Design Element Options

Phase 2 – Session 8

Single Schedule Market Project

May 23, 2018

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Today's Agenda

1. Update of the work plan for Single Schedule Market (SSM) stakeholdering
2. Present and discuss:
   - Preliminary decisions regarding
     - Dynamic Losses
     - Allocation of Congestion Rents and Loss Residuals
     - Uplift allocation
   - Considerations on constraint violation price setting from other jurisdictions
3. Summary and Next Steps

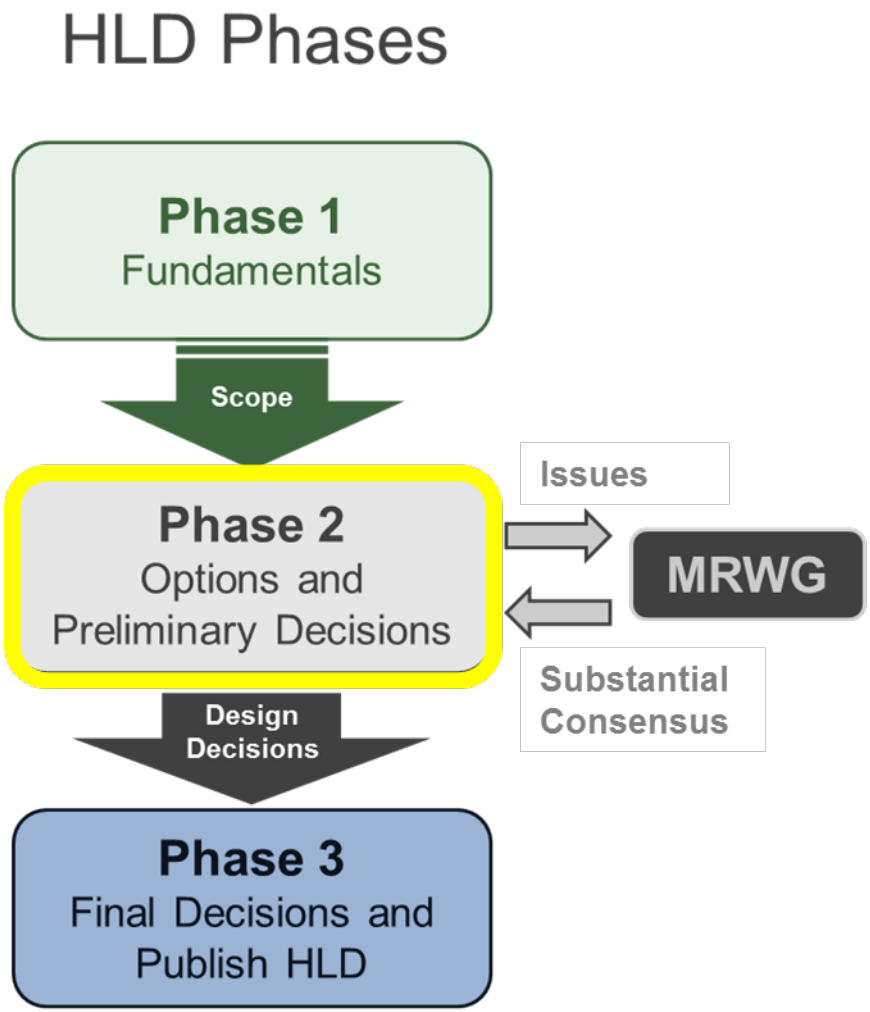
Preliminary Decisions

- Stakeholders have asked the IESO to bring forward preliminary decisions where possible
- These materials identify preliminary decisions and offer supporting rationale
- The IESO has made preliminary decisions where there is a single option or lack of viable alternative option, where there is substantial consensus by the IESO and stakeholders as to a preferred option, or where internal analysis has led the IESO to propose a specific solution
- Stakeholders are requested to use meeting time to discuss any comments, questions or concerns related to these preliminary decisions, and are also invited to provide written feedback
- Preliminary decisions are non-binding, are intended to facilitate progress on design elements which will be finalized in the High Level Design document

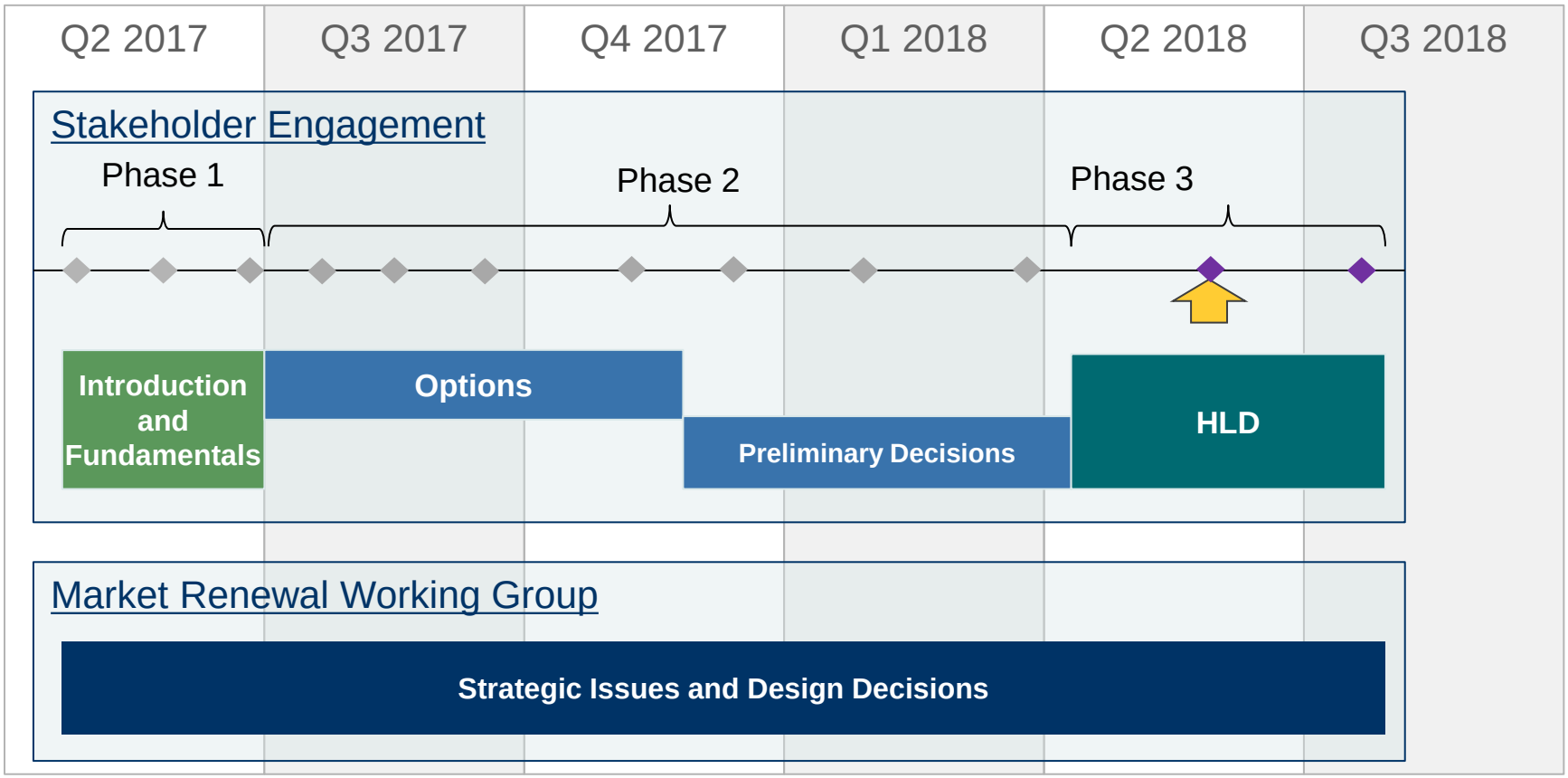
WORK PLAN FOR SINGLE SCHEDULE MARKET STAKEHOLDERING

Phases of High Level Design - Reminder

- SE Meetings will be the primary vehicle for design discussions
- In Phase 1 we will identify design elements, provide education, and define scope
- **In Phase 2 we will explore options for the design elements, provide analysis, as appropriate and develop preliminary decisions**
- In Phase 3 we will finalize decisions for all design elements and complete the HLD document
- Throughout this process we are looking for stakeholders to actively and collaboratively work with us on the design



SSM Timeline



- To streamline the SE process for SSM, DAM and ERUC the February and April meetings have been combined with the March and May sessions respectively

Today's Objectives – Outcomes and Expectations

- The IESO will be presenting a set of preliminary decisions

- Stakeholders are requested to use meeting time to discuss any comments, questions or concerns related to these preliminary decisions and are also invited to provide written feedback by June 21, 2018

Design Element #3

ENERGY PRICE – LOSS COMPONENT

Agenda

1. Loss Component – Preliminary Decision
2. Options for Determining Losses
3. History
4. Uniform vs. Locational Price Implications
5. Preliminary Recommendation
6. Summary and Next Steps

Preliminary Decision

- The preliminary decision regarding Design Element #3 was to include the cost of marginal losses in both price and dispatch
  - Decision did not discuss how those losses would be calculated
- Currently, losses are calculated using static loss factors determined once annually
- Moving to calculating losses more frequently – dynamic losses - will enable losses to be determined more accurately in each timeframe
- Dynamic losses provide more accurate dispatch and pricing results

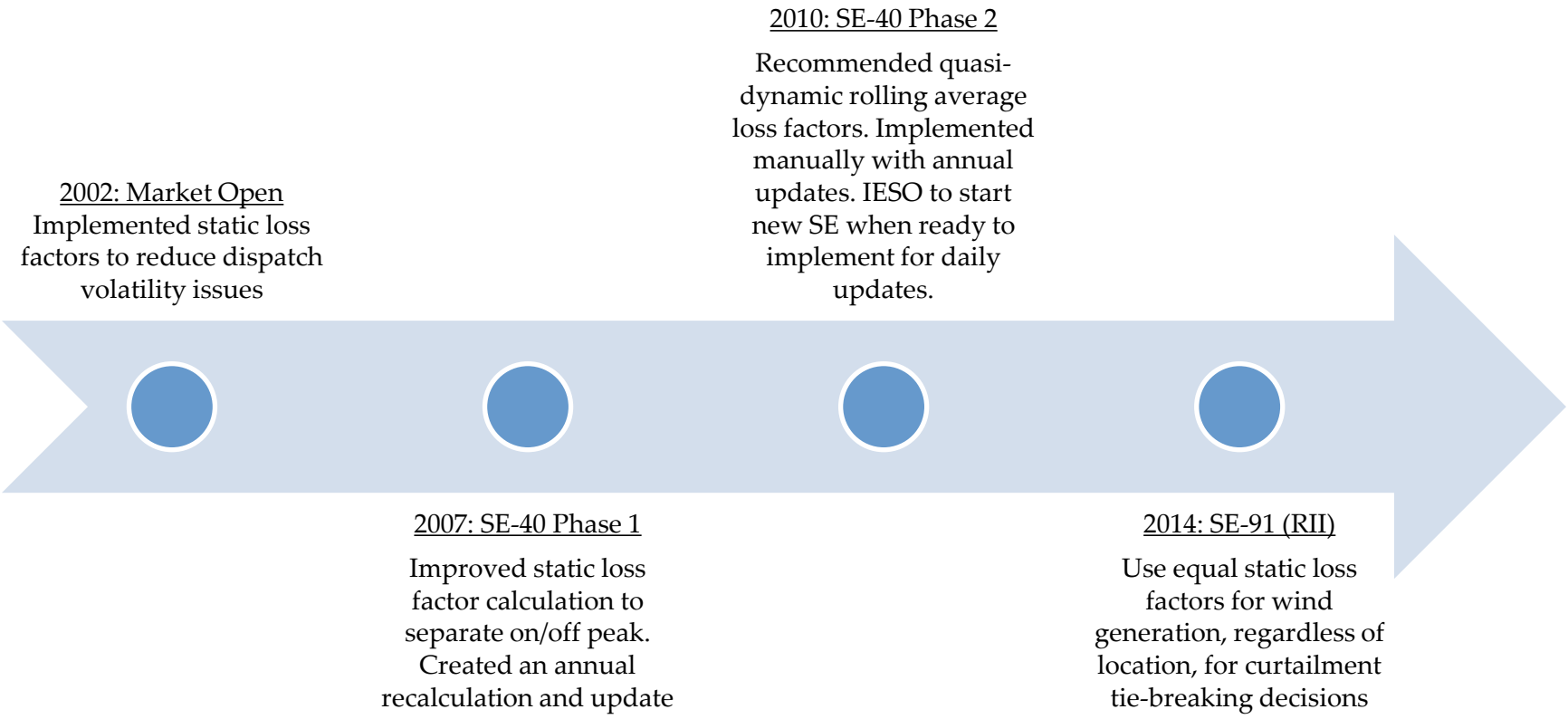
Loss Factor Options

- There are three high level options for the calculation of loss factors:
  1. Static Loss Factors
     - Calculated in advance using historical data and fixed for a period of time
  2. Dynamic Loss Factors
     - Calculated at the same time as the schedules and prices are determined
  3. Quasi-dynamic Loss Factors
     - Calculated using near-term historical data prior to the schedules and prices being determined

Loss Factor Options cont'd

- Loss factors are dependent on:
  - generation and load schedules
  - power flow
- Static loss factors reflect the cost of losses within the historical sample set used to calculate the factors
- Dynamic loss factors will provide the most accurate representation of the cost of losses for the schedule and power flow outcome. They are determined for each dispatch interval
- Quasi-dynamic loss factors will reflect some of the near-term system conditions in the cost of losses, but is less accurate than dynamic

History of Static Loss Factors in Ontario



Losses in Current System vs. SSM

- Under two-schedule system:
  - inaccuracies –increased dispatch costs are spread across the province
  - cost of losses also disbursed among all loads and exports
  - the implementation cost outweighed the benefit of moving to quasi-dynamic loss factors, as recommended under SE-40
- Under single schedule system:
  - the potential inaccuracies from static losses would directly impact the locational prices for energy

Other Jurisdictions

ISO	Loss Factor Calculation
CAISO	Dynamic
ERCOT	None
ISO-NE	Dynamic
MISO	Dynamic
NYISO	Dynamic
PJM	Dynamic
SPP	Dynamic

Preliminary Decision

- The IESO should pursue more dynamic loss factors to more accurately calculate losses
  - More accurate losses means that dispatch and pricing are also more accurate
- Decision will need to consider dispatch volatility issues that were a core problem with dynamic loss factors during market opening

Dispatch Volatility Considerations

- Dispatch volatility occurs when a resource's 5-minute dispatch changes frequently due to minor changes in the power flow solution without providing any economic or reliability improvements to the grid
- If the issue remains, the IESO will evaluate potential solutions - which could include:
  - Calculating loss factors at a station or area level, instead of nodal
  - Calculating loss factors in day-ahead and pre-dispatch but fix them in real-time

Summary and Next Steps

- The IESO recommends pursuing more dynamic loss factors for market renewal implementation
- Need to consider dispatch volatility

- The IESO will discuss this issue with vendors and will inform stakeholders of the applicable options

Design Element #17

CONGESTION RENTS AND LOSS RESIDUAL

Design Element Name Change

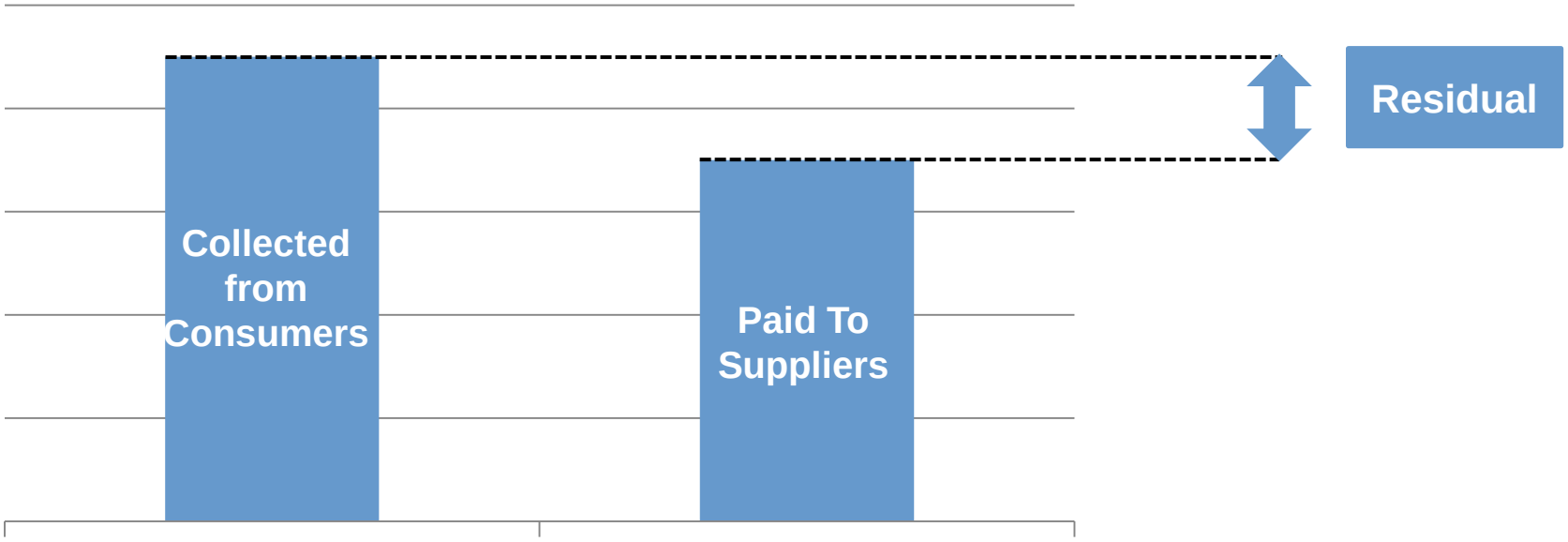
- This design element has been renamed "Congestion Rents and Loss Residual"
  - Formerly "Financial Transmission Rights"
- Discussion around this design element has focused on potential methodologies for disbursing the congestion rents and loss residuals (the "residuals") that would result from non-uniform load pricing
- New name better describes design content
  - Made in Ontario solution to mitigate potential impacts of moving away from a uniform price for market participant load
  - Removes any confusion from a link to traditional FTRs

Overview of Section

1. Recap design element, provide purpose, considerations and overview
2. Discuss preliminary decisions
   - Highlight how the proposals associated with Load Pricing (DE 16) are incorporated
   - Rationale for proposal on disbursements within a given zone
3. Summary and Next Steps

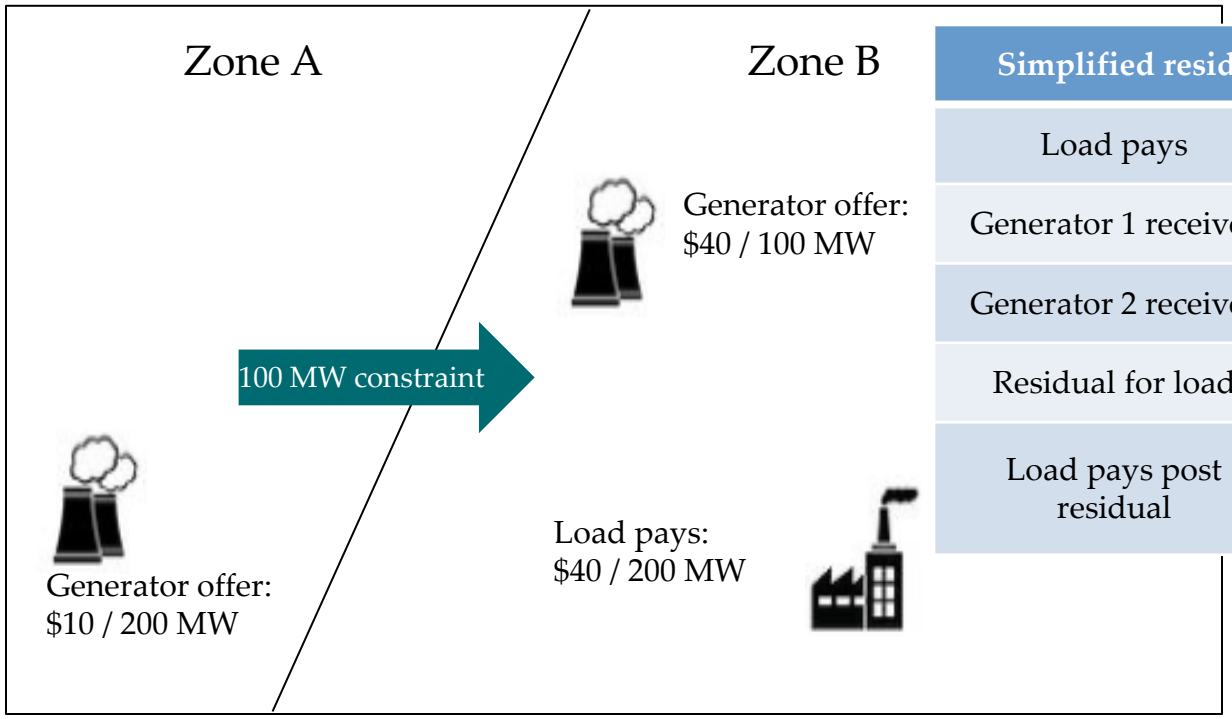
Residuals - Recap

- Locational Marginal Prices (LMPs) include the marginal value of congestion and losses
- Following the energy settlement of consumers and suppliers a remainder exists (known as a residual)



Residuals Explanation

- Residuals will occur when transmission congestion and losses cause the marginal price needed to meet demand to be different from the average prices paid to suppliers



Simplified residual settlement example	
Load pays	40 x 200 = $8,000
Generator 1 receives	10 x 100 = $1,000
Generator 2 receives	40 x 100 = $4,000
Residual for load	$3,000
Load pays post residual	8,000 – 3,000 = $5,000

Purpose of the Residual Disbursement

- The residual disbursement would be used to address the impacts of moving away from uniform pricing for wholesale loads
- All Ontario loads that are settled in the wholesale market would be eligible

Restatement of Considerations

- Mitigate the impact of moving to a nodal/zonal price for loads in a zone where the zonal price is greater than the uniform price in a given month

  Load weighted zonal price > Supplier weighted uniform price

- The disbursement will not result in higher price zones having a lower price (net of residuals) than the uniform supplier weighted price
- Process should preserve the marginal incentives of the price signal
  - Loads should still be encouraged to respond to locational prices
  - A monthly disbursement is unlikely to interfere with loads' marginal incentives to be price responsive

Residual Disbursement Process

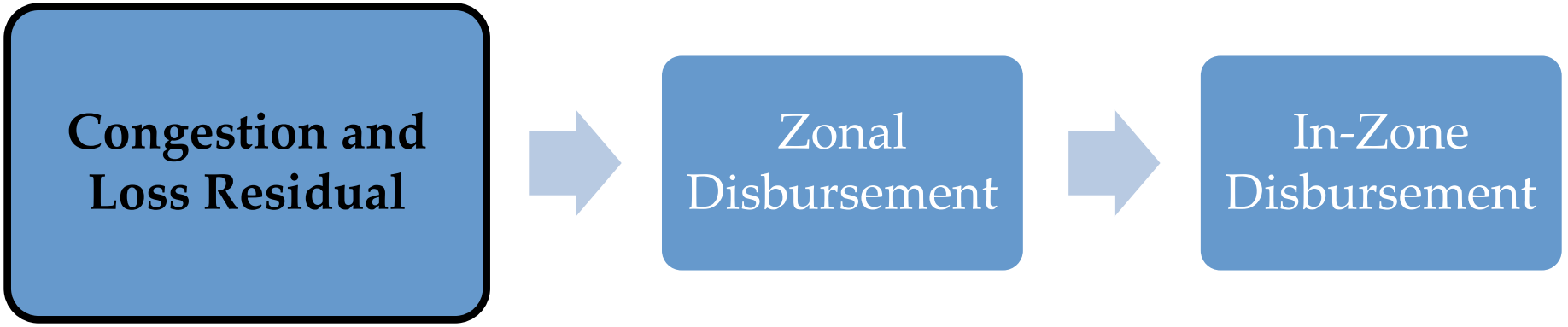
The process can be broken up into 3 key steps:

Step 1 - Collect the residual across a calendar month

Step 2 - Disburse monthly residual to zones

Step 3 - Disburse zonal residual to loads within the zone

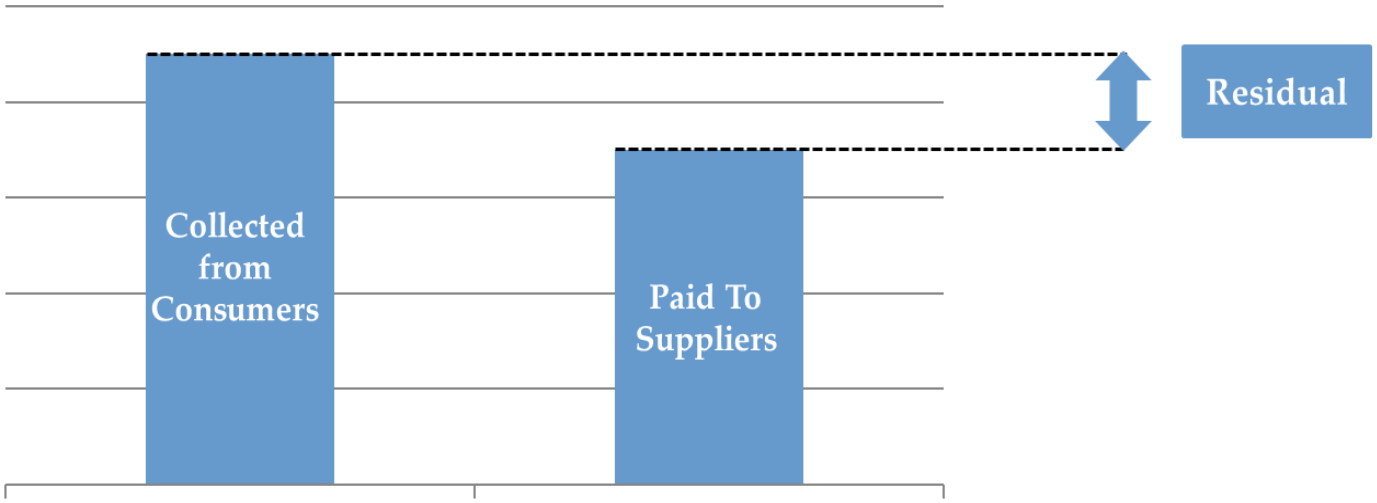
Step 1: Congestion and Loss Residual



- The residual exists as a result of including the marginal cost of congestion and losses in load pricing
- This residual surplus can be used to mitigate impacts for loads of moving to a zonal/nodal price

Collection Process – Residuals

- In a two settlement market the residual for congestion and losses will be collected in the day-ahead and the real-time balancing markets
- The residual collected will be applied to mitigate the impact on loads of moving to nodal/zonal pricing



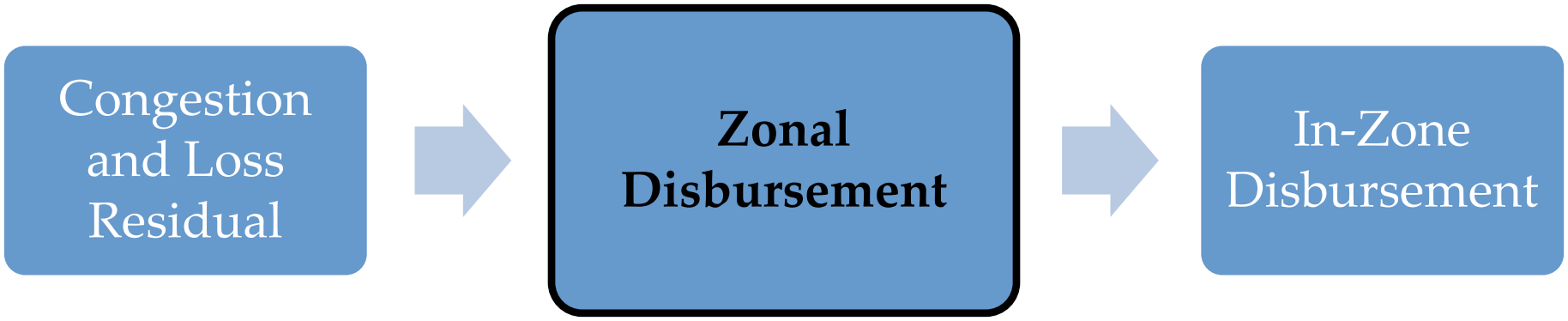
Preliminary Decision #1

The residual from congestion rents and marginal losses from both the day-ahead and real-time balancing markets will be used to fund the Residual Disbursement process

Rationale for Preliminary Decision #1

The residual can be utilized to mitigate impacts on Ontario loads of moving away from a uniform price

Step 2: Zonal Disbursement



- Collected residual will be disbursed across zones in the province
- Allocation among the zones will be relative to the increase in zonal expenditure with respect to the province-wide monthly average uniform price
- Zones that pay a monthly average price lower than uniform will not receive a portion of the residual

Zonal Disbursement

- Method used for zonal allocation will capture:
  - the relative size (by consumption) of the zone and
  - the difference between the zone's monthly average price relative to the monthly average uniform price
- Share of residual will be relative to the size of the impact on the zone from moving to locational prices, relative to other zones

Note: The zonal disbursement will use a uniform price that is the monthly average supplier weighted price for the province.

  - Same for all zones in a given month

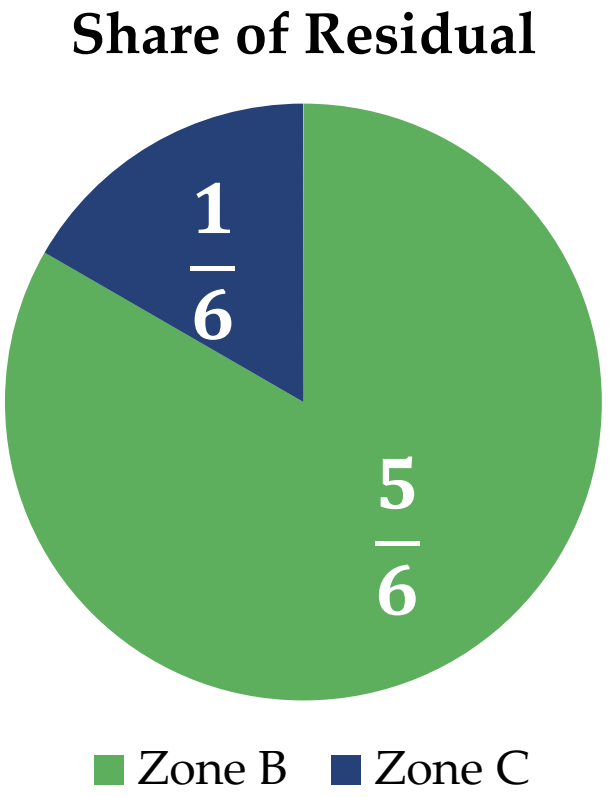
Zonal Disbursement Example

Zone	Avg. Monthly Zonal Price	Avg. Monthly Uniform Price	Disbursement Eligibility
A	$9.00	$10.00	
B	$11.00	$10.00	
C	$10.20	$10.00	

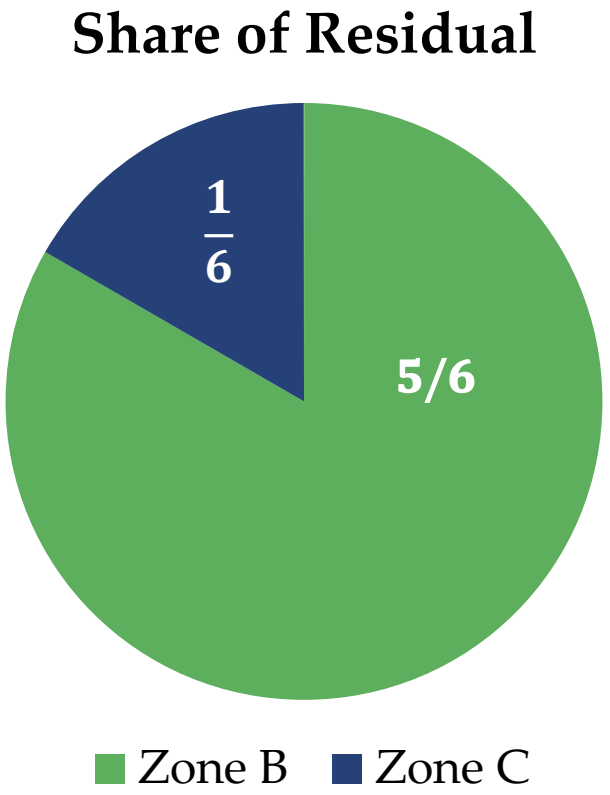
- Assume all zones consumed an equal amount of energy over the month
  - Increase in expenditure for the zone is relative to the difference between monthly average zonal price and the monthly average uniform price

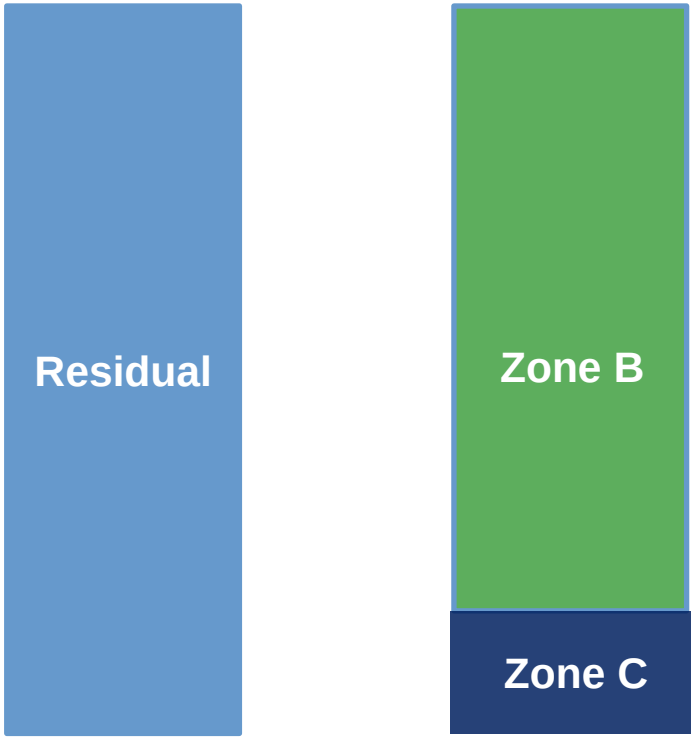
Zonal Disbursement Example (Continued)

- On a per MWh basis:
  - Zone A paid a lower price than uniform and does not qualify for the disbursement
  - Zone B paid $1.00 extra relative to the uniform price
  - Zone C paid $0.20 extra relative to the uniform price
- Zonal disbursement is based on increased expenditure relative to the uniform price



Zonal Disbursement Example (Continued)





Preserving Marginal Incentives

- Method for zonal disbursement should not have a material impact on marginal incentives
- Process depends on monthly averaging in order to determine zonal allocations
  - An increase of decrease in consumption by a single load in a given interval/hour would have little impact on the zonal allocation
  - Outcomes depend on how much, and when, other loads consume in the zone, and in other zones
- This allows a more direct allocation method to be used when determining In-Zone Disbursement

Nodal and Zonal Settled Loads

- All market participant loads are eligible for the residual disbursement
- Zonal allocation is based on each zone's expenditure
- Expenditure is not affected by the proportion of loads settled using a nodal price or zonal price
  - Zonal prices are load weighted prices based on nodal price and the consumption of zonal loads at the node
- Allocation is not impacted by the number of zonal loads that elect a nodal price (Load Pricing Decision)
  - Allows loads that are settled at different price granularities to coexist in the same zone without creating changes to the zonal disbursement

Preliminary Decision #2

Zonal Disbursement will be based on relative differences in zonal expenditure using

Load Weighted Average Price For The Zone

and

Monthly Uniform Supplier Weighted Average Price In The Province

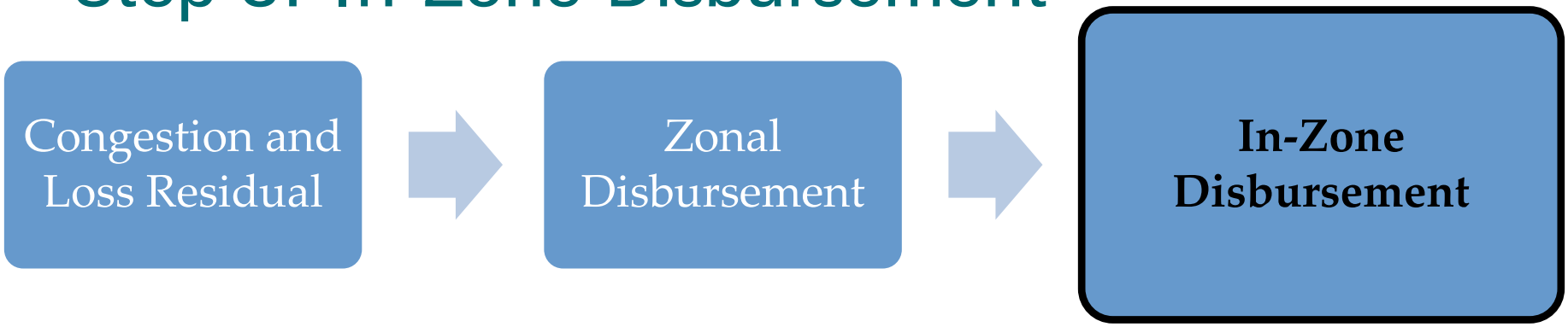
Load weighted average price for the zone will include both nodal and zonal price loads

Zones which have a load weighted average price that is lower than the monthly uniform do not receive a residual

Rationale for Preliminary Decision #2

- Zonal allocations are proportional to the impacts of moving away from a uniform price for zones paying a higher price
  - The uniform supplier weighted price is the basis for each zone's comparison
  - Zones which benefit in moving from a uniform price do not realize any further returns. This can change month to month.
- Method should not have a material impact on marginal incentives
- Zonal allocation will not change based on the number of nodally priced loads that exist in the zone
  - Loads with nodal pricing will continue to have its disbursement outcomes aligned with other loads that share the zone

Step 3: In-Zone Disbursement



- Residuals allocated to the zone will be distributed to individual loads within the zone
- At the January SSM meeting, the IESO presented 3 options for the in-zone disbursement
- Following further analysis and consideration, a 4th option has been added for consideration
  - New option recognizes the variations in consumption patterns among loads

From January SE Session -
Options for In-Zone Disbursement

Option A - Static allocation

- Proportional to its share of a static allocation of consumption in the zone with respect to other loads in the zone

Option B - Share of consumption for the month

- Proportional to its share of actual monthly consumption in the zone with respect to other loads in the zone

Option C - Share of energy expenditure for the month

- Proportional to its share of the total cost of energy that is in excess of the cost at the uniform supplier weighted price for that month with respect to other loads in the zone
  - Similar concept as Zonal Disbursement

Need for an Additional Option

- The disbursement methodology is intended to mitigate the impact on loads of moving to a non-uniform price
- Possible to improve on Options A, B and C to lessen impact of non-uniform price on average monthly price of loads:
  - Options A B and C can result in an allocation that is not proportional with the impact

Discounting of Original Options

Option A - Static allocation &

Option B - Share of consumption for the month

- Not dynamic enough to align with the timing and cost of consumption of loads relative to the uniform price
- Does not disburse residuals relative to a load's increase in cost relative to being settled at a uniform price

Option C - Share of energy expenditure for the month

- Load allocations are done with respect to a province-wide monthly average uniform price – this reference does not necessarily identify a load's increase in cost as a result of moving away from a uniform price

New Option for In-Zone Disbursement

Option D – More granular assessment of share of energy expenditure for the month

- Compares a load's total monthly cost under nodal/zonal pricing to what its cost would have been under uniform pricing
  - Similar concept to Option C
  - Assessment is performed on an interval basis using a uniform price applicable to that interval (varies by interval)
  - Loads in the zone receive an allocation based on relative impact of nodal/zonal vs. uniform

In-Zone Disbursement (Option D)

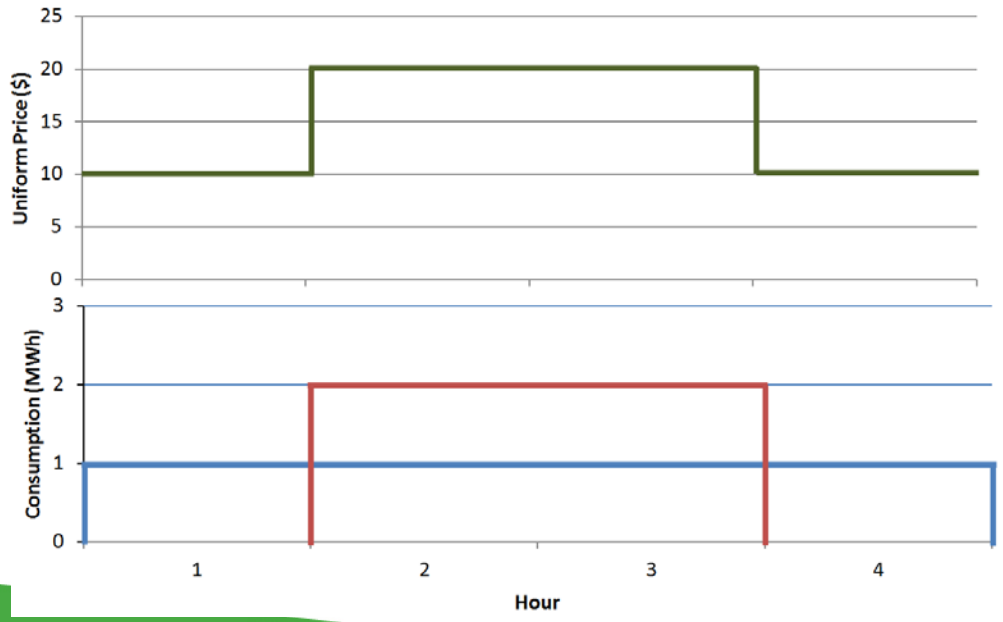
- Method used for in-zone allocation will capture
  - the relative size (by consumption) of the load
  - a loads settlement price relative to its uniform price
- Share of residual will account for the size of the impact of the load moving to locational prices relative to other loads in that zone

Note: The in-zone disbursement will use a uniform price that is the load's consumption weighted uniform price.

- Uniform prices can vary between loads

Effective Uniform Prices

- Under uniform pricing, all loads are subject to a common reference in the uniform price in each interval/hour
- However, the effective uniform price will vary by load
- The effective uniform price is based on the cost based average of the uniform price at the time of consumption.



- Load A and Load B consume 4MWh over a 4 hour period
- Cost incurred over the 4 hours varies based on magnitude of consumption at different times
- Effective Uniform for **Load** A: $15
- Effective Uniform for **Load B:** $20

In-Zone Disbursement Example

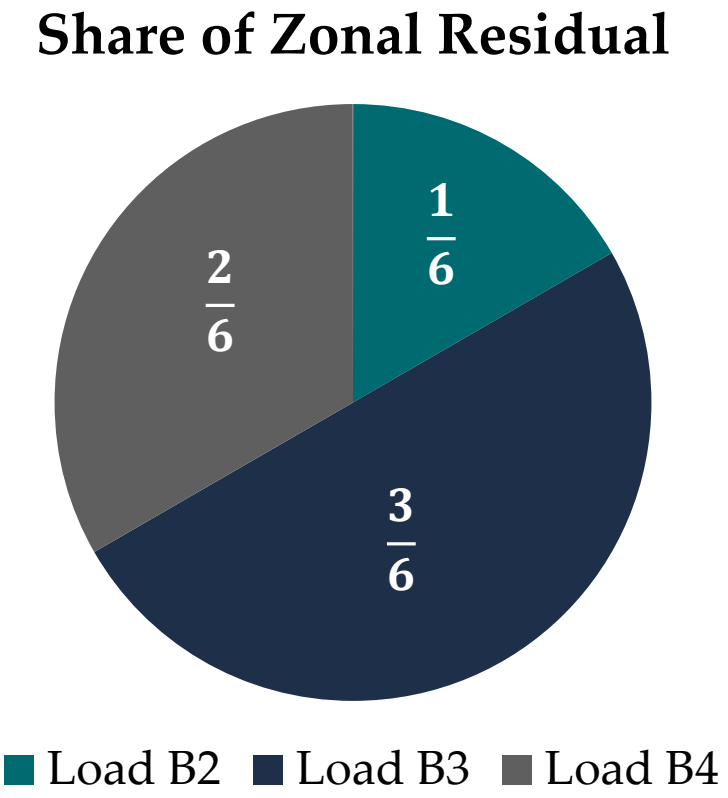
Load	Avg. Settlement Price	Avg. Uniform Price	Disbursement Eligibility
B1	$9.00	$10.00	✗
B2	$12.00	$11.50	✓
B3	$12.50	$11.00	✓
B4	$10.00	$9.00	✓

- Assume all loads consumed an equal amount of energy over the month
  - Increase in expenditure for each load is relative to the difference between their monthly average settlement price and their monthly uniform price

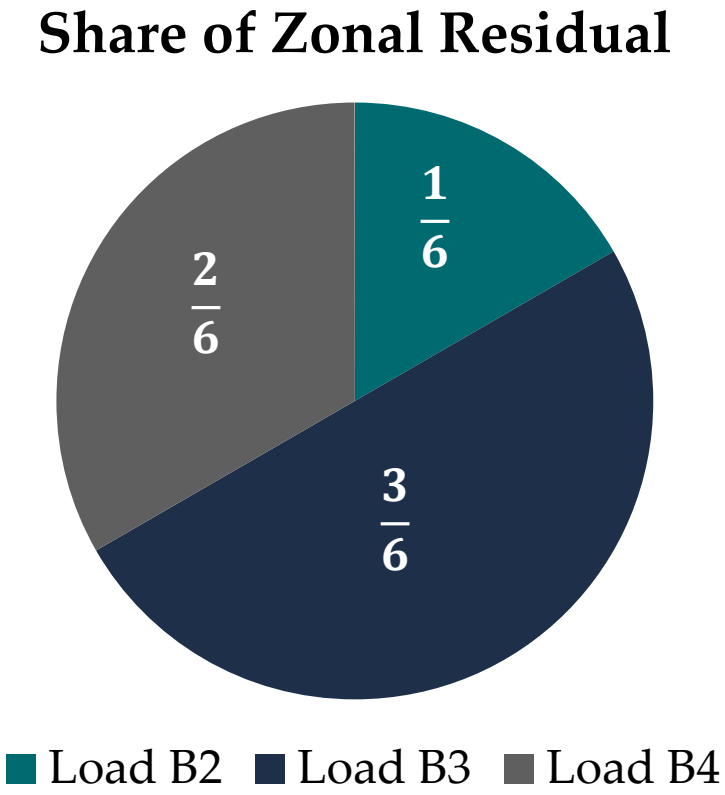
In-Zone Disbursement Example (Continued)

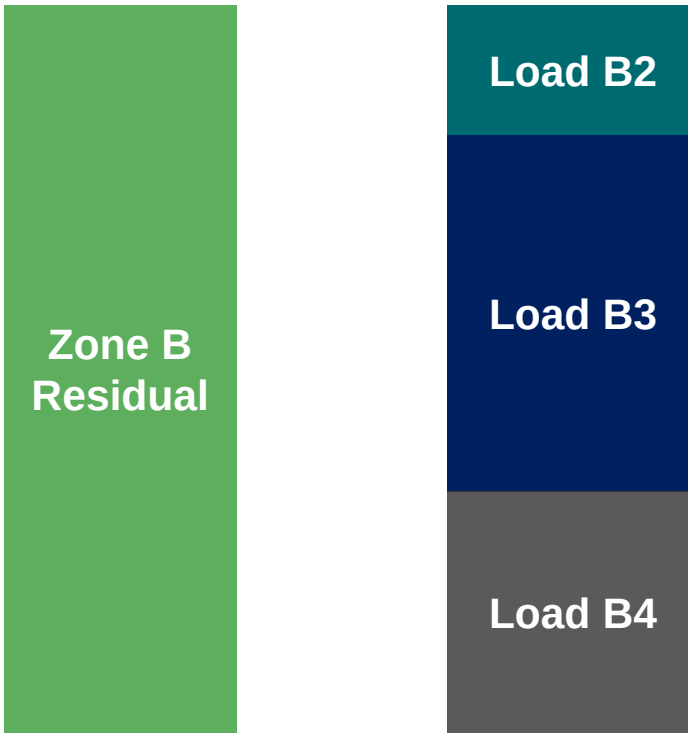
- On a per MWh basis:
  - Load B2 paid $0.50 extra relative to the uniform price
  - Load B3 paid $1.50 extra relative to the uniform price
  - Load B4 paid $1.00 extra relative to the uniform price

- Load disbursement is based on increased expenditure relative to a load's own uniform price



In-Zone Disbursement Example (Continued)





Preliminary Decision #3

In-Zone Disbursement will be based on (Option D) the relative difference between a load's expenditure across the month using

Loads Applicable Settlement Price - Nodal Or Zonal (in the interval)

and

Monthly Uniform Supplier Weighted Average Price In The Province (in the interval)

In-Zone Disbursement will be done relative to all other loads in the zone

Loads with a settlement price that is lower than their average uniform price, will not receive a portion of the residual

Rationale for Decision #3

- Option D recognizes that individual loads have different load patterns and allocates the residuals in recognition of those differences
  - All loads benefit proportionally to their impact
  - In-zonal share is directly tied to when a load consumed and its contribution to the residual, all relative to the experience of other loads in the zone
- While option D is the most direct method for calculating the in-zone disbursement, the overall mechanics of the process are intended to avoid adverse impacts to marginal incentives

Preliminary Decision #4

A limit will be applied to the zonal and in-zone disbursement to ensure that no load is settled at an overall monthly price that is less than what their monthly cost would have been under uniform pricing

Rationale for Preliminary Decision #4

Disbursement process is limited to only addressing the impact of loads moving to a nodal/zonal price

Summary

The preliminary decisions discuss how the residuals will be distributed to Ontario load:

1. Residuals will be used to mitigate the impact of moving to non-uniform pricing for Ontario load
2. Zones with prices higher than the uniform price will receive a share of the residuals
   - Lower priced zones keep the locational benefit
3. Residuals will be disbursed in-zone based on each load's locational price relative to what its cost would have been under a uniform price
   - Allocation will not result in a lower cost than the uniform price alternative

Next Steps

- The IESO encourages stakeholders to provide feedback, including questions and concerns, on the preliminary decisions made for the disbursement of Congestion Rents and Loss Residual.
- Feedback is requested by June 21, 2018

Design Element #19

UPLIFT

Overview of Section

1. Recap uplift design element
   - Review design recommendations in other design elements
   - Understand what uplift decisions are required to address any uplift created as a result of SSM decisions
2. Discuss preliminary design decisions
   - Residual Uplift
   - Make-Whole Uplift
3. Summary and Next Steps

Recap of Uplift Design Element

- Uplift charges are used to either recover revenue from consumers that has been under charged, or provide credits if they have been over charged

- In Nov. IESO provided options for distribution of congestion rents and loss residuals:
    1. Per MWh of actual withdrawals by Ontario load
    2. Per MWh of actual withdrawals by Ontario load and exports

    These options applied only to congestion and loss residuals not allocated in other ways (e.g. residuals disbursed as a result of design element #17)

Recap of Uplift Design Element

- Decision on uplift allocation was dependant on the preliminary decisions regarding:
  - **Load Pricing:** use prices from load nodes to reflect marginal losses and congestion
  - **Congestion Rents and Loss Residual:** use residual to lessen the impact to Ontario load of moving away from a uniform price

Objective of Design Element Decision

- There are also other SSM design elements that will influence uplift based on their preliminary decisions:

  Make-Whole Payments: calculate a payment for constrained up and constrained down suppliers (could be as a result of decisions below)

  - **Multiple Interval Optimization:** use MIO to determine schedules and prices
  - **Price Setting Eligibility:** resources with operating restrictions are not allowed to set price
  - **Constraint Violation Pricing:** can use different penalty prices between the dispatch and the pricing pass
  - **Control Action Pricing:** prevent certain control actions from affecting price

- This design element states how to assign the uplift costs associated with the above make-whole payments

Non-SSM Related Uplifts

Other types of uplifts are not being changed or are applicable to other projects within MRP Energy Stream

- Where applicable they will be discussed as part of DAM and ERUC

They include, but may not be limited to:

- Ancillary Services
- Demand Response Products
- Real-time commitment costs
- Day-ahead commitment costs
- Failure Charges

Congestion Rents and Loss Residual

- In a two settlement market congestion rents and loss residuals (the "residuals") will be collected in the day-ahead and real-time balancing markets
- The residual in a given month will be distributed to loads based on a monthly zonal/in-zone disbursement process discussed in the Congestion Rent and Loss Residual Design Element

Preliminary Decision #1

It has been proposed that the residual from congestion rents and marginal losses will be allocated according to the methodology outlined in Design Element #17 – Congestion Rents and Loss Residuals. Therefore no decision regarding the uplift of the residual is required.

Rationale for Preliminary Decision #1

Proposal is to disburse the residuals in a manner that serves to mitigate the impact to loads of moving to a non-uniform price.

Make-Whole Uplift

- For clarity, make whole payments discussed in SSM only apply to intra-hour payments
  - Payments assessed on an interval-by-interval basis as a result of a discrepancy between the LMP, the schedule and the offered/bid curve
  - Make up any lost cost/opportunity that is incurred
- Intra-hour make whole payments are the result of:
  - Optimization Outcomes
  - Price Formation Mechanics
  - Resource Characteristics
  - Manual Control Actions

Make-Whole Uplift

- Make whole payments provide appropriate incentives for resources to follow IESO dispatch instructions
  - This provides operational certainty for the IESO
  - SSM highlighted a need for these payments as part of:
    - Multiple Interval Optimization
    - Constraint Violation Pricing
    - Control Action Pricing
    - Price Setting Eligibility
- These payments are for costs not recovered through locational marginal prices
  - Cost of the make-whole payments needs to be assigned

Consideration for Uplift of Make Whole Payments

- Currently, make-whole uplift is assigned on an hourly basis
  - Continues to be an important principle to retain, as it causes this uplift to be disbursed based on a principle of cost causality
  - Consumers (Ontario loads and exports) which benefited as a result of their consumption in a given hour should cover any imbalance of costs in that hour

Preliminary Decision #2

Uplift associated with intra-hour make-whole payments will be allocated hourly on a per MWh of actual withdrawals by Ontario load and exports.

Rationale for Preliminary Decision #2

- Intra-hour cost as a result of make-whole payments are distributed based on a principle of cost causality
- These are unrecovered costs that are a necessity as a result of delivering energy and scheduling operating reserve
- Benefits are proportionally shared between load consumers and exports

Summary of Preliminary Decisions

#1 The residual from congestion rents and marginal losses is to be disbursed to loads to mitigate the impact of moving to a non-uniform price. No decision regarding the uplift of the residual is required.

#2 Uplift associated with intra-hour make-whole payments will be allocated hourly on a per MWh of actual withdrawals by Ontario load and exports

Next Steps

- The IESO encourages stakeholders to provide feedback, including questions or concerns, on the preliminary decisions made for Uplift
- Feedback is requested by June 21, 2018

Design Element #9

CONSTRAINT VIOLATIONS

Overview of Section

1. Constraint Violations Recap
2. Review of preliminary design decisions
3. Overview of practices in other markets
   - Considerations and methodologies in determination of constraint penalty prices
4. Next steps

Recap of Constraint Violations

- Constraint Violation Pricing deals with how prices are set when no feasible dispatch solution exists to one or more constraints
- Two categories of constraints
  - Reliability Based Constraints, which are representations of the IESO's obligations under NERC or NPCC standards
  - Non-reliability based constraints, which are not related to NERC or NPCC standards; compliance may be more discretionary
- At the March 2018 SSM meeting, the IESO presented two preliminary decisions regarding constraint violations

Review of Preliminary Decision #1

For reliability based constraints, apply current penalty prices in dispatch, but use a different set of penalty prices in pricing.

- This applies to constraints dealing with:
  - Power Balance (Under/Over Generation)
  - Operating Reserve Requirements (10S, 10N, 30Min)
  - Area Reserve Requirements (Min/Max)
  - Intertie Import/Export Transmission Limits
  - Security Transmission Violation

Review of Preliminary Decision #2

For non-reliability based constraints, apply the same penalty prices in dispatch and in pricing.

- This applies to constraints dealing with:
  - Net Interchange Scheduling Limit (NISL)

Overview of Other Jurisdictions' Practices

- The intent of this presentation is to provide an overview of considerations and methodologies used by other markets when determining whether and how to apply constraint penalty prices
- Considerations and methodologies presented are for discussion only. They may not be applicable to Ontario's market design
- The IESO intends to develop applicable considerations and methodologies during the detailed design phase

Considerations and Methodologies in Other Markets

1. **Decision on applying penalty pricing**
   - There has been increased use of penalty pricing rather than relaxation
   - Issues encountered in obtaining intended results from relaxation methodology
   - Lack of penalty pricing observed to potentially result in very high cost dispatch solutions to resolve relative low-risk/cost violations (e.g., occurring for only a few intervals)

Considerations and Methodologies in Other Markets

2. Does the same penalty price apply to dispatch and pricing runs

- Best practice is to send prices consistent with the dispatch, if possible
- May not be possible as a result of:
  - A need to enforce non-market constraints in the scheduling run
  - A need to enforce reliability based constraints
- Some ISOs have a margin by which their some constraints can be violated before encountering NERC limits.

Considerations and Methodologies in Other Markets

3. Analytical design of penalty functions:

- Typical design of steps:
  - First step, for a small number of MWs, with a fairly low price for a small violation
  - Big intermediate step at an intermediate price
  - Last step at high price, for a small number of MWs, sometimes at the price cap
- Other designs include:
  - A continuous penalty price curve ($/MW violation)
  - Multiple to many steps (e.g., 10 steps of increasing $/MW violation)
  - Single price
- Transmission penalty functions that differ based on:
  - Voltage level
  - Potential to be resolved efficiently through re-dispatch

Considerations and Methodologies in Other Markets

4. References used when determining penalty prices:

- Value of lost load and associated probability based on prevailing conditions
- Maximum market clearing price
- The energy cost of existing generation typically used or available to resolve a violation
- The cost of a new peaking generation that, if built, would solve the constraint
- Analysis of reasonable maximum level for penalty price so as not bring on a resource that would have minimal impact in solving the constraint (product of a low shift factor and offer price)
- Definition of a violation magnitude at which the penalty price should be set at the maximum market clearing price
- Definition of the MW value at which relaxing the constraint further does not provide additional value

Considerations and Methodologies in Other Markets

5. Reliability considerations in setting penalty prices:

- Prevent violation of power balance constraint versus violation of other constraints
- Prevent violation of regulation service constraint in order to maintain operating reserve
- Prevent violation of operating reserve constraint in order to maintain exports
- Avoid committing high cost resources with little impact on reliability or extremely high cost to achieve minor relief of violation (operators would not choose to commit them)
  - Allow the temporary use of regulation resources without affecting system reliability
  - Allow the temporary violation of the power balance or operating reserve without affecting system reliability

Considerations and Methodologies in Other Markets

5. Reliability considerations in setting penalty prices (cont'd):

- Consider whether within-day commitment for reliability likely to be feasible to avoid at a reasonable dispatch cost
- Avoid high resulting from anomalous dispatch solutions driven by extreme penalty values

Considerations and Methodologies in Other Markets

6. Market considerations:

- Desire to send appropriate market price signal for market participants taking actions outside of the dispatch (e.g., scheduling additional imports/exports)
- Avoid prices that are inconsistent with the reliability cost of small or short term violations
- Avoid price volatility for violations likely to require operator intervention

Next Steps

- The IESO intends to develop methodologies for, and determine, constraint violation penalty prices during the detailed design phase of the project
- Feedback on this topic is requested by June 21, 2018