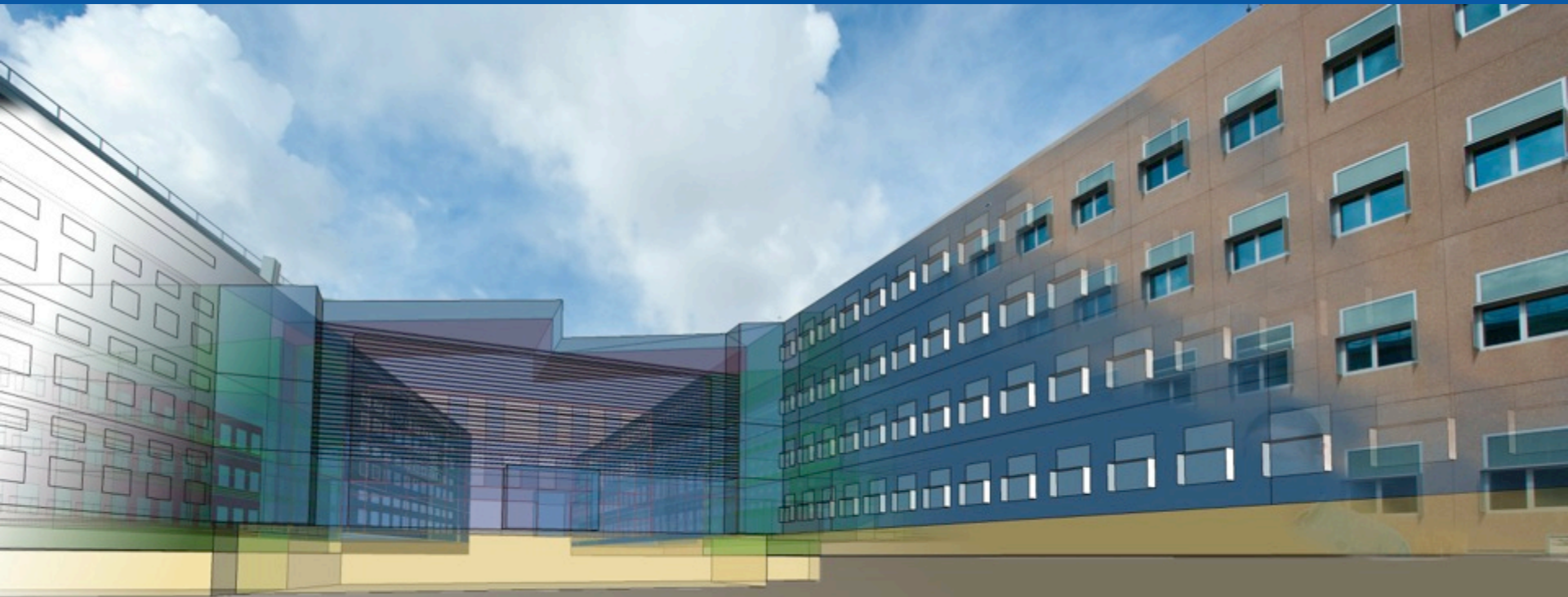


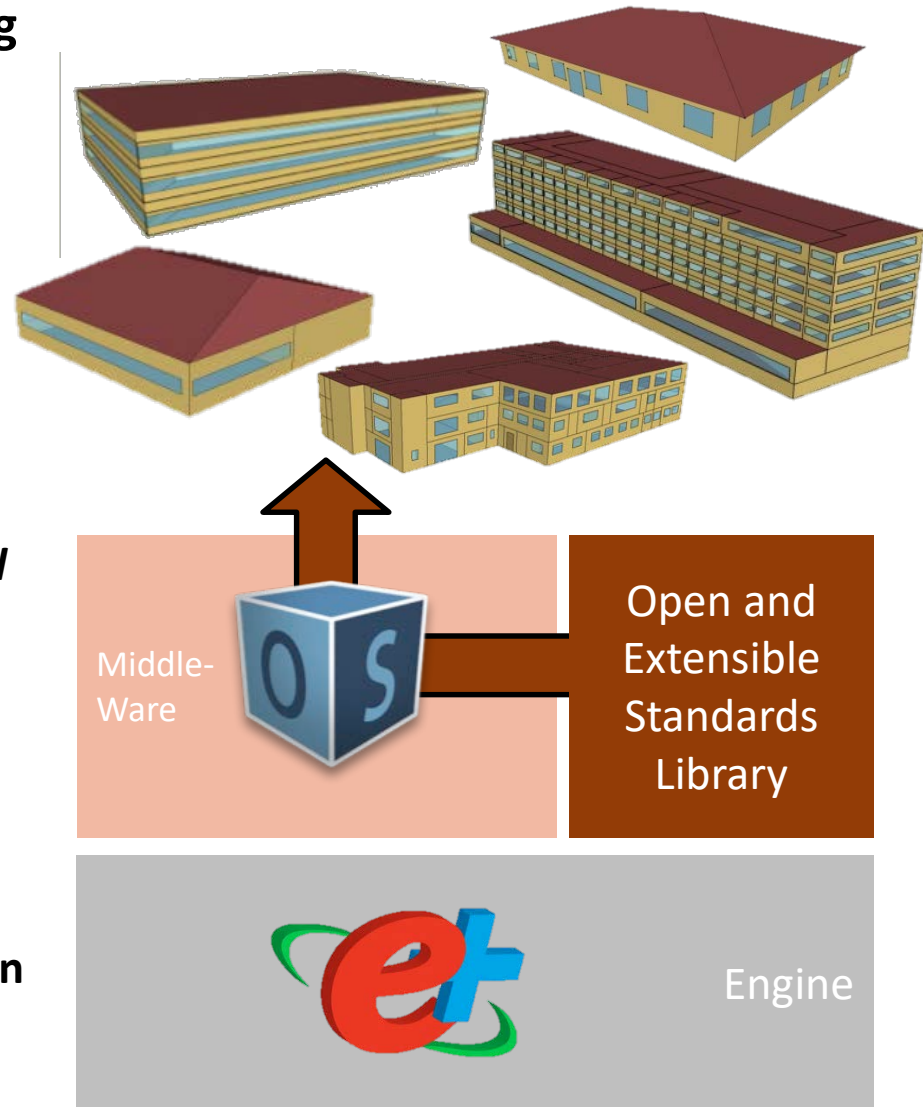
# OpenStudio Conversion of DEER Prototypes



**February 22<sup>nd</sup>, 2018**  
**L Brackney and A Parker**

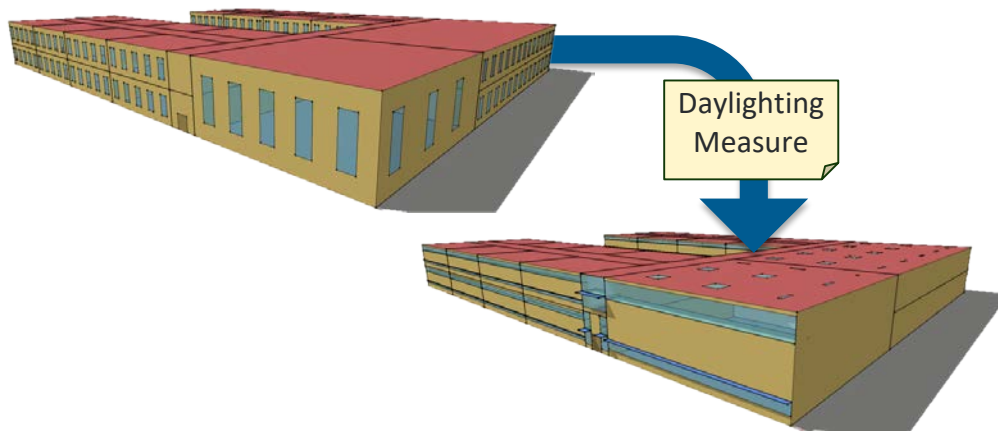
# OpenStudio-Based Portfolio-Analysis

- OpenStudio is "middleware" for building energy modeling
  - Simplifies process of generating and modifying energy models
  - Manages parametric analysis
  - Enables rapid-creation of 3<sup>rd</sup> party tools built on top of EnergyPlus (e.g. HAP)
- Prototypes are generated procedurally
  - Inputs: *Type + HVAC System, Vintage and Climate Zone*
  - Underlying assumptions stored in Excel sheets that feed the library
  - Easily extended for new building types
- Just completed addition of DEER prototype inputs to Standards Library for beta release in OpenStudio 2.5.0 (End of March)

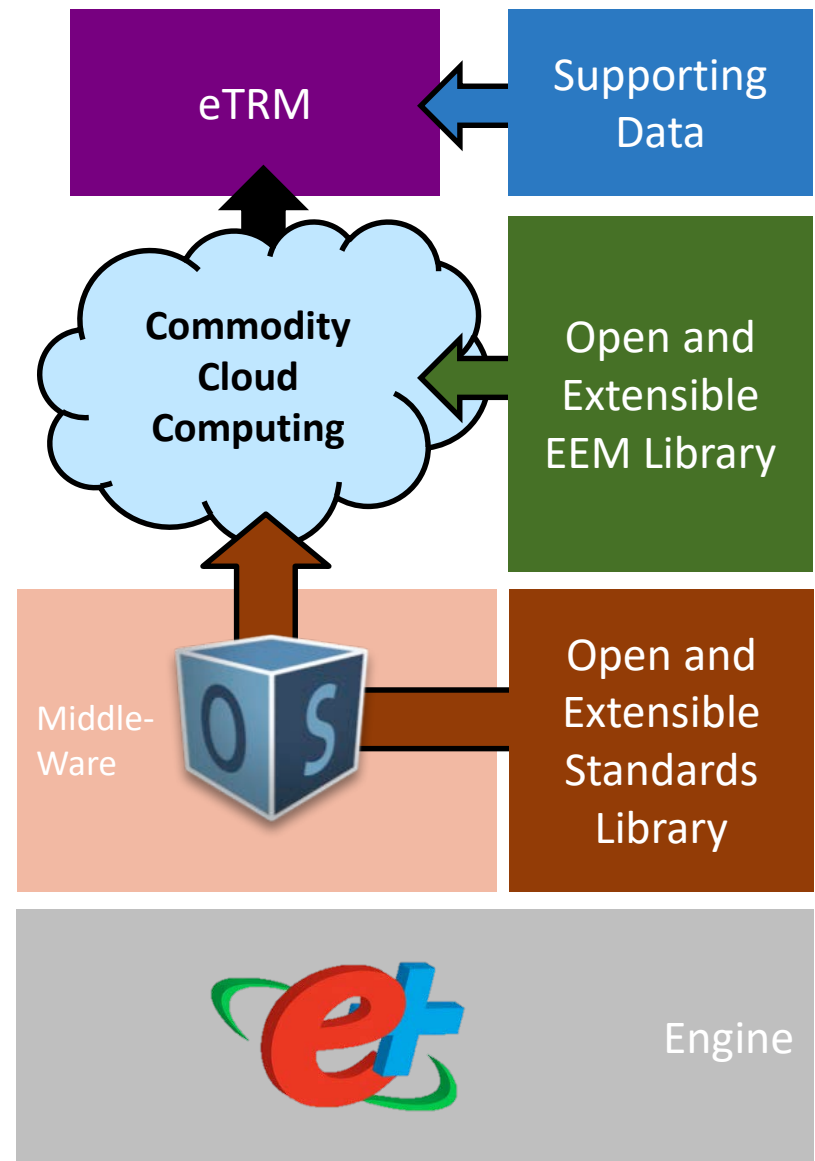


# OpenStudio-Based Portfolio-Analysis

- EEMs packaged as modular scripts that can perform simple or complex model transformations to arbitrary models



- Multiple private sector firms are now creating EEM content
- Portfolio Analysis is Massively Scalable
  - Uses commodity cloud services (Amazon)
  - Can perform full combinatorial analysis
  - Also uncertainty analysis and optimization





# DEER Integration Process

Prototype Model

Interior Equipment  
 Interior Lighting  
 Cooling  
 Fans  
 Heating

Open Stationary Rep (G)

3	Template	Building Type	Space Type	Lighting Standard	Lighting Primary Space Type	Lighting Secondary Space Type	LookupColumn	Lighting per Area (W/ft <sup>2</sup> )	LPD Fraction Linear Fluorescent	LPD Fraction Compact Fluorescent	LPD Fraction High Bay	LPD Fraction Specialty Lighting	LPD Fraction Exit Lightin	Lighting Schedule	Compact Fluorescent Light Schedule
1600	DEER Pre-1975	Asm	Auditorium	DEER Pre-1975	Any	Auditorium	DEER Pre-1975AnyAuditorium	1.5	0.2825	0.3846	0.2825	0.0434	0.007	D17_Asm_Aud_LF_Yr	D17_Asm_Aud_CFL_Yr
1601	DEER 1985	Asm	Auditorium	DEER 1985	Any	Auditorium	DEER 1985AnyAuditorium	1.5	0.2825	0.3846	0.2825	0.0434	0.007	D17_Asm_Aud_LF_Yr	D17_Asm_Aud_CFL_Yr
1602	DEER 1996	Asm	Auditorium	DEER 1996	Any	Auditorium	DEER 1996AnyAuditorium	1.5	0.2825	0.3846	0.2825	0.0434	0.007	D17_Asm_Aud_LF_Yr	D17_Asm_Aud_CFL_Yr
1603	DEER 2003	Asm	Auditorium	DEER 2003	Any	Auditorium	DEER 2003AnyAuditorium	1.2	0.2825	0.3846	0.2825	0.0434	0.007	D17_Asm_Aud_LF_Yr	D17_Asm_Aud_CFL_Yr
1604	DEER 2007	Asm	Auditorium	DEER 2007	Any	Auditorium	DEER 2007AnyAuditorium	1.2	0.2825	0.3846	0.2825	0.0434	0.007	D17_Asm_Aud_LF_Yr	D17_Asm_Aud_CFL_Yr
1605	DEER 2011	Asm	Auditorium	DEER 2011	Any	Auditorium	DEER 2011AnyAuditorium	1.2	0.2825	0.3846	0.2825	0.0434	0.007	D17_Asm_Aud_LF_Yr	D17_Asm_Aud_CFL_Yr
1606	DEER 2014	Asm	Auditorium	DEER 2014	Any	Auditorium	DEER 2014AnyAuditorium	1.2	0.2825	0.3846	0.2825	0.0434	0.007	D17_Asm_Aud_LF_Yr	D17_Asm_Aud_CFL_Yr
1607	DEER 2015	Asm	Auditorium	DEER 2015	Any	Auditorium	DEER 2015AnyAuditorium	1.2	0.2825	0.3846	0.2825	0.0434	0.007	D17_Asm_Aud_LF_Yr	D17_Asm_Aud_CFL_Yr
1608	DEER 2017	Asm	Auditorium	DEER 2017	Any	Auditorium	DEER 2017AnyAuditorium	1.2	0.2825	0.3846	0.2825	0.0434	0.007	D17_Asm_Aud_LF_Yr	D17_Asm_Aud_CFL_Yr
1609	DEER Pre-1975	Asm	Classroom	DEER Pre-1975	Any	Classroom	DEER Pre-1975AnyClassroom	1.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Clrn_LF_Yr	D17_Asm_Clrn_CFL_Yr
1610	DEER 1985	Asm	Classroom	DEER 1985	Any	Classroom	DEER 1985AnyClassroom	1.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Clrn_LF_Yr	D17_Asm_Clrn_CFL_Yr
1611	DEER 1996	Asm	Classroom	DEER 1996	Any	Classroom	DEER 1996AnyClassroom	1.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Clrn_LF_Yr	D17_Asm_Clrn_CFL_Yr
1612	DEER 2003	Asm	Classroom	DEER 2003	Any	Classroom	DEER 2003AnyClassroom	1.2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Clrn_LF_Yr	D17_Asm_Clrn_CFL_Yr
1613	DEER 2007	Asm	Classroom	DEER 2007	Any	Classroom	DEER 2007AnyClassroom	1.2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Clrn_LF_Yr	D17_Asm_Clrn_CFL_Yr
1614	DEER 2011	Asm	Classroom	DEER 2011	Any	Classroom	DEER 2011AnyClassroom	1.2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Clrn_LF_Yr	D17_Asm_Clrn_CFL_Yr
1615	DEER 2014	Asm	Classroom	DEER 2014	Any	Classroom	DEER 2014AnyClassroom	1.2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Clrn_LF_Yr	D17_Asm_Clrn_CFL_Yr
1616	DEER 2015	Asm	Classroom	DEER 2015	Any	Classroom	DEER 2015AnyClassroom	1.2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Clrn_LF_Yr	D17_Asm_Clrn_CFL_Yr
1617	DEER 2017	Asm	Classroom	DEER 2017	Any	Classroom	DEER 2017AnyClassroom	1.2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Clrn_LF_Yr	D17_Asm_Clrn_CFL_Yr
1618	DEER Pre-1975	Asm	Conference	DEER Pre-1975	Any	Conference	DEER Pre-1975AnyConference	1.8	0.565	0.3846	0	0.0434	0.007	D17_Asm_Conf_LF_Yr	D17_Asm_Conf_CFL_Yr
1619	DEER 1985	Asm	Conference	DEER 1985	Any	Conference	DEER 1985AnyConference	1.8	0.565	0.3846	0	0.0434	0.007	D17_Asm_Conf_LF_Yr	D17_Asm_Conf_CFL_Yr
1620	DEER 1996	Asm	Conference	DEER 1996	Any	Conference	DEER 1996AnyConference	1.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Conf_LF_Yr	D17_Asm_Conf_CFL_Yr
1621	DEER 2003	Asm	Conference	DEER 2003	Any	Conference	DEER 2003AnyConference	1.5	0.565	0.3846	0	0.0434	0.007	D17_Asm_Conf_LF_Yr	D17_Asm_Conf_CFL_Yr
1622	DEER 2007	Asm	Conference	DEER 2007	Any	Conference	DEER 2007AnyConference	1.4	0.565	0.3846	0	0.0434	0.007	D17_Asm_Conf_LF_Yr	D17_Asm_Conf_CFL_Yr
1623	DEER 2011	Asm	Conference	DEER 2011	Any	Conference	DEER 2011AnyConference	1.4	0.565	0.3846	0	0.0434	0.007	D17_Asm_Conf_LF_Yr	D17_Asm_Conf_CFL_Yr
1624	DEER 2014	Asm	Conference	DEER 2014	Any	Conference	DEER 2014AnyConference	1.4	0.565	0.3846	0	0.0434	0.007	D17_Asm_Conf_LF_Yr	D17_Asm_Conf_CFL_Yr
1625	DEER 2015	Asm	Conference	DEER 2015	Any	Conference	DEER 2015AnyConference	1.4	0.565	0.3846	0	0.0434	0.007	D17_Asm_Conf_LF_Yr	D17_Asm_Conf_CFL_Yr
1626	DEER 2017	Asm	Conference	DEER 2017	Any	Conference	DEER 2017AnyConference	1.2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Conf_LF_Yr	D17_Asm_Conf_CFL_Yr
1627	DEER Pre-1975	Asm	Dining	DEER Pre-1975	Any	Dining	DEER Pre-1975AnyDining	1.5	0.565	0.3846	0	0.0434	0.007	D17_Asm_Din_LF_Yr	D17_Asm_Din_CFL_Yr
1628	DEER 1985	Asm	Dining	DEER 1985	Any	Dining	DEER 1985AnyDining	1.5	0.565	0.3846	0	0.0434	0.007	D17_Asm_Din_LF_Yr	D17_Asm_Din_CFL_Yr
1629	DEER 1996	Asm	Dining	DEER 1996	Any	Dining	DEER 1996AnyDining	1.3	0.565	0.3846	0	0.0434	0.007	D17_Asm_Din_LF_Yr	D17_Asm_Din_CFL_Yr
1630	DEER 2003	Asm	Dining	DEER 2003	Any	Dining	DEER 2003AnyDining	1.3	0.565	0.3846	0	0.0434	0.007	D17_Asm_Din_LF_Yr	D17_Asm_Din_CFL_Yr
1631	DEER 2007	Asm	Dining	DEER 2007	Any	Dining	DEER 2007AnyDining	1.3	0.565	0.3846	0	0.0434	0.007	D17_Asm_Din_LF_Yr	D17_Asm_Din_CFL_Yr
1632	DEER 2011	Asm	Dining	DEER 2011	Any	Dining	DEER 2011AnyDining	1.3	0.565	0.3846	0	0.0434	0.007	D17_Asm_Din_LF_Yr	D17_Asm_Din_CFL_Yr
1633	DEER 2014	Asm	Dining	DEER 2014	Any	Dining	DEER 2014AnyDining	1.3	0.565	0.3846	0	0.0434	0.007	D17_Asm_Din_LF_Yr	D17_Asm_Din_CFL_Yr
1634	DEER 2015	Asm	Dining	DEER 2015	Any	Dining	DEER 2015AnyDining	1.3	0.565	0.3846	0	0.0434	0.007	D17_Asm_Din_LF_Yr	D17_Asm_Din_CFL_Yr
1635	DEER 2017	Asm	Dining	DEER 2017	Any	Dining	DEER 2017AnyDining	1.3	0.565	0.3846	0	0.0434	0.007	D17_Asm_Din_LF_Yr	D17_Asm_Din_CFL_Yr
1636	DEER Pre-1975	Asm	Exhibit	DEER Pre-1975	Any	Exhibit	DEER Pre-1975AnyExhibit	2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Exhbt_LF_Yr	D17_Asm_Exhbt_CFL_Yr
1637	DEER 1985	Asm	Exhibit	DEER 1985	Any	Exhibit	DEER 1985AnyExhibit	2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Exhbt_LF_Yr	D17_Asm_Exhbt_CFL_Yr
1638	DEER 1996	Asm	Exhibit	DEER 1996	Any	Exhibit	DEER 1996AnyExhibit	2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Exhbt_LF_Yr	D17_Asm_Exhbt_CFL_Yr
1639	DEER 2003	Asm	Exhibit	DEER 2003	Any	Exhibit	DEER 2003AnyExhibit	2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Exhbt_LF_Yr	D17_Asm_Exhbt_CFL_Yr
1640	DEER 2007	Asm	Exhibit	DEER 2007	Any	Exhibit	DEER 2007AnyExhibit	2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Exhbt_LF_Yr	D17_Asm_Exhbt_CFL_Yr
1641	DEER 2011	Asm	Exhibit	DEER 2011	Any	Exhibit	DEER 2011AnyExhibit	2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Exhbt_LF_Yr	D17_Asm_Exhbt_CFL_Yr
1642	DEER 2014	Asm	Exhibit	DEER 2014	Any	Exhibit	DEER 2014AnyExhibit	2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Exhbt_LF_Yr	D17_Asm_Exhbt_CFL_Yr
1643	DEER 2015	Asm	Exhibit	DEER 2015	Any	Exhibit	DEER 2015AnyExhibit	2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Exhbt_LF_Yr	D17_Asm_Exhbt_CFL_Yr
1644	DEER 2017	Asm	Exhibit	DEER 2017	Any	Exhibit	DEER 2017AnyExhibit	1.8	0.565	0.3846	0	0.0434	0.007	D17_Asm_Exhbt_LF_Yr	D17_Asm_Exhbt_CFL_Yr
1645	DEER Pre-1975	Asm	Hall	DEER Pre-1975	Any	Hall	DEER Pre-1975AnyHall	0.8	0.565	0.3846	0	0.0434	0.007	D17_Asm_Hall_LF_Yr	D17_Asm_Hall_CFL_Yr
1646	DEER 1985	Asm	Hall	DEER 1985	Any	Hall	DEER 1985AnyHall	0.8	0.565	0.3846	0	0.0434	0.007	D17_Asm_Hall_LF_Yr	D17_Asm_Hall_CFL_Yr
1647	DEER 1996	Asm	Hall	DEER 1996	Any	Hall	DEER 1996AnyHall	0.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Hall_LF_Yr	D17_Asm_Hall_CFL_Yr
1648	DEER 2003	Asm	Hall	DEER 2003	Any	Hall	DEER 2003AnyHall	0.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Hall_LF_Yr	D17_Asm_Hall_CFL_Yr
1649	DEER 2007	Asm	Hall	DEER 2007	Any	Hall	DEER 2007AnyHall	0.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Hall_LF_Yr	D17_Asm_Hall_CFL_Yr
1650	DEER 2011	Asm	Hall	DEER 2011	Any	Hall	DEER 2011AnyHall	0.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Hall_LF_Yr	D17_Asm_Hall_CFL_Yr
1651	DEER 2014	Asm	Hall	DEER 2014	Any	Hall	DEER 2014AnyHall	0.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Hall_LF_Yr	D17_Asm_Hall_CFL_Yr
1652	DEER 2015	Asm	Hall	DEER 2015	Any	Hall	DEER 2015AnyHall	0.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Hall_LF_Yr	D17_Asm_Hall_CFL_Yr
1653	DEER 2017	Asm	Hall	DEER 2017	Any	Hall	DEER 2017AnyHall	0.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Hall_LF_Yr	D17_Asm_Hall_CFL_Yr
1654	DEER Pre-1975	Asm	Kitchen	DEER Pre-1975	Any	Kitchen	DEER Pre-1975AnyKitchen	1.7	0.565	0.3846	0	0.0434	0.007	D17_Asm_Ktchn_LF_Yr	D17_Asm_Ktchn_CFL_Yr
1655	DEER 1985	Asm	Kitchen	DEER 1985	Any	Kitchen	DEER 1985AnyKitchen	1.7	0.565	0.3846	0	0.0434	0.007	D17_Asm_Ktchn_LF_Yr	D17_Asm_Ktchn_CFL_Yr
1656	DEER 1996	Asm	Kitchen	DEER 1996	Any	Kitchen	DEER 1996AnyKitchen	1.7	0.565	0.3846	0	0.0434	0.007	D17_Asm_Ktchn_LF_Yr	D17_Asm_Ktchn_CFL_Yr
1657	DEER 2003	Asm	Kitchen	DEER 2003	Any	Kitchen	DEER 2003AnyKitchen	1.7	0.565	0.3846	0	0.0434	0.007	D17_Asm_Ktchn_LF_Yr	D17_Asm_Ktchn_CFL_Yr
1658	DEER 2007	Asm	Kitchen	DEER 2007	Any	Kitchen	DEER 2007AnyKitchen	1.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Ktchn_LF_Yr	D17_Asm_Ktchn_CFL_Yr
1659	DEER 2011	Asm	Kitchen	DEER 2011	Any	Kitchen	DEER 2011AnyKitchen	1.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Ktchn_LF_Yr	D17_Asm_Ktchn_CFL_Yr
1660	DEER 2014	Asm	Kitchen	DEER 2014	Any	Kitchen	DEER 2014AnyKitchen	1.6	0.565	0.3846	0	0.0434	0.007	D17_Asm_Ktchn_LF_Yr	D17_Asm_Ktchn_CFL_Yr
1661	DEER 2015	Asm	Kitchen	DEER 2015	Any	Kitchen	DEER 2015AnyKitchen	1.2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Ktchn_LF_Yr	D17_Asm_Ktchn_CFL_Yr
1662	DEER 2017	Asm	Kitchen	DEER 2017	Any	Kitchen	DEER 2017AnyKitchen	1.2	0.565	0.3846	0	0.0434	0.007	D17_Asm_Ktchn_LF_Yr	D17_Asm_Ktchn_CFL_Yr
1663	DEER Pre-1975	Asm	Lobby/Waiting	DEER Pre-1975	Any	Lobby/Waiting	DEER Pre-1975AnyLobby/Waiting	1.5	0.565	0.3846	0	0.0434	0.007	D17_Asm_LobWt_LF_Yr	D17_Asm_LobWt_CFL_Yr
1664	DEER 1985	Asm	Lobby/Waiting	DEER 1985	Any	Lobby/Waiting	DEER 1985AnyLobby/Waiting	1.5	0.565	0.3846	0	0.0434	0.007	D17_Asm_LobWt_LF_Yr	D17_Asm_LobWt_CFL_Yr
1665	DEER 1996	Asm	Lobby/Waiting	DEER 1996	Any	Lobby/Waiting	DEER 1996AnyLobby/Waiting	1.3	0.565	0.3846	0	0.0434	0.007	D17_Asm_LobWt_LF_Yr	D17_Asm_LobWt_CFL_Yr
1666	DEER 2003	Asm	Lobby/Waiting	DEER 2003	Any	Lobby/Waiting	DEER 2003AnyLobby/Waiting	1.3	0.565	0.3846	0	0.0434	0.007	D17_Asm_LobWt_LF_Yr	D17_Asm_LobWt_CFL_Yr
1667	DEER 2007	Asm	Lobby/Waiting	DEER 2007	Any	Lobby/Waiting	DEER 2007AnyLobby/Waiting	1.3	0.565	0.3846	0	0.0434	0.007	D17_Asm_LobWt_LF_Yr	D17_Asm_LobWt_CFL_Yr
1668	DEER 2011	Asm	Lobby/Waiting	DEER 2011	Any	Lobby/Waiting	DEER 2011AnyLobby/Waiting	1.3	0.565	0.3846	0	0.0434	0.007	D17_Asm_LobWt_LF_Yr	D17_Asm_LobWt_CFL_Yr

Climate Zones Standards Climate Zone Sets Parking Entrypaths Occupancy Exterior Lighting Interior Lighting DEER Lighting Fractions Ventilation Schedules Space Types Cons

# Additional Transparency

Script reports what it is doing as it constructs the prototype model

Onsite Power Generation

Whole Building 8

Whole Building Schedules 1

Space Types 7

- BCL AedgK12Kitchen
- My CA Modeling Assumptions
- My ChangeBuildingLocation
- My Create DEER Prototype Building**
- BCL Create DOE Prototype Building
- My Get Site from Building Component Librar

Creates the DEER Prototype Building Models as starting points for other analyses.

Modeler Description

Inputs

Building Type: HVAC Type

Health/Medical - Hospital: No Cooling with Gas

Template

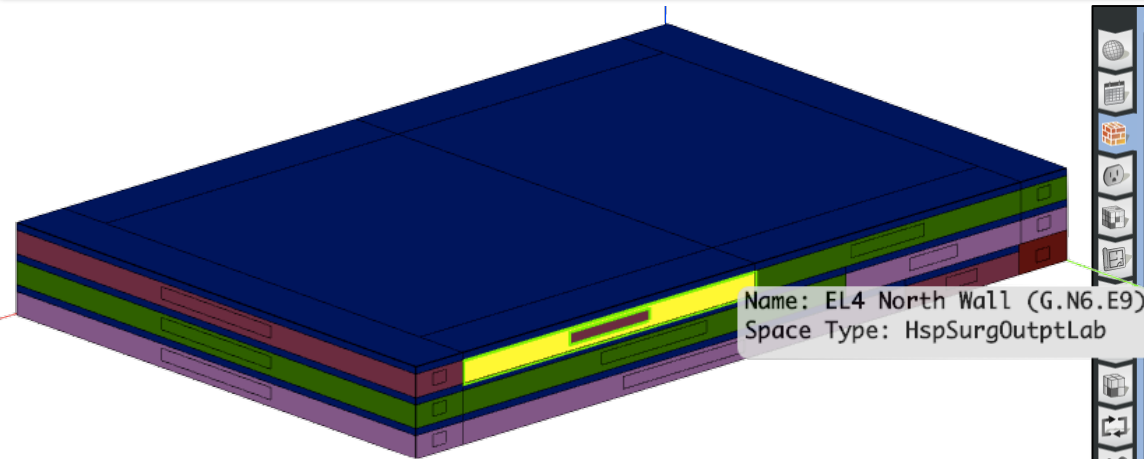
DEER 2011

Climate Zone

CEC T24-CEC9

```
Info: Finished adding geometry
Info: Started applying space types (loads)
Info: Dining had no people, one has been created.
Info: Dining set occupancy to 44.4 people/1000 ft^2.
Info: Dining had no lights, one has been created.
Info: Dining set LPD to 1.3 W/ft^2.
Info: Dining had no electric equipment, one has been created.
Info: Dining set electric EPD to 0.5 W/ft^2.
Info: Dining had no ventilation specification, one has been created.
Info: Dining set ventilation per area to 0.89 cfm/ft^2.
Info: Dining set occupancy schedule to D_Hsp_Ktchn_Occup_Yr.
Info: Dining set occupant activity schedule to DEER Activity 161W/person.
Info: Dining set lighting schedule to D17_Hsp_Din_LF_Yr.
Info: Dining set electric equipment schedule to D_Hsp_Ktchn_Misc_Yr.
Info: Dining set infiltration schedule to D_Hsp_All_C_Inf_Yr.
Info: Dining set heating setpoint schedule to D_Hsp_All_HTemp_Yr.
Info: Dining set cooling setpoint schedule to D_Hsp_All_CTemp_Yr.
Info: HspSurgOutptLab had no people, one has been created.
Info: HspSurgOutptLab set occupancy to 6.7 people/1000 ft^2.
Info: HspSurgOutptLab had no lights, one has been created.
Info: HspSurgOutptLab set LPD to 1.2 W/ft^2.
Info: HspSurgOutptLab had no electric equipment, one has been created.
Info: HspSurgOutptLab set electric EPD to 1.5 W/ft^2.
Info: HspSurgOutptLab had no ventilation specification, one has been created.
```

# Additional Transparency



Constructions Construction Sets Constructions Materials

DEER 2011 - Hsp - CEC T24-CEC9

Name: DEER 2011 - Hsp - CEC T24-CEC9

**Exterior Surface Constructions**

Walls: VEER Insulated Exterior Mass Wall

Floors: VEER Uncarpete 6in Slab Floor

Roofs: DEER Mass Roof R-25.64

**Interior Surface Constructions**

Walls: Typical Interior Wall

Floors: VEER Uncarpete 6in Slab Floor

Ceilings: VEER Uncarpete 6in Slab Floor

**Ground Contact Surface Constructions**

Walls: Typical Uninsulate Basement Mass Wall

Floors: VEER Carpeted 6in Slab Floor

Ceilings: Drag From Library

HVAC Systems

Layout Control Grid

EL2 NNW Perim Spc (G.NNW3) ZN EL2 Sys1 (PUVT) (G.NNW3)

OS-Coll-Cooling:DX:SingleSpeed

Name: AC Clg Coil 7x8In/ft 13.0SEER

Rated Total Cooling Capacity: Hard Sized W

Rated Sensible Heat Ratio: Hard Sized

Rated COP: 3.6504

Rated Air Flow Rate: Hard Sized m<sup>3</sup>/s

Rated Evaporator Fan Power Per Volume Flow Rate: 773.3 Pa

D. Hsp\_Ktchn\_Misc\_Yr

D. Hsp\_Ktchn\_Occup\_Yr

summer design day  
winter design day  
Priority 1 - (SunSat) 2006-Jan-01-2006-Dec-31  
Priority 2 - (Mon-Fri) 2006-Jan-01-2006-Dec-31  
default profile

summer design day  
winter design day  
default profile

Dimensions

Hours

Space Types

Drop Space Type

General Loads Measure Tags Custom

Filter: Load Type

Show all loads

Space Type Name	All	Load Name	Multiplier	Definition	Schedule	Activity Schedule (People Only)
Dining	<input type="checkbox"/>	Dining People	1.000000	Dining People Definitio	D_Hsp_Ktchn_Occup_Yr	DEER Activity 161Wipe
	<input type="checkbox"/>	Dining Lights	1.000000	Dining Lights Definition	D17_Hsp_Din_LF_Yr	
	<input type="checkbox"/>	Dining Elec Equip	1.000000	Dining Elec Equip Defini	D_Hsp_Ktchn_Misc_Yr	
HspSurgOutputLab	<input type="checkbox"/>	urgOutputLab People	1.000000	HspSurgOutputLab Peop	D_Hsp_SrgOutLab_Occ	DEER Activity 132Wipe
	<input type="checkbox"/>	urgOutputLab Lights	1.000000	HspSurgOutputLab Light	D17_Hsp_Din_LF_Yr	
	<input type="checkbox"/>	OutputLab Elec Equip	1.000000	HspSurgOutputLab Elec	D_Hsp_SrgOutLab_Misc	
Kitchen	<input type="checkbox"/>	Kitchen People	1.000000	Kitchen People Definitio	D_Hsp_Ktchn_Occup_Yr	DEER Activity 220Wipe
	<input type="checkbox"/>	Kitchen Lights	1.000000	Kitchen Lights Definition	D17_Hsp_Ktchn_LF_Yr	
	<input type="checkbox"/>	officeGeneral People	1.000000	eneral People Definition	D_Hsp_OffGen_Occup_Yr	DEER Activity 132Wipe

My Model Library Edit

OS:People:Definition

Name: HspSurgOutputLab People Definition

Number of People Calculation Method: People/Area

Number of People: people

People per Space Floor Area: 0.0721181997919551 people/m<sup>2</sup>

Space Floor Area per Person: m<sup>2</sup>/person

Fraction Radiant: 0.3

Add/Remove Extensible Groups

Sensible Heat Fraction

Carbon Dioxide Generation Rate: 1/p

Enable ASHRAE 55 Comfort

# Hsp/2011/CZ9 Simulation Results

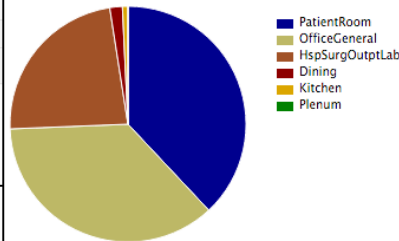
## Building Summary

Information	Value	Units
Building Name	-Hsp-CEC T24-CEC9 created: 2018-02-21 09:57:27 -0800	building_name
Net Site Energy	12,184,966	kBtu
Total Building Area	249,925	ft <sup>2</sup>
EUI (Based on Net Site Energy and Total Building Area)	48.75	kBtu/ft <sup>2</sup>
OpenStudio Standards Building Type	Hsp	

## Weather Summary

	Value
Weather File	Burbank Glendale Pasadena Ap CA USA TMY3 WMO#=722880
Latitude	34.20
Longitude	-118.3
Elevation	741 (ft)
Time Zone	-8.0
North Axis Angle	0.00
ASHRAE Climate Zone	

## Space Type Breakdown - view table



## Base Surface Constructions

Construction	Net Area (ft <sup>2</sup> )	Surface Count	R Value (ft <sup>2</sup> h <sup>2</sup> R/Btu)
DEER Insulated Exterior Mass Wall R-3.51	40,897	59	3.34
DEER Mass Roof R-13.16	83,332	8	12.99

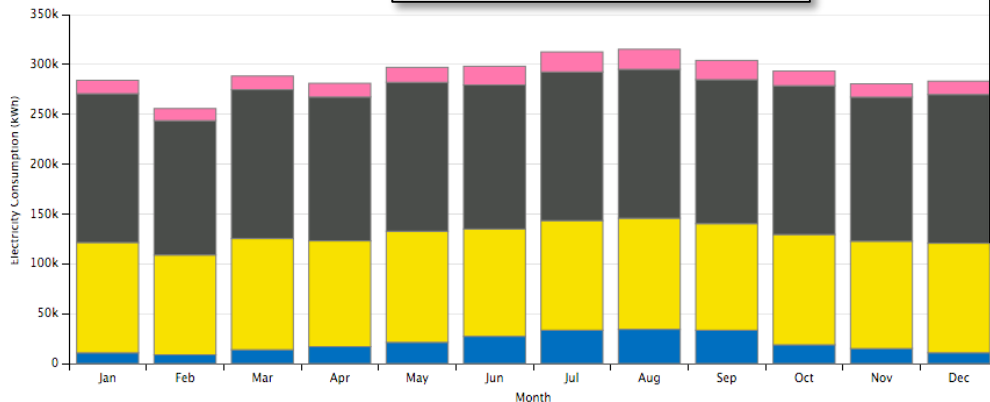
## Sub Surface Constructions

Construction	Area (ft <sup>2</sup> )	Surface Count	U-Factor (Btu/ft <sup>2</sup> h <sup>2</sup> R)
DEER Metal Framed Window U-0.77 SHGC 0.61	5,059	32	0.8860

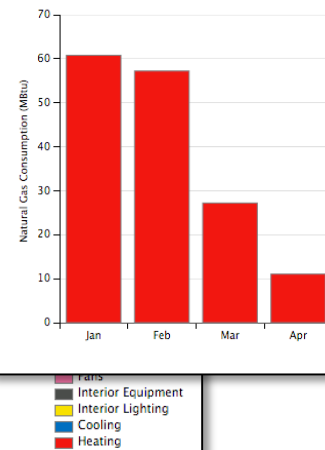
## WWR & Skylight Ratio

Description	Total (%)	North (%)	East (%)	South (%)	West (%)
Gross Window-Wall Ratio	11.01	11.0	11.0	11.0	11.04
Gross Window-Wall Ratio (Conditioned)	13.97	14.19	14.3	14.19	13.05
Skylight-Roof Ratio	0.0				

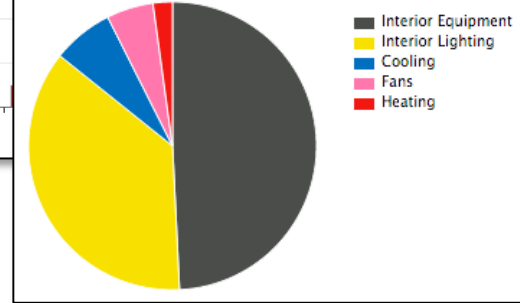
## Electricity Consumption (kWh) - view table



## Natural Gas Consumption (MBtu) - view table



## End Use - view table





# Using Prototypes at Scale

Select analysis

DEER\_Test

Analysis: Algorithmic

Algorithmic Method: Design Of Experiments (DOE)

Default Seed Model: empty.osm

Default Weather File: USA\_CA\_Burbank-Glendale-Pasadena.Bob.Hope.AP.722

Algorithm Settings

Additional Analysis Files

Server Scripts

OpenStudio Measures

+ Add Measure

Check for Updates

gem environment report

Create DEER Prototype Building

Create DEER Prototype Building

Duplicate Measure

Model To Base Inputs On: empty.osm

Skip this measure

Name	Short Name	Variable Settings	Static/Default
Building Type: HVAC Type	building_hvac	Discrete	Assembly: Split or Packag

Measure Inputs

Value	Weight	
Assembly: Split or Packag		+
Assembly: Split or Packag		+
Assembly: Split or Packag		+
Assembly: No Cooling witt		+
Assembly: No Cooling witt		+
Education - Community Cr		+
Education - Community Cr		+

Scroll down to add EE Measures, custom reports, etc.

Select building types, vintages, and climate zones

# Using Prototypes at Scale

Run Run on Cloud Server Status

Analysis Name  
DEER\_Test\_1

Remote Server Settings

Remote Server Type: Existing Remote Server

Existing Server URL: http://bball-130449.nrel.gov:8080 Disconnect

Run Entire Workflow View Server View Results

Analysis completed

Analysis Status completed ID 5f46f892-df96-42c0-933f-78d5c016fec7

Total Datapoints 1404 Queued 0 Started 0 Completed 1404

Name	Last Run	Run Time	Status	NAs	Warnings	Errors			
> DOE Autogenerated 1			completed completed normal						
> DOE Autogenerated 2			completed completed normal						
> DOE Autogenerated 3			completed completed normal						
> DOE Autogenerated 4			completed completed normal						

Parallel simulations run on dedicated servers or Amazon cloud computing



# Demo

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# Next Steps

- **Complete DEER prototype integration with OpenStudio**
  - Finish minimal functional testing:
    - Are prototype models generated?
    - Are model input arguments being sourced from spreadsheet fields as expected?
    - Do the models simulate?
    - Fix prototype combinations that do not simulate.
  - NREL is presently funded by other projects to complete this work
- **Rigorous comparison of OS/E+ prototypes to DOE-2 equivalents**
  - We believe it would be inappropriate for us to “validate” our own work
  - Based on discussions within the CalTF, we recommend that staff at UC Davis perform an independent assessment including:
    - Simulation of all combinations of Building type, vintage, and climate zone in both systems
    - Creation of percent difference for monthly and annual energy use broken down by end use & fuel type
    - Identify sources of variation and either fix or recommend fixes for NREL to perform
    - Preferably, this methodology would be developed as an automated process that could be used as part of the OpenStudio continuous integration development and testing processes
  - Final report would be reviewed by the CalTF for presentation to the CPUC
  - Funding for proposed UC Davis validation efforts is required

# FY19 and Beyond: Continuous Improvement

- **Translation of input data from MASControl to OpenStudio has identified opportunities for continuous improvement:**
  - Prototype space types are defined but unused for multiple building types
  - Better data might be obtained to replace input values patterns that appear to have been cut/pasted for the sake of expedience
  - Mechanical systems that are more easily represented in OpenStudio could be substituted to better reflect typical conditions
- **Explicit analysis of risk**
  - A longer term approach should capture stock variability via probability distributions for key parameters that could be quantified via CEUS, Co-Star, and other databases
  - This would enable a more rigorous, defensible, and transparent approach to risk in predicting realization rates and determining if deemed savings are appropriate for a measure

