# Integrated Energy Project (IEP) Model: Final Report

www.kw-engineering.com

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**kW Engineering**

# Acknowledgements


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  http://www.calsolarresearch.ca.gov/

- Special thanks to Smita Gupta, Grant Project Manager

Program Manager:

# IEP Model – Team

kW ENGINEERING

solarnexus
Accelerating Your Solar Business

SaveEnergy123

kW

# Who is kW Engineering?

Engineering consulting focused on EE/RE

- Energy Efficiency
  - LEED / ENERGY STAR
  - Energy Audits
  - Retro-commissioning
  - Modeling
  - Energy Analysis
  - Field M&V
  - Implementation
- Renewable Energy
  - Research
  - Inspections
  - Feasibility

# Need for EE/DR/PV Integration

- Energy efficiency (EE) and Demand Response (DR) measures often more cost effective than PV
- EE audits are a prerequisite to CSI program & others
- Common info required for evaluating EE/DR/PV
- Integrated approaches reduce data collection redundancies and facilitate integrated projects

# Integrating Focused Tools

- Numerous tools exist for evaluating EE and PV
- Lack of tools for evaluating comprehensive projects, or facilitating implementation.
- Interoperability between specialized tools will facilitate more integrated energy projects (IEP).
- Overall ROI on IEPs better than PV only creating potential for higher sales and deeper PV penetration.

# Solution: A Common Language

**Introduce a set of XML schemas** that will become a comprehensive, standardized definition of:

- An Integrated Energy Project (EE/DR+PV)
- How stakeholders communicate between each other

**Provide a open means for passing electronic information** among the parties through various software and web-based applications.

# Why is IEP Model Valuable?

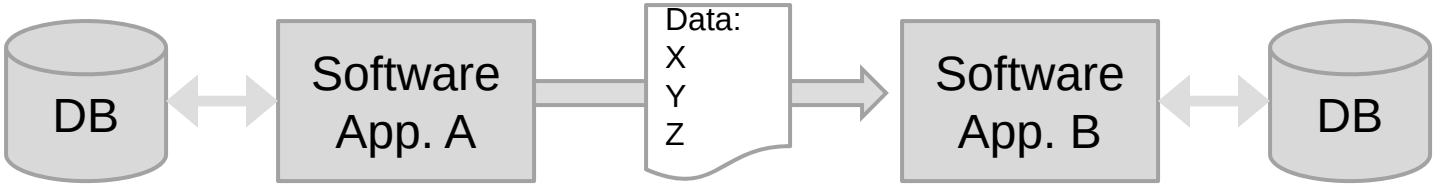
Reduces costs of sales and implementation of energy efficiency and solar projects

1) Enables cost effective integration of software in energy efficiency and solar markets

2) Integrated software solutions eliminate duplicate data entry, reduce errors, reduce risk

# Custom Integrated Software

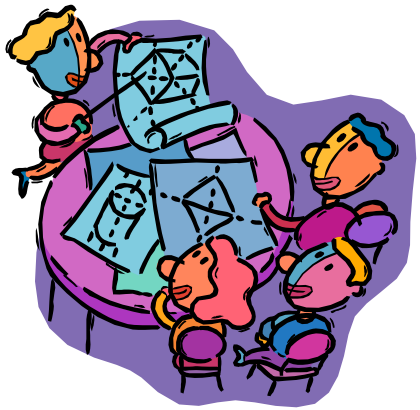
Integrated software:




Write Output Data

Read Input Data

To get integrated software, there is a process:

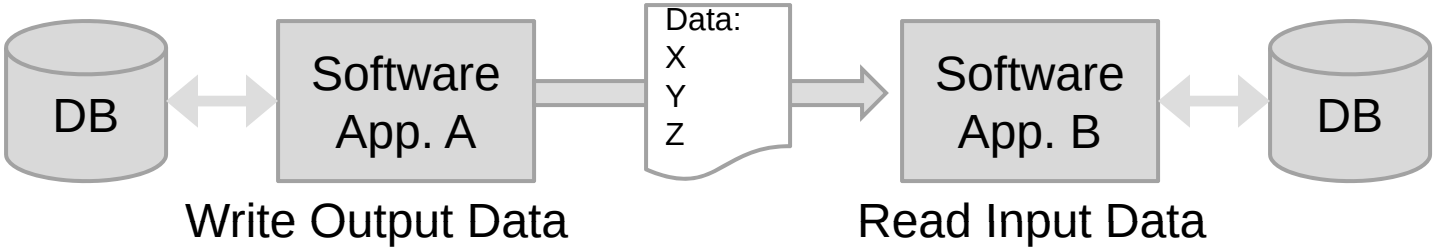


1) Engineer Data Specification

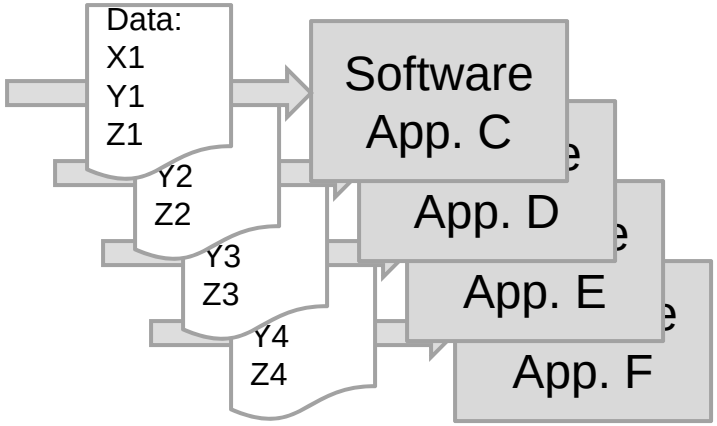
2) Code Data Translations

# Custom Integrated Software

Integrated software:




Process is repeated for multiple partner integrations:

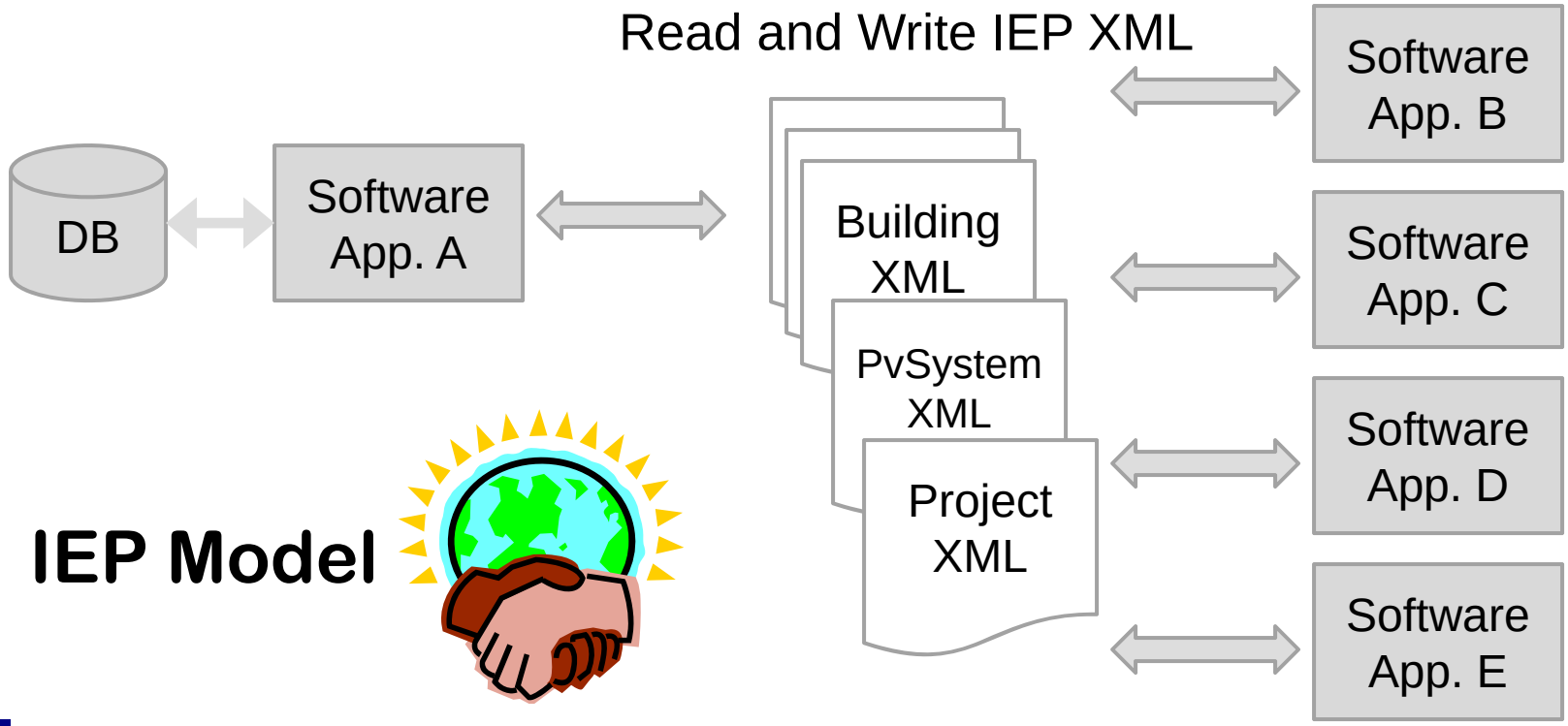



Each integration is difficult and costly ($), very risky for vendors

# IEP Model Compliant Software

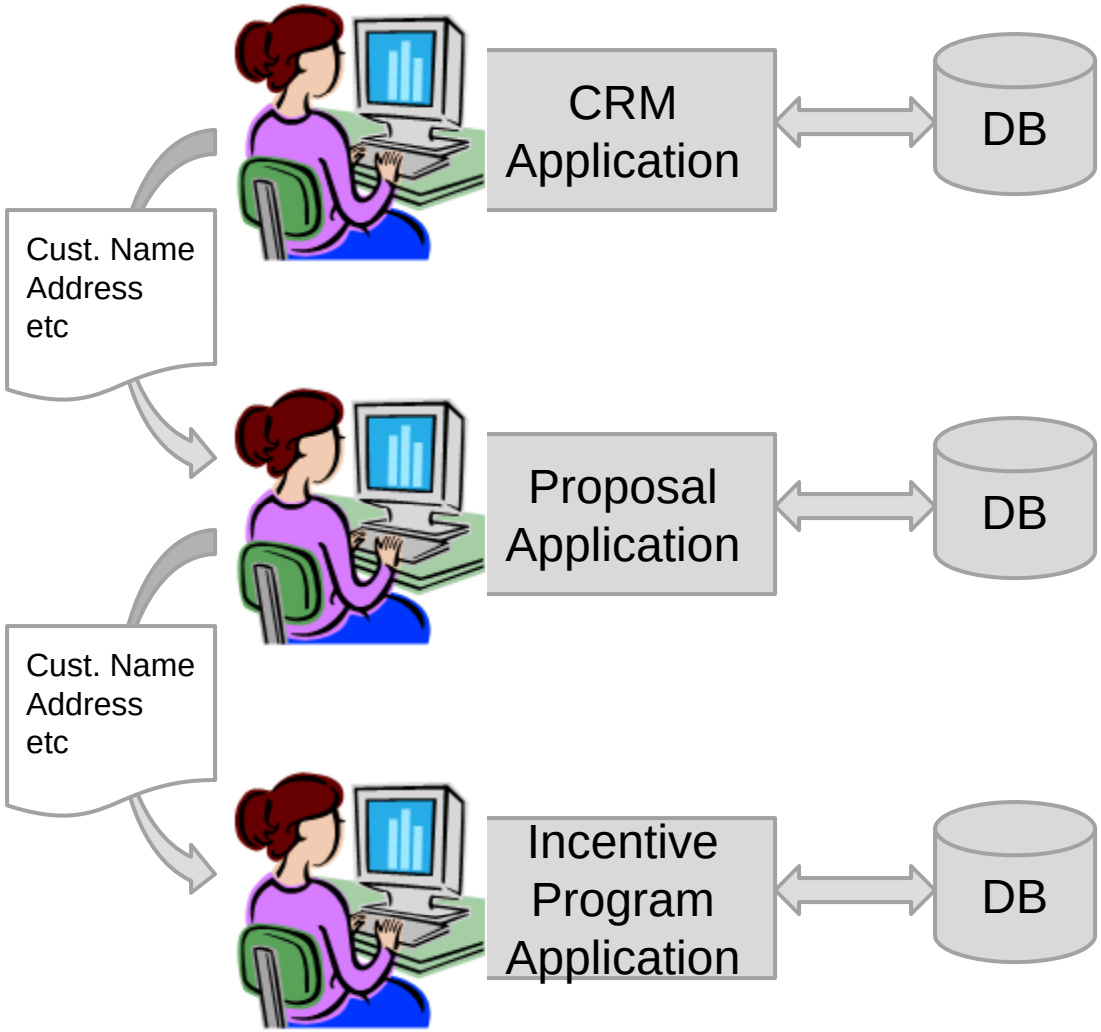
One-time development effort to translate from native data structures to pre-defined IEP Model data structure

Re-use across many integrations!



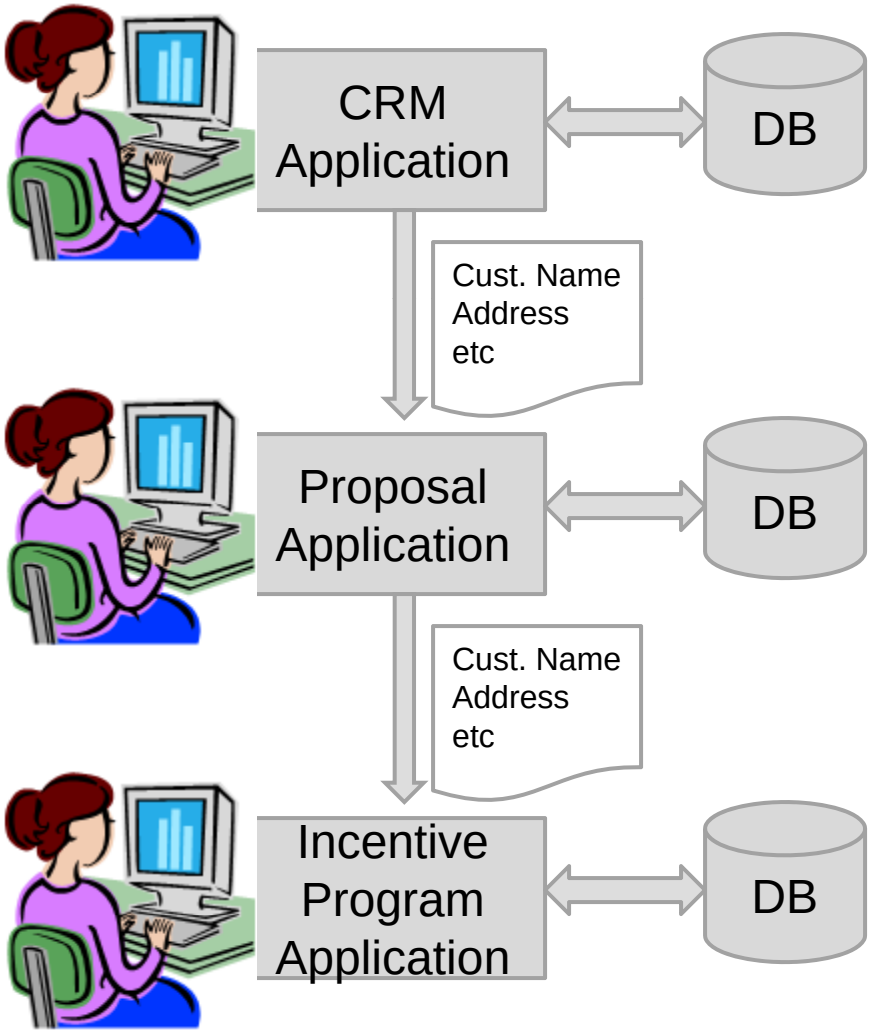
# Data Entry: Manual

- Slow
- Error-prone
- Unsatisfying



# Data Entry: Auto

- Fast
- Accurate
- Satisfying



# Project Tasks

**Task 1**
**Research**

- Research existing approaches toward EE/DR/PV
- Analyze IEP requirements & create IEP Model

**Task 2**
**Implementation**

- Modify existing software from SolarNexus & SaveEnergy123
- Market concept & recruit user group
- Gather historic data & monitor usage by user group

**Task 3**
**Impact Analysis**

- Conduct follow-up surveys
- Gather post-installation data
- Comparative analysis of participating users
- Estimate impact & publish summary report

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# Project Timeline

| | |
|---|---|
| Research | • similar existing standards, tools, and practices of EE and PV implementers. (2010) |
| Identify Key Stakeholders | • to help shape the specification of the IEP Model. (2010-present) |
| Publish Draft Specification | • of the IEP model with input from key stakeholders. (Feb '11) |
| Deploy Test Implementation | • in SolarNexus and SaveEnergy123 tools. (July '11) |
| Publish Summary Report | • including lessons learned and implementation best practices. (April '12) |

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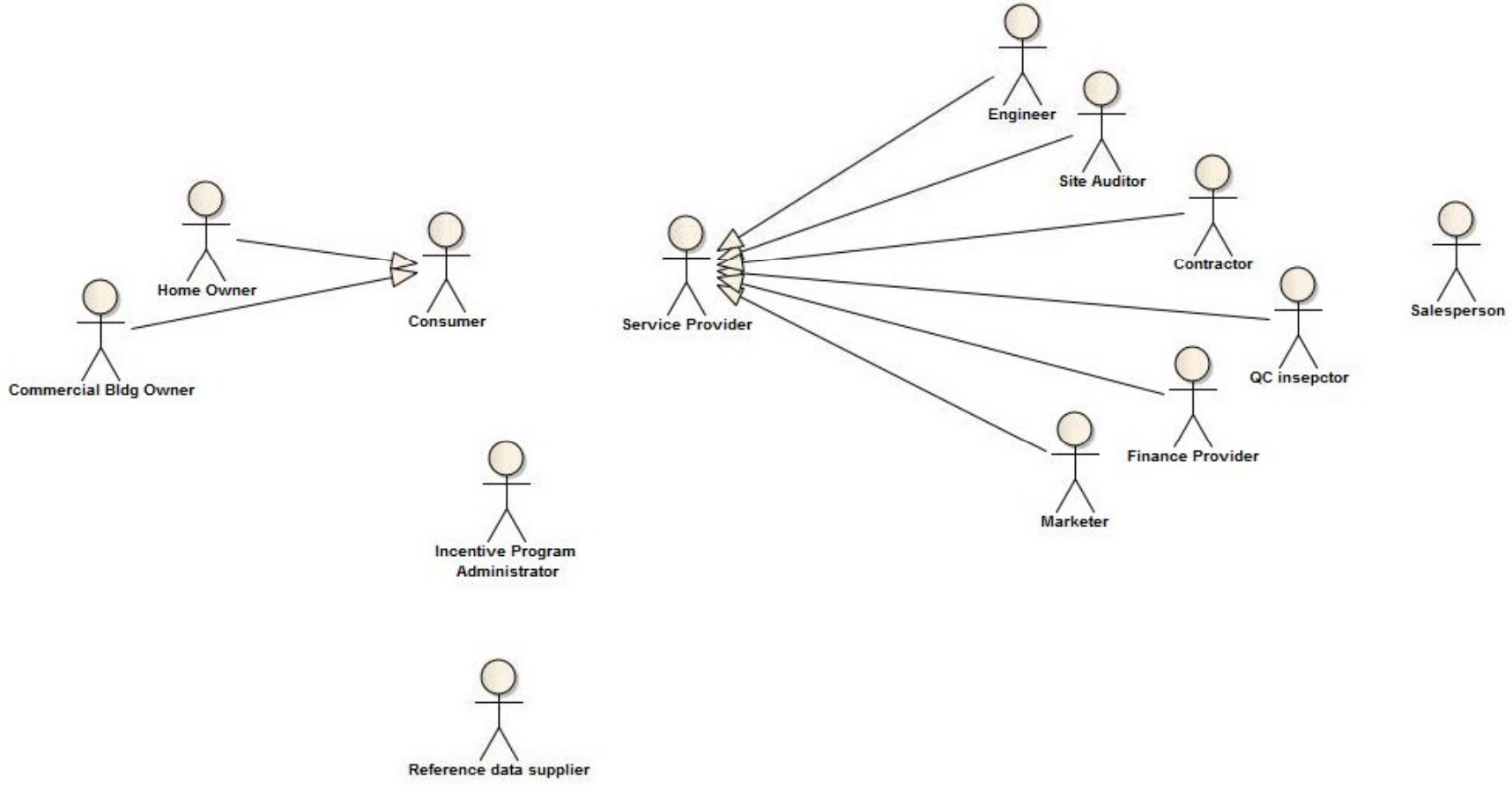
# Task 1 – Initial Research

- Performed surveys/interviews of solar & EE contractors
- Identified IEP stakeholders
- Identified activities between stakeholders during IEP
- Assessed existing software applications and tools used
- Defined common project data exchange during IEP
- Created parameter inventories for IEP model

# Types of IEP Stakeholders

Numerous stakeholders may be involved with IEP depending on the type and complexity of a project:



# Initial Surveys

Online surveys were conducted with the following groups:

- Solar contractors
- Energy auditors
- Building system professionals

The primary goals of the surveys were:

- Understand size & scope of business
- Survey attitudes toward integrated EE/DR/PV projects
- Identify pain points in business processes
- Survey use of computer software
- Discover what domain specific applications used

# Existing Applications

In our initial research we identified 40 applications falling into the following categories:

- Lead Generation
- Benchmarking Energy Use
- Energy Audit & Consumption Analysis
- Incentive Processing
- Estimating & Proposal
- PV Modeling

# IEP Schema Development

- For each activity in the IEP lifecycle, the team developed an inventory of parameters that might be passed between project stakeholders
- Industry experts reviewed & commented on drafts of model specification.
- Model schemas and documentation are publicly available
  - http://iepmodel.net
- External stakeholder review of incremental versions provided helpful input as well as significant contributions
  - Solmetric Corporation contributed to PV schemas
  - Geopraxis, Inc. contributed to Participant schema

# IEP Schema Versions

| | |
|---|---|
| Version 0.1 | • Dec. ‘10 – First version published for limited stakeholder review. |
| Version 0.2 | • Jan. ‘11 – Incorporate feedback from external stakeholders. Second review. |
| Version 0.3 | • Feb. ‘11 – Incorporate feedback from external stakeholders. Third review. |
| Version 0.4 | • Feb. ‘11 – First public draft for review. Began implementing with this version. |
| Version 1.0 | • Oct. ‘11 – Incorporates changes identified in pilot implementation. |
| Version 1.1 | • Apr. ‘12 – Ongoing refinements and additions based on lessons learned. |

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# Task 2 – Pilot Implementation

- Initial integration of IEP Model data exchange between partner software tools: SolarNexus & SaveEnergy123
- Implementation needed to fully test design of IEP XML with lessons learned contributing to schema updates
- Marketing and outreach led to greater awareness of IEP Model and potential benefits
- Attempted to demonstrate that integrated EE/DR/PV projects could drive higher PV sales rates
  - Primary goal of the pilot implementation was to demonstrate that PV installers who offer integrated project proposals would see increased sales rates
  - Participants recruited to utilize an integrated EEM recommendation feature to assist with developing integrated EE/DR/PV project proposals
  - Comparative analysis of historic installations versus installations during pilot used to determine impact

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# IEP Model – Initial Integration

Integrated SolarNexus solar project management tool with SaveEnergy123 energy efficiency audit tool

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SaveEnergy123

| | |
|---|---|
| Contractor-facing solar project management tool | Customer-facing residential energy efficiency audit tool |

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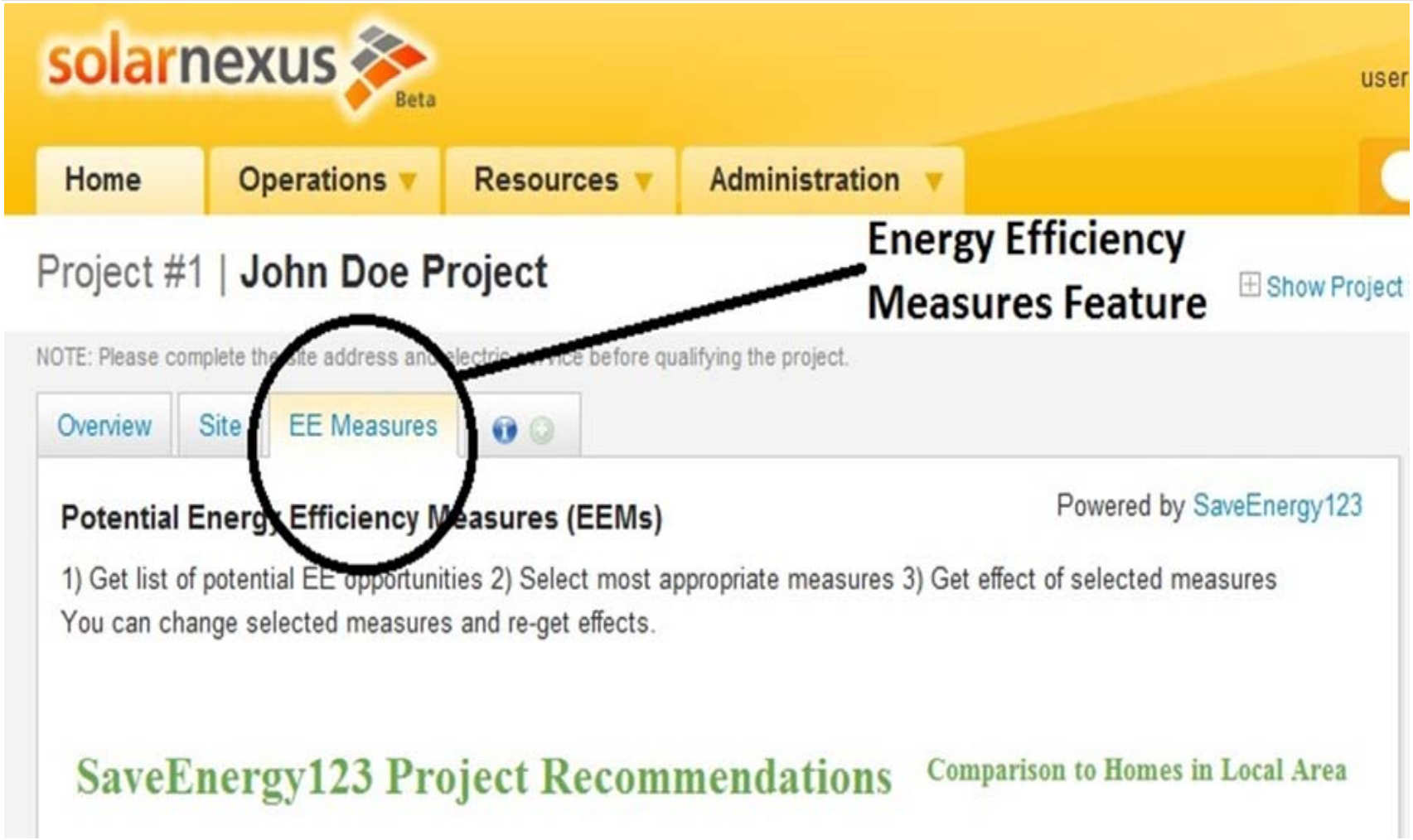
# IEP Model – Initial Integration



# IEP Model – Initial Integration

Building loads information gathered by solar contractor during site assessment

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Energy loads information entered by solar contractor

# IEP Model – Initial Integration

Building loads sent as IEP XML in request for energy efficiency measure (EEM) recommendations

solarnexus
Accelerating Your Solar Business

→

SaveEnergy123

Request EE evaluation from SaveEnergy123

# IEP Model – Initial Integration

EEM recommendations sent as IEP XML in response

solarnexus
Accelerating Your Solar Business

← SaveEnergy123

Respond with EEM recommendations for building

# IEP Model – Initial Integration

Solar contractor can perform what-if scenarios with different combinations of recommended EEMs

solarnexus
Accelerating Your Solar Business

↔

SaveEnergy123

Contractor selects EEMs to include in integrated proposal

Estimated energy impacts and costs returned for selections

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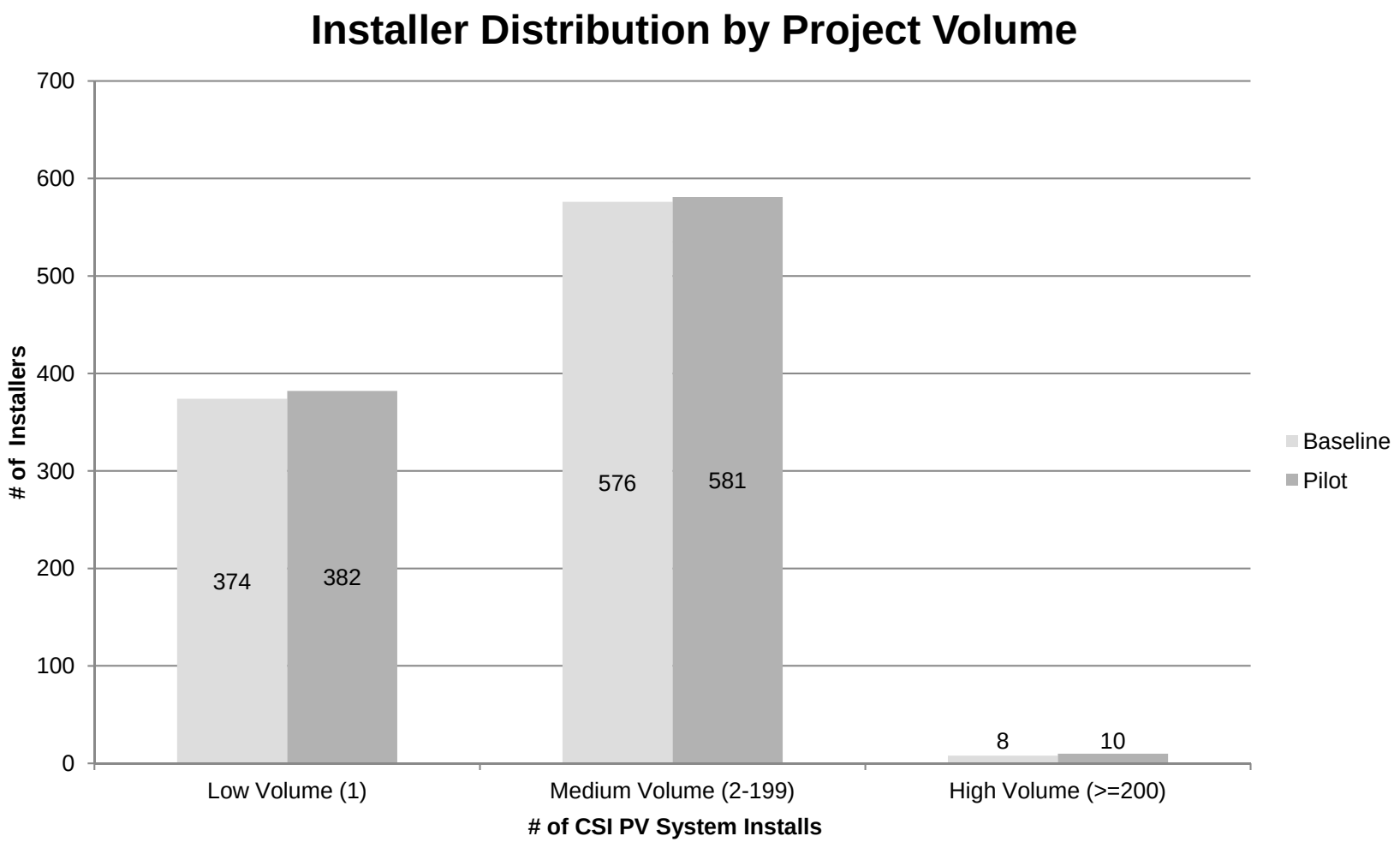
# Pilot Development

- SolarNexus & SaveEnergy123 mapped their existing application data models to the IEP Model in order to send and receive IEP XML documents
- SaveEnergy123 developed an API based on IEP XML to allow SolarNexus (and others) to request an EE opportunity analysis from within their application
- Marketing & outreach focusing on existing SolarNexus users as pilot participants

# Pilot Participation



# Task 3 – Analyze Implementation

The analysis of the pilot implementation included:

- Follow-up surveys of solar contractors to reassess level of integrated projects being implemented
- Comparative analysis of PV contractor installation rates and installed system sizes between pilot and baseline, participants, and non-participants
- Impact analysis of pilot implementation toward goals

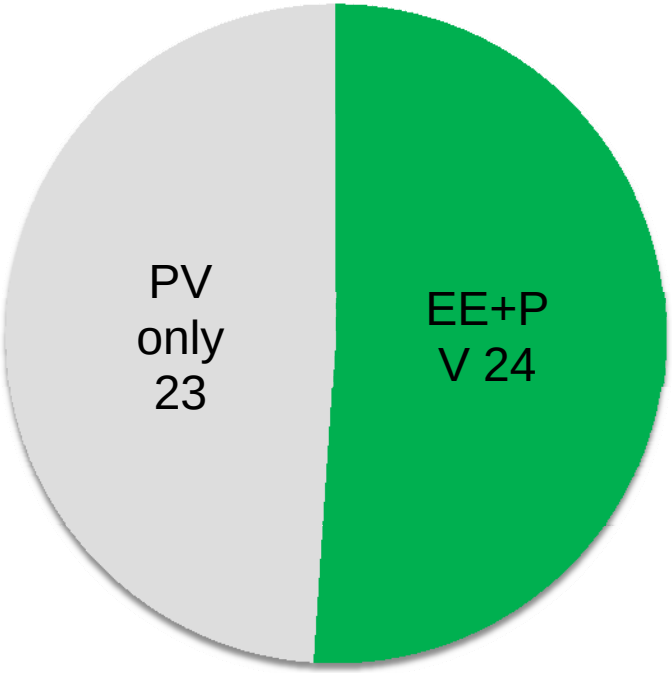
# Follow-up Surveys

Solar contractors installing 5 or more systems in California in the last year were surveyed about EE integration:

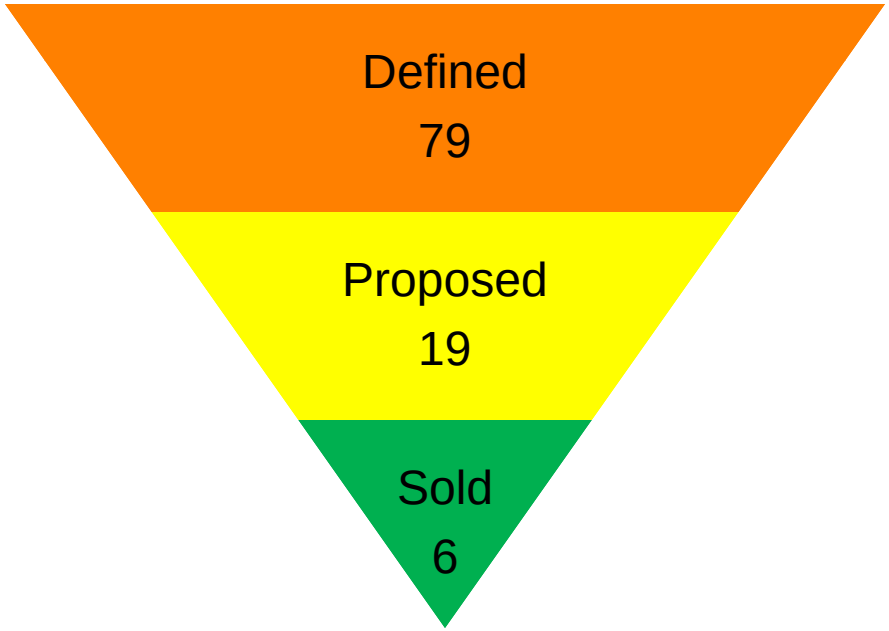
- 100% either offer or recommend EE services with PV proposals
  - Notable increase over 51% from initial survey 2 years previous
  - However, most responded that <10% of PV projects sold included EE
- 64% felt inclusion of EE resulted in smaller PV systems sold
  - Majority responded that PV system size decreased <=15% with EE
- 40% felt integrated EE/PV projects increased sales rates

# Pilot Usage Data

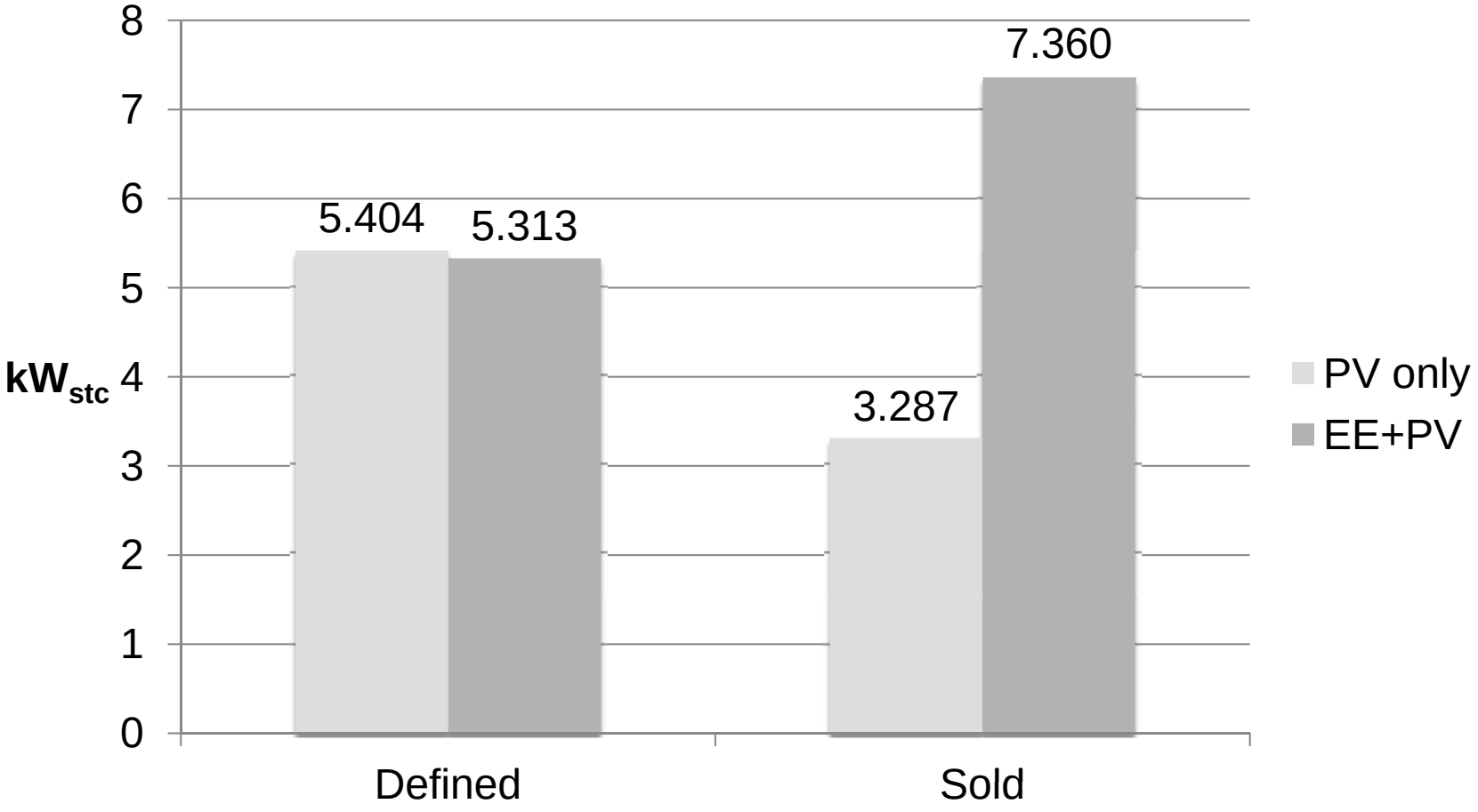
**Participant Usage**




**Integrated EE+PV Projects**



# Pilot Project Data



# Comparative Analysis

**Baseline and Trial Period Participant Data Comparison**

| | *Baseline Period* | | | *Trial Period* | | |
|---|---|---|---|---|---|---|
| | **# of Projects** | **Average size (kW CSI-AC)** | **Average $/W** | **# of Projects** | **Average size (kW CSI-AC)** | **Average $/W** |
| **Participant Totals** | 115 | 5.266 | $ 8.14 | 72 | 4.910 | $ 7.95 |
| **Med. Volume Installer Non-Participant Totals** | 6,951 | 4.863 | $ 7.99 | 6,812 | 4.903 | $ 7.40 |
| **All Volume Installer Non-Participant Totals** | 10,608 | 5.123 | $ 8.02 | 14,590 | 5.531 | $ 7.96 |

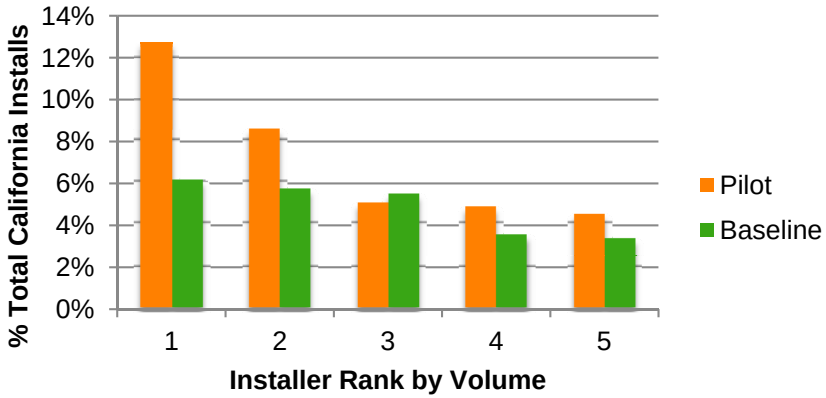
Notes:

1. Install volume decreased for all med.-volume installers during pilot period
2. Avg. size decreased for participants, but increased slightly for population

# PV Market Drivers

Highest volume installers saw the biggest change in installed volume between the baseline and pilot period

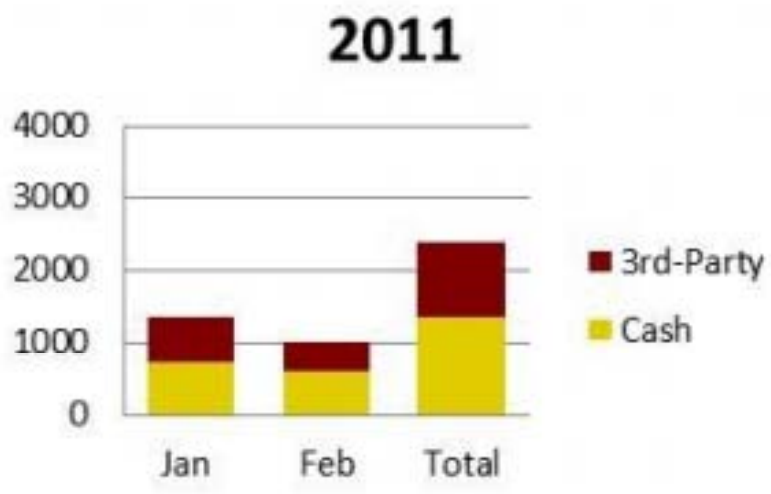
**Shift of Volume to Top Installers**

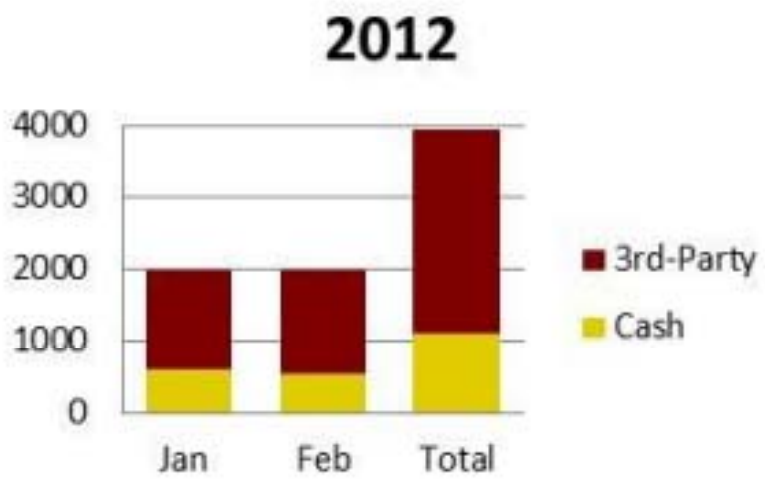



**Driven by Move from Home Equity to $0 Down Financing**

# PV Market Drivers

## Over 70% of Californians Going Solar Choose Third-party-owned Options




Source: CleanTechnica March 28, 2012
http://cleantechnica.com/2012/03/28/over-70-of-californians-go-solar-using-a-service-dont-buy-their-solar-power-systems/

# Impact of IEP Model

- Shift to zero-down financing not available to pilot participants dominated market trends during project
- Lower installation volume of pilot participants consistent with non-participant medium-volume installers
- Move toward offering more integrated projects can benefit from integrated tools facilitated by IEP Model

# Further Potential for IEP XML

Open public format for exchange of energy project data can be used for:

- Developing APIs for software integration as demonstrated in the pilot
- Data aggregation from multiple tools to central database
- Data portability between non-integrated applications

Looking for appropriate organization to house standard in the long-term. Project team will continue to support in short-term.

XML Schemas and documentation currently available at:

http://iepmodel.net

# Thank You

**Questions & Break before technical section**

# IEP Model Structural Design

Design Principles:

- Modular - Allow subsets of data to be exchanged
- Flexible

Design patterns:

- Break out common elements, use include statements
- Organize related data types into container schemas
- Mostly optional data elements to facilitate flexibility

# IEP XML Schemas

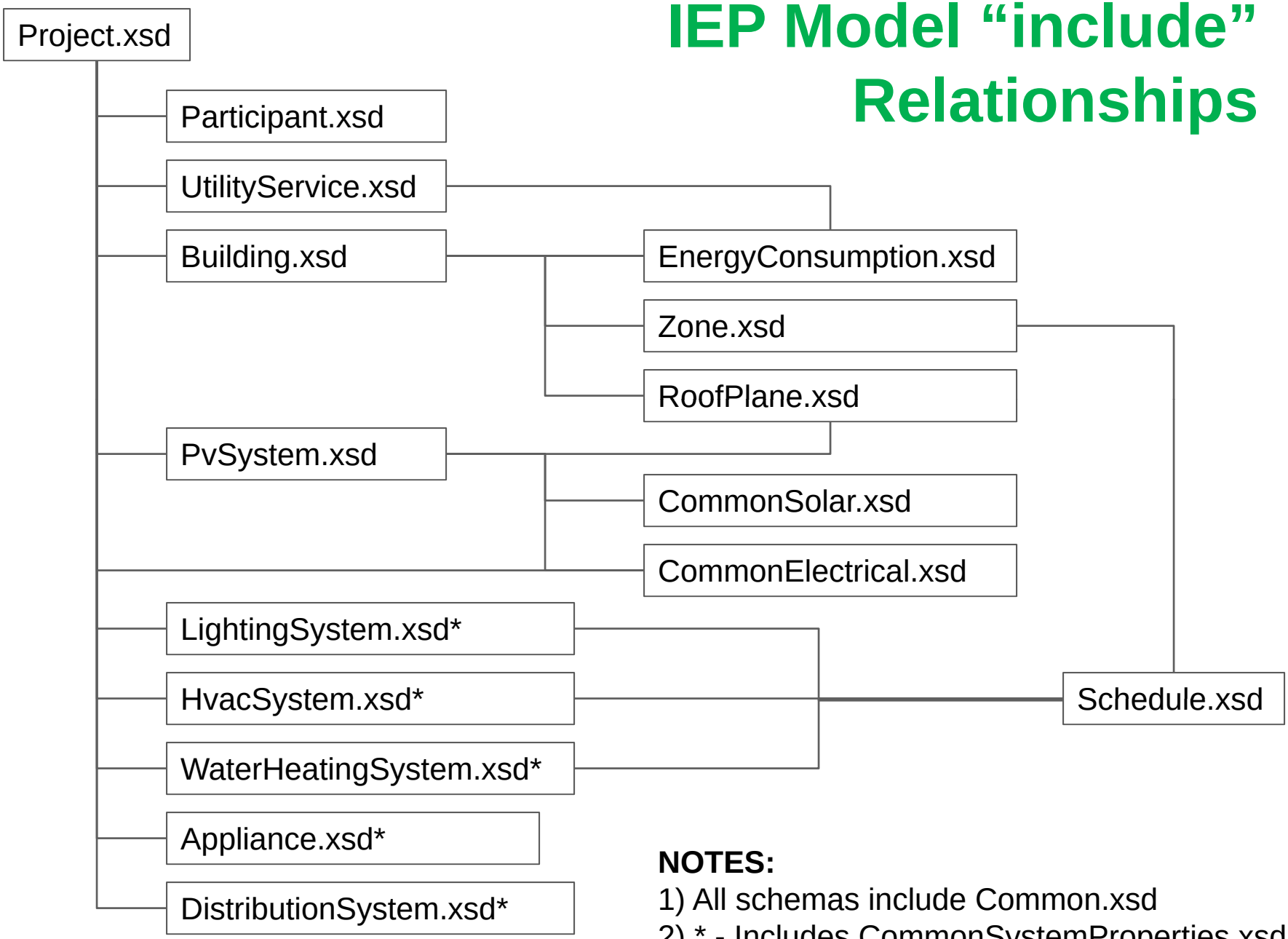
IEP XML schemas describe:

- Site and Building information
- Energy systems (HVAC, Lighting, Appliance, PV, etc.), equipment specifications, and operating schedules
- Utility service and energy consumption data
- Project participants (customers, contractors, financiers, etc.)
- Measures (EE, DR, DG)

Schema documentation available online:

**http://www.iepmodel.net/**

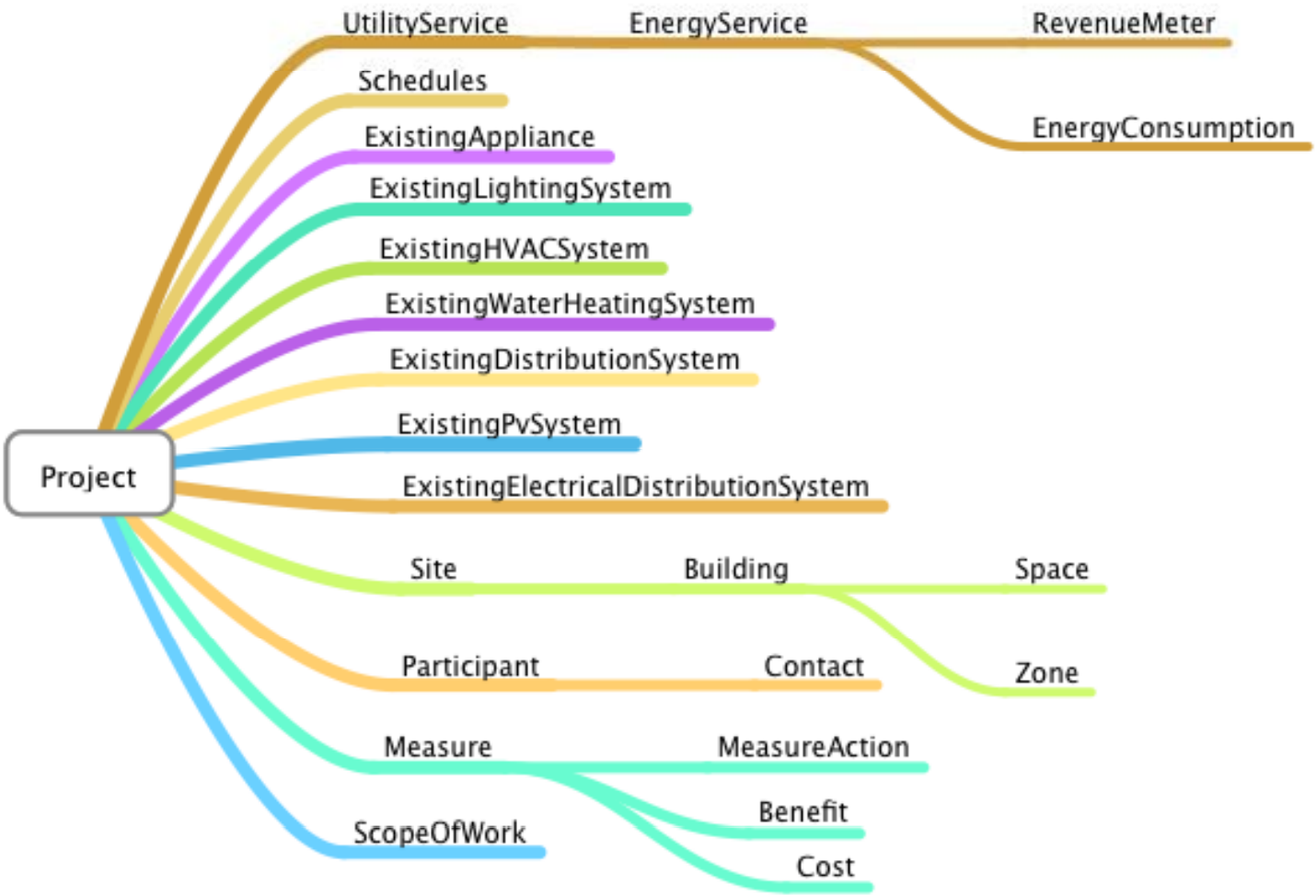
# IEP Model “include” Relationships




**NOTES:**

1) All schemas include Common.xsd
2) * - Includes CommonSystemProperties.xsd

# IEP XML - “Project” Overview



# In-depth Schema Review

**Review IEP XML Schemas via Oxygen XML Developer**

# IEP Sample Application

- Developed an open source sample application as an implementation example for developers
- Demonstrates simple transfer of energy project data between tool and XML database
- Excel add-in developed in VB facilitates transfer of IEP XML to and from database
- Excel template contains VBA to call add-in functions
- eXist-db open source native XML database used to aggregate XML
- XQuery used in eXist-db web services, and reports

DAJ_SCE_ProjectProfile.xls [Compatibility Mode] - Microsoft Excel

Home Insert Page Layout Formulas Data Review View Developer Acrobat

S13

# Project Profile

View IEP Aggregate Benefits Report

Update Data from DB

Save Data

| Project Info | |
|---|---|
| Name | kW Office |
| Classification | Retrofit |
| Customer Class | Commercial |
| Utility Name | SCE |
| Energy Type | KilowattHours |

| Host Customer Info | |
|---|---|
| Organization | kW Engineering |
| Sector | Commercial |

| Site Address | |
|---|---|
| Address | 920 Atlantic St. |
| Address Line 2 | Suite 200 |
| City | Long Beach |
| County | USA |
| State | California |
| Zip | 90813 |

Measures

| # | Name | Description | Measure Code | Est. kW | Est. kWh | Initial Costs | Recurring Costs | Savings |
|---|---|---|---|---|---|---|---|---|
| 1 | Lighting Controls | Lighting occupancy | 111222 | 18.4 | 32450 | $450.00 | $0.00 | $212.14 |
| 2 | Lighting Efficiency | Replace T8 lamps ar | 122333 | 3.6 | 18420 | $499.12 | $18.45 | $275.45 |
| 3 | HVAC Controls | Programmable therm | 223444 | 1.3 | 7546 | $122.25 | | $177.45 |
| | | Totals | 3 | 23.3 | 58416 | $1,071.37 | $18.45 | $665.04 |

Project Profile

Ready

75%

# IEP Sample Application

- Data can be submitted to central XML database from multiple copies of the Excel template, or other tools

Project Profile

http://beta.kw-engineering.com/projectProfile.php

## Project Info

Name

Classification

Customer Class

Utility

Energy Type

## Host Customer Info

Organization

Sector

## Site Address

Address

Address Line 2

City

County

State

Zip

## Measure Codes

| # | Name | Description | Code # | kWh | kW | Emissions | Water | Intial Costs | Recurring Costs | Savings | Actions |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | + - |
| | | | | | | | | | | | + - |
| | | | | | | | | | | | + - |
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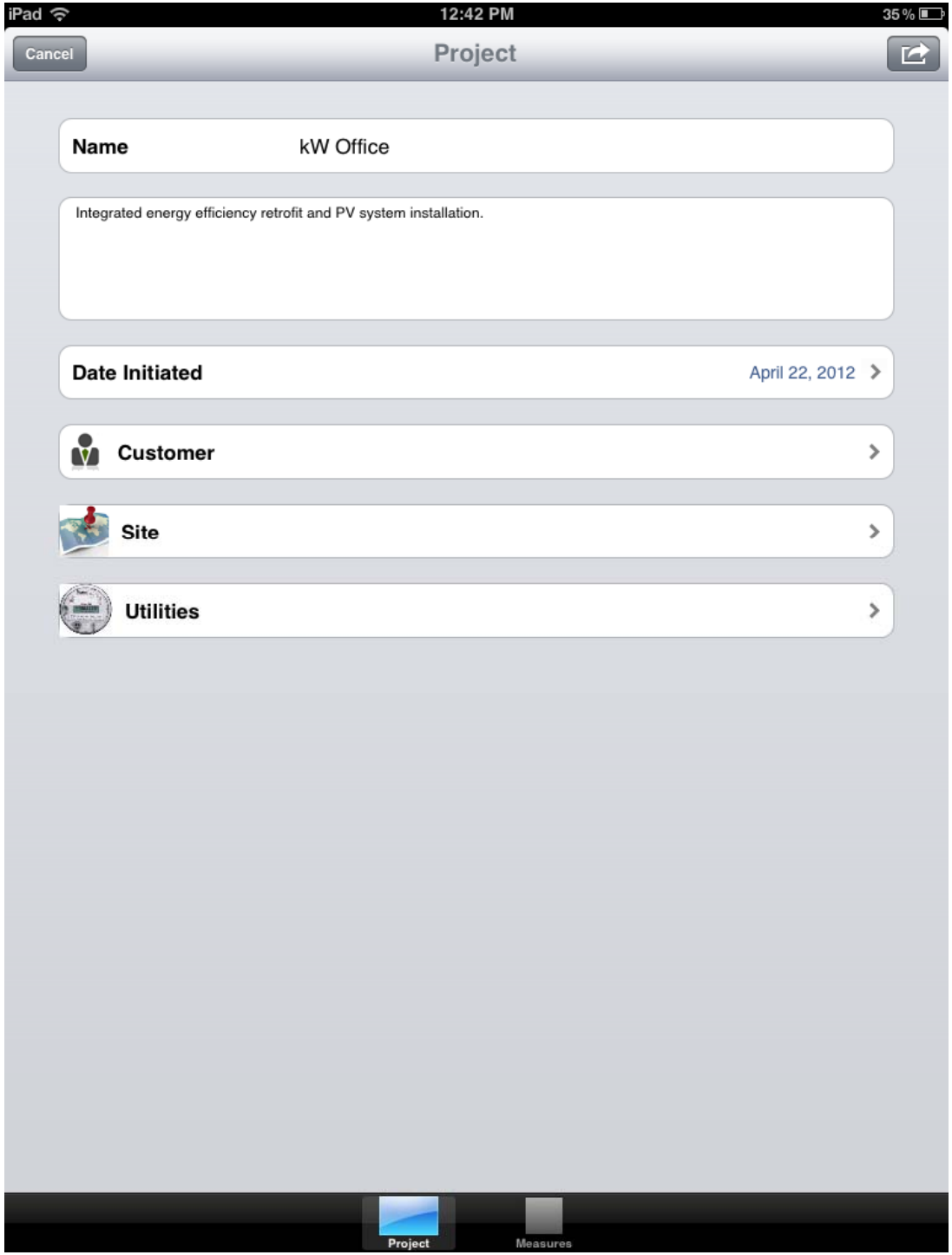
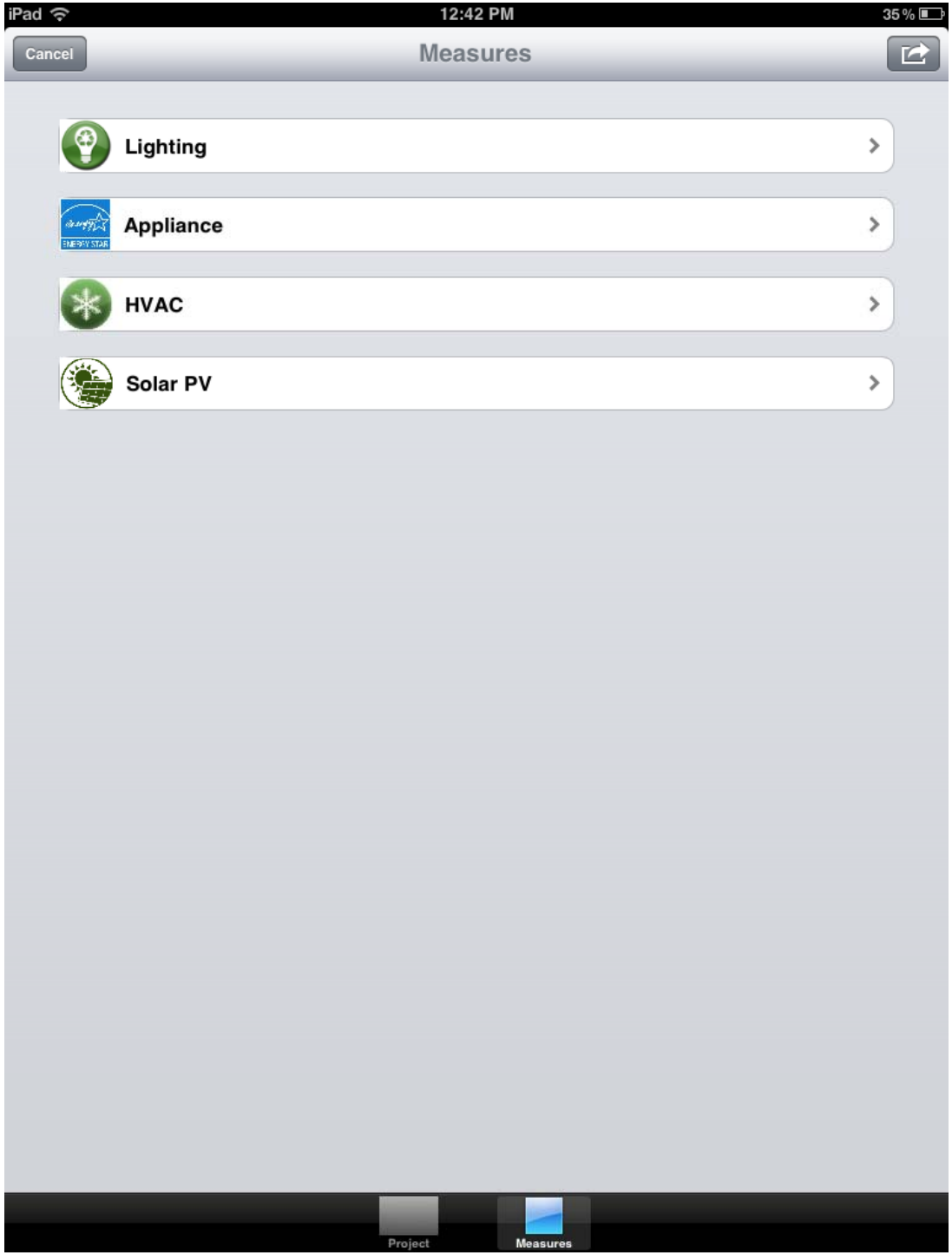
Submit Project

Sunday, April 22, 2012


iPad
12:42 PM
35 %
Cancel
Project
Name
kW Office
Integrated energy efficiency retrofit and PV system installation.
Date Initiated
April 22, 2012
Customer
Site
Utilities
Project
Measures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Cancel
Measures
Lighting
Appliance
HVAC
Solar PV
Project
Measures

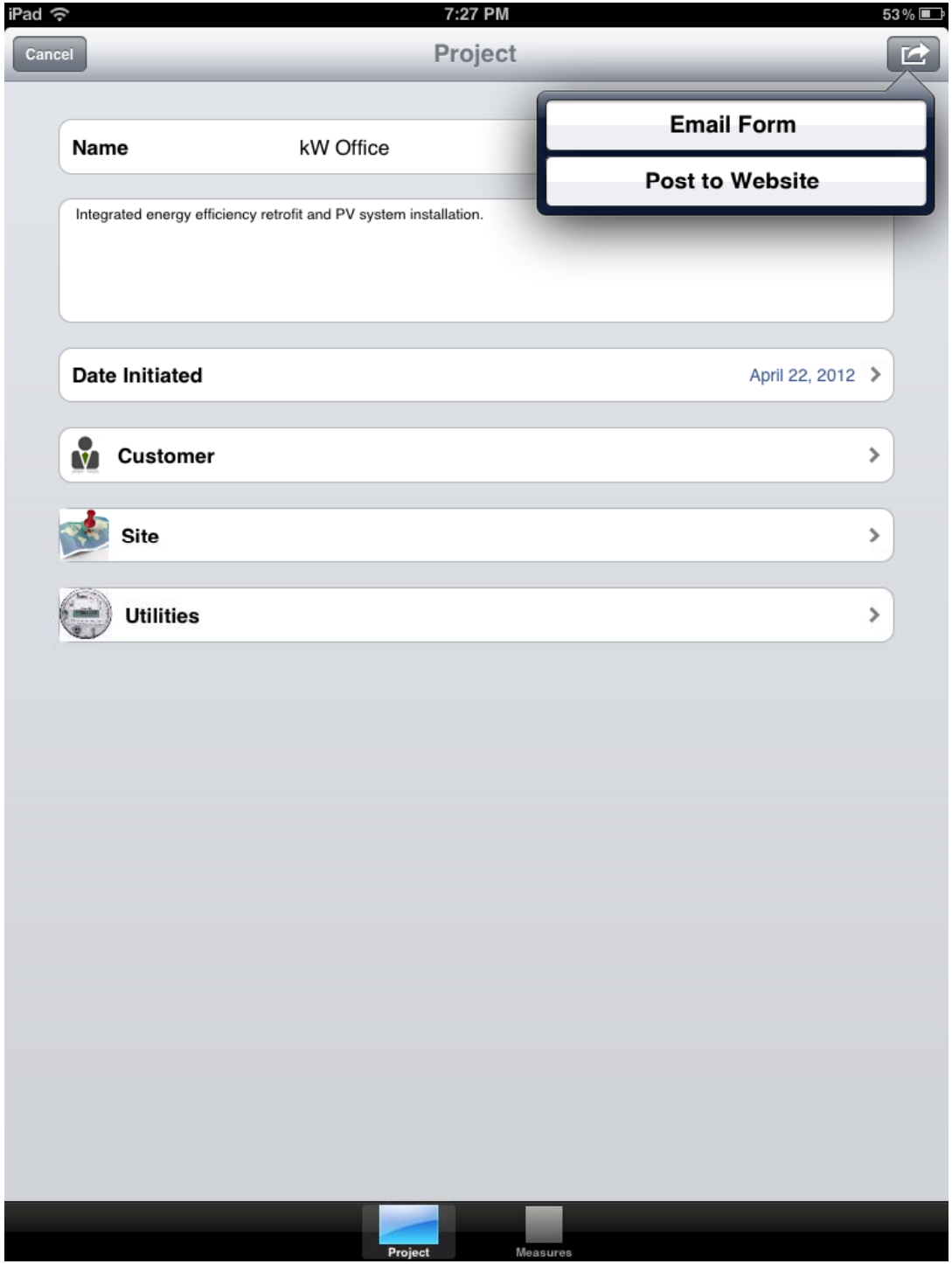
iPad 12:43 PM 35 %

Measures

# Lighting

| | |
|---|---|
| **Recommended?** | Yes |
| **Name** | Lighting Efficiency |
| | |
| **kW Savings** | 8.4 |
| **kWh Savings** | 34,500 |
| **Therms Savings** | |
| **Cost Savings** | $4,150.00 |
| **Installed Cost** | $8,000.00 |

Project Measures


iPad
7:27 PM
53 %
Cancel
Project
Email Form
Post to Website
Name
kW Office
Integrated energy efficiency retrofit and PV system installation.
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Customer
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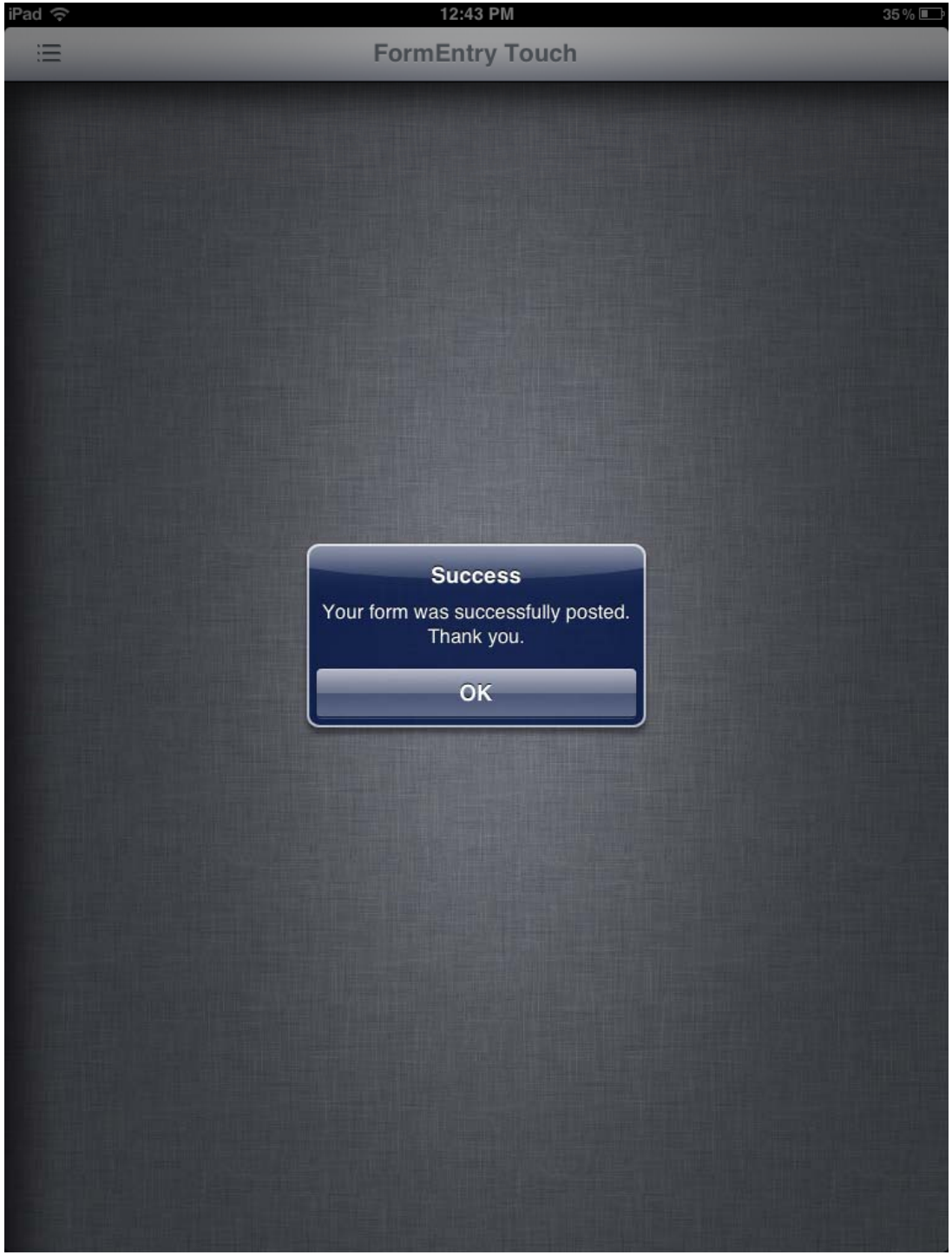
Measures


iPad
12:43 PM
35 %
FormEntry Touch
Success
Your form was successfully posted.
Thank you.
OK

IEP Aggregate Benefits Rep

exist.kw-engineering.com:8080/exist/rest//db/IEP/IEP_MeasuresReport_V3.xql

# IEP Aggregate Benefits Report

## Utility Distribution

| Utility | Customer Class | Count | Esimated kW | Esimated kWh |
|---|---|---|---|---|
| PG&E | Residential | 0 | 0 | 0 |
| SDG&E | Residential | 0 | 0 | 0 |
| SCE | Residential | 0 | 0 | 0 |
| SCG | Residential | 0 | 0 | 0 |
| SDG | Non-Residential | 0 | 0 | 0 |
| PG&E | Non-Residential | 1 | 18.3 | 35500 |
| SDG&E | Non-Residential | 1 | 20.5 | 51671 |
| SCE | Non-Residential | 1 | 23.3 | 58416 |

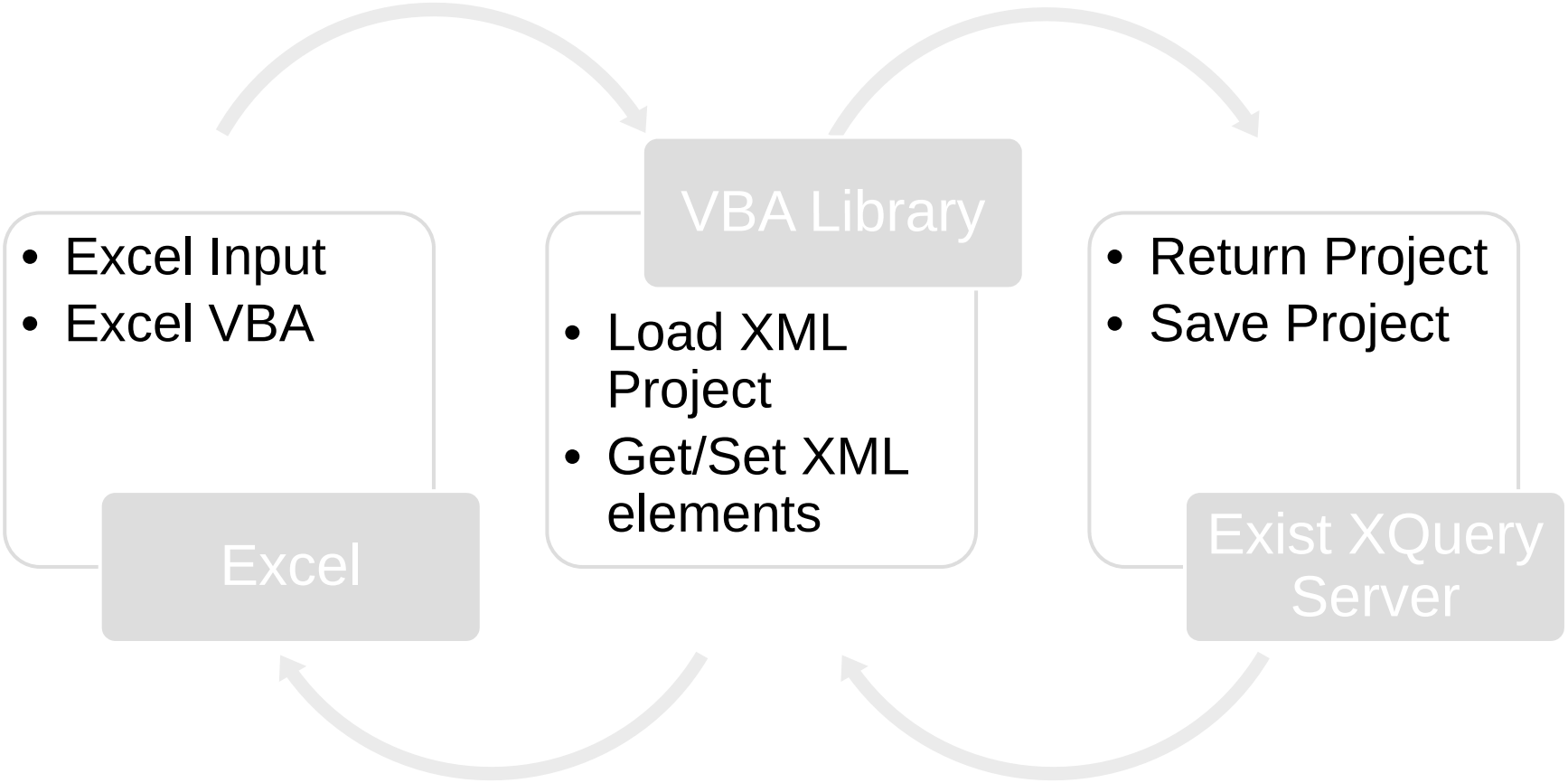
## Savings by Measure

| Name | Count | Esimated kW | Esimated kWh |
|---|---|---|---|
| HVAC Controls | 3 | 3.9 | 23323 |
| Lighting Efficiency | 3 | 10.4 | 42870 |
| Lighting Controls | 3 | 47.8 | 79394 |

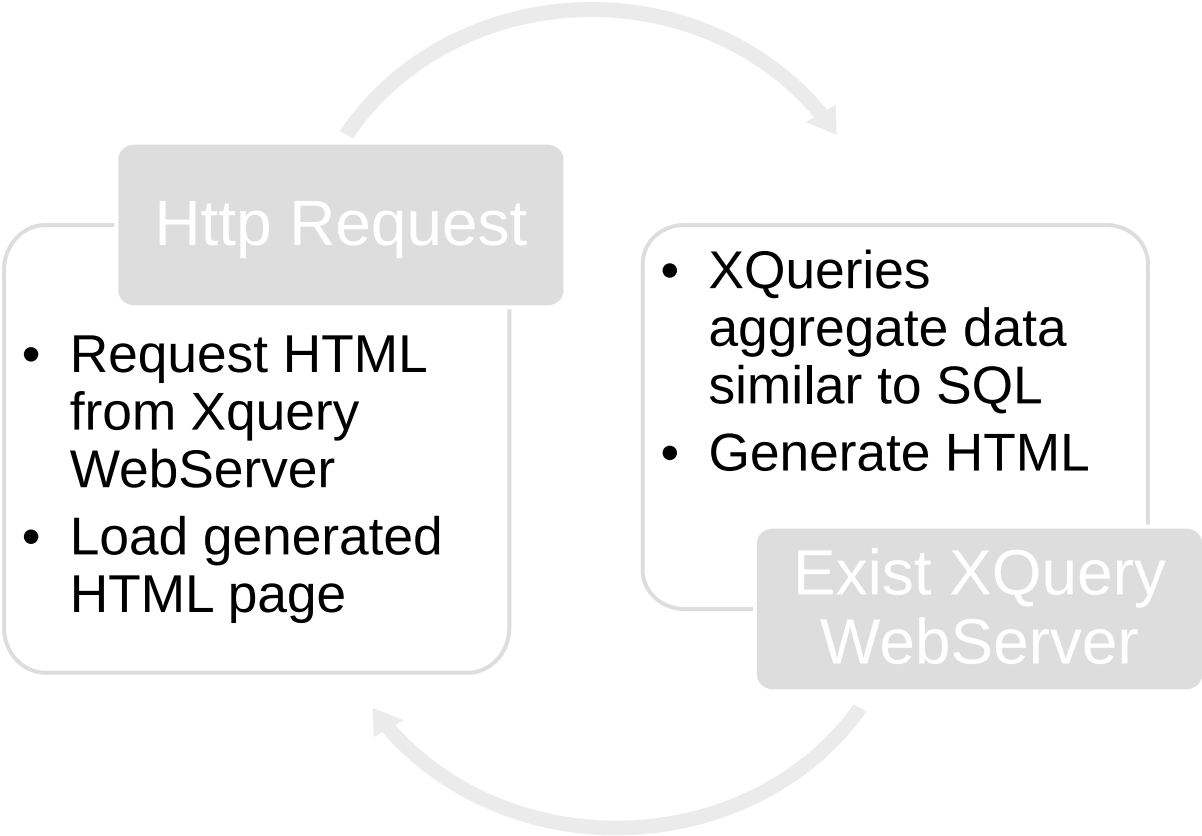
## Totals

| Total Estimated Measure Costs | Total Estimated Savings (kW) | Total Estimated Peak Demand (kWh) |
|---|---|---|
| 3010.83 | 1902.84 | 145587 |

# Sample Project Collection



# Sample Report



# Sample Project Lessons

- There is a learning curve in the transition from SQL to Xquery
  - Specifically switching from table joins to dealing with entire XML hierarchy
- Not all Document Object Model implementations are created equal
  - Use LINQ for MS
- Incorrectly defined datasets can easily disrupt an XQuery, requiring a lot of additional error checking – this is where validation comes in
- XQuery is flexible enough for complete replacement of PHP interfaces or allow for integration with PHP or other webservice languages
- We have found that storing XML data files on the eXist db via webservices may be somewhat problematic.
- Registering libraries for Excel has numerous headaches. There needs to be a simplified library for this. Possibly – 'Add-In Express' - http://www.add-in-express.com/add-in-net/index.php

kW

# Implementation Tips

- Use only parts of the model that are required to satisfy a particular use case that you are interested in
- With specific integration partner, agree upon:
  - Which IEP Model schema(s) will be used as the data payload
  - Which optional schema definition elements are required in your integration
- Build software modules to generate specific parts of the IEP Model XML from your database. Most of the work is in this initial conversion:
  - Mapping is not necessarily one to one, but the flexibility of the spec can allow for most cases
  - A good initial understanding of all the high level structures will save a lot of time in the conversion process
- The Document Object Model can greatly reduce the amount of time necessary to do the conversion.
- XML is strongly typed – validation is critical
- The IEP spec uses the ID reference extensively. It's critical to use unique descriptive ID names
- There are other methods of ID within the spec that are available that can simplify and avoid errors
  - Program Code
  - Enumerations (Project Classification, Real Estate Classification)

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# Moving Forward with IEP

- Anyone can use IEP XML as a common format for saving and exchanging energy project data collected by mobile, online, and desktop tools
- Those interested in using IEP XML are welcome to contribute to its ongoing refinement and expansion
- Collaboration with ongoing related standards development efforts will be important
- Ultimately looking for a standard development organization to maintain long-term

# Thank You

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