StorageVET 2.0 Task Force

ESIC Working Group 1: Grid Services and Analysis

Miles Evans | EPRI
Halley Nathwani | EPRI
Giovanni Damato | EPRI

January 9, 2020

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- As a result, please make sure your phone is on mute throughout the webcast unless speaking. Do not place your phone on hold.

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Agenda

- StorageVET 2.0 Documentation Review
- DER-VET Demo
- DER-VET Beta Testing

Documentation Review

Inputs Documentation

- See current user guide
- See current ‘Description’ column from model_parameters_template.csv
- Expanding file input documentation and model parameters descriptions.

- Documentation helps, but guided tool interaction will come with DER-VET

Outputs Documentation

- Output file descriptions
- Column descriptions
- Logs

npv file

The file reports the net present value of the cash flows reported in the *proforma* file. These values consider inflation and discount rates of entire life of the project to help identify whether the project adds value over multiple years.

DER TIME SERIES RESULTS

The following columns will be included for every **Battery** object that is modelled:

- *BESS: <user given name> Charge (kW)*
  The charging value of the BESS. This is the raw optimization solution value.
- *BESS: <user given name> Discharge (kW)*
  The discharging value of the BESS. This is the raw optimization solution value.
- *BESS: <user given name> Power (kW)*

Error Log

Description:

The user can look at this error log file to identify any error or critical warnings that could prevent the case simulation from fully running or producing reasonable results.

How It Works:

The error log file is created after the empty Input class object initializes its attributes with the Schema. It is included inside the results_filename (Results) folder, which is determined by the

Formulation Document

- Optimization documentation
- Pseudocode

if grid_charge is False the include the following equations:

$$\sum ch - pv\_out \leq 0$$

If *loc* is 'ac' then include the following equations:

$$pv\_out - inv\_\max \leq 0$$

$$-inv\_\max - pv\_out \leq 0$$

Else, if *loc* is 'dc' then:

$$pv\_out + \sum P_{net,ESS} - inv\_max \leq 0$$

$$-inv\_max - pv\_out - \sum P_{net,ESS} \leq 0$$

DER-VET Alpha Demo

What is the optimal size of a battery to pair with my already-installed PV system for net cost minimization?

Required Modules

Scenario

- Optimization parameters
- Timeseries data
- Monthly data
- Yearly data

Finance

- Retail Tariff
- Taxes

DER

Battery

PV

Value Stream

Demand Charge Reduction

Energy Charge Reduction

Methods

(1) Optimize for Battery Size

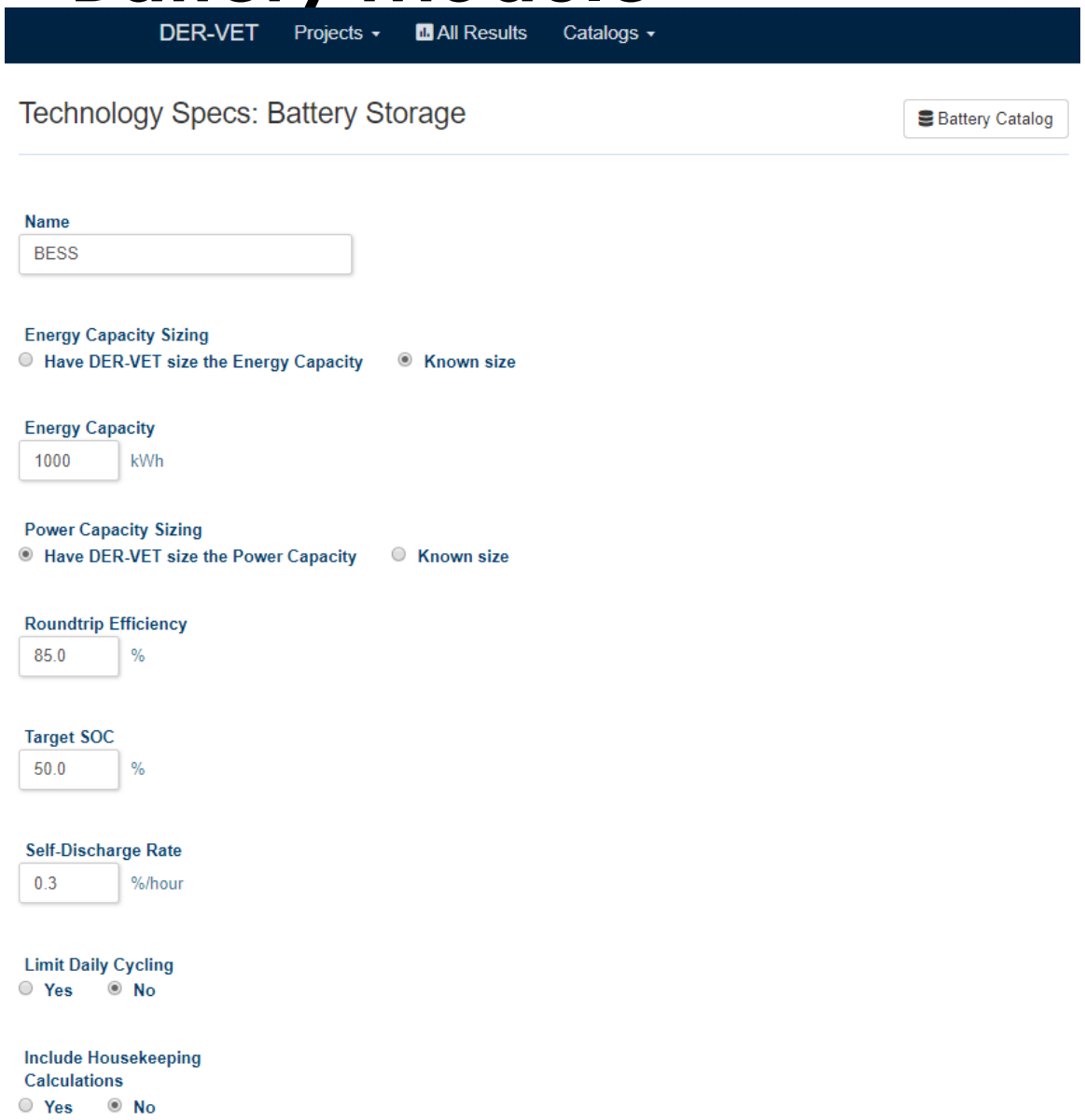
- Pair the battery with a fixed-roof PV stystem
- Would like to operate the battery to reduce my monthly bill when not being used
- Fix **energy rating -** size **power rating**

(2) Validate through Sensitivity Analysis

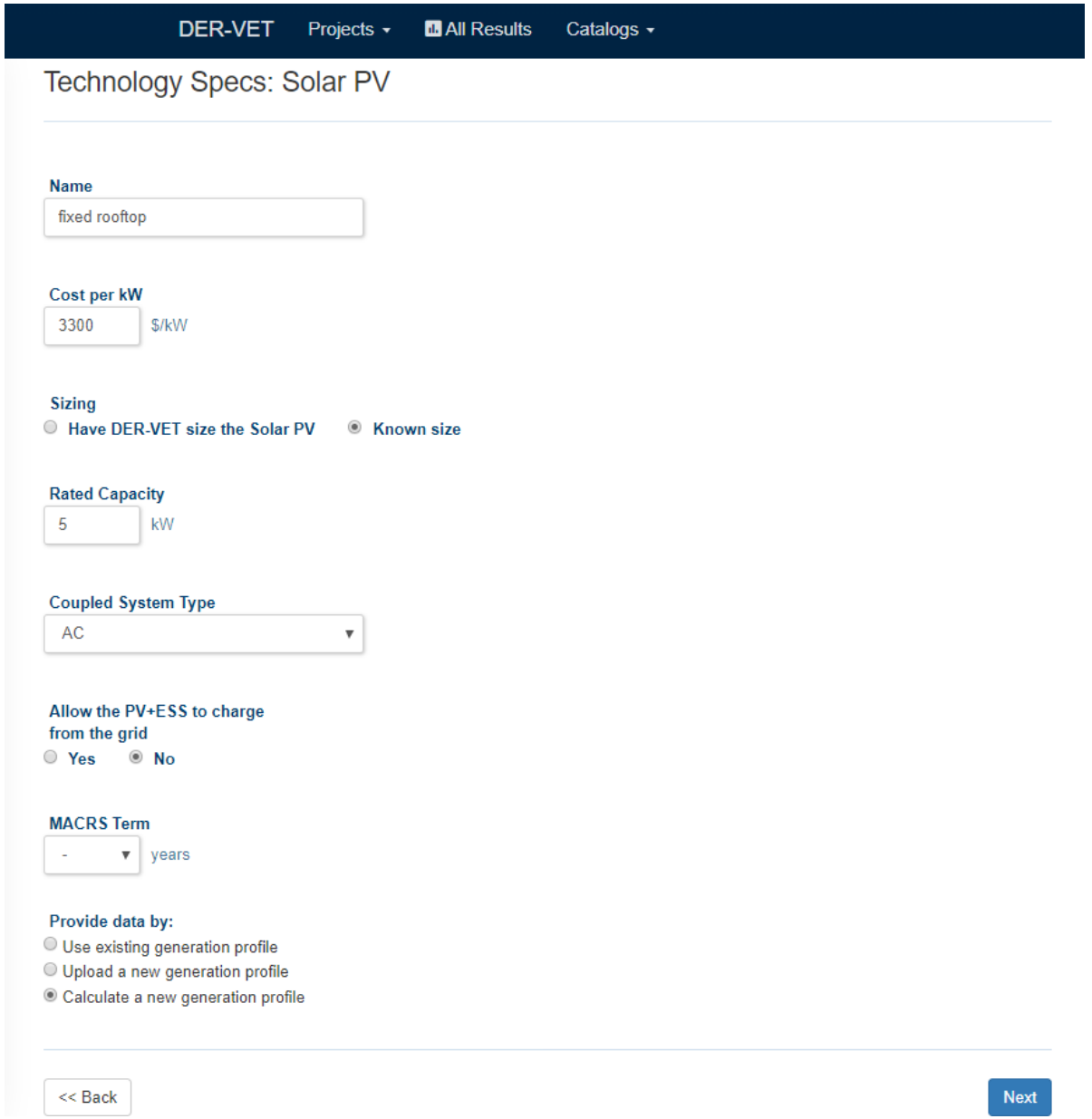
- Select the solution to step (1) as the base case
- Vary **energy rating**
  - Choose 2 values higher and 2 values lower than the base

MODEL INPUTS

Battery Module



PV Module



PV Module: PV Watts

DER-VET Projects All Results Catalogs

Technology Specs: Solar PV

Module Type
Standard

Array Type
Fixed - Open Rack

System Losses
14.08 %

Tilt
38 degrees

Azimuth
180 degrees

Inverter Efficiency
96 %

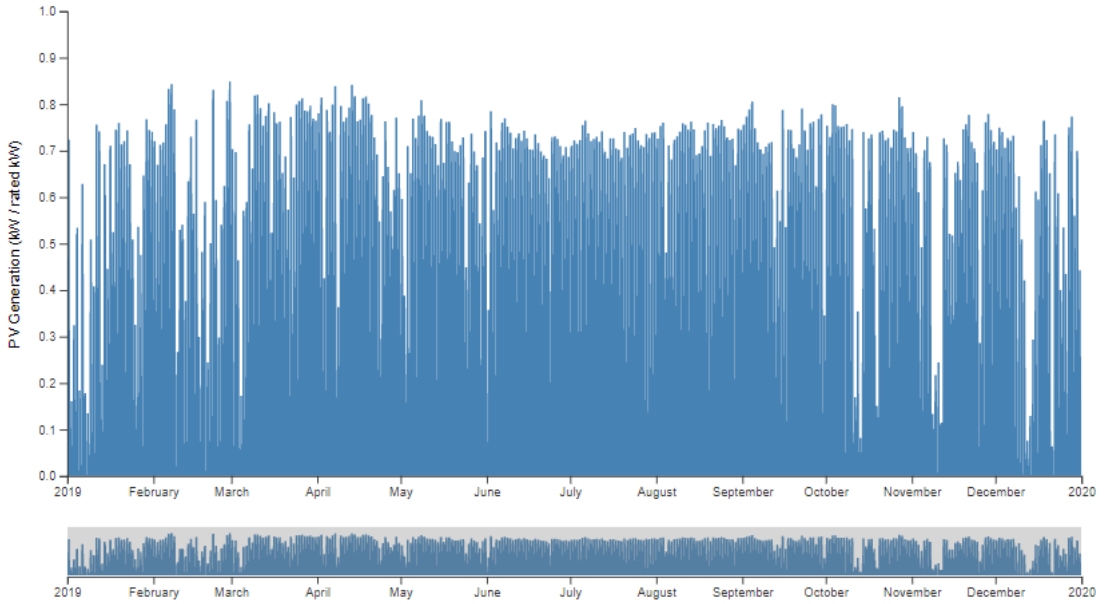
Ground Coverage Ratio
0.4

<< Back Next

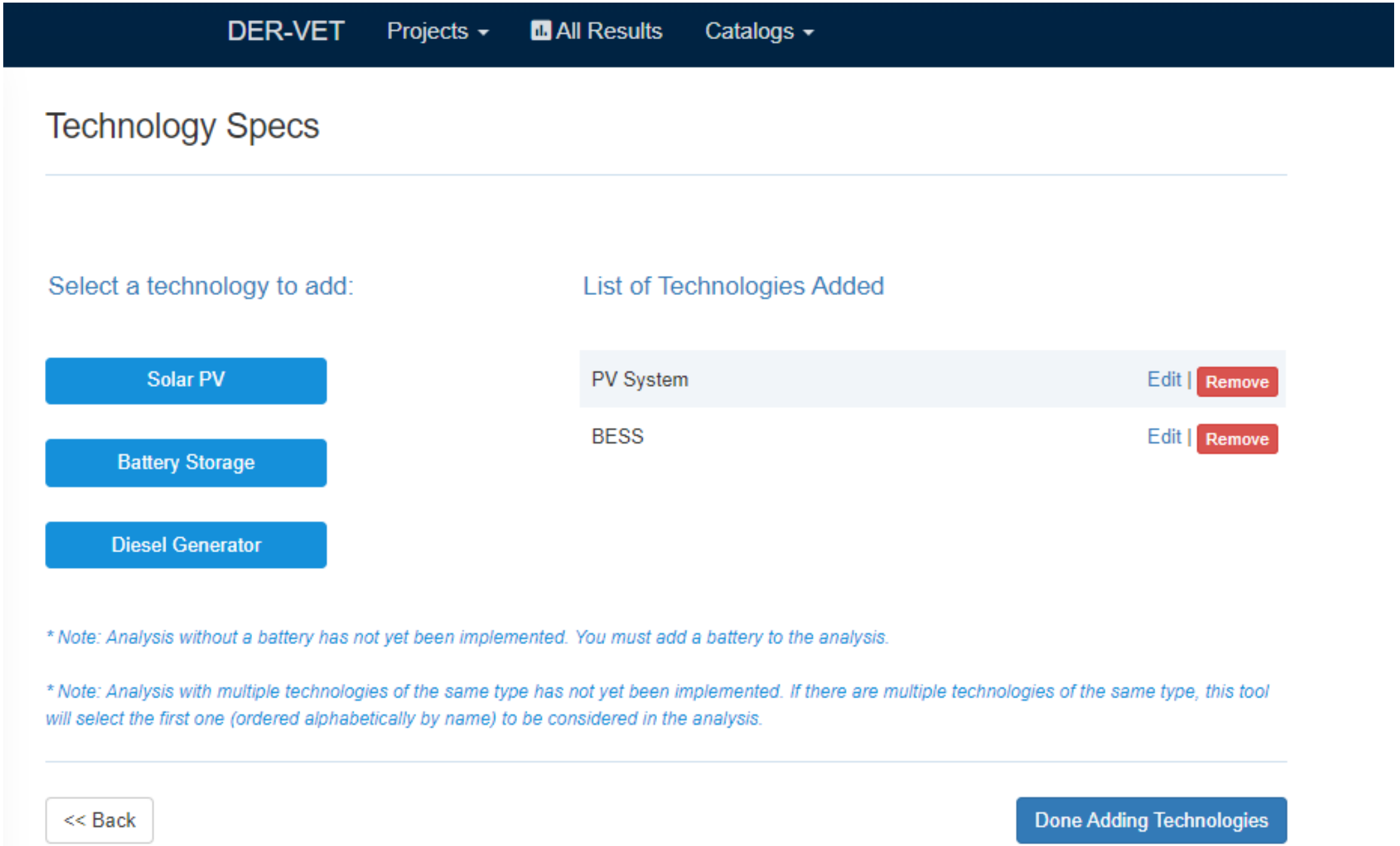
DER-VET Projects All Results Catalogs

Technology Specs: Solar PV

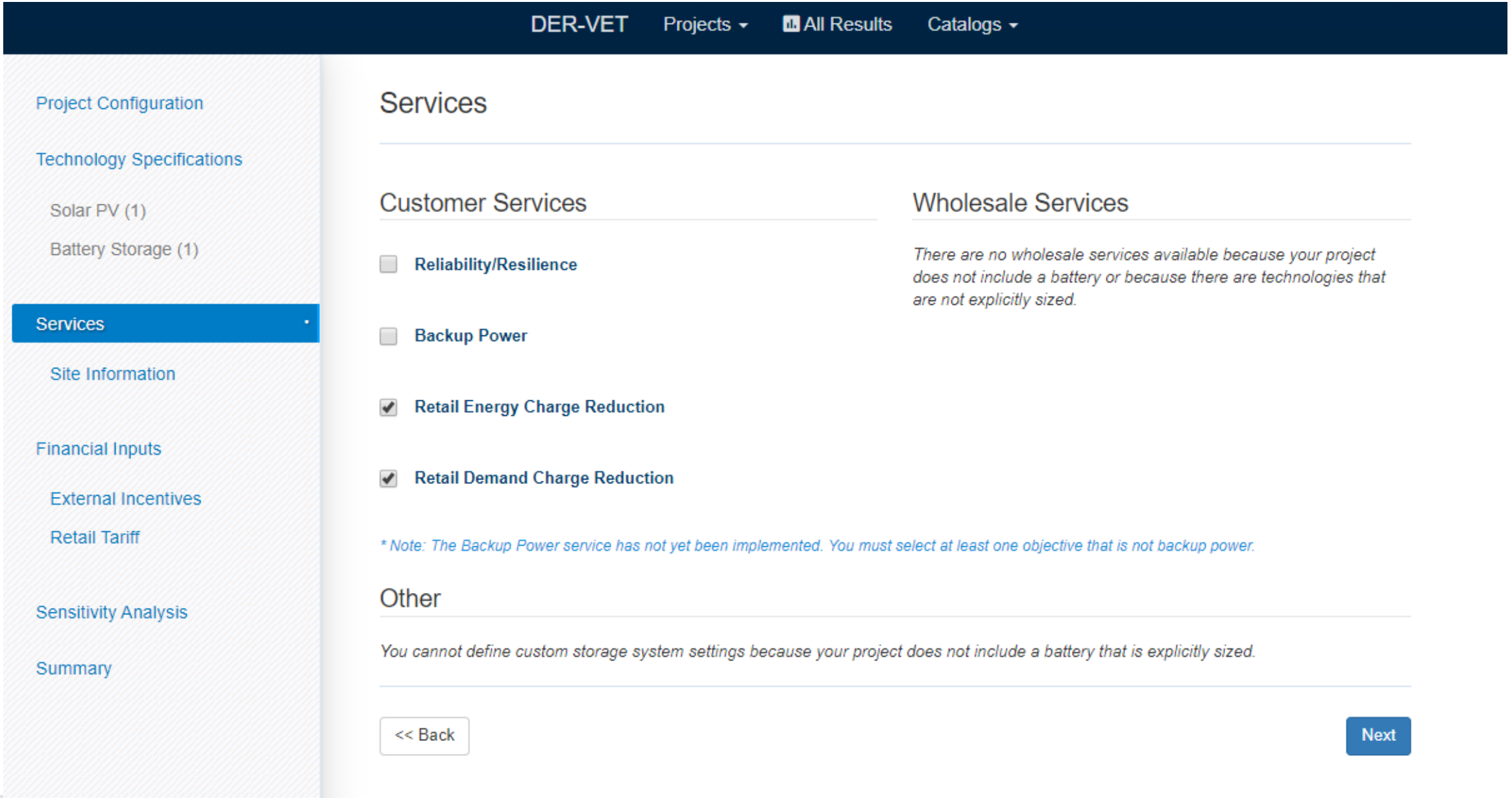
Please take a moment to review the Solar PV data for your project. Click the **Back** button below to upload different Solar PV data, or click **Next** to continue using the Solar PV data below.



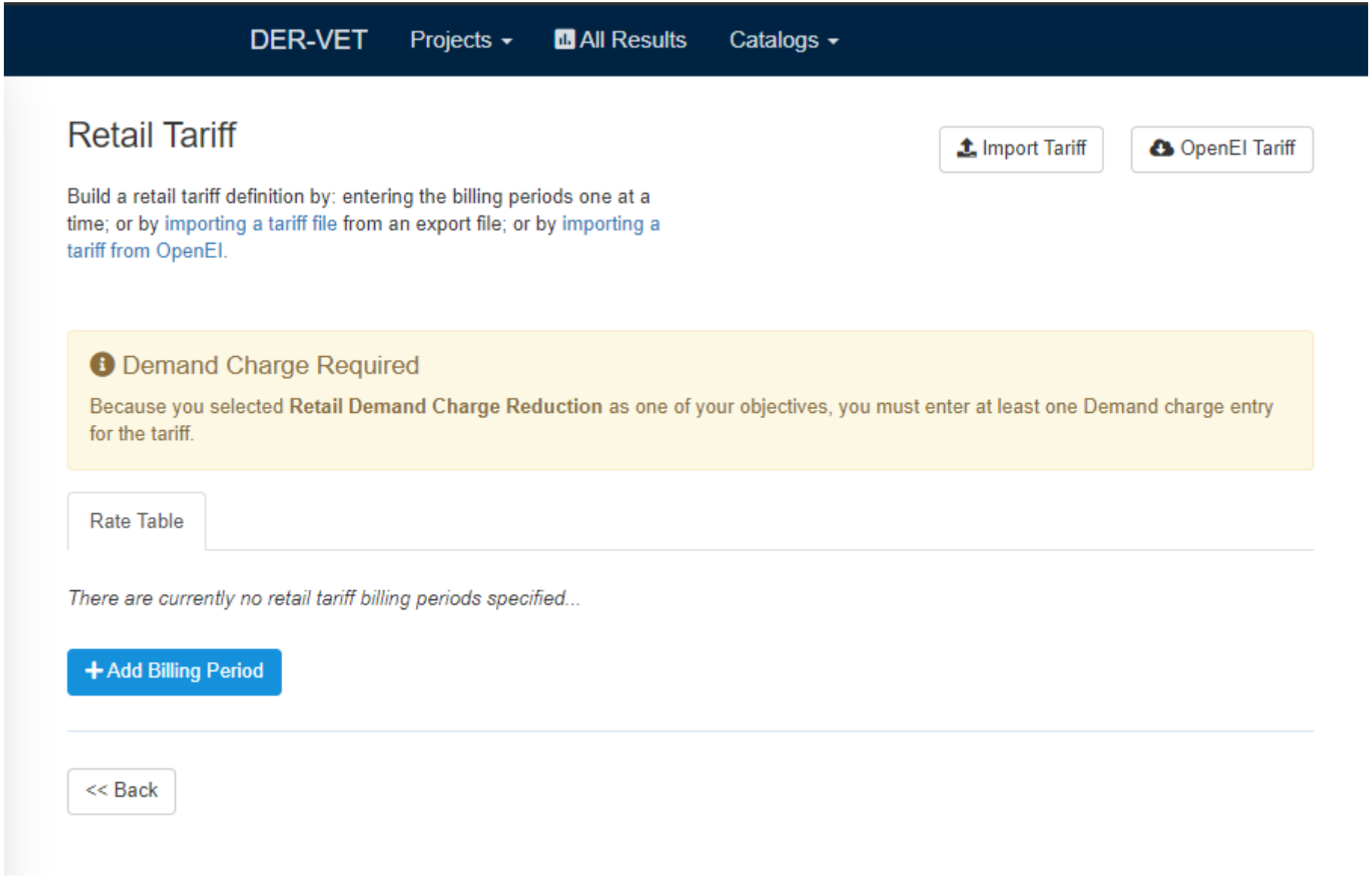
<< Back Next



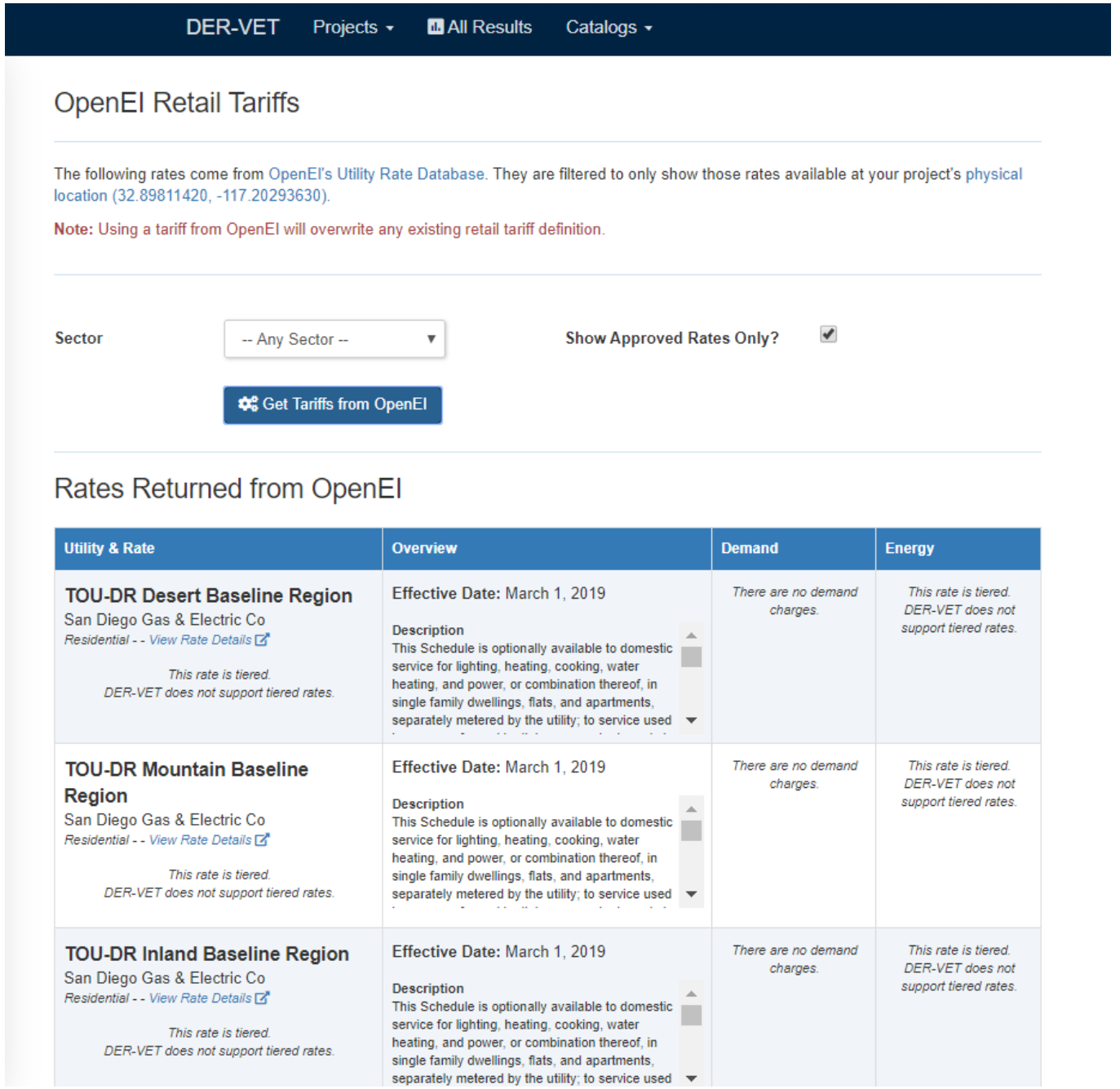
Select your services



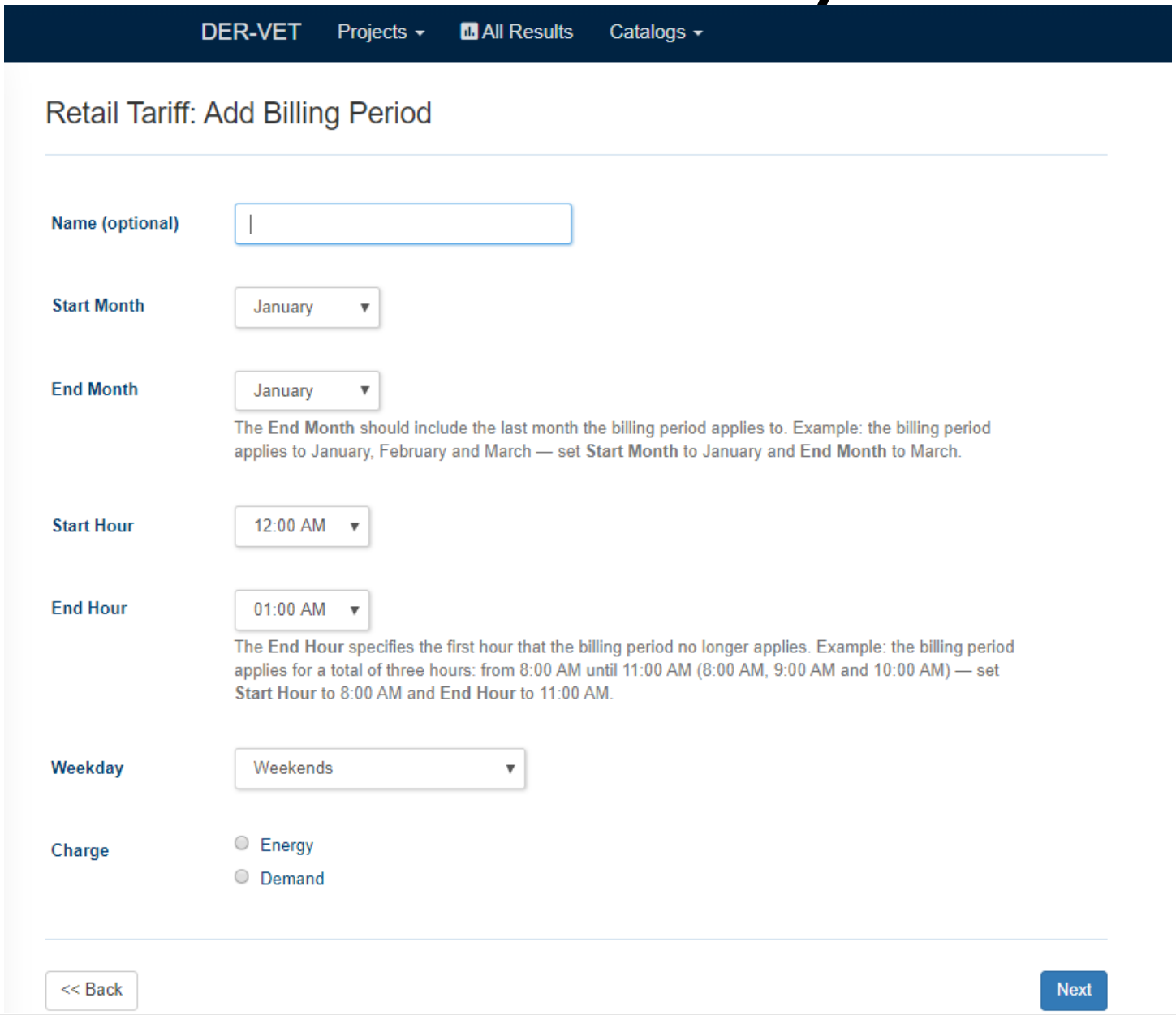
Retail Tariff



Retail Tariff: OpenEI



Retail Tariff: Custom Entry



DER-VET Projects All Results Catalogs

Retail Tariff

Import Tariff Export Tariff OpenEI Tariff

Build a retail tariff definition by: entering the billing periods one at a time; or by importing a tariff file from an export file; or by importing a tariff from OpenEI.

Rate Table | Energy Heatmap | Demand Heatmap

	Name	Period	Coverage	Day of Week	Value	Charge	Remove All
Edit	Entry-001	1	January 12:00 AM - 06:00 AM (6 hours)	Weekdays	$0.0898	Energy	Remove
Edit	Entry-002	2	January 06:00 AM - 04:00 PM (10 hours)	Weekdays	$0.1036	Energy	Remove
Edit	Entry-003	3	January 04:00 PM - 09:00 PM (5 hours)	Weekdays	$0.1162	Energy	Remove
Edit	Entry-004	4	January 09:00 PM - 12:00 AM (3 hours)	Weekdays	$0.1036	Energy	Remove
Edit	Entry-005	5	February 12:00 AM - 06:00 AM (6 hours)	Weekdays	$0.0898	Energy	Remove
Edit	Entry-006	6	February 06:00 AM - 04:00 PM (10 hours)	Weekdays	$0.1036	Energy	Remove
Edit	Entry-007	7	February 04:00 PM - 09:00 PM (5 hours)	Weekdays	$0.1162	Energy	Remove
Edit	Entry-008	8	February 09:00 PM - 12:00 AM (3 hours)	Weekdays	$0.1036	Energy	Remove
Edit	Entry-009	9	March 12:00 AM - 06:00 AM (6 hours)	Weekdays	$0.0898	Energy	Remove
Edit	Entry-010	10	March 06:00 AM - 10:00 AM (4 hours)	Weekdays	$0.1036	Energy	Remove
Edit	Entry-011	11	March 10:00 AM - 02:00 PM (4 hours)	Weekdays	$0.0898	Energy	Remove

Retail Tariff: Energy Charges

Rate Table | Energy Heatmap | Demand Heatmap

Energy Usage Charge Structure

Period	Rate $/kWh
1	$0.0886
2	$0.0898
3	$0.1036
4	$0.1162
5	$0.1173
6	$0.1391

Weekdays

Month	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
January	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	3	3	3
February	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	3	3	3
March	2	2	2	2	2	2	3	3	3	3	2	2	2	2	3	3	4	4	4	4	4	3	3	3
April	2	2	2	2	2	2	3	3	3	3	2	2	2	2	3	3	4	4	4	4	4	3	3	3
May	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	3	3	3
June	1	1	1	1	1	1	5	5	5	5	5	6	5	5	5	5	8	8	8	8	8	6	6	6
July	1	1	1	1	1	1	5	5	5	5	5	6	5	5	5	5	8	8	8	8	8	6	6	6
August	1	1	1	1	1	1	5	5	5	5	5	6	5	5	5	5	8	8	8	8	8	6	6	6
September	1	1	1	1	1	1	5	5	5	5	5	6	5	5	5	5	8	8	8	8	8	6	6	6
October	1	1	1	1	1	1	5	5	5	5	5	6	5	5	5	5	8	8	8	8	8	6	6	6
November	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	3	3	3
December	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	3	3	3

Weekends

Month	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
January	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	4	4	4	4	4	3	3	3
February	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	4	4	4	4	4	3	3	3
March	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	4	4	4	4	4	3	3	3
April	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	4	4	4	4	4	3	3	3
May	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	4	4	4	4	4	3	3	3
June	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	8	8	8	8	8	6	6	6
July	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	8	8	8	8	8	6	6	6
August	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	8	8	8	8	8	6	6	6
September	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	8	8	8	8	8	6	6	6
October	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	8	8	8	8	8	6	6	6
November	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	4	4	4	4	4	3	3	3
December	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	4	4	4	4	4	3	3	3

<< Back | Done Adding Billing Periods

Retail Tariff: Demand Charges

Rate Table | Energy Heatmap | Demand Heatmap

Demand Charge Structure

Period	Rate $/kWh
1	$21.00
2	$37.44
3	$48.47
4	$58.44
5	$69.47

Weekdays

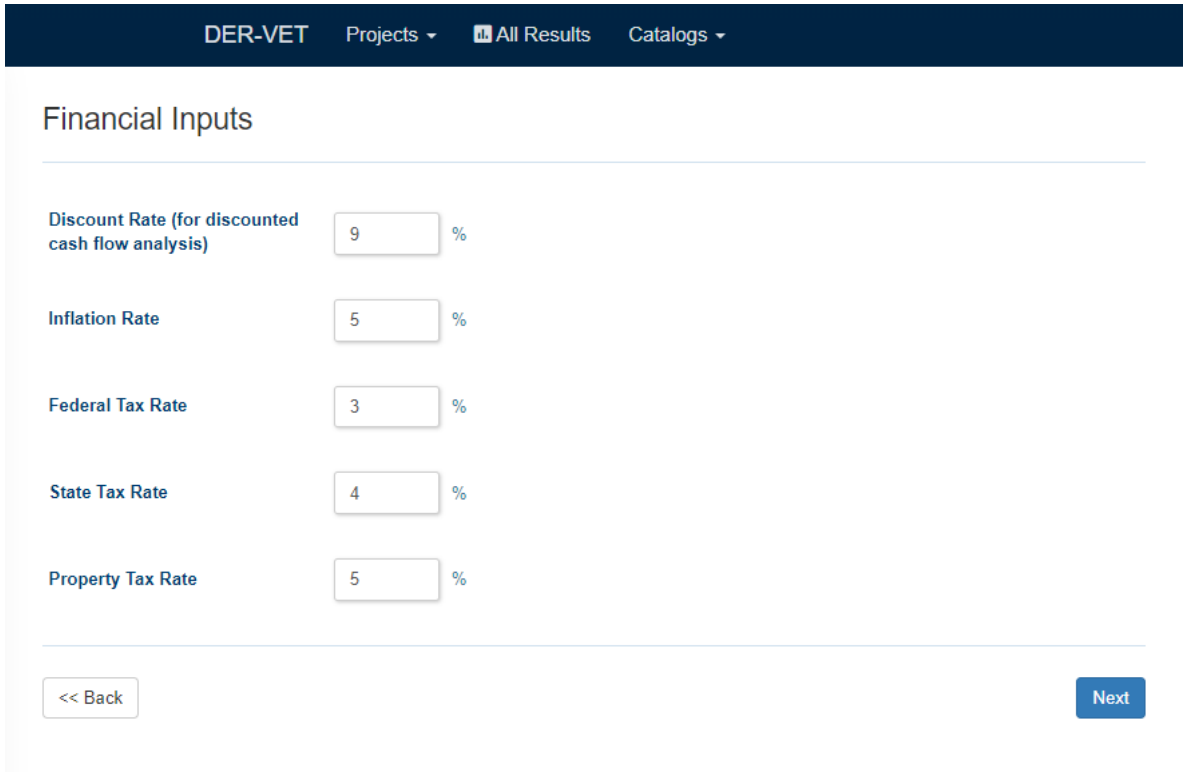
Month	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
January	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	4	4	1	1	1
February	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	4	4	1	1	1
March	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	4	4	1	1	1
April	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	4	4	1	1	1
May	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	4	4	1	1	1
June	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	5	5	1	1	1
July	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	5	5	1	1	1
August	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	5	5	1	1	1
September	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	5	5	1	1	1
October	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	5	5	1	1	1
November	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	4	4	1	1	1
December	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	4	4	1	1	1

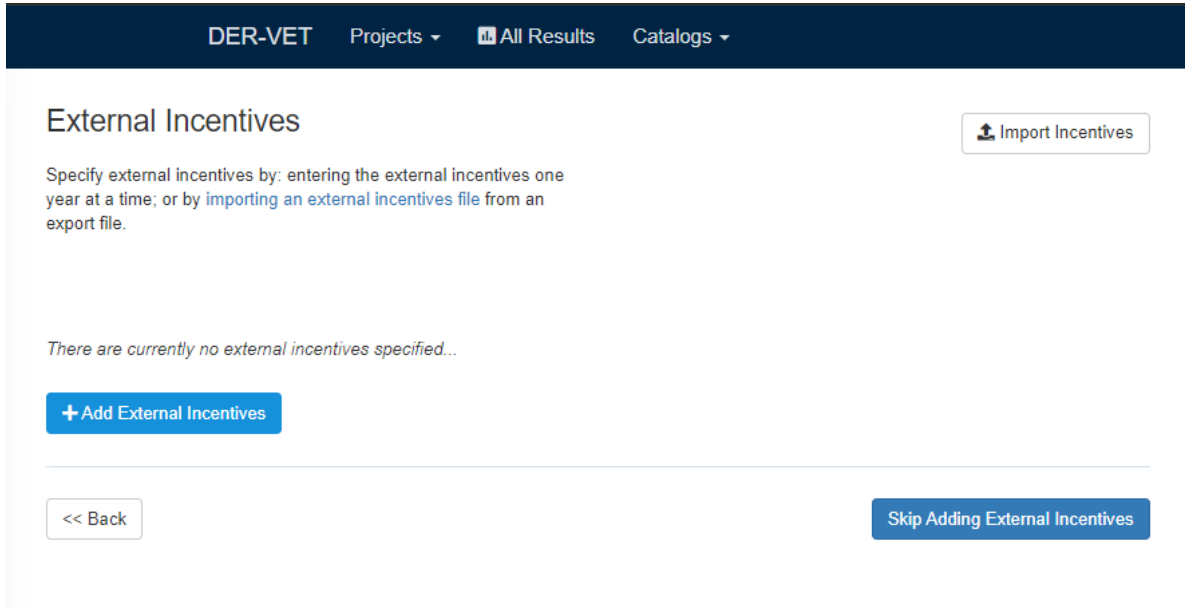
Weekends

Month	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
January	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1
February	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1
March	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1
April	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1
May	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1
June	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	1	1	1
July	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	1	1	1
August	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	1	1	1
September	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	1	1	1
October	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	1	1	1
November	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1
December	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1

<< Back | Done Adding Billing Periods

CBA Module





Site Module

DER-VET Projects All Results Catalogs

Services: Site Information

☐ **Prevent the system from charging from the grid**

☑ **Prevent the system from discharging to the grid**

Site load data has already been uploaded for this project. Do you want to use the existing data?

○ **Yes** ◉ **No, upload new data**

Upload the site load as a .csv file that contains a reading at each time interval on a separate line. The number of total lines expected depends on the selected year and timestep selected below. For instance, an upload with a timestep of 30-minutes for a year with 365 days would require an input file with 17,520 readings.

Click here to download a sample .csv file with a 60-minute timestep for a year with 365 days (8,760 readings)

*Click here to download a sample .csv file with a 60-minute timestep **for a leap year with 366 days** (8,784 readings)*

Site Load for the year 2019

Choose File SampleSiteL...60 (1).csv

Timestep

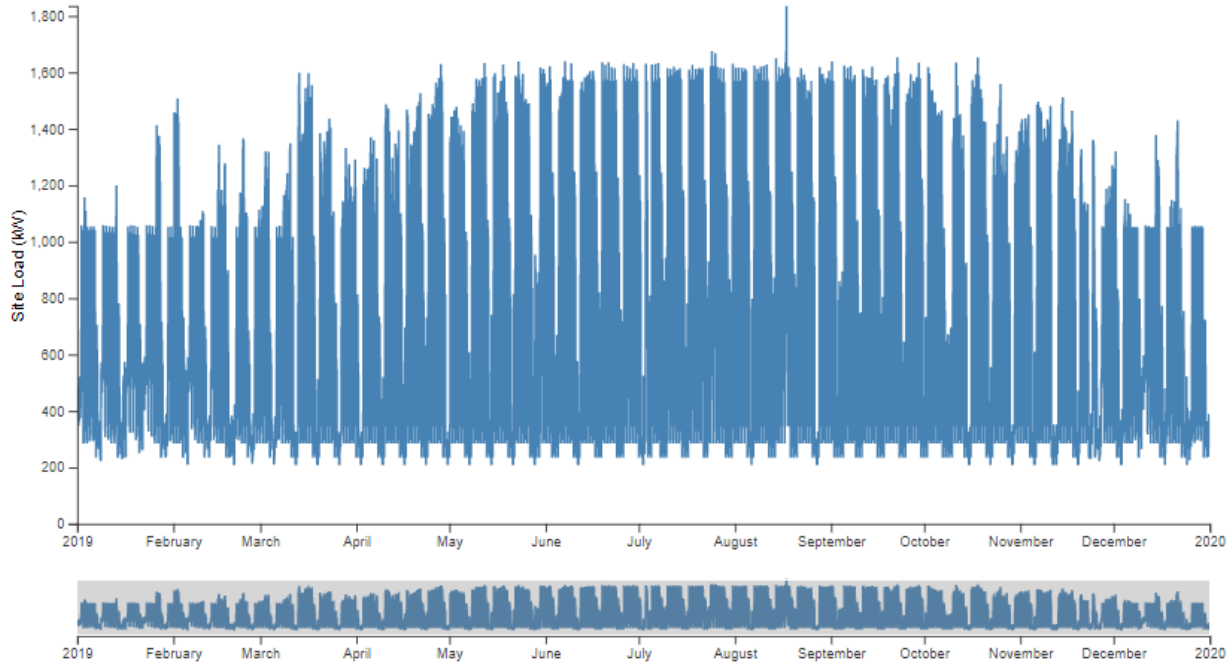
60 ▾ minutes

<< Back Next

DER-VET Projects All Results Catalogs

Services: Site Load

Please take a moment to review the Site Load data for your project. Click the **Back** button below to upload different Site Load data, or click **Next** to continue using the below Site Load data.



<< Back Next

Summary

Setup

Project Name	BTM test
Start year	2019
Analysis Horizon	20 years
Data year	2019
Grid Domain	Customer
Latitude	32.89811420
Longitude	-117.20293630

Technology Specs

Solar PV considered in analysis	1
Battery Storage considered in analysis	1
Diesel Generators considered in analysis	0

Services

- Retail Energy Charge Reduction
- Retail Demand Charge Reduction

Financial Inputs

Discount rate	7 %
Inflation rate	0 %
Federal tax rate	0 %
State tax rate	0 %
Property tax rate	0 %

Sensitivity Analysis

Number of Sensitivity Analysis Cases	Baseline

Name or Description of Analysis

Name or Description (optional)

You may optionally enter a name or short description for the analysis you are about to perform.

Notification When Complete?

Receive an email notification when the analysis completes?

No, do not send me an email

<< Back

Run Analysis

Status

Running Analysis for BTM test

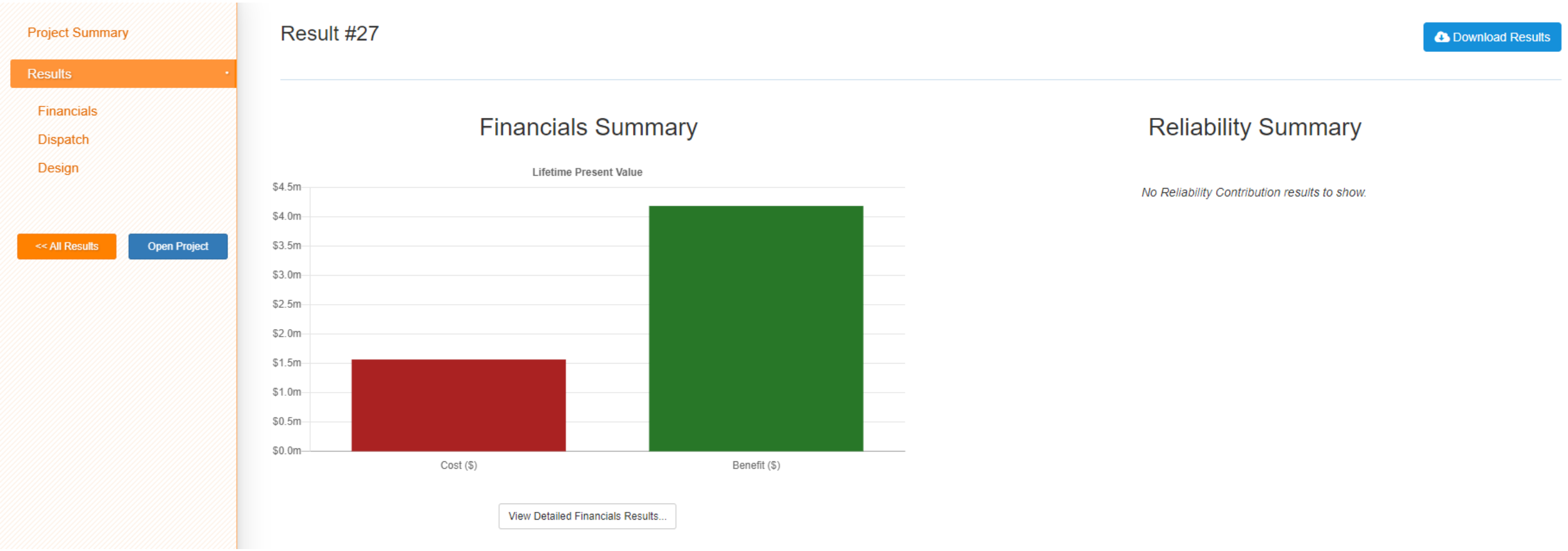
Please be patient... this can take several minutes to complete...

<< Back

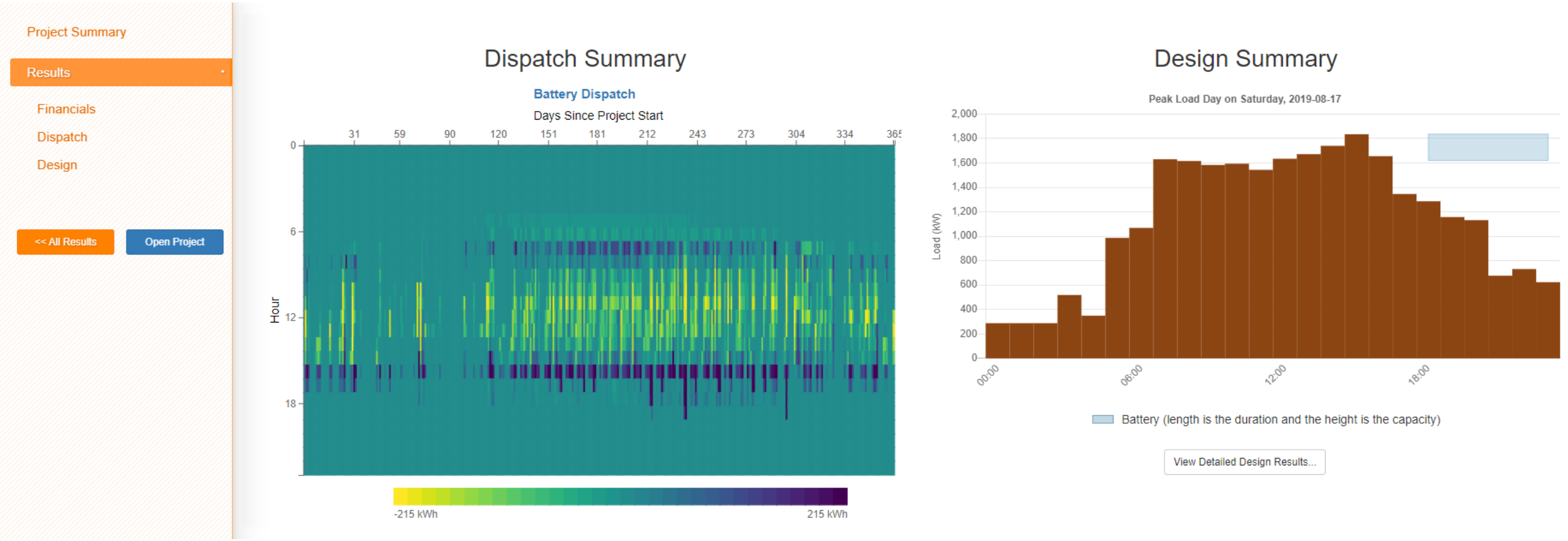
View Results

MODEL OUTPUTS

Summary Page



Summary Page



Project Summary

Results

Financials

Dispatch

Design

<< All Results

Open Project

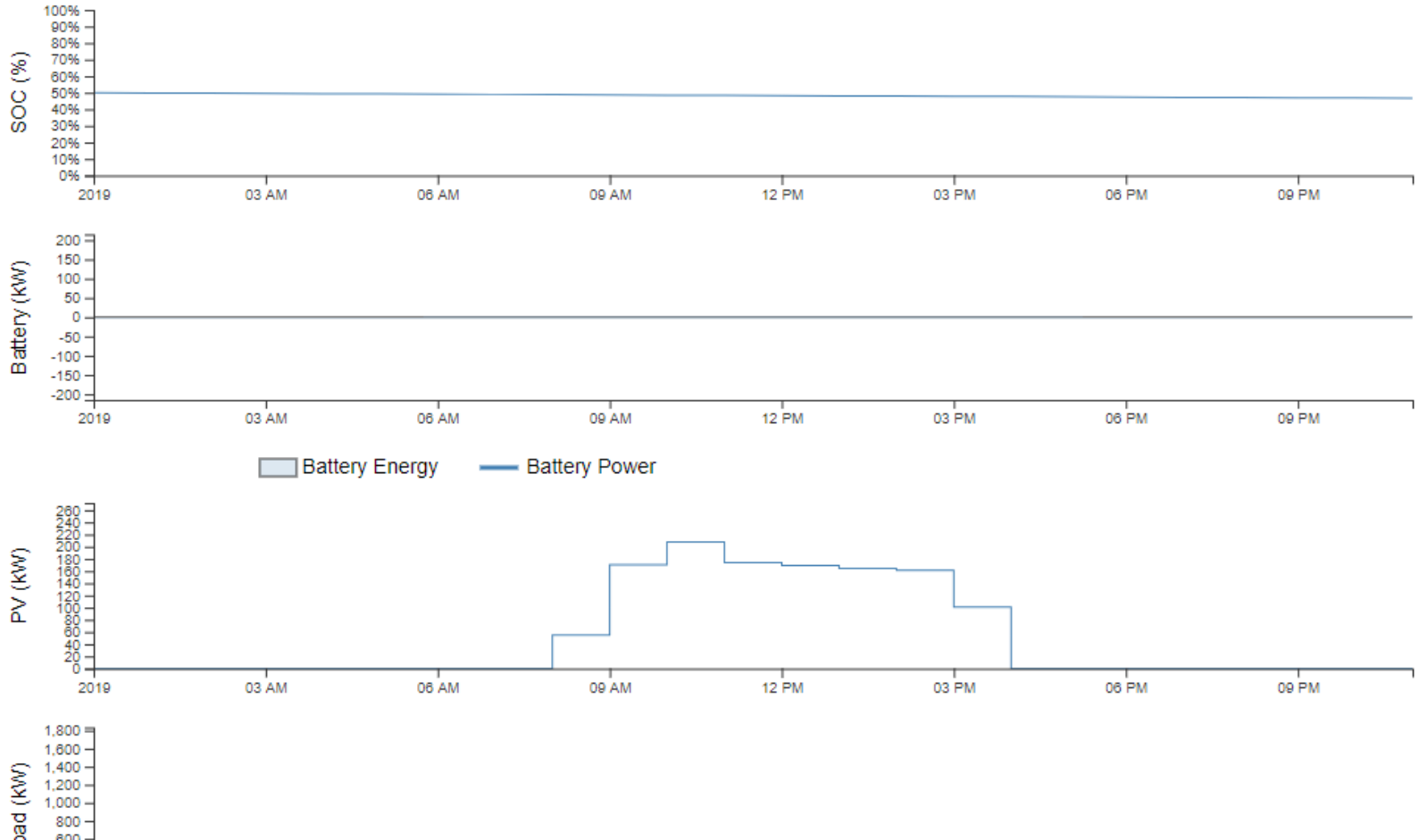
Results: Dispatch

January 1, 2019

Day

SOC | Battery | PV | Load | Net Load

From: 01/01/2019 **To:** 01/01/2019



Project Summary

Results

Financials

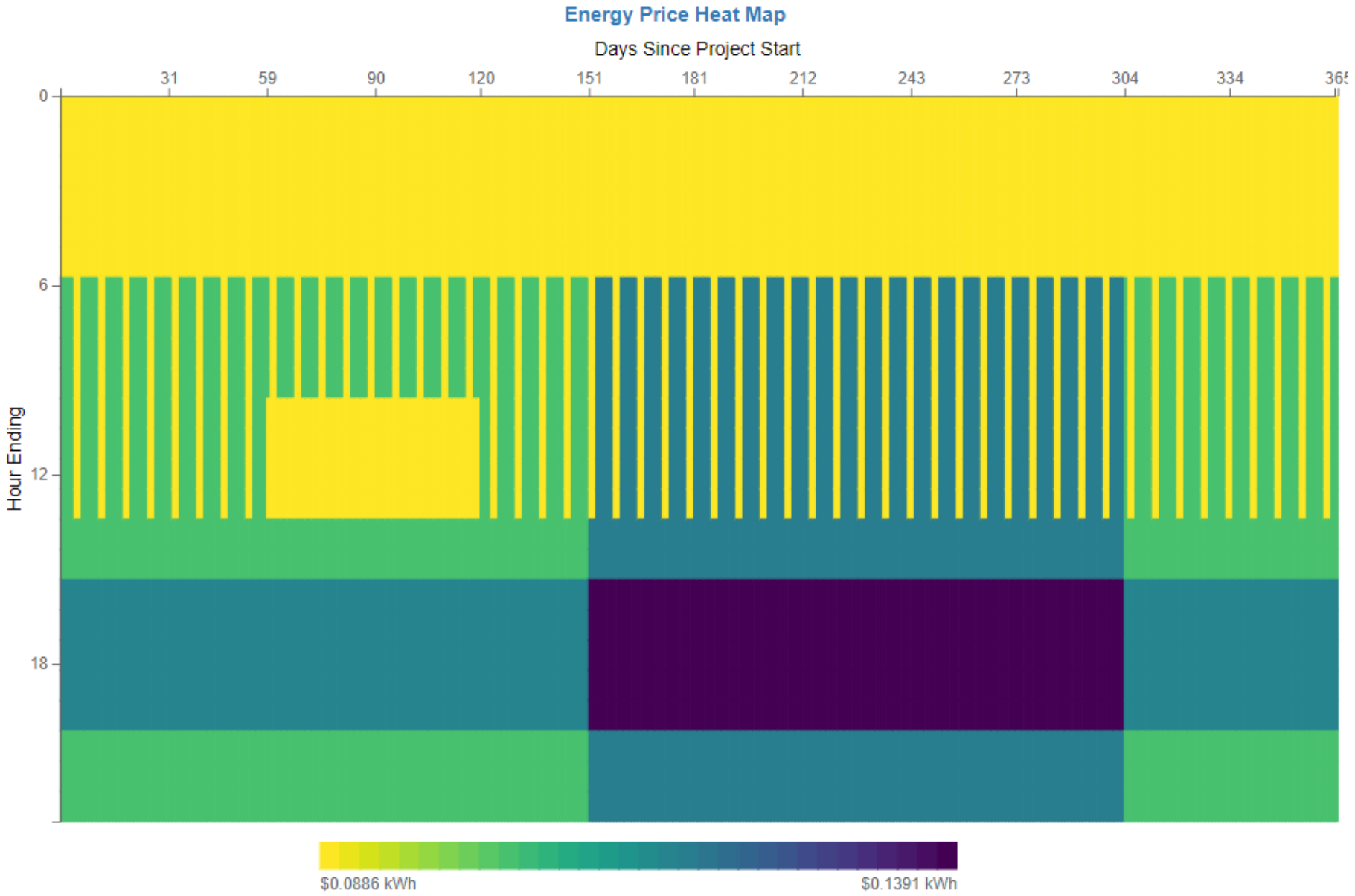
Dispatch

Design

<< All Results

Open Project

Results: Dispatch



CBA Results

Project Summary

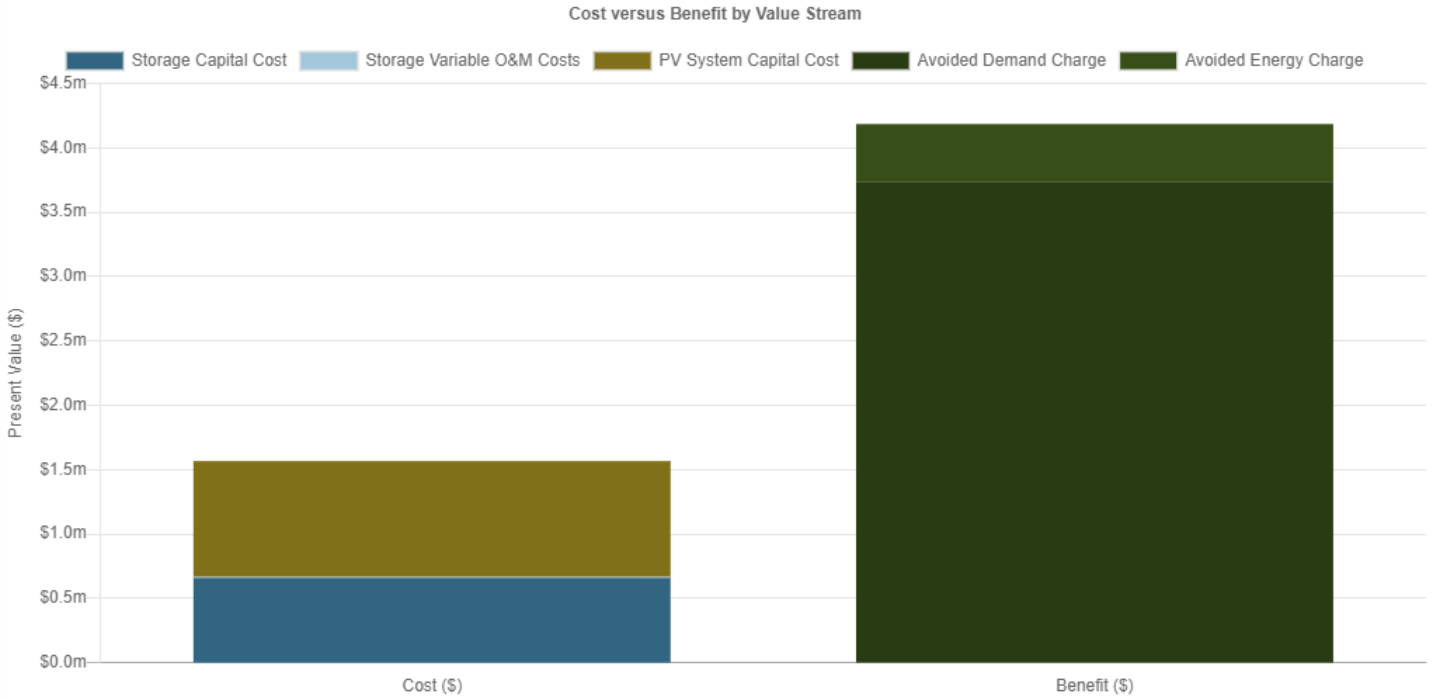
Results

Financials

Dispatch

Design

<< All Results | Open Project



Pro-forma (Nominal Cash Flow)

Year	Avoided Demand Charge	Avoided Energy Charge	Storage Capital Cost	Storage Fixed O&M Cost	Storage Variable O&M Costs	PV System Capital Cost	PV System Fixed O&M Cost
CAPEX Year	$0	$0	-$658,340	$0	$0	-$900,000	$0
2019	$344,359	$41,765	$0	$0	-$680	$0	$0
2020	$344,359	$41,765	$0	$0	-$680	$0	$0
2021	$344,359	$41,765	$0	$0	-$680	$0	$0
2022	$344,359	$41,765	$0	$0	-$680	$0	$0

CBA Results

Project Summary

Results

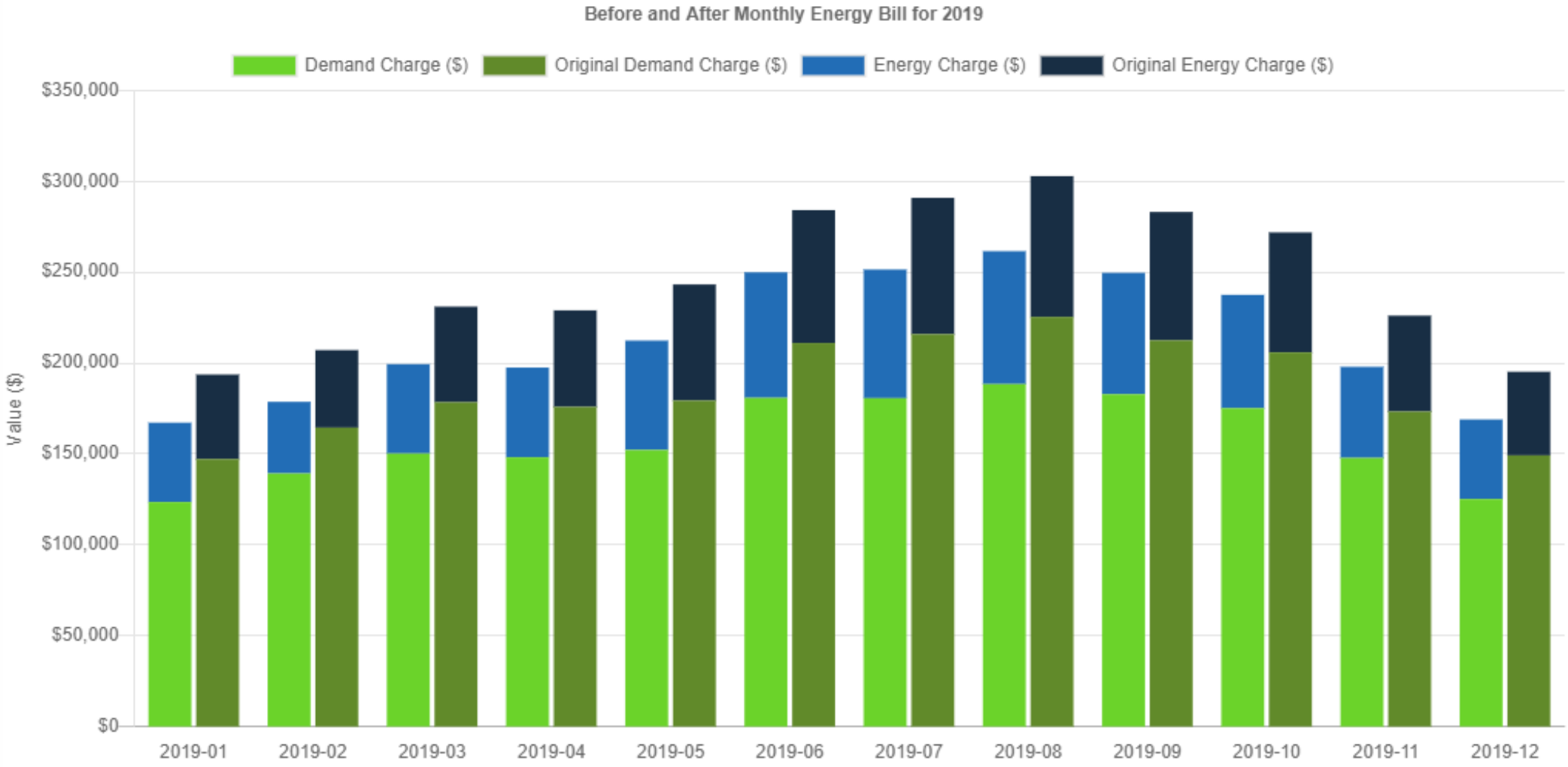
Financials

Dispatch

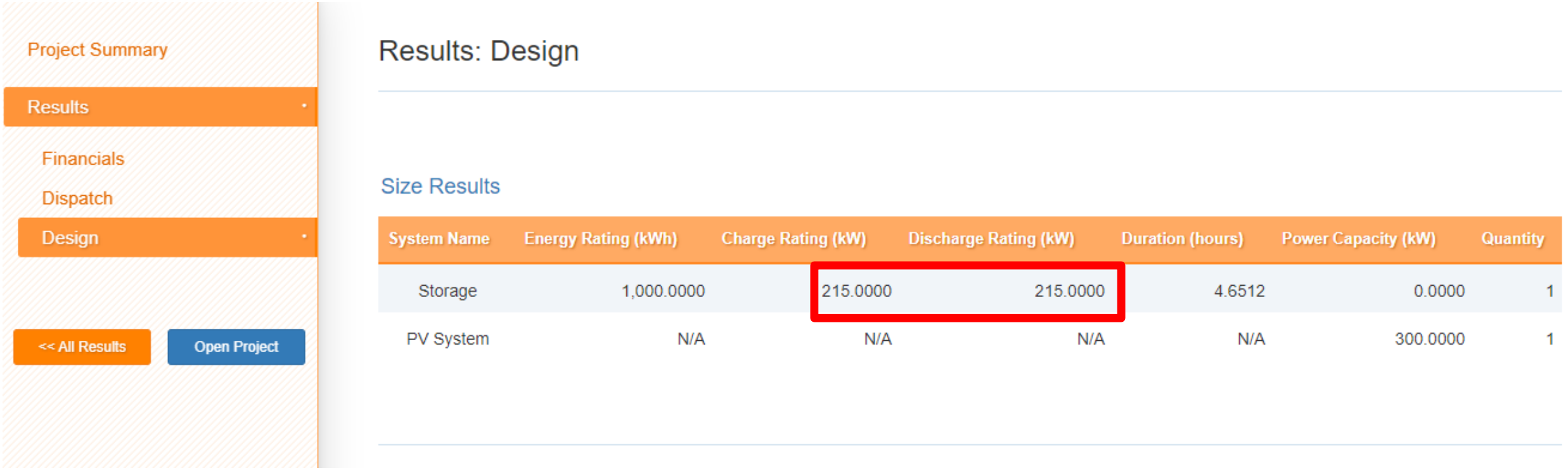
Design

<< All Results

Open Project



Design Results

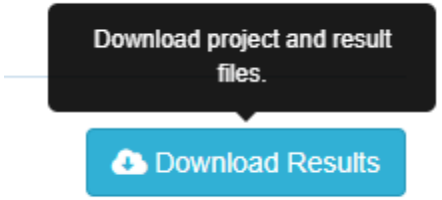


System Name	Energy Rating (kWh)	Charge Rating (kW)	Discharge Rating (kW)	Duration (hours)	Power Capacity (kW)	Quantity
Storage	1,000.0000	215.0000	215.0000	4.6512	0.0000	1
PV System	N/A	N/A	N/A	N/A	300.0000	1

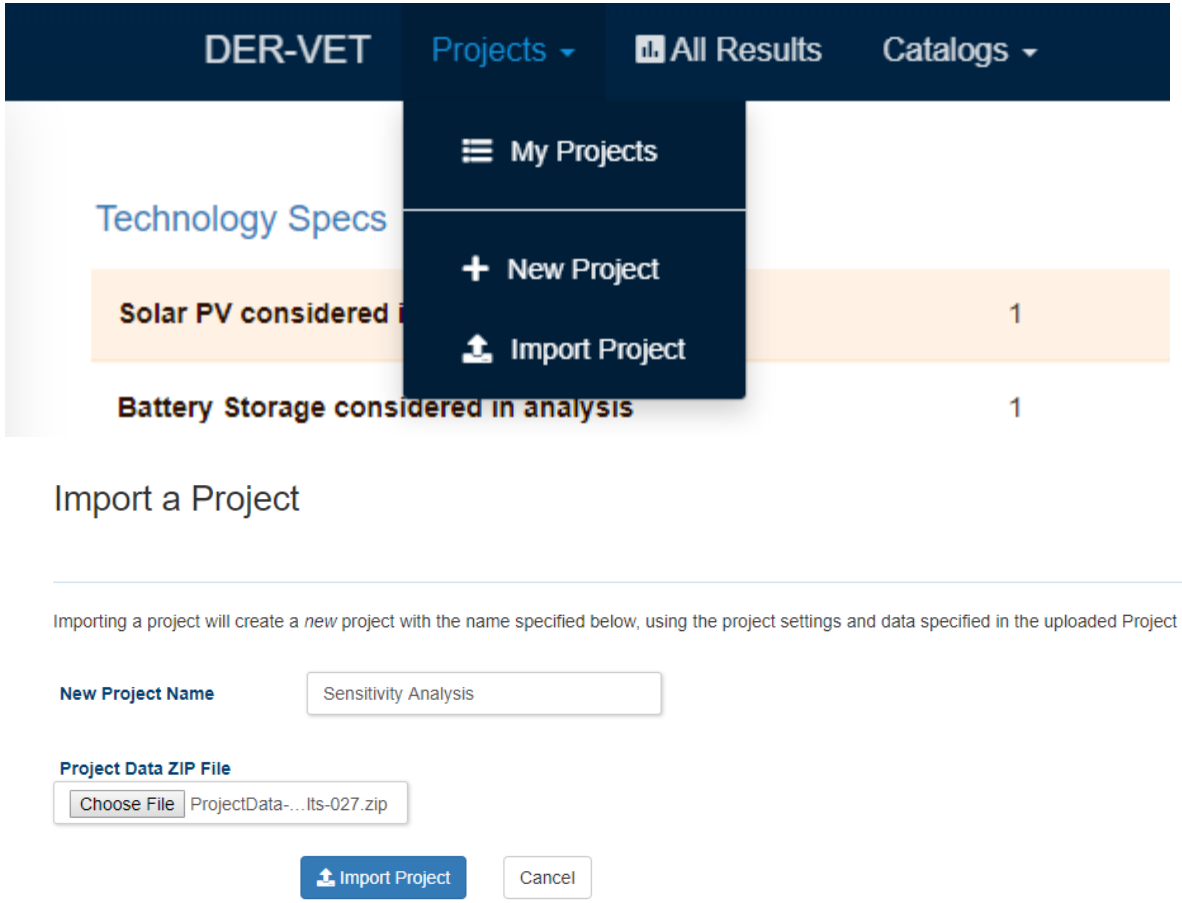
SENSITIVITY ANALYSIS

Download & Import

Download Results

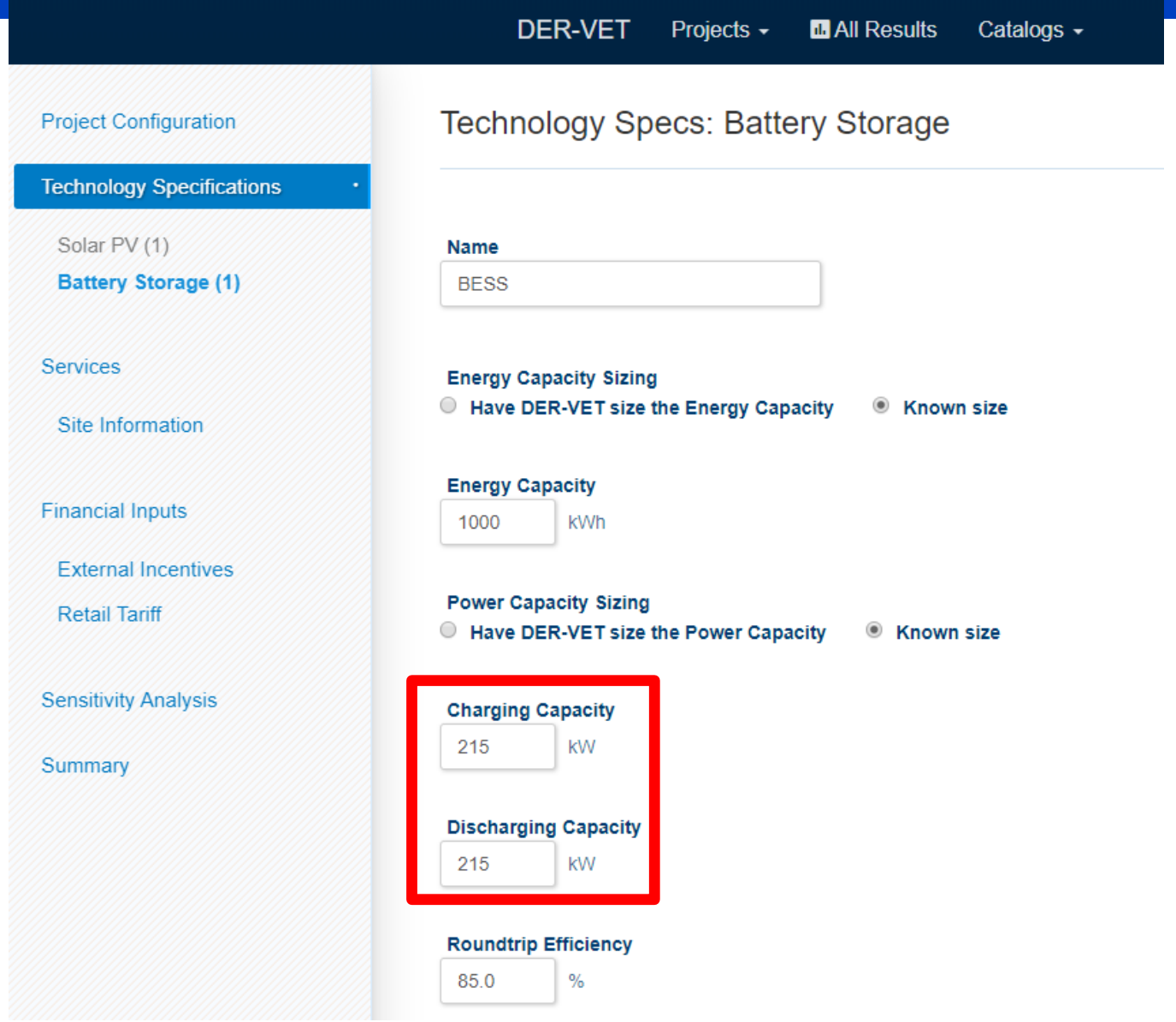


Import



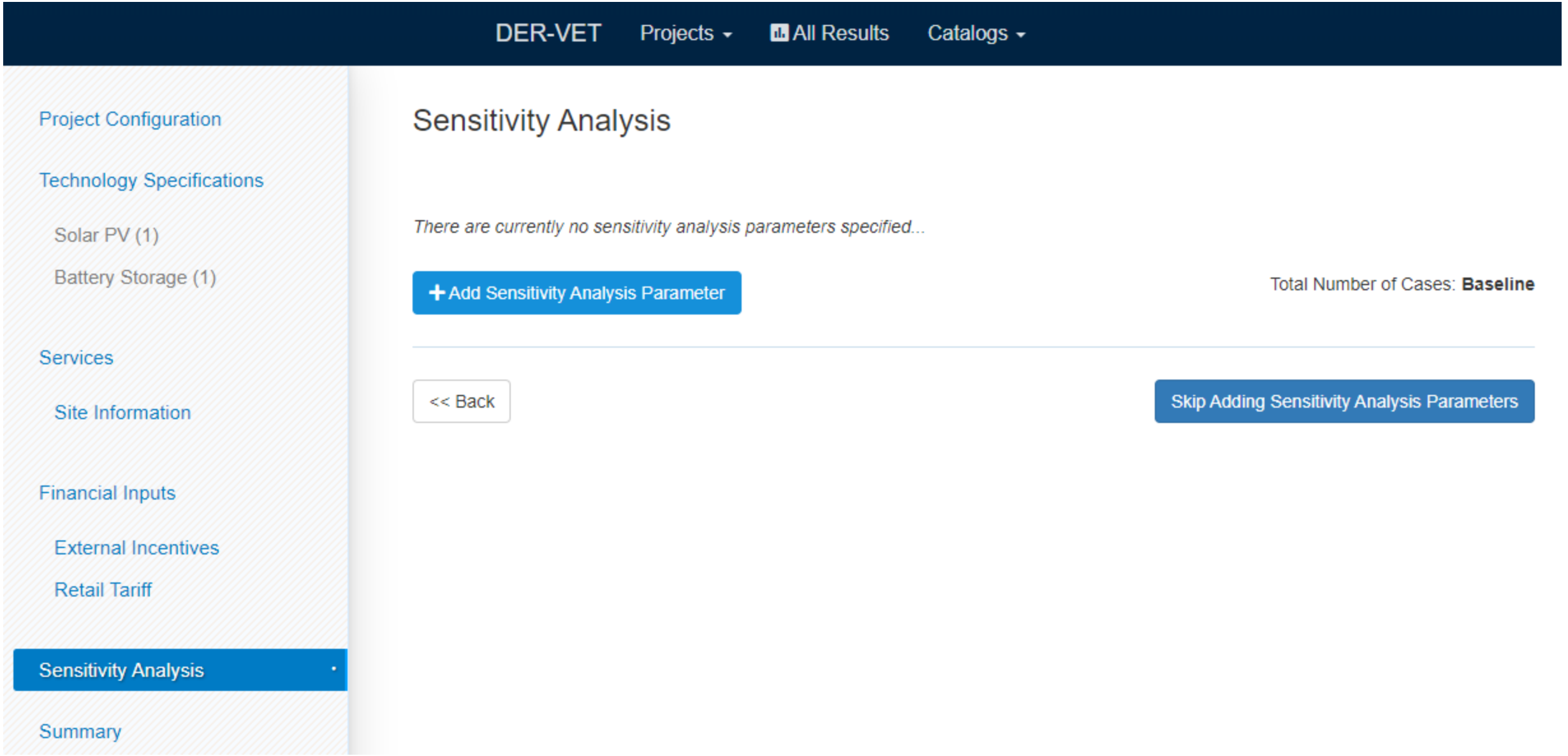
Edit Battery Module

Use the solution of part 1 to fix the battery size

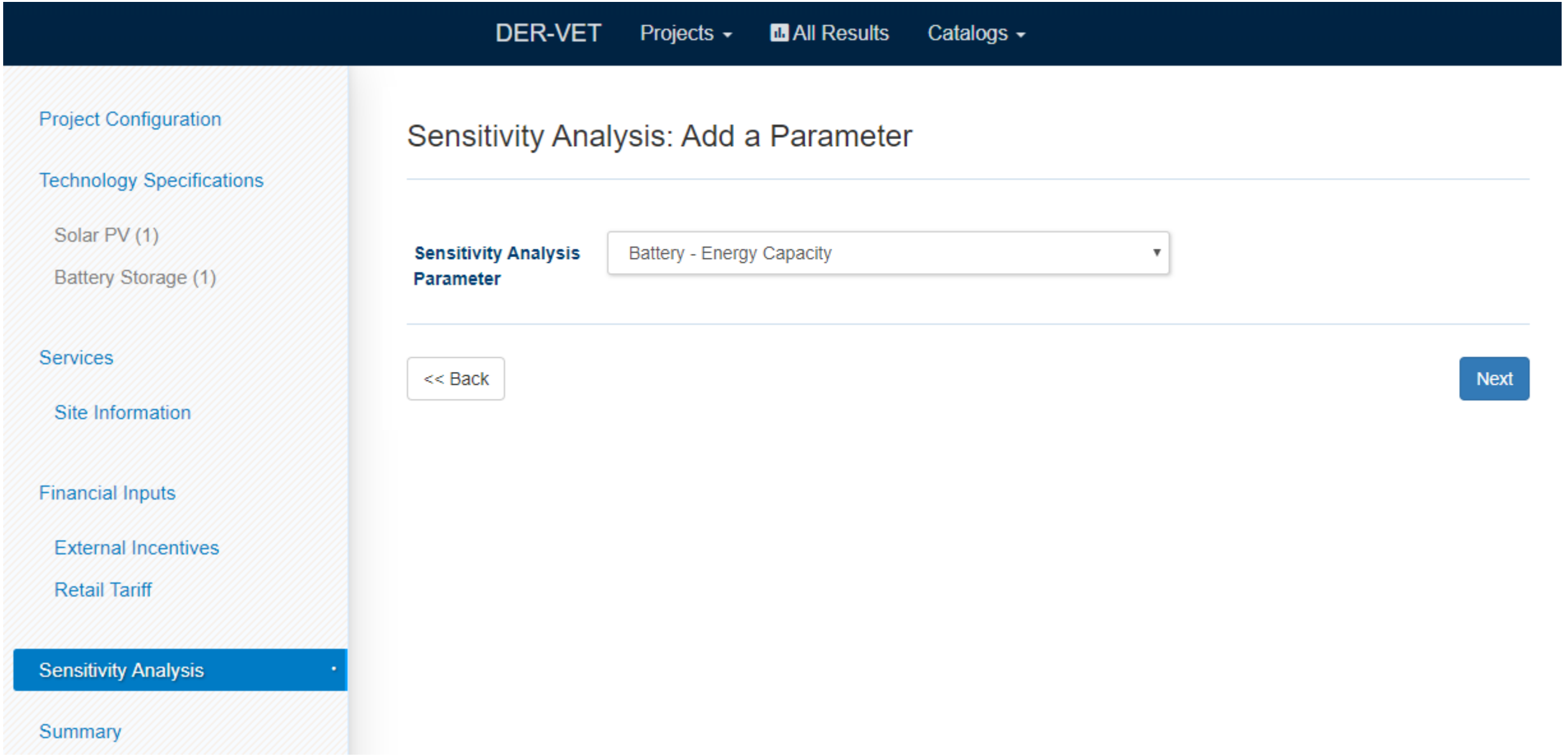


Setting up the base case

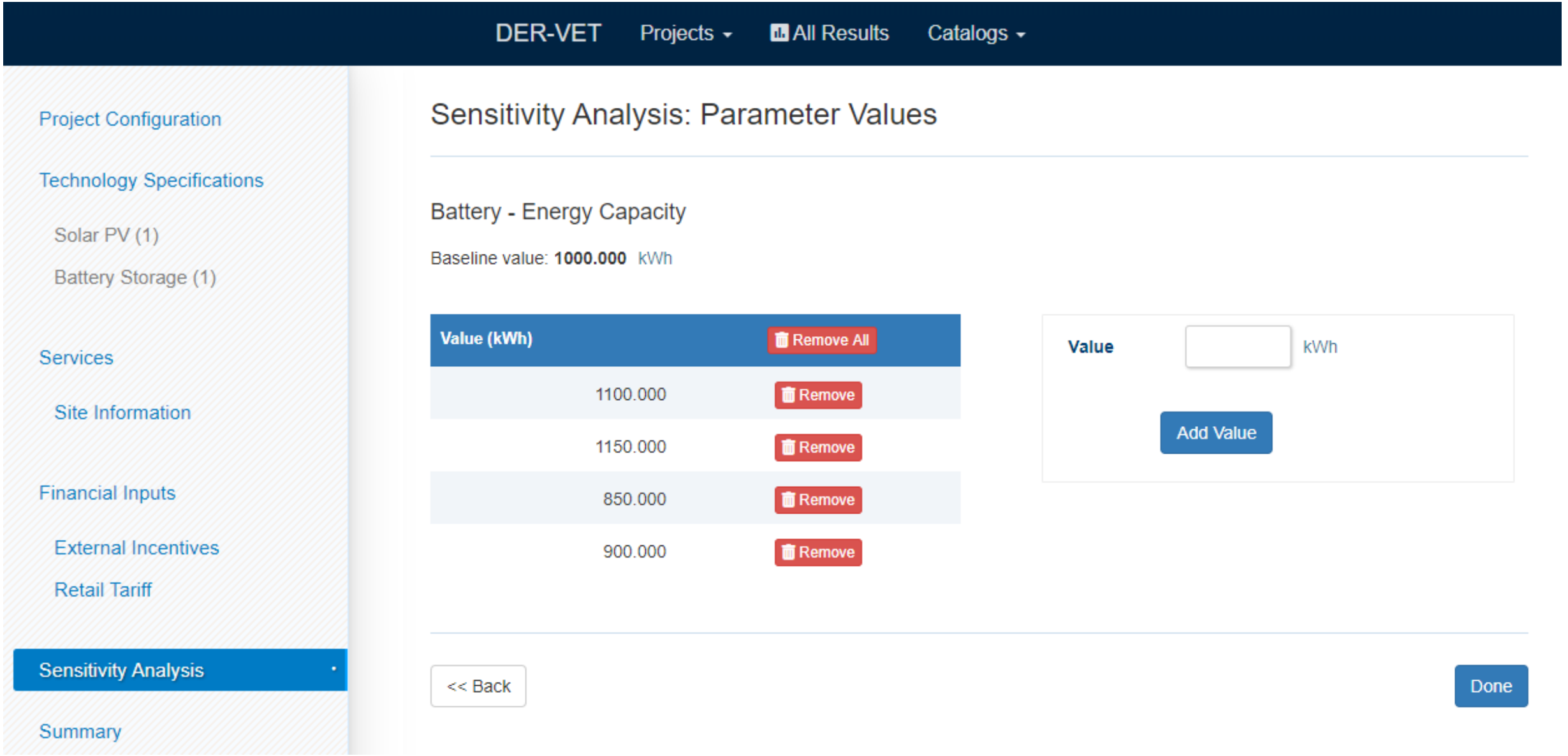
Sensitivity Analysis Module: Inputs



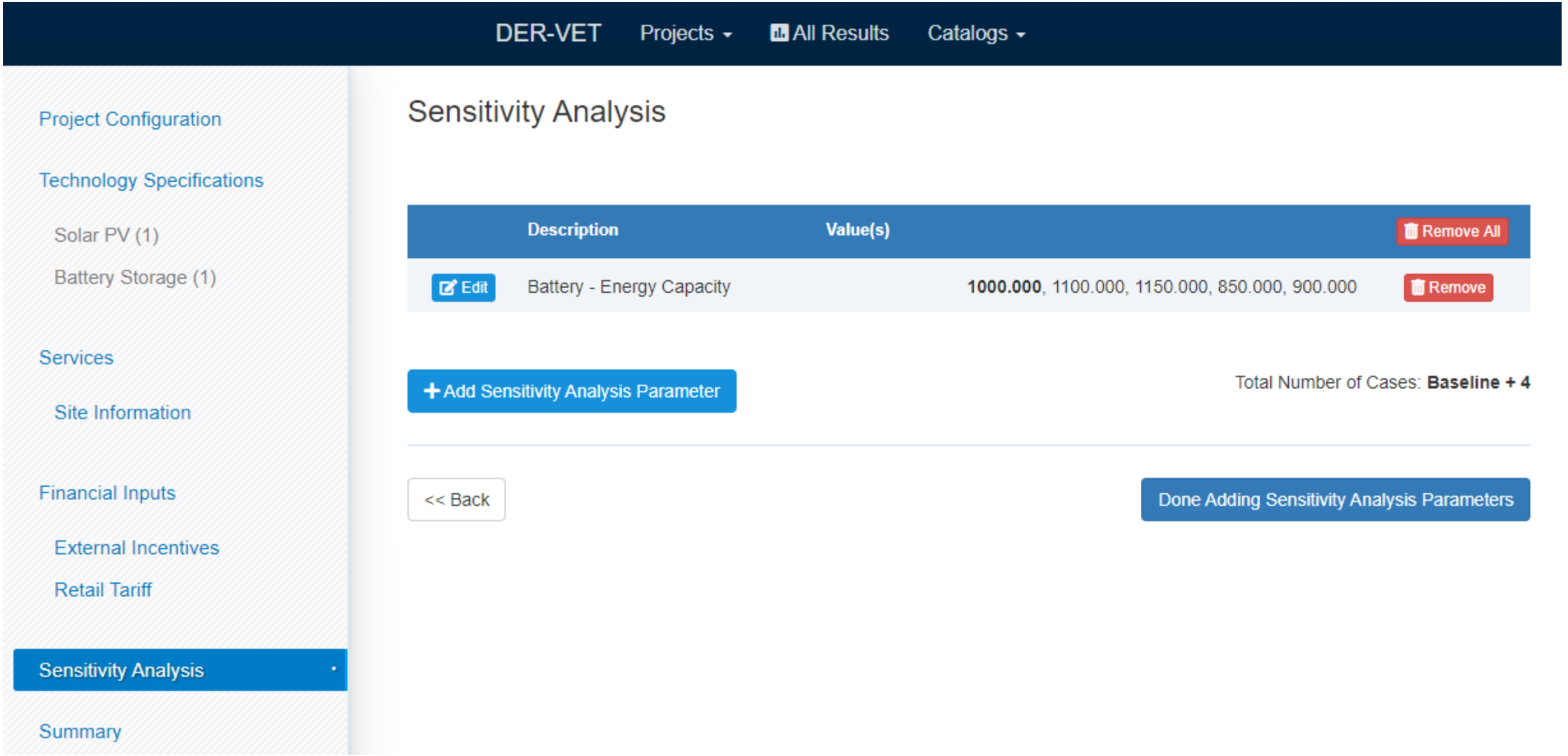
Sensitivity Analysis Module: Inputs



Sensitivity Analysis Module: Inputs



Sensitivity Analysis Module: Inputs



DER-VET Alpha Test Signup

Alpha Test Sign Up

- Sign up for a 30-minute alpha test here:
- https://www.surveymonkey.com/r/GWGSNFZ

Next Meeting

Regularly-Scheduled Meetings

- Next Meeting – **Thursday February 6, 11:00 am Pacific Time**

Together…Shaping the Future of Electricity