GHG Emission Tracking Report

Abhishek Hundiwale
Lead Engineering Specialist

November 14, 2016

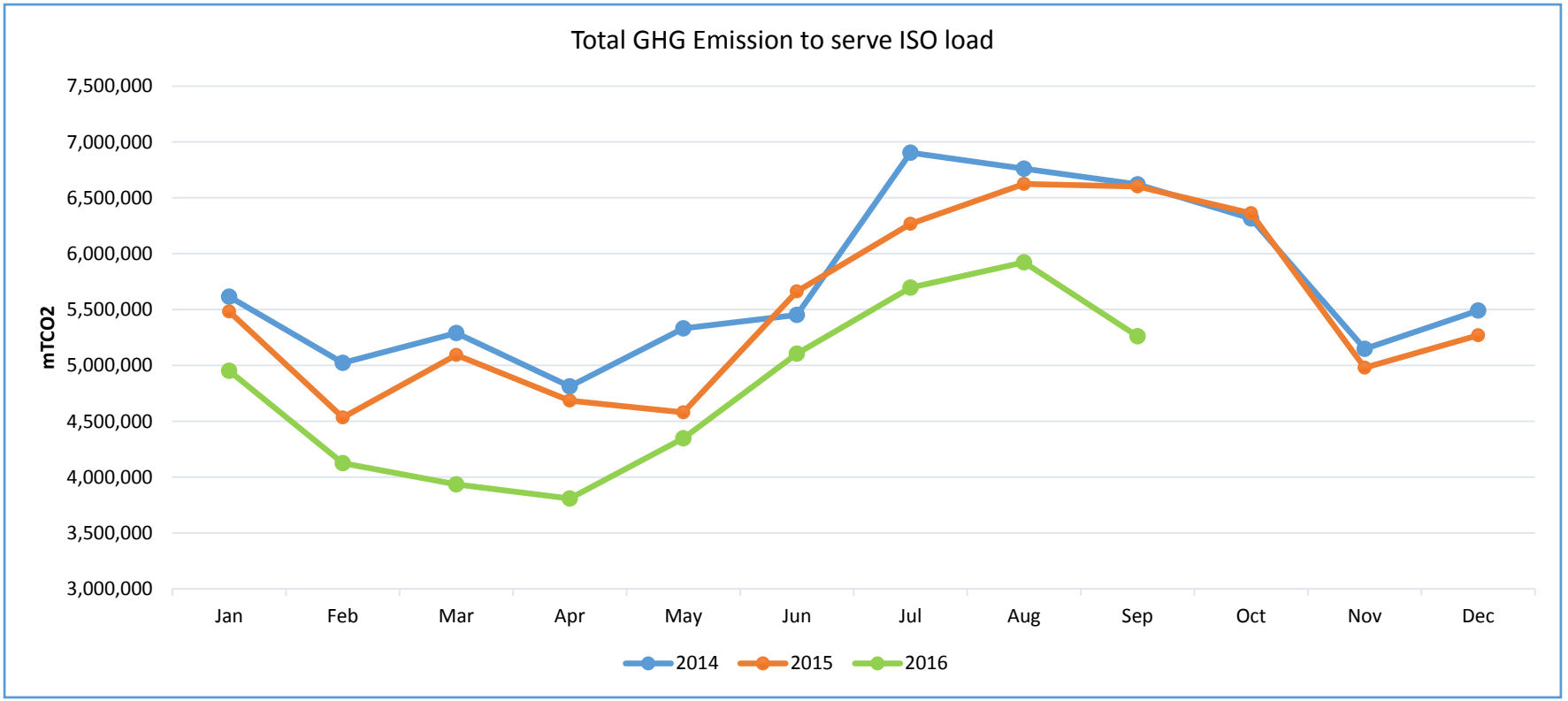
Agenda

- Background
- GHG emission calculation
  - Total GHG emissions to serve ISO load
  - Cumulative effect of EIM on GHG emissions
- Conclusion and next steps

Background

- ISO has committed to track GHG emissions serving ISO load
- Report is preliminary and for informational purposes only
- Does not replace CARB's regulation for GHG accounting

Total GHG emissions to serve ISO load

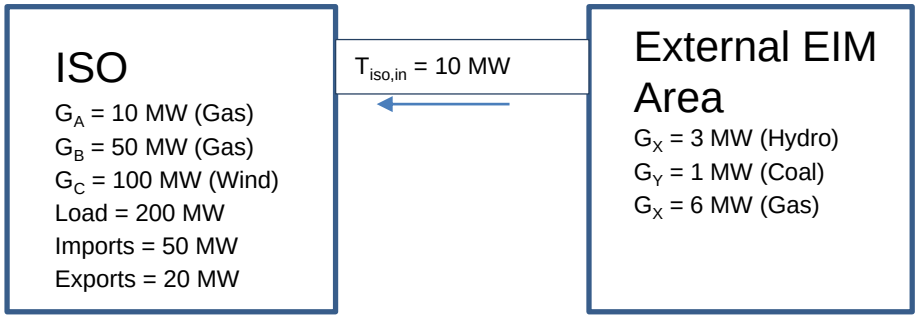


YTD (January - September) million mTCO2	2014	2015	2016
GHG Emission to serve ISO load	51.81	49.53	43.15

Methodology to track GHG emissions to serve ISO load

- Comparison GHG emissions pattern for years 2014 - 2016
- Total GHG emissions to serve ISO load
  - = GHG emissions from internal ISO dispatches including dynamic schedules
  - + GHG emissions from imports serving ISO load (imports minus exports)
  - + GHG Impact from EIM transfers into ISO using counter-factual determination
  - - GHG Impact from EIM transfers out of ISO using counter-factual determination
- GHG Emissions (mTCO2) = resource heat rate (MMBTU/MWh) * CO2 emission factor by resource type (mTCO2/MMBTU) * Energy (MWh)
- For unspecified imports emission rate of 0.428 mTCO2/MWh used
- Higher solar production along with improved hydro conditions in 2016 contribute to GHG emissions reductions compared to 2014 – 2015.

Example 1: Total GHG emissions to serve ISO load



Gas Resource		
Heat Rate (BTU/KWh)	GHG Emission Rate (mTCO2/MMBTU)	GHG Emission Rate (mTCO2/MWh)
10,000	0.053165	0.53165
9500	0.053165	0.50507
8500	0.053165	0.45190

EIM Case

Total GHG emission to serve ISO load

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

= 29.77 + 21.4 – 8.56 + 3.82

= 46.43 mTCO2

Where:

GHG_{Giso} = $GHG_{G,A}$ + $GHG_{G,B}$ + $GHG_{G,C}$

= (8500/1000) MMBTU/MWh x 0.053165 mTCO2/MMBTU x10 MWh

+ (9500/1000) MMBTU/MWh x 0.053165 mTCO2/MMBTU x 50 MWh + 0

= 29.77 mTCO2

GHG_{Iiso} = 50MWh x 0.428 mTCO2/MWh = 21.4 mTCO2

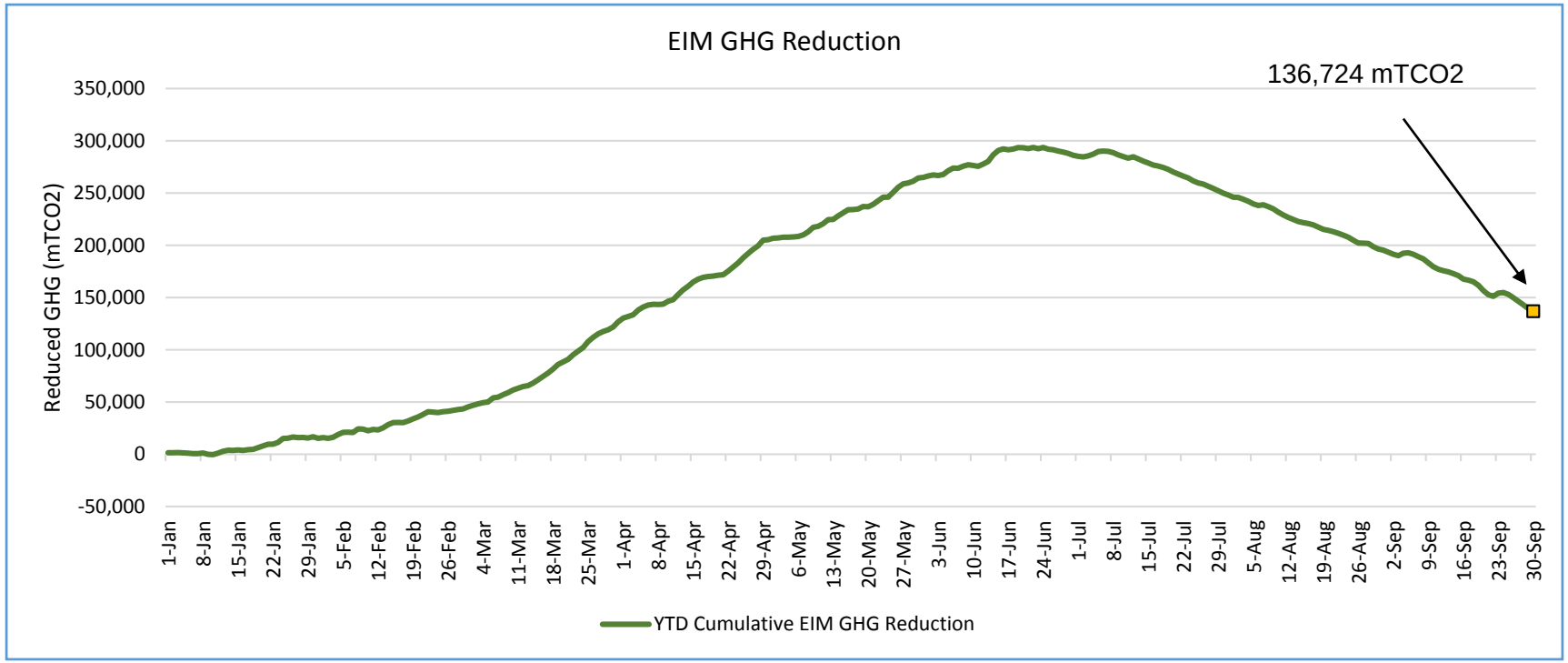
GHG_{Eiso} = 20MWh x 0.428 mTCO2/MWh = 8.56 mTCO2

$GHG_{Tiso,in}$ = 3.82 mTCO2 (Based on EIM counter-factual comparison)

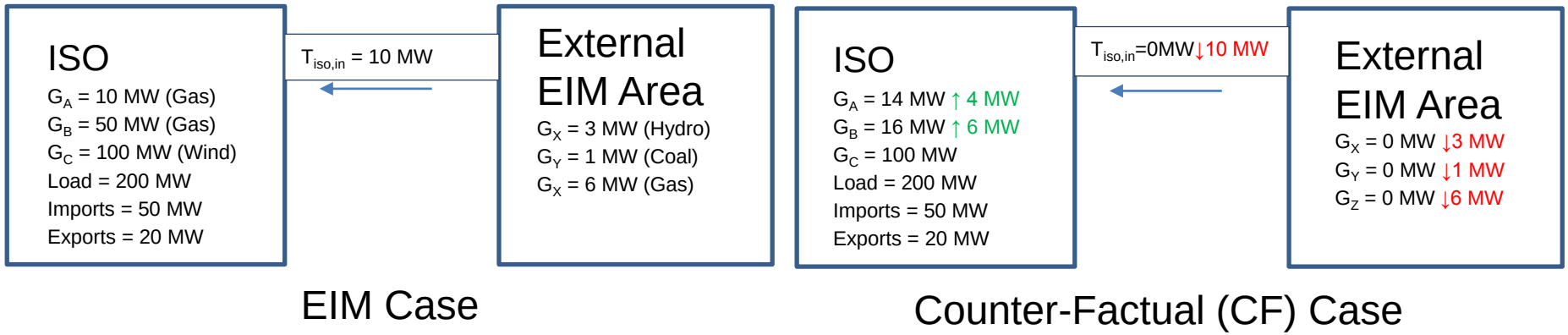
GHG emission calculation – Cumulative effect of Energy Imbalance Market on GHG emissions

- Uses counter-factual determination without EIM transfers
- Compares
  - EIM Transfers into ISO: GHG of external resources supporting ISO imbalances and internal ISO supply displaced by EIM transfers to the ISO
  - EIM Transfers out of ISO: GHG of internal supply supporting transfers and external resources displaced by EIM transfers out of ISO
- Positive benefits indicate how EIM transfers have reduced GHG emissions relative to a counter-factual assessment of emissions across the ISO and EIM balancing authority areas without EIM transfers

Cumulative effect of Energy Imbalance Market on GHG emissions



Example 2: EIM effect on GHG emissions



EIM Case

Counter-Factual (CF) Case

- GHG emissions of external resources supporting EIM transfer are determined by comparing dispatch of the EIM case with counter-factual (CF) case without transfers:
  - $T_{iso,in}$ = 10 MW transfer provided by
    - ΔG_x = 3 MW (Hydro)
    - ΔG_y = 1 MW (Coal resource with heat rate = 10000 BTU/KWh)
    - ΔG_z = 6 MW (Gas resource with heat rate = 9000 BTU/KWh)
- GHG emissions of internal ISO resources displaced by EIM transfers are determined by comparing EIM case with the counter-factual case without transfers:
  - $T_{iso,disp}$
    - ΔG_A= 4 MW (Gas with heat rate of 10000 BTU/KWh)
    - ΔG_B= 6 MW (Gas with heat rate of 9000 BTU/KWh)

Example 2: EIM effect on GHG emissions

Overall EIM GHG Reduction

$= (-1)*(GHG_{Tiso,in} - GHG_{Tiso,disp})$

= (-1)*(3.82 - 4.99) mTCO2

= 1.17 mTCO2

Where:

$GHG_{Tiso,in}$

$= \Delta G_x$ x 0 mTCO2

$+ \Delta G_Y$ x 0.09471 mTCO2/MMBTU x (10000/1000) MMBTU/MWh

$+ \Delta G_Z$ x 0.05316 mTCO2/MMBTU x (9000/1000) MMBTU/MWh

= 3.82 mTCO2

$GHG_{Tiso,disp}$

$= \Delta G_A$ x 0.05316 mTCO2/MMBTU x (10000/1000) MMBTU/MWh

$+ \Delta G_B$ x 0.05316 mTCO2/MMBTU x (9000/1000) MMBTU/MWh

= 4.99 mTCO2

Conclusion

- Tracking report will be published monthly
- Report will
  - Track annual GHG total emissions serving ISO load
  - Show year-over-year and seasonal trends
  - Illustrate effects of EIM on GHG emissions

Questions