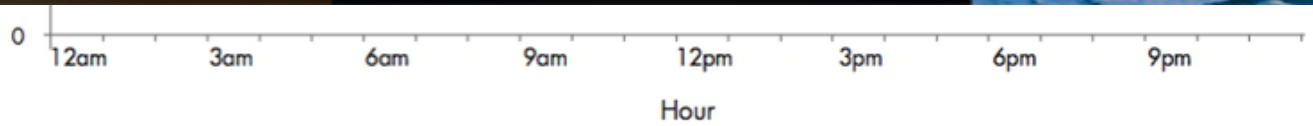
Go Green, Go Home

"Make America Green Again"

Tremendous Problem w/EV's & Renewables



Solution - Go Green, Go Home

GGGH aligns energy use with renewable energy generation.

Take energy demands from users and execute them based on when energy generation is cleanest and most readily available

The Best People

Brandon Wong

Web visualization
LCD Hardware

Kan Ito

Actuation
Hardware Connectivity

Sara Mitchell

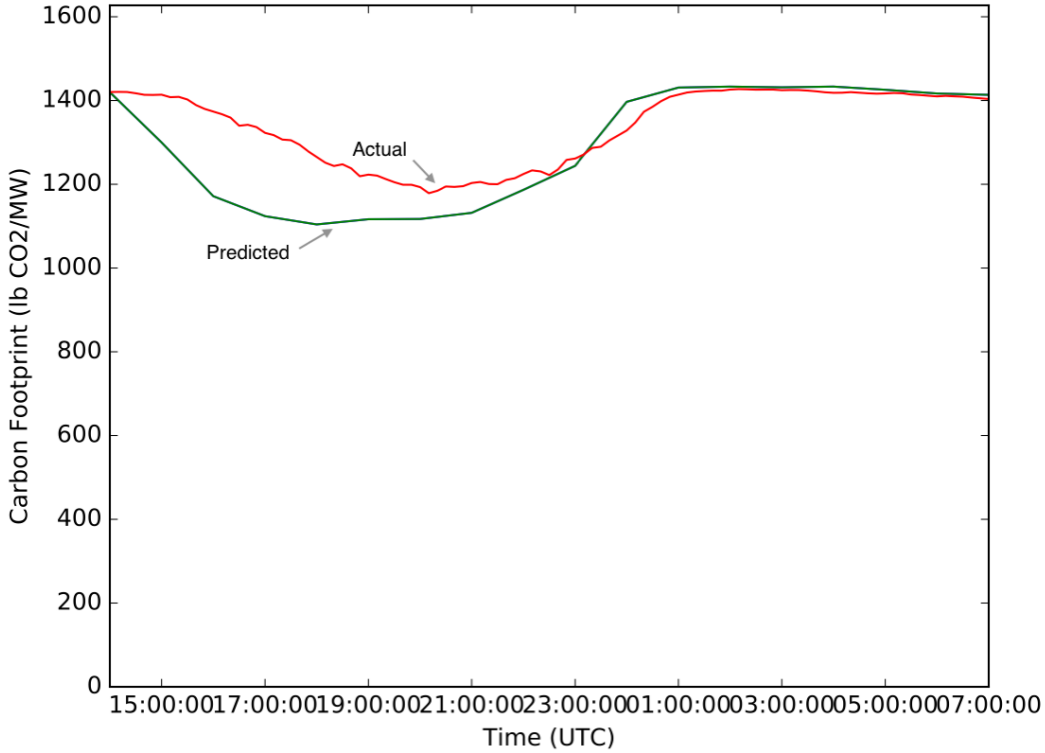
User Interface
Industry Research

Liam Weaver

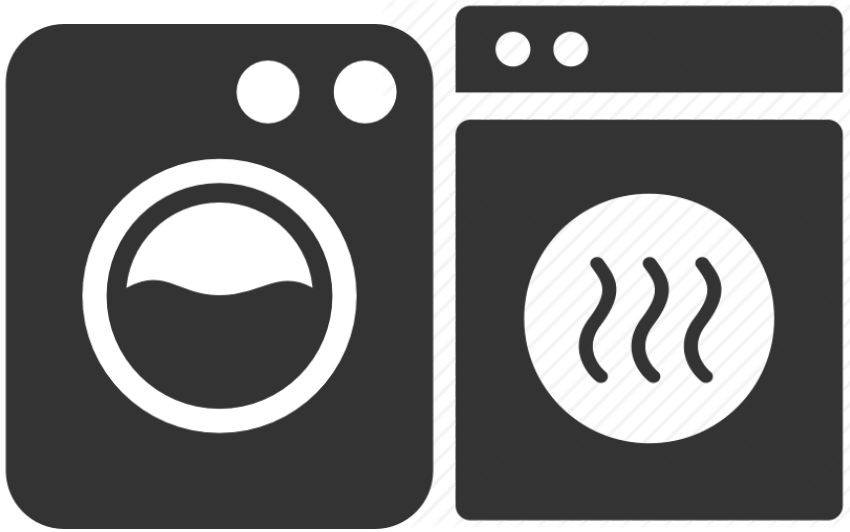
Data Analysis
‘Sensor’ Communication

The ‘Sensor’

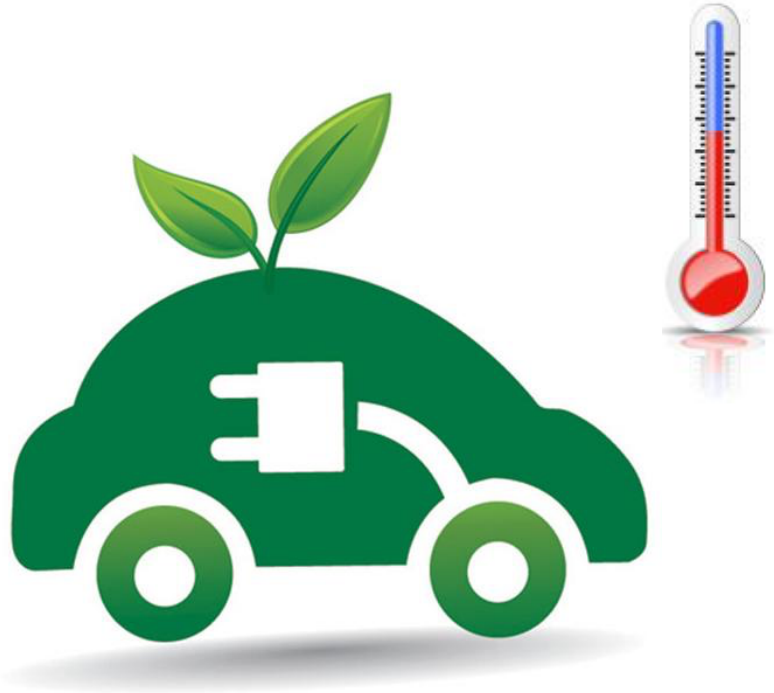
WattTime provides real-time data about the carbon footprint of electricity coming from the grid.



Deferrable Load



Shapeable Loads



Fixed Load

Data Analysis

3 separate optimization problems to create load schedules for:

electric vehicle charging

running a washer and dryer (these are one problem)

regulating indoor air temperatures with an air conditioner and electric heater

211 Decision Variables

633 Constraints

Optimization Equations

Shapeable Load (Electric Vehicle)

$$\min f(\boldsymbol{x}) = \boldsymbol{c}^T \boldsymbol{x} \qquad \boldsymbol{x} = [P(0), P(1), \dots, P(23), E(0), E(1), \dots, E(23)]$$

$$\boldsymbol{c} = [c_0, c_1, \dots, c_{23}, 0, \dots, 0]$$

$$E_{min} \le E(k) \le E_{max}$$
$$E(k+1) = E(k) + \Delta t \cdot P(k)$$
$$0 \le P(k) \le P_{max}$$

$$E_{min} = E_{max} - (k_{out} - k) P_{max}$$

Deferrable load (washer/dryer)

$$\min f(\boldsymbol{x}) = \boldsymbol{c}^T \boldsymbol{x}$$

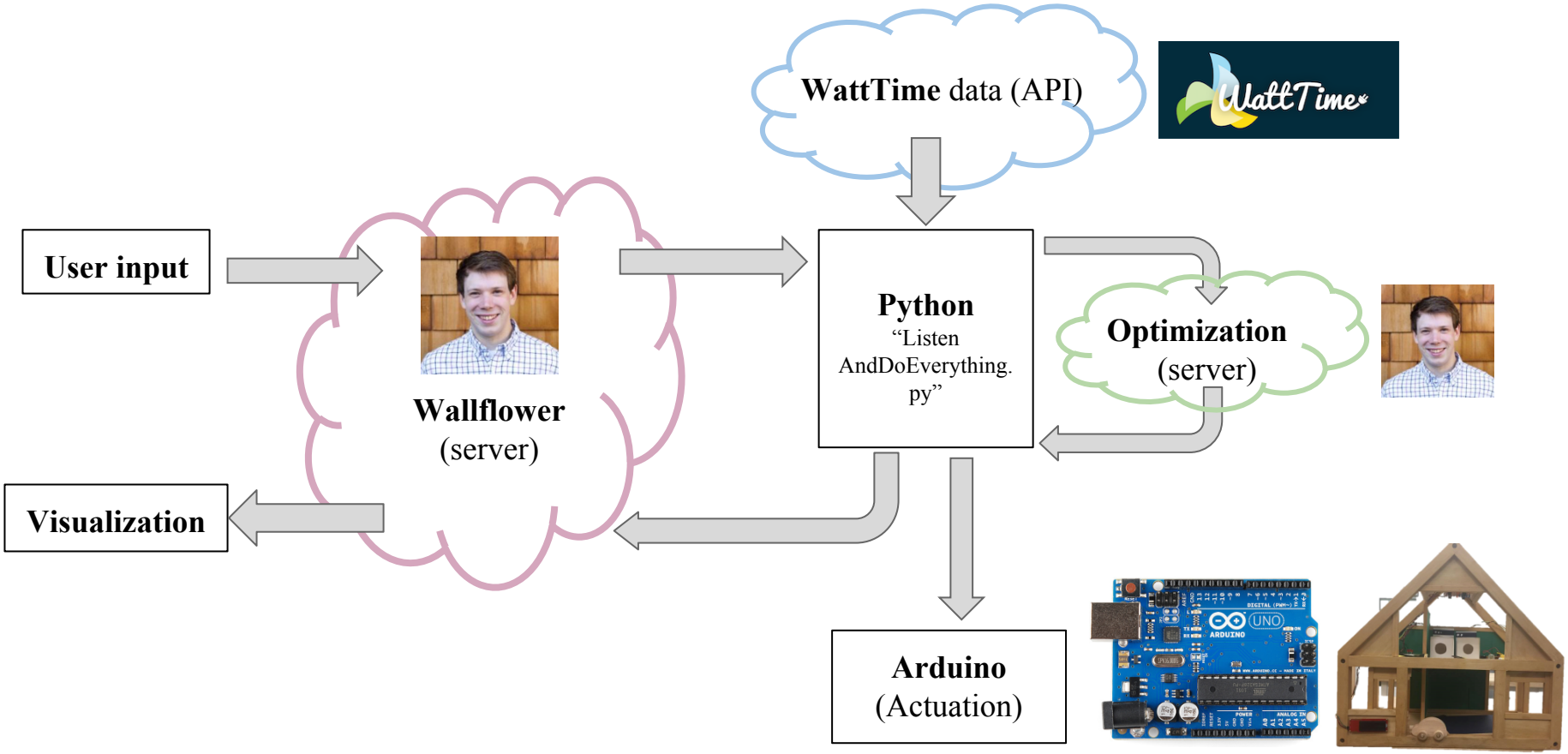
$$\boldsymbol{x} = [W(0), W(1), \dots, W(23), D(0), D(1), \dots, D(23), E(0), E(1), \dots, E(23)]$$

$$\boldsymbol{c} = [P_W c_0, P_W c_1, \dots, P_W c_{23}, P_D c_0, P_D c_1, \dots, P_D c_{23}, 0, \dots, 0]$$

$$W(k) \in \mathbf{Z}$$
$$D(k) \in \mathbf{Z}$$
$$0 \le W(k) \le 1$$
$$0 \le D(k) \le 1$$
$$D(k+1) = W(k)$$
$$\boldsymbol{T}^T \boldsymbol{W}(k) = 1$$
$$\boldsymbol{T}^T \boldsymbol{D}(k) = 1$$

We use an optimization server to solve the MILP (**Mixed Integer Linear Program**)

The Cyber-Physical System



Residential Actuation

Typical Household Loads

Fixed
-Lights
-small electronics
-small appliances
-Furnace
-Stove/oven

Shapeable
-EV Charge State
-HVAC
-Battery Storage

Deferrable
-Washer
-Dryer
-Dishwasher

www.georgiapower.com

Let’s see it.

1,825 lbs

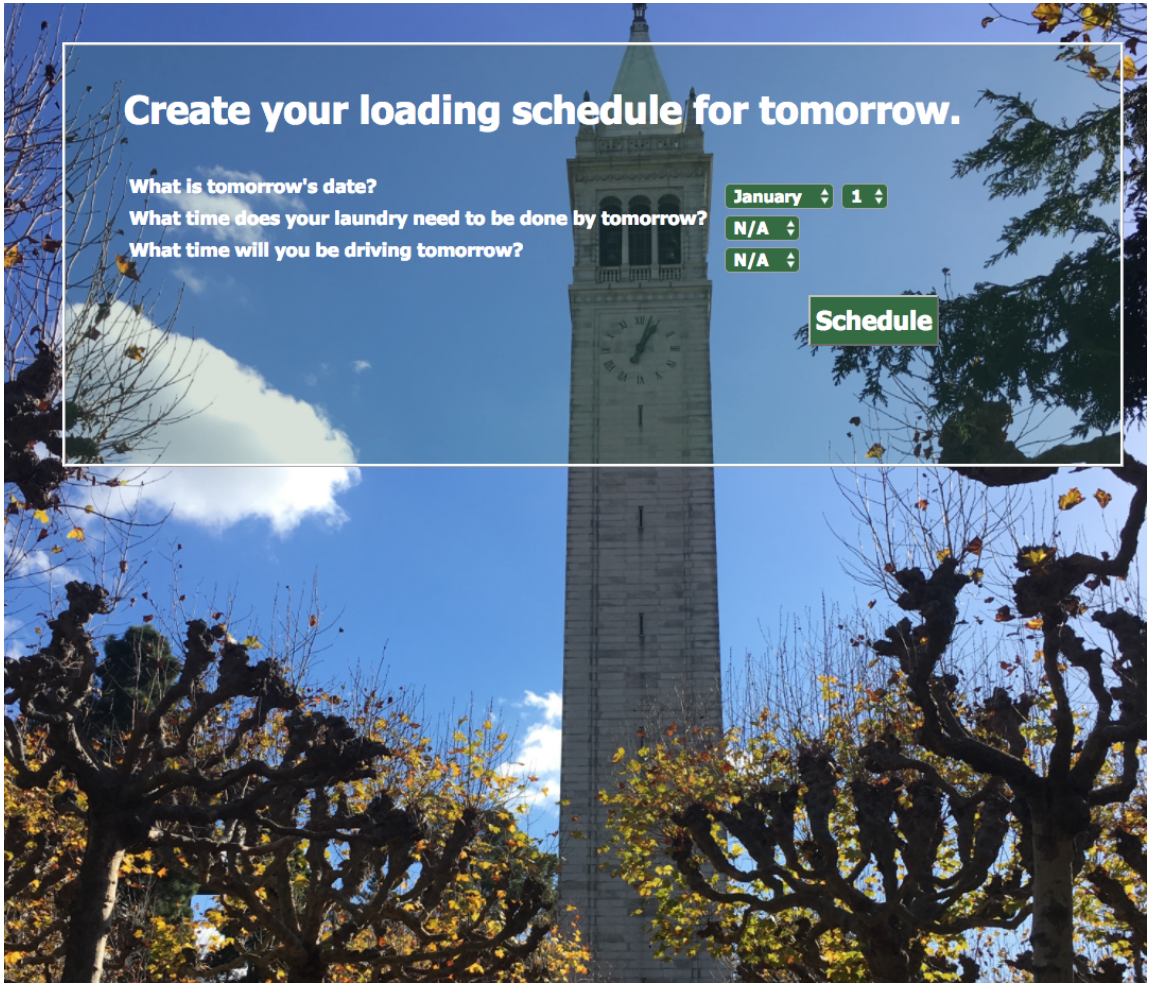
Potential yearly CO2-e saved by using optimization

Equivalent to 100 gallons of gasoline or
3,000 miles traveled

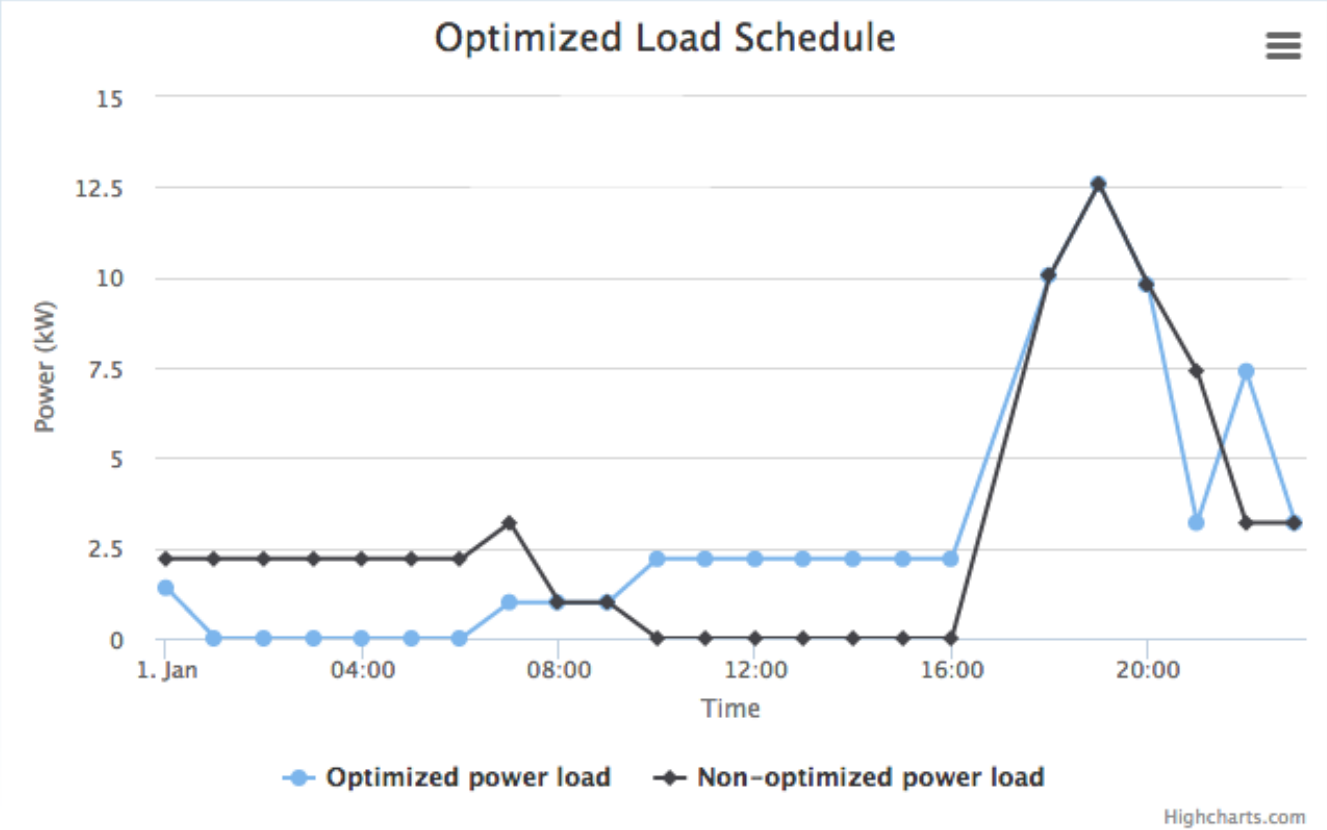
20%

Reduction in Peak Demand

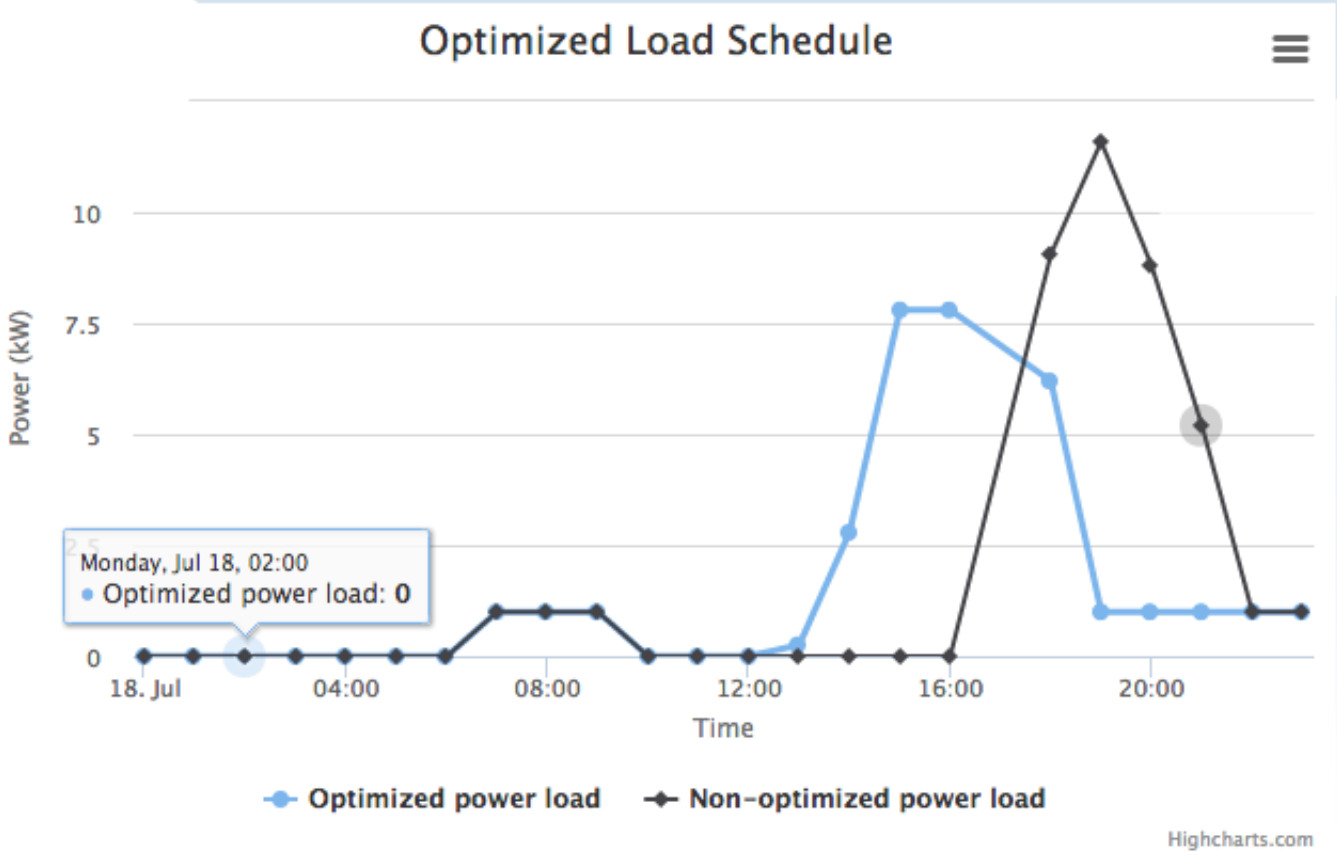
Implementation in 160,000 homes would prevent the need for construction of a $600 million Natural Gas power plant

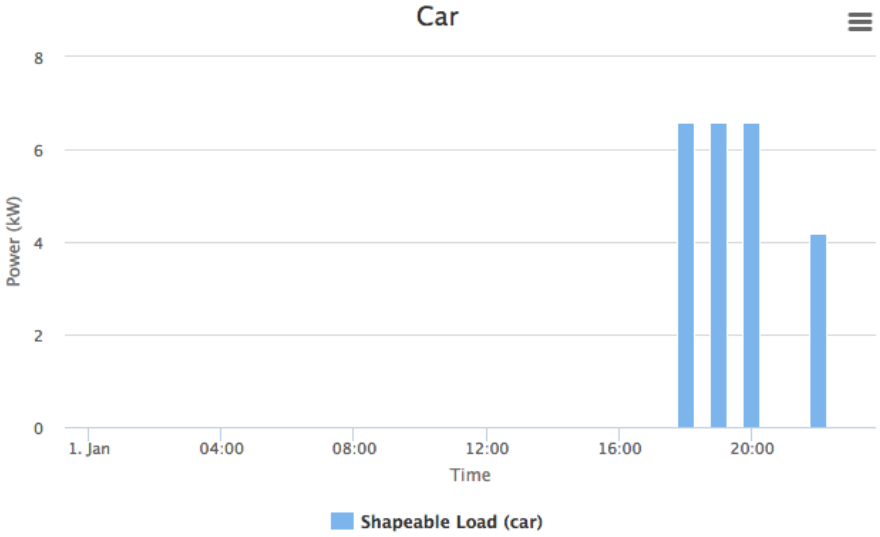

Create your loading schedule for tomorrow.
What is tomorrow's date?
January
1
What time does your laundry need to be done by tomorrow?
N/A
What time will you be driving tomorrow?
N/A
Schedule

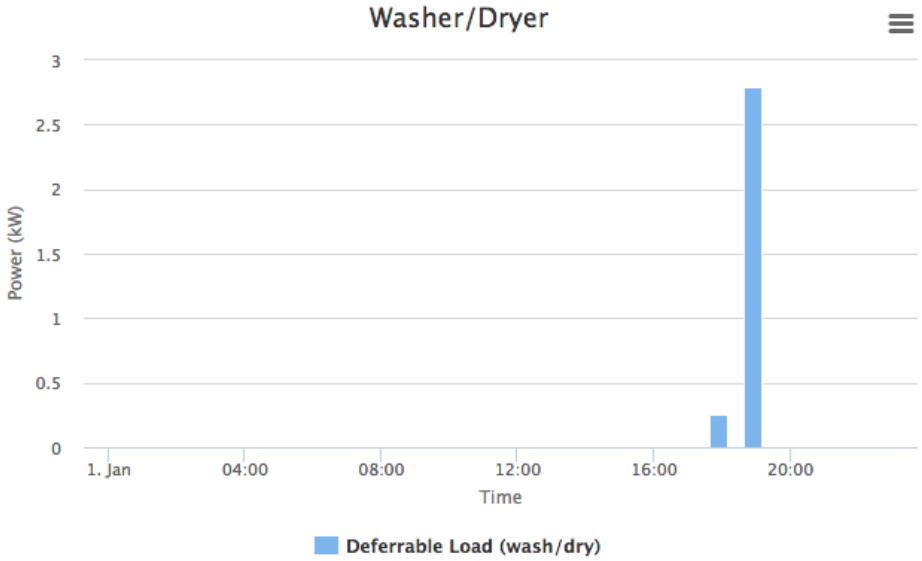
Scheduling Summary

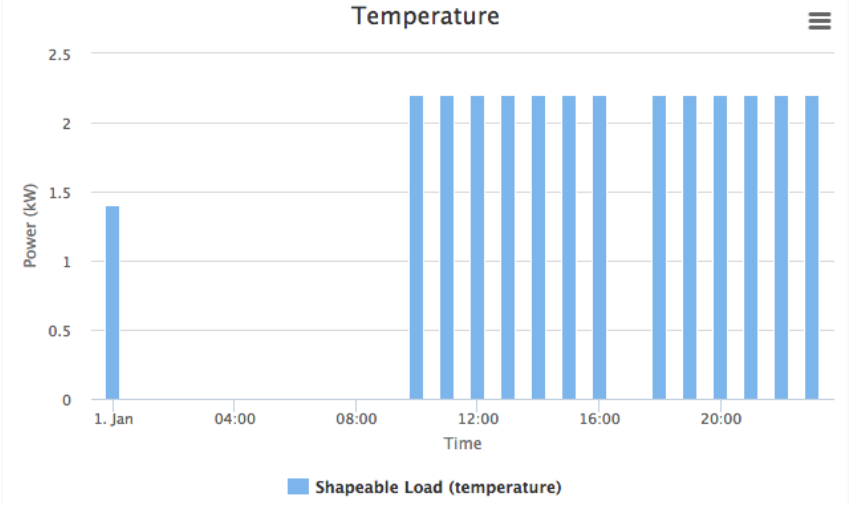


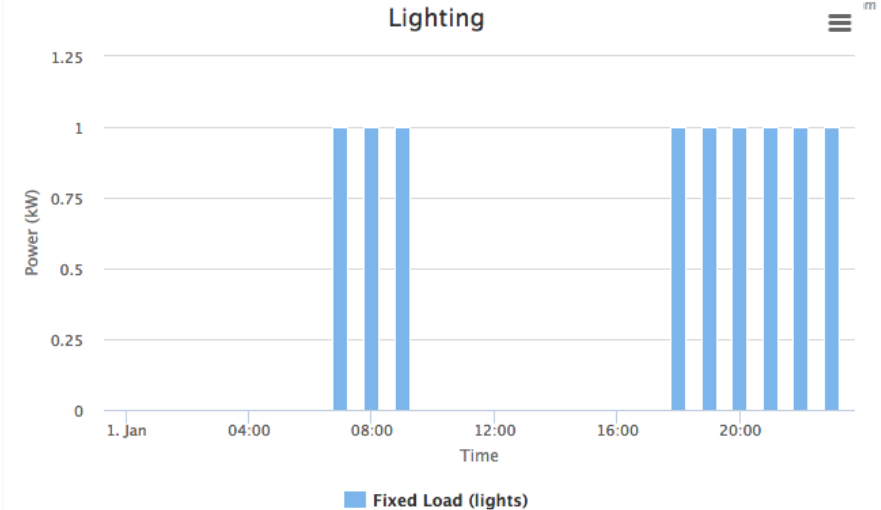
Scheduling Summary

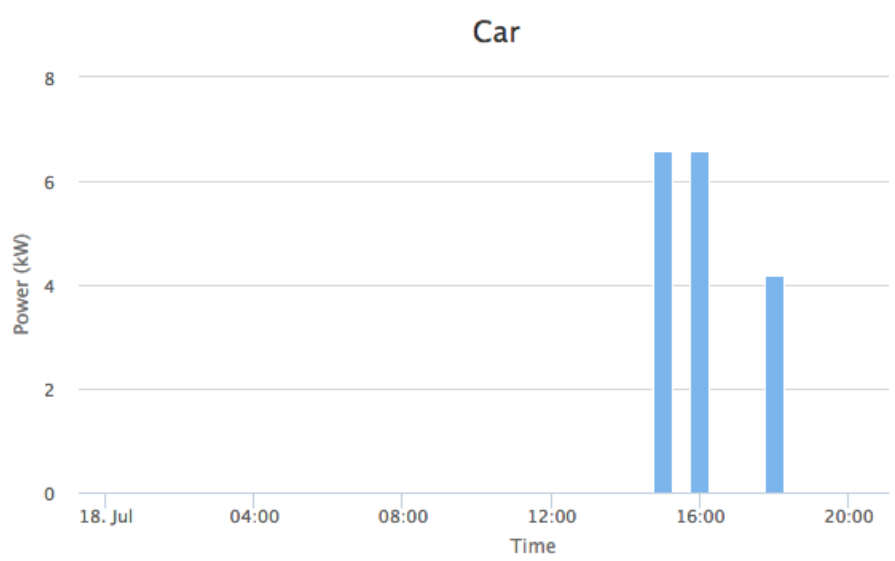


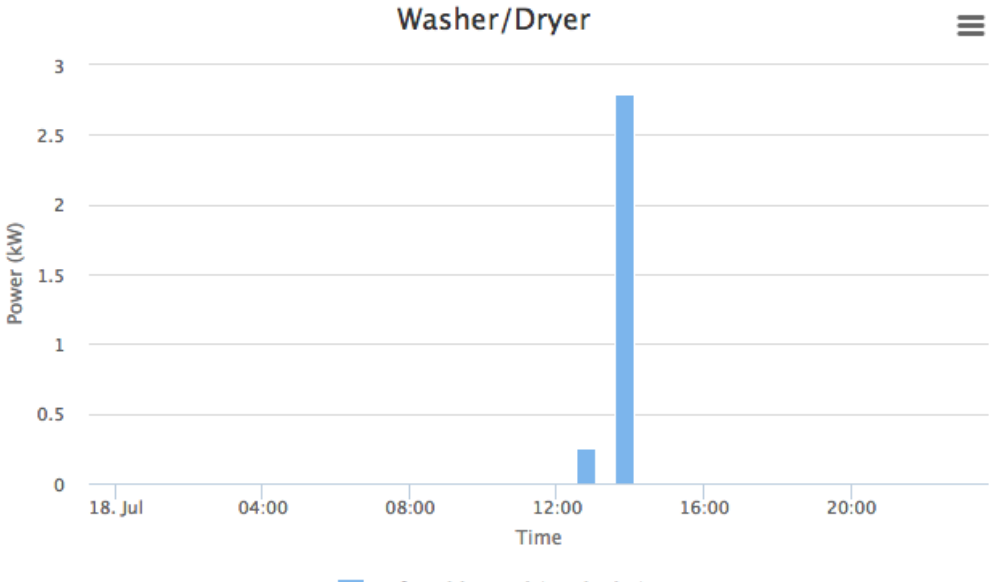

Car
Power (kW)
8
6
4
2
0
1. Jan
04:00
08:00
12:00
16:00
20:00
Time
Shapeable Load (car)

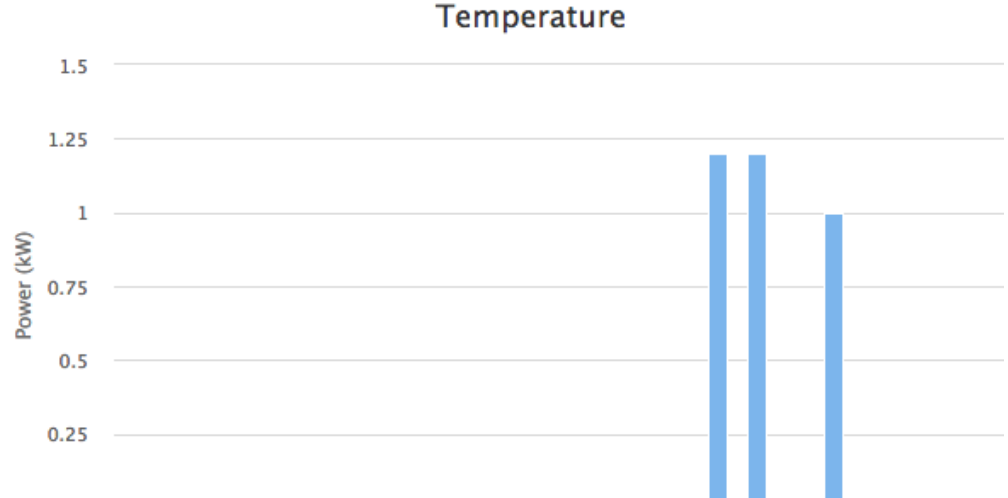

Washer/Dryer
Power (kW)
3
2.5
2
1.5
1
0.5
0
1. Jan
04:00
08:00
12:00
16:00
20:00
Time
Deferrable Load (wash/dry)

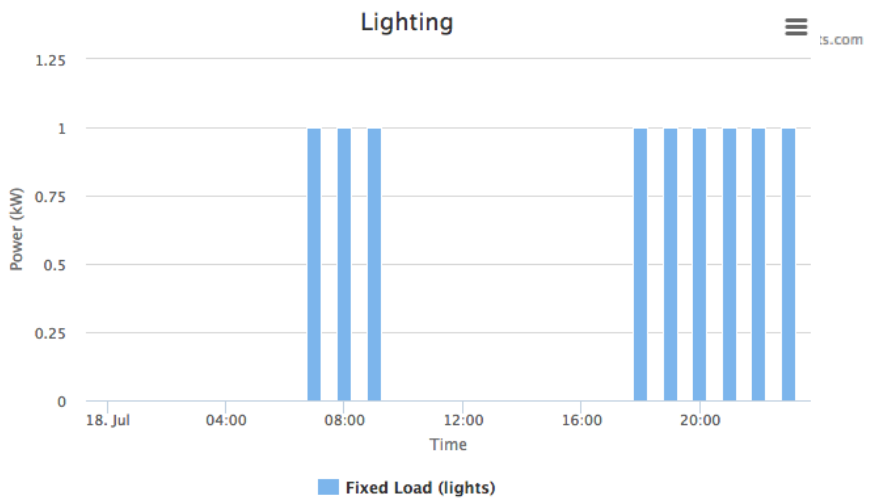

Temperature
Power (kW)
2.5
2
1.5
1
0.5
0
1. Jan
04:00
08:00
12:00
16:00
20:00
Time
Shapeable Load (temperature)


Lighting
Power (kW)
1.25
1
0.75
0.5
0.25
0
1. Jan
04:00
08:00
12:00
16:00
20:00
Time
Fixed Load (lights)


Car
Power (kW)
8
6
4
2
0
18. Jul
04:00
08:00
12:00
16:00
20:00
Time


Washer/Dryer
Power (kW)
3
2.5
2
1.5
1
0.5
0
18. Jul
04:00
08:00
12:00
16:00
20:00
Time


Temperature
Power (kW)
1.5
1.25
1
0.75
0.5
0.25


Lighting
Power (kW)
1.25
1
0.75
0.5
0.25
0
18. Jul
04:00
08:00
12:00
16:00
20:00
Time
Fixed Load (lights)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GO HOME
MAKE AMERICA GREEN AGAIN!

Together, let's
MAKE AMERICA
GREEN AGAIN!