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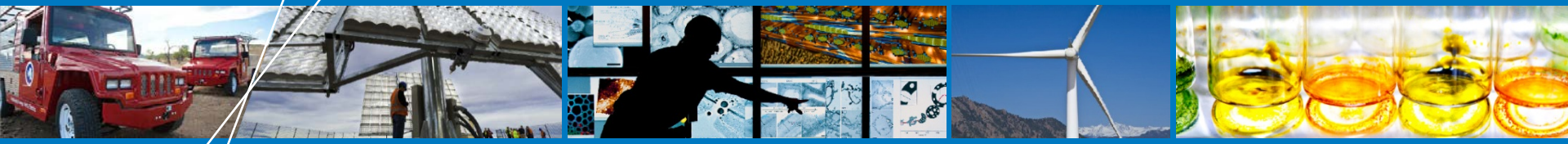
NATIONAL RENEWABLE ENERGY LABORATORY

FCTAC Web Portal Tool Development



2014 DOE Annual Merit Review and Peer Evaluation Meeting

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June 18, 2014: Washington, D.C.

Project ID # MT015

Overview

Timeline

Project start date: October 2013
Project end date: August 2014
Percent complete: 90%

Budget

Total project funding: $127,000
DOE share: $127,000
Contractor Share: $0

Funding received in FY13:
$127,000

Total funding planned for FY14 :
$0

Barriers

- **Non-technical issues preventing full commercialization of fuel cell systems**

Partners

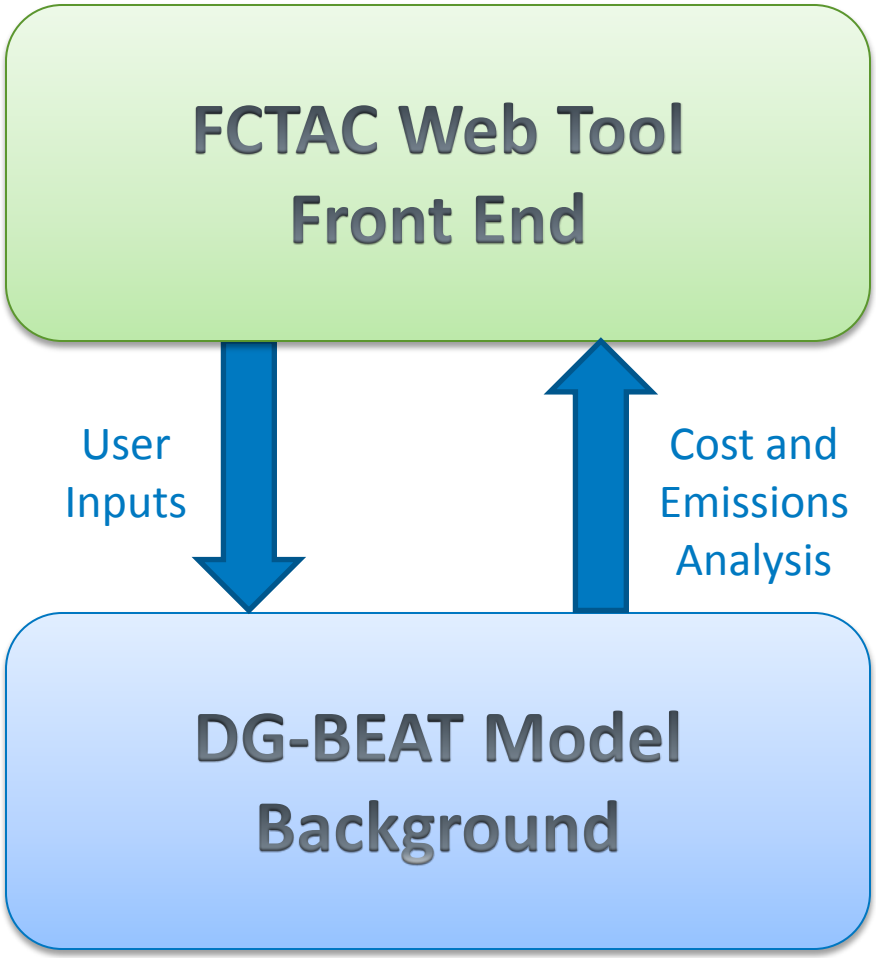
- **FCTO Market Transformation Team**
- **University of California, Irvine**

Relevance

Objective: Develop a Web tool for assessing the implementation of stationary fuel cells

- **Creates stationary fuel cell awareness**
  - A building owner or manager can get an idea of how a stationary fuel cell would impact his or her facility in terms of cost and emissions reduction.
  - The tool is intended to provide an initial assessment of a stationary fuel cell.
- **Simple to use**
  - FCTAC is a Web-deployed tool that is available to the public.
  - The tool has 12 streamlined inputs to go along with other default assumptions needed by the model.
  - All of the information that users need is included or described in the tool.
    - Help and About pages describe and define what is needed to use the tool.
    - Users can download or print a checklist that will help them gather the information that is needed to complete the inputs properly.
- **Accurate**
  - FCTAC uses the DG-BEAT model in the background.
  - DG-BEAT is a powerful and all-encompassing model developed at NREL in conjunction with University of California, Irvine.

Approach


FCTAC Web Tool
Front End
User
Inputs
Cost and
Emissions
Analysis
DG-BEAT Model
Background

Approach

Create a simple Web tool backed by a complex model

- **FCTAC is based on DG-BEAT, an all-encompassing model**
  - DG-BEAT is being developed under the NREL Technology Validation program.
  - The scope of the DG-BEAT model can be intimidating to many users.
  - FCTAC narrows the scope of DG-BEAT to be a first step toward making a decision about going forward with a stationary fuel cell installation.
- **Narrowing down the inputs**
  - The inputs were reduced to the 12 with the most impact.
  - Default values were carefully chosen for all other inputs, including installation costs, load requirements, and combined heat and power (CHP) usage.
  - Assumptions were made that will cover most users needs.
- **Narrowing down the outputs**
  - The three outputs chosen for FCTAC are a net present value cost analysis, greenhouse gas emissions analysis, and criteria pollutant emissions analysis.
  - In all three cases, FCTAC compares the building's performance with standard equipment to the building's performance with a solid oxide fuel cell sized to handle the building base load energy use.

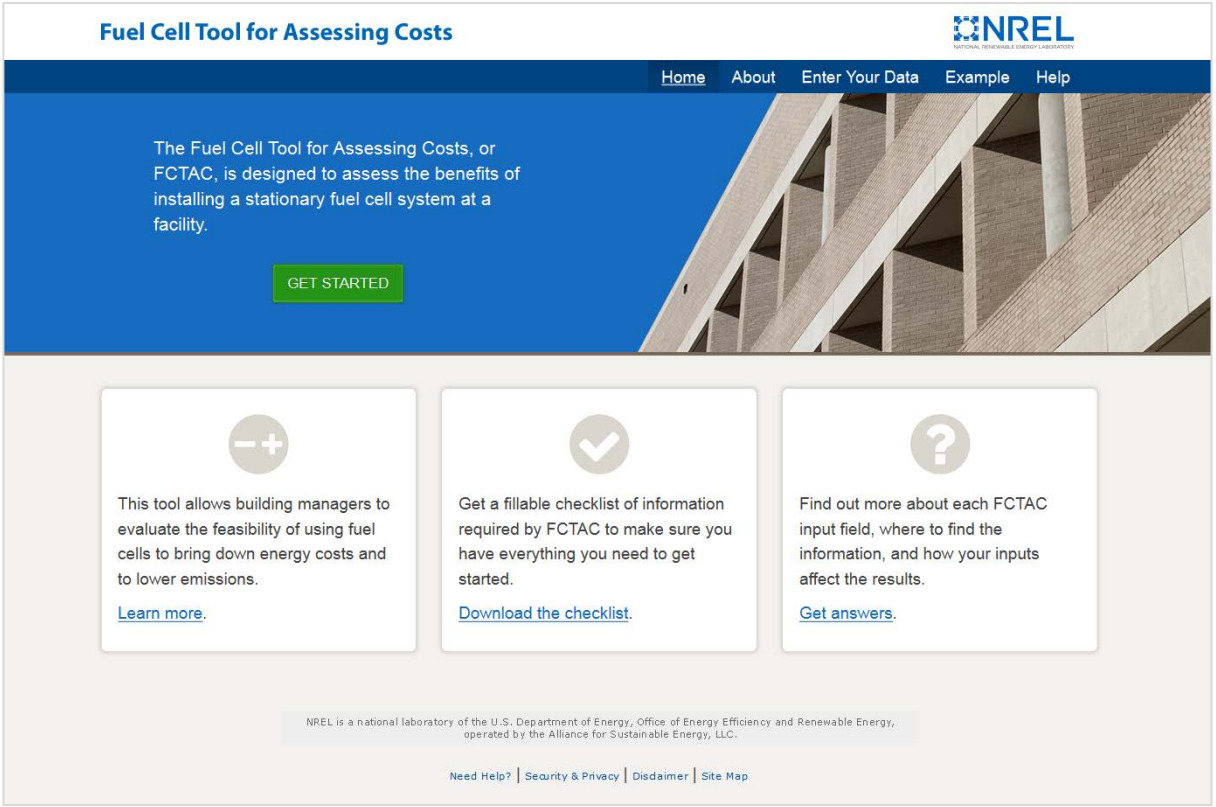
Accomplishments

- **Developed the FCTAC Web tool**
  - A dozen inputs were decided upon as being the most influential in terms of cost and emissions production.
  - All inputs are information that is readily available to building operators.
  - A panel of experts was consulted to determine the best default assumptions. The experts represent building operators in government agencies as well as fuel cell experts.
- **Configured FCTAC to use DG-BEAT in the background**
  - DG-BEAT is programmed using MATLAB®.
  - A Java Web deployment tool was programmed into the DG-BEAT architecture to allow it to be compiled as a Web service.
  - GitHub, a Web-deployed code management system, was used as a collaboration tool for DG-BEAT development and FCTAC integration.

Accomplishments

fctac.nrel.gov

FCTAC was deployed and fully functional in May 2014.

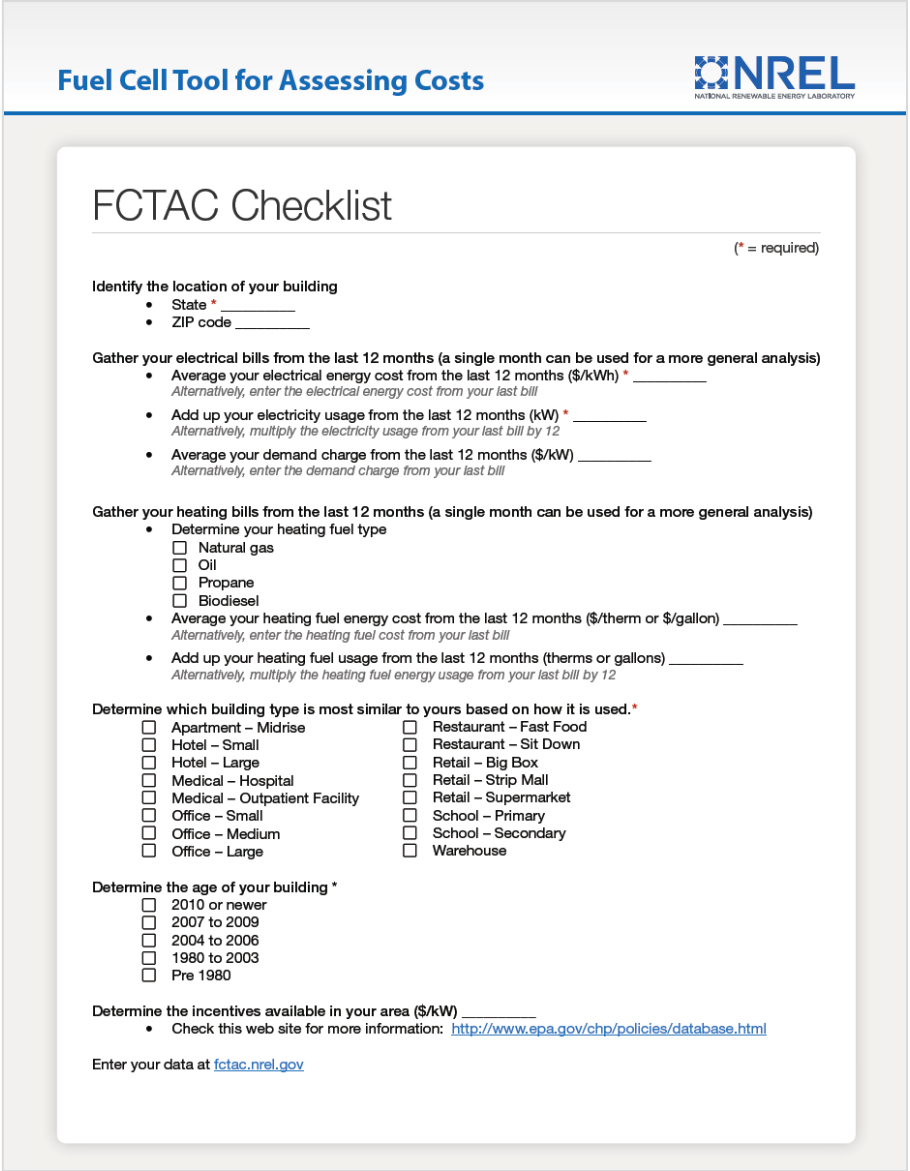


The home page is easy to use and has links to everything users need to get started.

Accomplishments

A downloadable checklist helps users collect all the information they need to complete the inputs properly.

The checklist is a fillable PDF file that can be completed and saved or printed and filled out by hand.



Fuel Cell Tool for Assessing Costs

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FCTAC Checklist

(* = required)

Identify the location of your building
- State * _____
- ZIP code _____

Gather your electrical bills from the last 12 months (a single month can be used for a more general analysis)
- Average your electrical energy cost from the last 12 months ($/kWh) * _____
  Alternatively, enter the electrical energy cost from your last bill
- Add up your electricity usage from the last 12 months (kW) * _____
  Alternatively, multiply the electricity usage from your last bill by 12
- Average your demand charge from the last 12 months ($/kW) _____
  Alternatively, enter the demand charge from your last bill

Gather your heating bills from the last 12 months (a single month can be used for a more general analysis)
- Determine your heating fuel type
  - ☐ Natural gas
  - ☐ Oil
  - ☐ Propane
  - ☐ Biodiesel
- Average your heating fuel energy cost from the last 12 months ($/therm or $/gallon) _____
  Alternatively, enter the heating fuel cost from your last bill
- Add up your heating fuel usage from the last 12 months (therms or gallons) _____
  Alternatively, multiply the heating fuel energy usage from your last bill by 12

Determine which building type is most similar to yours based on how it is used.*

☐ Apartment – Midrise	☐ Restaurant – Fast Food
☐ Hotel – Small	☐ Restaurant – Sit Down
☐ Hotel – Large	☐ Retail – Big Box
☐ Medical – Hospital	☐ Retail – Strip Mall
☐ Medical – Outpatient Facility	☐ Retail – Supermarket
☐ Office – Small	☐ School – Primary
☐ Office – Medium	☐ School – Secondary
☐ Office – Large	☐ Warehouse

Determine the age of your building *
- ☐ 2010 or newer
- ☐ 2007 to 2009
- ☐ 2004 to 2006
- ☐ 1980 to 2003
- ☐ Pre 1980

Determine the incentives available in your area ($/kW) _____
- Check this web site for more information: http://www.epa.gov/chp/policies/database.html

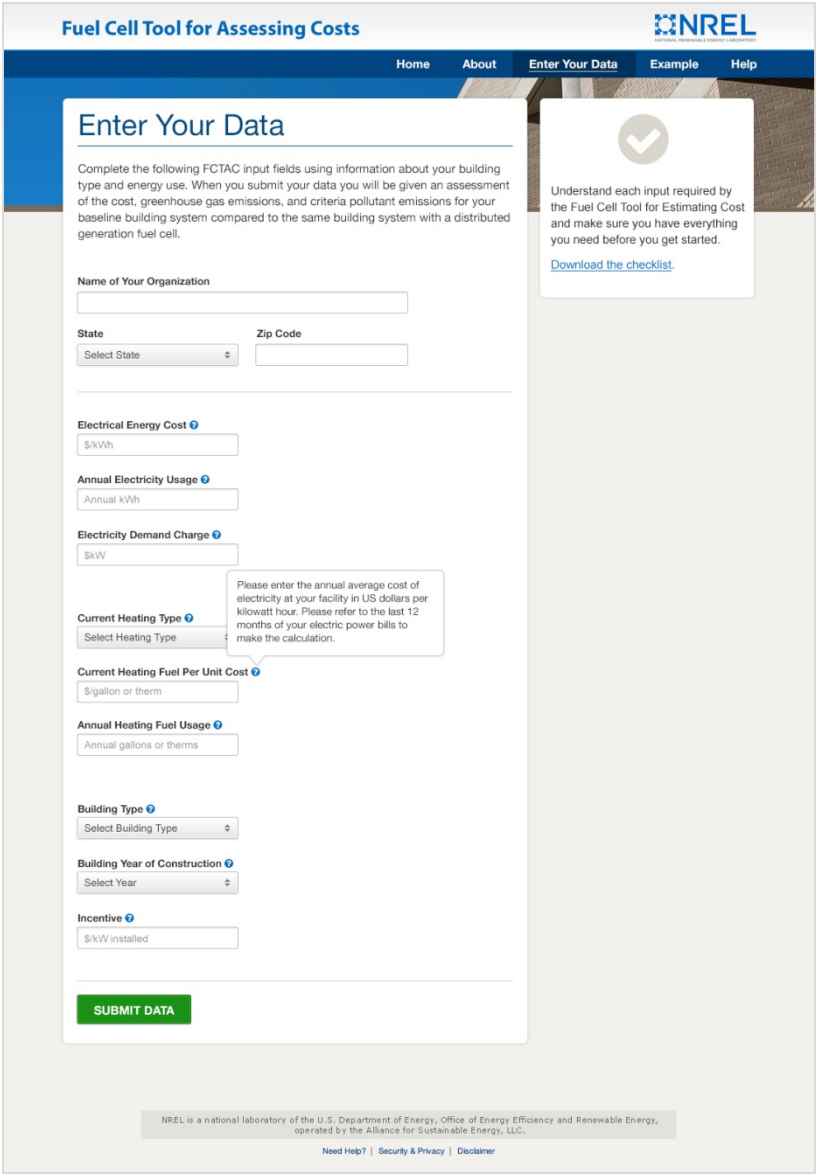
Enter your data at fctac.nrel.gov

Accomplishments

Users enter all of the information they collected on the "Enter Your Data" page.

Inputs are kept to a minimum for this tool.

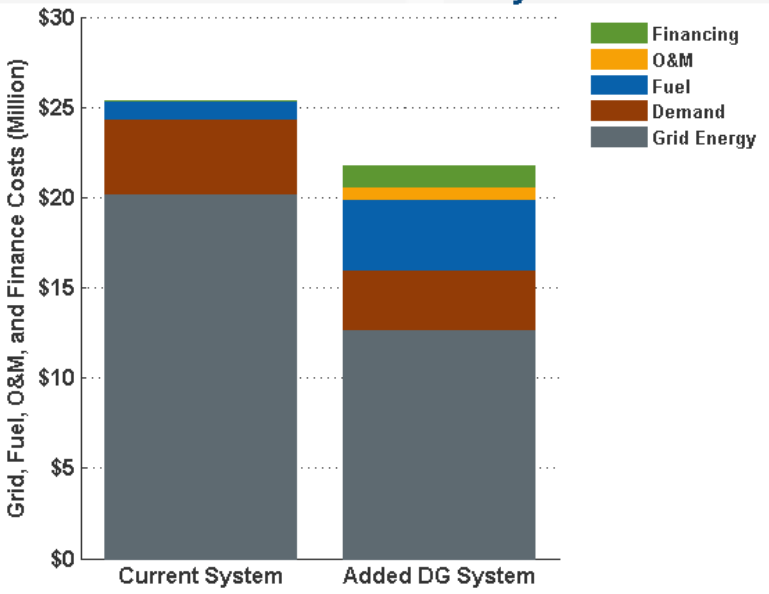
Tooltips give a short explanation of each input the user needs to enter.



Accomplishments

Net Present Value Cost Analysis:

- The net present value cost analysis compares the current building energy costs to the equivalent building with a stationary fuel cell.
- A 20-year analysis period is used for the comparison.
- Grid prices are based on user inputs of the actual cost of electricity at the facility.



Net Present Value Cost Analysis (US$)

	Current System	Added DG
Finance	$0	$1,156,572
O&M	$0	$752,124
Fuel	$1,046,906	$3,850,430
Demand	$4,097,682	$3,305,239
Grid	$20,241,179	$12,724,983
Total	$25,385,767	$21,789,348

$3,596,419reduction (14%) over the 20 year analysis period.

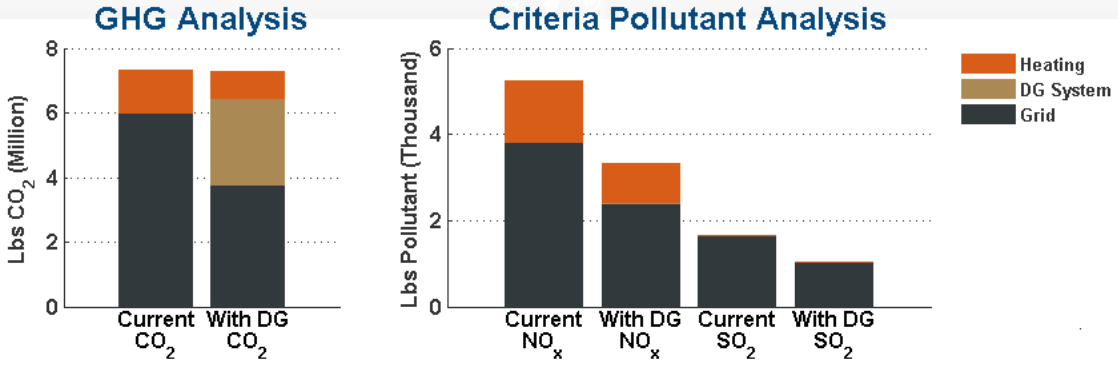
Accomplishments

Greenhouse Gas (GHG) Analysis:

The GHG analysis shows CO_2 production for the building with and without a fuel cell.

Criteria Pollutant Analysis:

The criteria pollutant analysis shows nitrogen oxides (NO_x)and sulfur dioxide (SO_2) production for the building with and without a fuel cell.



Annual GHG and Pollutant Production (lbs)

	CO_2		NO_x		SO_2	
	Current	With DG	Current	With DG	Current	With DG
Heating	1,339,806	852,144	1,432	911	6	4
DG System	0	2,687,360	0	34	0	0
Grid	5,994,030	3,759,026	3,815	2,392	1,658	1,040
Total	7,333,836	7,298,530	5,247	3,337	1,664	1,044

Emissions calculations are based on the grid mix of electricity at the location of the facility. The grid mix is determined by data published by the EPA.

Accomplishments and Progress: Responses to Previous Year Reviewers' Comments

- **This project was not reviewed in FY13.**

Collaborations

- **U.S. Department of Energy**
  - Fuel Cell Technologies Office Market Transformation team
  - Funded the project
- **National Renewable Energy Laboratory**
  - Technology Validation team
  - Working on DG-BEAT development
- **University of California, Irvine**
  - National Fuel Cell Research Center
  - Contractor working on model development
  - Separately funded project by NREL

Proposed Future Work

- **Establish links to FCTAC from other websites**
- **Update the website based on user feedback**
  - The team has made a list of users who will test the site and provide feedback on site usability and accuracy of results.
  - The feedback will be used to update the site in August 2014.
- **Update the website as the DG-BEAT model is updated**
  - As the DG-BEAT model is updated, the FCTAC model will also be updated.
  - Based on how the FCTAC portal communicates with the DG-BEAT model, there will be minimal down time during the updates.
- **Track and analyze user statistics**
  - Google Analytics statistics will be kept on how many unique users visit the site, where they are from, and what pages they are accessing.
  - NREL will prepare quarterly analytics reports for FCTAC.

Summary

- **Fuel Cell Tool for Assessing Costs (FCTAC)**
  - http://fctac.nrel.gov went live in May of 2014.
  - FCTAC:
    - Is a first step in determining if a stationary fuel cell is a good fit for a building.
    - Is an easy-to-use Web tool based on a complex model.
    - Provides a 20-year net present value cost analysis.
    - Provides greenhouse gas and criteria pollutant emissions analysis.
  - The Distributed Generation Building Energy Analysis Tool (DG-BEAT) is an independent model that is used in the background of FCTAC.
  - FCTAC will be updated in August based on user feedback and as DG-BEAT is updated.
  - FCTAC is hosted at NREL and can be easily linked to from other websites.