 1320. The formula for an EAP for an HDR associated with a PRL is:

EAP = Maximum (0, Bid Price – Maximum (0, Real-time LMP)) X Curtailed Energy

Example: Emergency Activation Payment

Assume For Hour Ending 13

- HDR Offered Quantity: 30 MW
- HDR Bid Price: $105
- HDR Schedule: 0 MW
- HDR Actual Consumption: 6 MW
- HDR Baseline: 28 MW
- Real-time LMP Price: $75

EAP = Max(0, Bid Price – Max(0, Real-time LMP)) X Curtailed

Energy EAP = Max(0, $105 – Max(0, $75)) X (28 - 6) MW

EAP = Max(0, $105 - $75)) X 22

MW EAP = Max(0, $30) x 22 MW

EAP = $660

4.5 Uplifts

Price Responsive Loads are subject to uplift charges, which are applied to all loads and exports in the physical market. These uplifts allow for the equitable recovery from all consumers on a volumetric basis of the various charges, variances, and program costs that relate to the overall operation of the market, and which are not covered within market prices. For example, settlement of congestion rents and loss residuals arising from the use of LMPs.

5. Additional Resources

- Market Rules and Manuals available through the [IESO website:](#)
  - Market Rules, Chapter 2: Participation (and Appendices)
  - Market Rules, Chapter 7: System Operations and Physical Markets (and Appendices)
  - Market Rules, Chapter 9: Settlements and Billing
  - Market Manual 1.5: Registration
  - Market Manual 4.2: Operation of the Day Ahead Market
- Participant Technical Reference Manual
- Training materials available through the [IESO Training website:](#)
  - [IESO Academy eLearning](#) – Price Responsive Loads
  - [Introduction to Ontario's Physical Markets Workbook](#)
  - [Submitting, Revising and Cancelling Energy Bids](#)

Appendix 1 – Comparison Chart of Load Types

Below is a comparison of Dispatchable Loads, Price Responsive Loads, and Non-Dispatchable Loads.

Table 4: Comparison Chart of Load Types

Attribute	Dispatchable Load	Price Responsive Load	Non-Dispatchable Load
Submits energy bids in the DAM	✓	✓	
Can submit bids for operating reserve	✓		
Can receive a DAM schedule	✓	✓	
Follows IESO dispatch instructions in real-time	✓		
Does not receive dispatch instructions in real-time. Can consume as required		✓	✓
Is settled using locational marginal prices	✓	✓	
Settled using Ontario Zonal Price (OZP) plus the Load Forecast Deviation Adjustment (LFDA)			✓
Can also be associated with a Virtual HDR resource			✓
Can also be associated with a Physical HDR resource		✓	✓

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