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Greenhouse Gas Emissions Tracking Methodology

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Executive Summary

Starting January 2013, the ISO market became subject to the state's greenhouse gas cap-and-trade program compliance requirements. California Assembly Bill 32 (AB 32), the Global Warming Solutions Act of 2006, directed the California Air Resources Board (CARB) to develop regulations to reduce greenhouse gas emissions to 1990 levels by 2020. In support of the greenhouse gas cap-and-trade compliance requirements, the ISO enhanced its market dispatch to support scheduling coordinators representing generators in the ISO balancing area and the imports serving load in ISO to incorporate GHG costs into their energy bids. Since the introduction of the western Energy Imbalance Market (EIM) the ISO has been operating an expanding regional electric grid across the western United States. The EIM allows for the economic transfer of energy between participating systems in real-time to serve electric load. The EIM dispatch also incorporates GHG costs associated with resources that are supporting transfers into the ISO that are serving demand in California. To the extent EIM transfers of non-emitting resources are displacing energy that would have been produced by emitting resources across participating systems the EIM dispatch can reduce greenhouse gas emissions associated with serving electric load both within the ISO's balancing authority area and the EIM Entities' balancing authority areas. In order to provide increased transparency into the overall GHG effects of serving load in the ISO, the ISO has developed a GHG tracking report. This report quantifies the amount of estimated GHG emission to serve ISO load. Furthermore the tracking report estimates the volume of GHG emissions reductions facilitated by the EIM by comparing a counter-factual dispatch without EIM optimized dispatch to the GHG emission of the EIM dispatch. In other words the counter-factual dispatch analysis quantifies the difference in GHG emissions that would have occurred without the ability to effect real-time transfer of energy among the ISO and EIM participants' systems with the GHG emission that actually occurred as a result of the EIM dispatch.

Background

This document provides methodology of tracking of the greenhouse gas emissions for the ISO balancing authority area as a direct result from dispatch of ISO internal resources (including dynamic resources), net imports, and transfers from EIM entities into the ISO based on the counter-factual determination. In addition, this document provides the methodology of calculating the overall greenhouse gas emissions reduction using the counter-factual method as a result of the EIM operations.

Total GHG emissions to serve ISO demand = GHG emissions from internal ISO dispatches including dynamic schedules + GHG emissions from net imports + GHG Impact from EIM transfers into ISO using counter-factual determination - GHG Impact from EIM transfers out of ISO using counter-factual determination[1].

[1] Computation of GHG impact for EIM transfers using counter-factual dispatch was started from January 2016. Before January 2016, GHG resource allocation in EIM entity was used for EIM transfers.

The GHG Emission for internal ISO dispatches includes all the resources dispatched by the ISO market within balancing area to serve the ISO load including the resource specific dynamic resources. The GHG Emission from net ISO imports includes the net of all the energy to be transferred to/from the ISO Balancing Authority Area from/to another Balancing Authority Area based on agreed-upon megawatts, start and end time, beginning and ending ramp times and rate, and type required for delivery and receipt of power and energy between the source and sink Balancing Authority Areas involved in the transaction. The net imports are the imports that serve ISO load. Net Imports does not account for the EIM transfers into/out of ISO.

The GHG impact from EIM transfers in and out of ISO using the counter-factual determination is based on the EIM Quarterly Benefit Report Methodology[2]. EIM transfers into to ISO are serving load in the ISO that would have otherwise been served by other resources within or into the ISO. EIM transfers out of the ISO are serving load in the EIM balancing area that would have otherwise been served by other resources within or into the EIM balancing area. The counter-factual dispatch meets the same amount of real – time load imbalance in each BAA without EIM transfers with neighboring EIM BAAs. For each 5-minute interval, the EIM transfers are unidirectional.

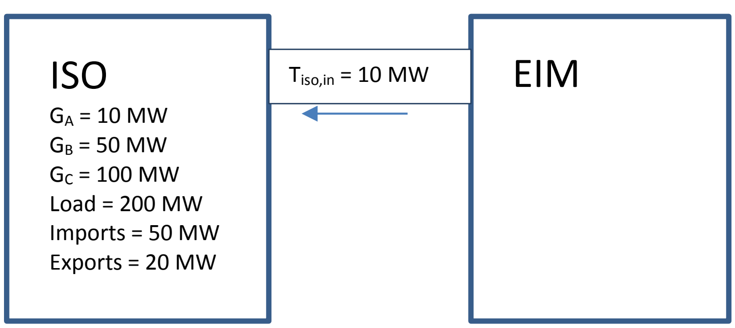
The heat rate used in the calculation of GHG emission is resource specific heat - rate provided by the respective scheduling coordinator of the resource.

With appropriate unit conversions

GHG Emissions (mTCO2) = resource heat rate (MMBTU/MWh) * CO2 emission factor by resource type[3] (mTCO2/MMBTU) * Energy (MWh)

For net imports in ISO and EIM, the default CO2 emission factor of 0.0428 mTCO2/MMTBU was used. Otherwise, resource specific CO2 emission factor was used.

Example 1 (with EIM Transfers into ISO serving ISO load):



[2] http://www.caiso.com/Documents/EIM_BenefitMethodology.pdf
[3] http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&tpl=/ecfrbrowse/Title40/40cfr98_main_02.tpl

ISO Assumptions:

ISO resource A = $G_{iso,a}$ = 10 MW (Gas with heat rate of 8500 BTU/KWh)
ISO resource B = $G_{iso,b}$ = 50 MW (Gas with heat rate of 9500 BTU/KWh)
ISO resource C = $G_{iso,c}$ = 100 MW (Wind)
ISO imports = I_{iso} = 50 MW
ISO exports = E_{iso} = 20 MW
EIM Transfers into ISO based on counter-factual determination of external resources dispatched to support EIM transfer in ISO = $T_{iso,in}$

$T_{iso,in,x}$ = 3 MW (Hydro)
$T_{iso,in,y}$ = 1 MW (Coal resource with heat rate = 10000 BTU/KWh)
$T_{iso,in,z}$ = 6 MW (Gas resource with heat rate = 9000 BTU/KWh)

EIM transfers into ISO based on counter-factual determination of ISO supply that is displaced by EIM transfers into ISO = $T_{iso,disp}$

$T_{iso,disp,i}$ = 4 MW (Gas with heat rate of 10000 BTU/KWh)
$T_{iso,disp,j}$ = 6 MW (Gas with heat rate of 9000 BTU/KWh)

GHG Emission for ISO:

ISO internal dispatch = $G_{iso} = G_{iso,a} + G_{iso,b} + G_{iso,c}$
= 10 + 50 + 100 = 160 MW

ISO Demand = L_{iso} = ISO internal dispatch + ISO imports – ISO exports + EIM transfers into ISO using counterfactual determination

$= G_{iso} + I_{iso} – E_{iso} + T_{iso,in}$
= 160 + 50 – 20 + 10 = 200 MW

Total GHG Emission for ISO = GHG_{iso}

= GHG emission to serve ISO demand = GHG_{Liso}

= GHG emission ISO internal dispatch + GHG emission ISO imports – GHG emission ISO exports + GHG emission from EIM transfers into ISO using counter factual determination

$= GHG_{Giso} + GHG_{Iiso} – GHG_{Eiso} + GHG_{Tiso,in}$

GHG emission from ISO internal dispatch = GHG_{Giso}

$= GHG_{Giso,a} + GHG_{Giso,b} + GHG_{Giso,c}$

$GHG_{Giso,a}$ = (8500/1000)*0.053165*10 = 4.519 mTCO2
$GHG_{Giso,b}$ = (9500/1000)*0.053165*50 = 25.25 mTCO2
$GHG_{Giso,c}$ = 0 mTCO2

GHG_{Iiso} = (10000/1000)*0.0428*50 = 21.4 mTCO2
GHG_{Eiso} = (10000/1000)*0.0428*20 = 8.56 mTCO2

$GHG_{Tiso,in} = GHG_{Tiso,in,x} + GHG_{Tiso,in,y} + GHG_{Tiso,in,z}$
$= 0 + (10000/1000)* 0.09471*1 + (9000/1000)*0.053165*6$
$= 3.82$ mTCO2

GHG emission to serve ISO demand $= GHG_{Giso} + GHG_{Iiso} – GHG_{Eiso} + GHG_{Tiso,in}$
$= (4.52 + 25.25 + 0) + 21.4 – 8.56 + 3.82$
$= 46.43$ mTCO2

Overall EIM GHG Benefit Reduction:

Overall EIM GHG Benefit Reduction based on counter-factual determination
$= (-1)*GHG_{net,eim}$
= (-1)*(GHG benefit reduction based on EIM transfers into ISO using counter-factual dispatch)
$= (-1)*(GHG_{Tiso,in} - GHG_{Tiso,disp})$

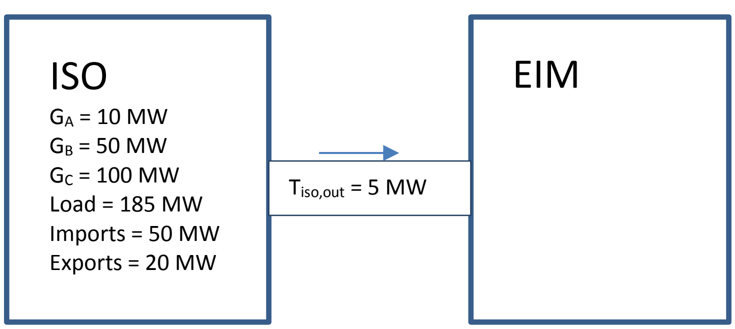
$GHG_{Tiso,disp} = GHG_{Tiso,disp,i} + GHG_{Tiso,disp,j}$
$= (10000/1000)*0.053165*4 + (9000/1000)*0.053165*6$
$= 2.12 + 2.87 = 4.99$ mTCO2

Overall EIM GHG Benefit Reduction = (-1)*(3.82 – 4.99) = 1.17 mTCO2

There was 1.17 mT CO2 of GHG emission reduction due to EIM using the counter-factual dispatch for the example above.

GHG	mTCO2
GHG emission to serve ISO Load	46.43
GHG EIM Benefit Reduction	1.17

Example 2 (with EIM Transfers out of ISO serving EIM load):



ISO Assumptions:

ISO resource A = $G_{iso,a}$ = 10 MW (Gas with heat rate of 8500 BTU/KWh)

ISO resource B = $G_{iso,b}$ = 50 MW (Gas with heat rate of 9500 BTU/KWh)
ISO resource C = $G_{iso,c}$ = 100 MW (Wind)
ISO imports = I_{iso} = 50 MW
ISO exports = E_{iso} = 20 MW

EIM Transfers out of the ISO based on counter-factual determination of internal ISO resources dispatch to support EIM transfer out of ISO = $T_{iso,out}$

$T_{iso,out,v}$ = 1 MW (Gas resource with heat rate = 9000 BTU/KWh)
$T_{iso,out,u}$= 4 MW (Solar resource)

EIM transfers out of ISO based on counter-factual determination of external supply that is displaced by EIM transfers out of ISO = $T_{eim,disp}$

$T_{eim,disp,k}$ = 4 MW (Coal with heat rate of 10000 BTU/KWh)
$T_{eim,disp,l}$ = 1 MW (Gas with heat rate of 10000 BTU/KWh)

GHG Emission for ISO:

ISO internal dispatch = $G_{iso} = G_{iso,a} + G_{iso,b} + G_{iso,c}$
= 10 + 50 + 100 = 160 MW

ISO Demand = L_{iso} = ISO internal dispatch + ISO imports – ISO exports + EIM transfers into ISO using counterfactual determination – EIM transfers out of ISO using counter-factual determination

$= G_{iso} + I_{iso} – E_{iso} – T_{iso,out}$
= 160 + 50 – 20 – 5 = 185 MW

Total GHG Emission for ISO = GHG_{iso}
= GHG emission to serve ISO demand = GHG_{Liso}
= GHG emission ISO internal dispatch + GHG emission ISO imports – GHG emission ISO exports - GHG emission from EIM transfers out of ISO using counter-factual determination
$= GHG_{Giso} + GHG_{Iiso} – GHG_{Eiso} – GHG_{Tiso,out}$

GHG emission from ISO internal dispatch = GHG_{Giso}
$= GHG_{Giso,a} + GHG_{Giso,b} + GHG_{Giso,c}$

$GHG_{Giso,a}$ = (8500/1000)*0.053165*10 = 4.519 mTCO2
$GHG_{Giso,b}$ = (9500/1000)*0.053165*50 = 25.25 mTCO2
$GHG_{Giso,c}$ = 0 mTCO2

GHG_{Iiso} = (10000/1000)*0.0428*50 = 21.4 mTCO2
GHG_{Eiso} = (10000/1000)*0.0428*20 = 8.56 mTCO2

$GHG_{Tiso,out} = GHG_{Tiso,out,v} + GHG_{Tiso,out,u}$
= (9000/1000)*0.053165*1 + 0
= 0.47 mTCO2

GHG emission to serve ISO demand = $GHG_{Giso} + GHG_{Iiso} – GHG_{Eiso} – GHG_{Tiso,out}$
= (4.52 + 25.25 + 0) + 21.4 – 8.56 – 0.47
= 42.14 mTCO2

Overall EIM GHG Benefit Reduction:

Overall EIM GHG Benefit Reduction based on counter-factual determination
= (-1)*$GHG_{net,eim}$
= (-1)*(GHG benefit reduction based on EIM transfers out of ISO using counter-factual dispatch)
= (-1)*($GHG_{Tiso,out}$ - $GHG_{Teim,disp}$)

$GHG_{Teim,disp}$ = $GHG_{Teim,disp,k} + GHG_{Teim,disp,l}$
= (10000/1000)*0.09471*4 + (10000/1000)*0.053165*1
= 4.32 mTCO2

Overall EIM GHG Benefit Reduction = (-1)*(0.47 – 4.32) = 3.85 mTCO2

There was 3.85 mT CO2 of GHG emission reduction due to EIM using the counter-factual dispatch for the example above.

GHG	mTCO2
GHG emission to serve ISO Load	42.14
GHG EIM Benefit Reduction	3.85

Implementation Plan

The GHG report will be published by every 30th of the month for the previous month data.