The plan for the numbers behind the WattTime business plan

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1 Introduction

The goal is to determine the carbon savings that can be obtained from changes to electricity use patterns. The amount of savings will vary by time, place (i.e., balancing authority), and method of shifting (i.e., which markets the shifting is commensurate with, which markets are informed of the shifting). Key summary statistics are the mean and standard deviation by hour of the day and by month of the year.

2 Directly calculated measures of carbon intensity

For each hour h, the most simplistic measure of carbon intensity is

$$REI_{a,h} = RE_{a,h}/RL_{a,h}. \tag{1}$$

$REI_{a,h}$ measures the instantaneou.s carbon intensity of the electricity demanded and generated locally. It does not imply causal relationships between emissions intensity between any two hours.

After adjusting for import/export, this measure of carbon intensity becomes

$$EI_{a,h} = E_{a,h}/L_{a,h}. \tag{2}$$

$EI_{a,h}$ measures the instantaneous carbon intensity of the electricity demanded locally, regardless of generation location.

3 Predicted measures of carbon intensity

4 Appendix: Definitions

Question: F and L both adjusted by same I?

Table 1: Raw variables

variable	explanation	source	units
RL	load	balancing authority	MW
RW	wind generation	ISO	MW
RF	fossil generation	EPA	MW
$I_{a\to b}$	intertie flow from a to b	ISO or WECC	MW
RE	emissions	EPA	lb CO_2

Table 2: Processed variables

name	explanation	equation	units
REI	emissions intensity	varies	lb/MW
F	fossil gen adjusted for intertie flow	$F_a = RF_a + \sum_{b\neq a}(I_{b\to a} - I_{a\to b})$	MW
E	emissions adjusted for intertie flow	$E_a = RE_a + \sum_{b\neq a}(I_{b\to a}REI_b - I_{a\to b}REI_a)$	MW
L	load adjusted for intertie flow	$L_a = RL_a + \sum_{b\neq a}(I_{b\to a} - I_{a\to b})$	MW

Table 3: Modifiers

x_a	value of x in balancing authority (often implicit)
x_b	value of x in other balancing authority (for import/export)
x_h	value of x in hour h
$\hat{x}$	our prediction for x