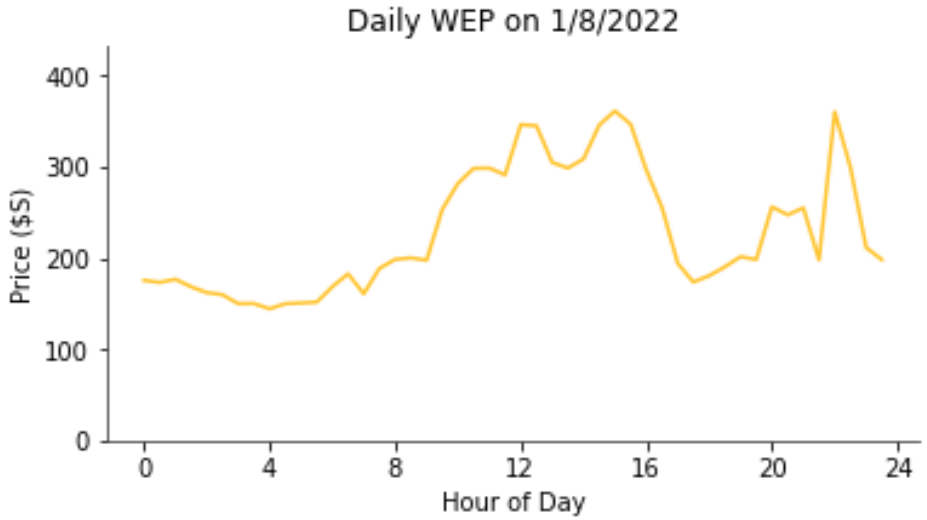
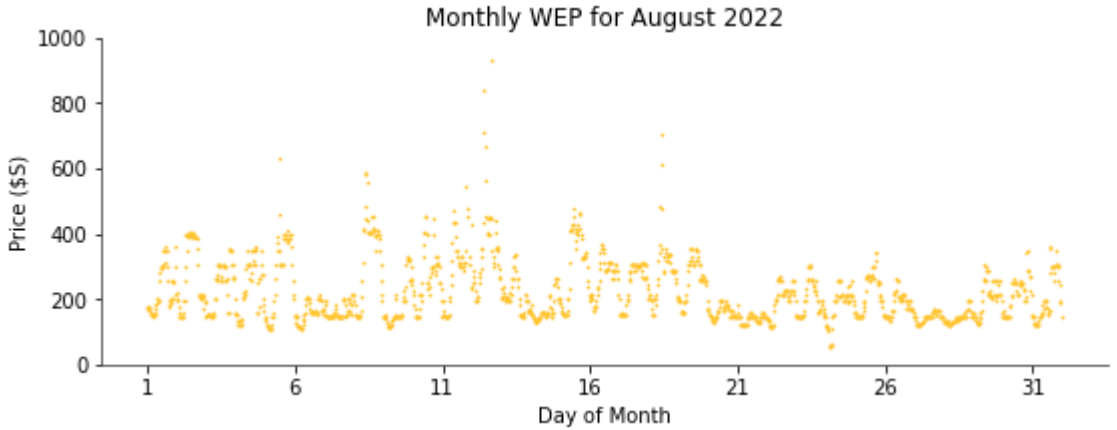
The Problem Statement

P.E.A.K

Electricity is more expensive and dirtier to produce during peak demand periods

Generally, price can fluctuate because of less supply of cheap energy and greater demand because people are using more.





To meet the increased demands at its peaks, more expensive and dirtier power plants (which are predominantly inactive) are turned on. This leads to a drastic spike in electricity price and more carbon emissions for a short window of time.

1. For businesses and large consumers (>4,000 kWh monthly consumption), electricity is often purchased at wholesale which means they are **subjected to the market fluctuations**.

2. **Market fluctuations can be large**. In October 2021, Wholesale Electricity Prices (per kWh) averaged at $0.49 and fluctuated between $0.16 at its lowest and $4.20 at its highest.

3. **Electricity prices are only released a week after.** Businesses and large consumers often have to pre-use electricity blindly and have no means of forecasting data ahead.

Source: Our World in Data, Environmental Defense Fund (All Electricity is Not Priced Equally: Time-Variant Pricing 101)

P.E.A.K

Our Solution

P.E.A.K stands for <Price & Electricity Analytics Kit>

P.E.A.K is a smart energy management kit for businesses and industries to flatten the energy curve. Our solution enables you to save costs and reduce carbon emissions by tracking and optimizing energy consumption.

Our Vision

Enabling energy consumers to make better choices for a greener world.

Awareness

Up to 20% of home energy demand could potentially be saved from behavioural changes. Through awareness, we can achieve a greener world.

Tracking

For most institutions, there is no visibility in their electricity consumption. P.E.A.K is offers plug-and-play smart meters for easy energy monitoring.

Optimisation

Paying less price for the same amount of energy signals that the energy was spent right. P.E.A.K. leverages on AI to recommend peak shifting strategies to businesses

Focus Areas

Source: Our World in Data

Solution Architecture

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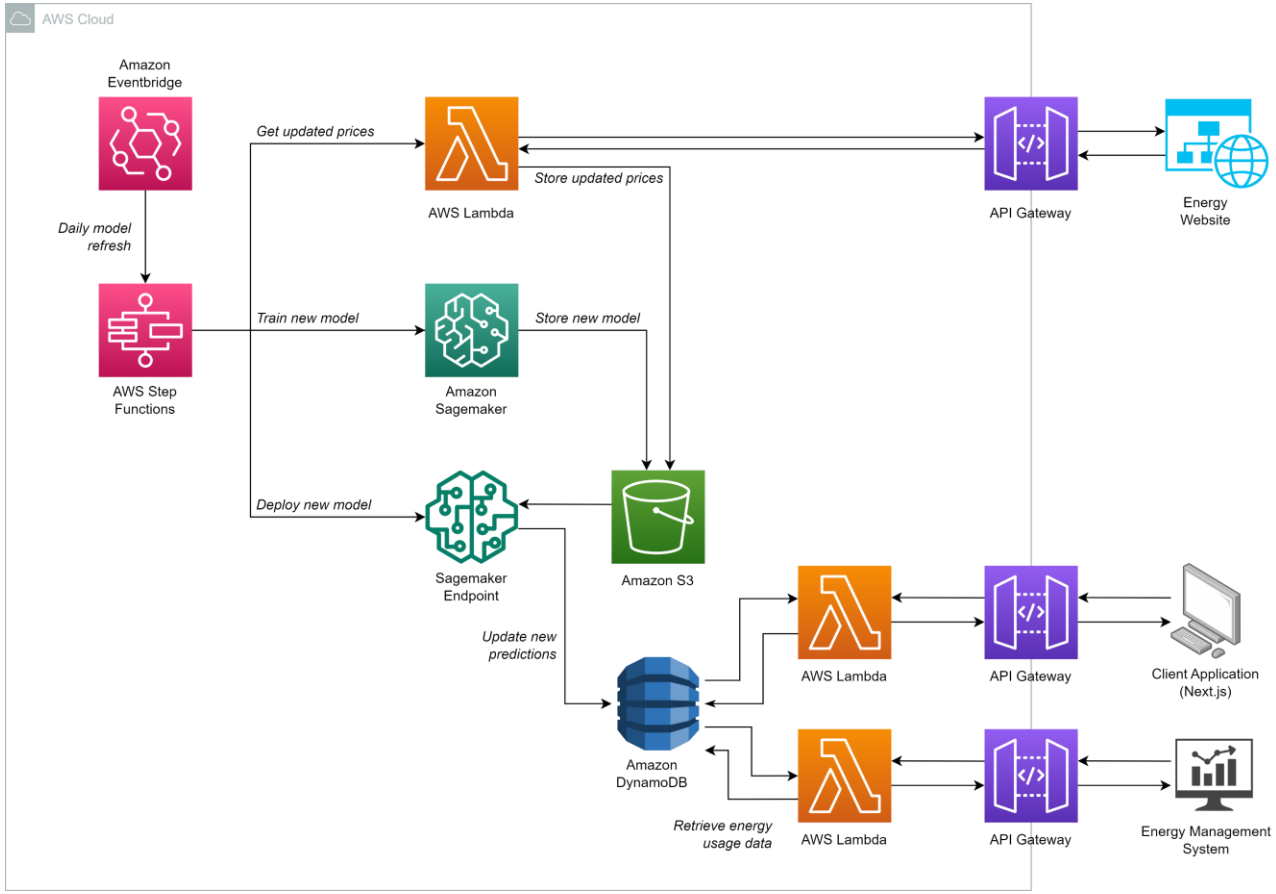
We prioritized some features to implement the hack within time limits

Intended Optimization Model



**RED features represents accurately implemented.*

1. **Smart Electricity Meter**

   Power tracking is not yet constructed. To simulate the tracking, we measured voltage of LEDs using Arduino and fed the data into the server using Raspberry Pi.

2. **AI-powered Electricity Price Prediction**

   Electricity price data is abundant. We took the data and created an AI model that focuses on random fluctuations of the model over seasonality.

3. **Energy Management Dashboard**

   Our dashboard can currently pick up analog measurements. We have also displayed key measurements results from our AI.

4. **Smart Scheduler**

   We have yet to include AI for the scheduler. Currently, the scheduler is based on a simple next-best algorithm instead of leveraging on AI to spread out consumption.

Source: Our World in Data

Smart Electric Meter (equivalent)

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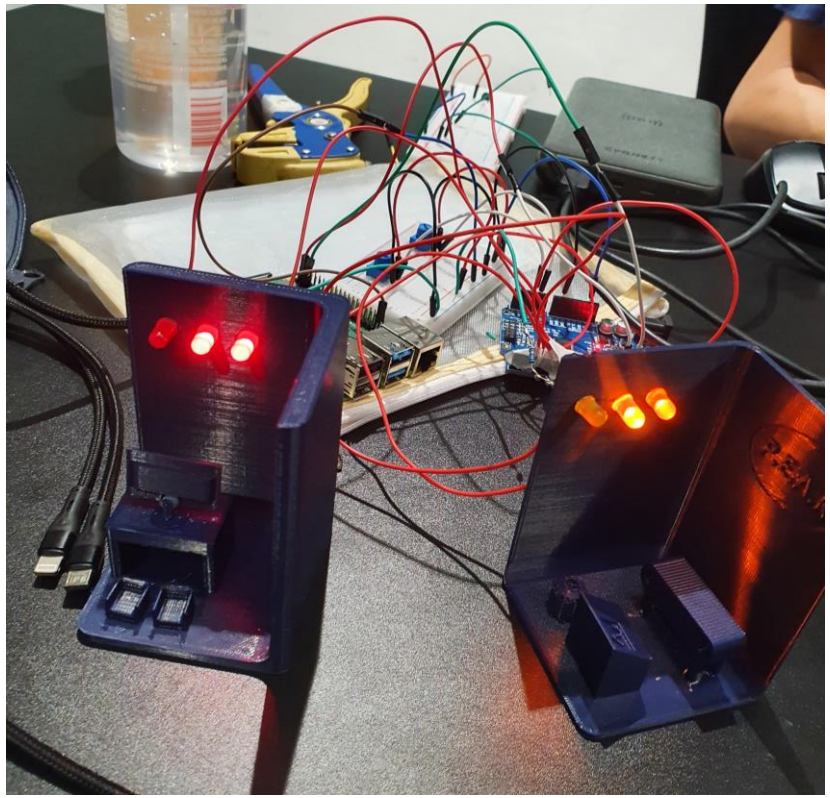
P.E.A.K tracks electricity consumption behavior



1. We have implemented a prototype which allows us to vary and track energy consumption.
2. Energy consumption in our prototype is represented by LEDs. They can be varied through adjusting its respective potentiometers.
3. To track energy consumption, we tracked analog data using an Arduino.
4. Data is uploaded from Raspberry Pi to the server through WiFi.
5. The goal of the system is to be able to track multiple sources of electricity consumption which is why we wired two sets of “offices”.

Source: Our World in Data

AI Price Prediction

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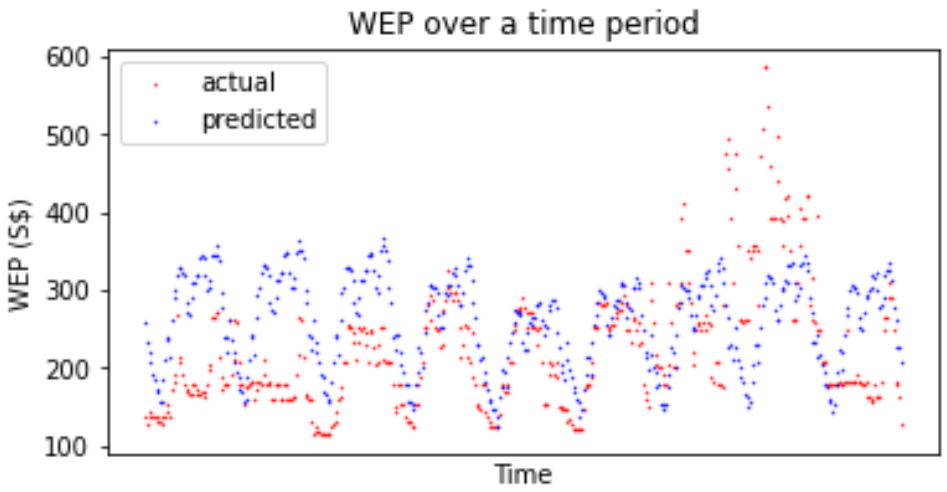
P.E.A.K. helps energy consumers identify demand peaks where prices are highest



Model	MAE	RMSE
Neural Prophet (clipped test)	77	92
Neural Prophet (non-clipped test)	82	153
FB Prophet (clipped test)	90	106
FB Prophet (non-clipped test)	96	160
LSTM (clipped test)	*71*	*88*
LSTM (non-clipped train, clipped test)	72	89

Implementation Journey

1

Proof-of-concept

We first deployed the model with FB Prophet. The goal is to test the viability of our idea in the shortest time possible. But with Prophet, the AI model focuses too much on seasonality and is unable to react to randomness that is commonplace in energy markets.

2

Construction of own LSTM model

Next, we built our own model. This time we chose LSTM which emphasizes more on deep learning. This model is more robust with market fluctuations but performs slightly worse than Prophet when it comes to seasonality.

3

Model Optimization

We used 30 days of price data to predict the pricing for D+10. For energy markets, it is difficult to predict using AI due to macro conditions.

Source: Our World in Data

Smart Scheduler

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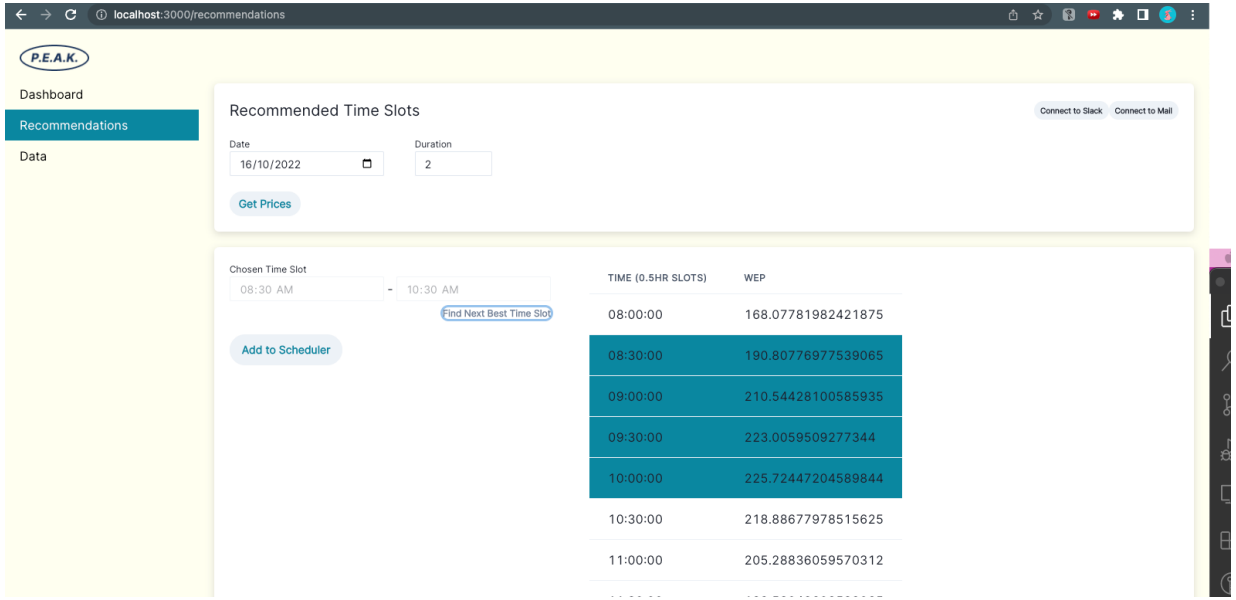
P.E.A.K save costs by recommending time slots – to shave and spread-out peak consumption



1. At its core, our scheduler highlights time slots at which electricity demand is off-peak and price is lowest.

2. Users get to check out the time slots weeks in advance. By defining the duration, our smart scheduler will suggest options for which the window has maximum savings.

3. At its original form, the scheduler is meant to be driven by AI which allows a more robust conflict management system. For our prototype, we implemented a simple next-best algorithm.

Source: Our World in Data

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Target Impact

Different use cases enabled by P.E.A.K

1. Gain insights towards energy usage patterns for organizational energy reports
2. Better planning for energy-intensive operations (photocopying, GPU training, etc)
3. Better planning of meetings and large-scale corporate event timings
4. Roll out of a staggered break schedule of employees to spread out energy consumption

Transparency in energy usage

Cheaper electricity bills

Reduce carbon emissions

Increase organizational green awareness

Source: Sensorfact (Peak demand power: the most overlooked potential energy saving)

Competitor Landscape

	FOCUS AREA	Consumption Monitoring			Demand management		
		Installable smart meters	Segmented energy monitoring	Customizable dashboard	Price and cost prediction	Time slot recommendations	Bottom-up approach
P.E.A.K	Electricity tracking and management platform for masses	✓	✓	✓	✓	✓	✓
octopus energy	Renewable energy provider with price analytics				✓	✓	
KAYRROS	Analytics for traders, investors, operators and governments			✓	✓		
VERDIGRIS	Electricity tracking and management platform for businesses	✓	✓	✓	✓	✓	
myst ai	Analytics for energy providers, retailers, aggregators and grid			✓	✓		

Source: Competitor website