Appendix A. Audit Protocol

NEEA 2002-2004 Commercial Building Survey

PROJECT INFORMATION

Inspector _____ Date _____

Building Name _____

Building Address _____

Contact At Building_____ Phone_____ Email _____

Completion Date _____ % Occupied _____

Class of Work [New] [Addition] [Other] _____

Total Floor Area _____ New/Addition Floor Area _____

Number of Buildings _____ Number of Stories _____

Stand Alone Bld Y_____N_____

Latitude _____ Longitude _____

BUILDING/SURVEYED AREA

Surveyed Floor Area _____

Surveyed Area/Building Description_____

_____

STANDARD BUILDING USE CATAGORY (choose one)

☐ Assembly	☐ Institution	☐ Restaurant/Bar
☐ Education	☐ Laboratory	☐ Retail
☐ Grocery	☐ Office	☐ Warehouse Storage/Distribution
☐ Health Services	☐ Residential and Lodging	☐ Other (describe)

STANDARD BUILDING USE TYPE

Space ID[1]	Use Code[2]	Use Description	Floorspace			Inside insulated Envelop	Heat Level[3]	Cool Level[4]
			New	Remodel	Total			
						Y N	H S U	F R C U
						Y N	H S U	F R C U
						Y N	H S U	F R C U
						Y N	H S U	F R C U
						Y N	H S U	F R C U
						Y N	H S U	F R C U
						Y N	H S U	F R C U
						Y N	H S U	F R C U
						Y N	H S U	F R C U
						Y N	H S U	F R C U
						Y N	H S U	F R C U
						Y N	H S U	F R C U

[1] Separate spaces based on major use type, special use categories, differences in space conditioning level, and business. Separate unfinished tenant areas too. Special Uses: K-12 ed – classroom, gym/multipurpose, office, corridor; Health – Patient, surgery, diagnostics, office, service

[2] Enter the Standard use type code from the use type reference sheet.

[3] Heated, Semi-heated, Unheated [4] Frozen, Refrigerated, Cooled, Uncooled

Ownership and Operations

What best describes the building ownership: [Individual] [Corporation] [Religious] [Federal Gov't] [Local/State Gov't] [Syndicated Partnership (REIT)] [Other Partnership] [Non-Gov't Institution] [Private University/College] [Other]

Percent of area occupied by Owner _____

Building Management [Owner] [Tenant] [Property Management Firm] [Unknown]

Does the building operator have formalized training? [BOC] [Other] [None] [Unknown]

Is there an on-site facility *manager* [Yes] [No] [Unknown]

How many staff are assigned to O&M _____

How many facilities are this staff responsible for _____

Is there a staff person with energy management/conservation duties [Yes] [No] [Unknown]

Is energy use tracked? (explain below) [Yes] [No] [Unknown]

Is or can the energy use tracked by end use? (explain below) [Yes] [No] [Unknown]

Is the O&M manual specific to the installed systems [Yes] [No] [Unknown]

Has trending been set up through the DDC to monitor systems? [Yes] [No] [Unknown]

Is the trending data actively used? (note what data & how below) [Yes] [No] [Unknown] [NA]

Are the following systems regularly maintained in-house or contracted. Regular inspection?

Item	In-house or Out		Inspected?		Frequency
General O&M	I	O			
HVAC Equipment	I	O	Y	N	
HVAC Controls	I	O	Y	N	
Lighting	I	O			
Refrigeration	I	O	Y	N	

Programs

Did this building participate in any utility energy efficiency programs [Yes] [No] [Unknown]

Were incentives paid by utilities for energy efficient design or equipment [Yes] [No] [Unknown]

Did this building participate in any state energy efficiency programs [Yes] [No] [Unknown]

Did this building receive state energy efficiency incentives or tax credits [Incentive] [Tax Credit] [Other] [None] [??]

What items received incentives: [insulation] [windows] [LPD] [lighting control] [HVAC] [HVAC controls] [unknown]

What building code jurisdiction is this building in _____

What Energy code was used to determine compliance (code,year) _____

What Energy code path was used ? [prescriptive] [simulation] [OR-simplified tradeoff] [WA-component perf] [unknown]

Is this building LEED certified [No] [Yes] [Basic] [Silver] [Gold] [Platinum] [Other] [Unknown]

Did this project receive LEED energy credits? [No] [Yes] If yes, attach copy of leed certificate.

Did this building receive carbon credits? [No] [Yes] [huh]

Was project benchmarked? [No] [Yes] [huh] Method Used _____

Building Problems

Is the building finished? [Yes] [No] [Unknown]

Is the building fully occupied? [Yes] [No] [Unknown] if not explain:

Are systems/controls setup complete? [Yes] [No] [Unknown]

Has building be "delivered" from builders to owner? [Yes] [No] [Unknown]

Was system training adequate [Yes] [No] [Unknown] [NA]

Have there been any problems with comfort and HVAC control? [Yes] [No] [Unknown] if yes explain:

Have there been any problems with lighting and lighting control? [Yes] [No] [Unknown] if yes explain:

Have there been any problems with refrigeration systems? [Yes] [No] [NA] [Unknown] if yes explain:

Have there been any problems with the windows? [None] [Water Leakage] [Air Leakage] [Other]

Have there been any other problems with energy use or energy using systems? [Yes] [No] [Unknown] if yes explain:

Commissioning

Was the building commissioned?	[Yes] [No] [Unknown] [NA]
Agent	[designer] [installer] [3rd party] [building operator] [Unknown]
Is the final commissioning report onsite	[Yes] [No] [Unknown] [NA]

Systems commissioned (check all that apply)

EMS	[Yes] [No] [Unknown] [NA]
Building level mechanical systems	[Yes] [No] [Unknown] [NA]
Zone level mechanical system	[Yes] [No] [Unknown] [NA]
Lighting Control	[Yes] [No] [Unknown] [NA]
Electric Acceptance Testing	[Yes] [No] [Unknown] [NA]
Emergency Power	[Yes] [No] [Unknown] [NA]
Plumbing	[Yes] [No] [Unknown] [NA]
Fire/Life/Safety	[Yes] [No] [Unknown] [NA]
Envelope	[Yes] [No] [Unknown] [NA]
Refrigeration	[Yes] [No] [Unknown] [NA]
Elevators	[Yes] [No] [Unknown] [NA]

other _____

Did building get LEED commissioning credit: [Yes] [No] [Unknown] [NA]

Describe process used in project. Was the building manager or owner satisfied?

Air Flow Testing & Balanced [Yes] [No] [Unknown] [NA]

Auditor Recommendations

Utilities

						Area Served by meter but not audited.	
Ute Name	Type (G/E)	Meter #	Account #	Street Address (leave blank if same as front page address)	Spaces Served[1]	Floor area[2]	Area Description

1 Enter the space Ids of all spaces served by this meter. Indicate percentages if only part of space on given meter. Indicate enduses if only some enduses on meter.
2 Mostly for central plants. Ask manager for area served by plant or meter, and subtract the surveyed area.

Describe any unusual meter issues. Particularly when the permited space is an addition to an existing space, or when the meters do not cover all enduses..

Describe any major changes that will change energy use between this year and next. Contractor schedules versus operator schedules, remodels, and what not.

Describe type, use, and quantity of other fuels used on site?

Schedules

Hours Per Week

	Schedule Type			
Space ID	Doors Open	Lights	HVAC	Season

Server Rooms

Total Floor Area:
Describe:

Number of processors:
Does space have it's own conditioning [y] [n] [?]
System Id's _____ _____ _____ _____
Cooling Capacity:
UPS Electrical Capacity:
UPS current load:

Lighting

Space ID	Designer(name,co,#)	Designer(name,co,#)
_____	_____	_____
_____	_____	_____
_____	_____	_____

Controlled by Centralized Lighting Controller [Yes] [No] [Unknown]

Manufacturer/model:_____

Is it integrated with HVAC control system [Yes] [No] [Unknown]

How often are schedules adjusted?

Make, model of primary T8 lamp specified: _____

Make, model of actual replacement T8 lamp:_____

Is egress lighting on 24/7? [Yes] [No] [Unknown]

General lighting control description plus any comments by building operator, tenants or auditor (ask building manager and tenants about lighting. Do they like it? Do the controls work?).

Fixture Schedule:

Fixture Type ID	Fixture Type	Lamp Type	# of Lamps	Watts/ Lamp	Ballast Type	# of Ballst	Ballst Factor	Plan Watts/ Fixture	Field Verif	Notes *(ballast # if known)*

Notes:

For track lighting record # of lamps and lamp type per fixture head. Enter # of heads on lighting page & put lineal feet in margin. Be sure to document any fixture or lamp types not well characterized in the reference pages. Include exit lights on this page but there is no need to count them in the fixture counts.

Interior Lighting

Subspace Information					Fixture Takeoff			
SpaceID, Subspace Type[1]	Area (ft^2)[2]	Fixture Height	Space Control Codes[3]& Schedule	Desktop Foot-candles high/low	Fixture Type ID	Fixture Controls[3]	Special Code Cat[3]	Total Count

[1]Subspace Type Codes

Aud	Auditoriums	Exam	Medical exam rooms	Offop	Open Office
Class	Classroom	Groc	Grocery	Retail	Retail
Conf	Conference rooms	Gym	Gyms	Ware	Warehouses
Core	Building Core/lobby/bathrooms	Kit	Kitchens	Show	Wholesale showrooms
Corr	Corridor	Mech	Mech	Room	Patient/hotel room
Eating	Eating areas	Offcl	Enclosed Office (<300sf)	*specify*	Other

[2]If fixture counts are for portion of area enter XXX of YYY. XXX=area surveyed, YYY=total area

[3]See lighting control reference, enter all the apply. Do not leave control blank.

Fixtures to NOT Survey

1. Emergency lighting that is automatically OFF during normal building operation.
2. Lighting that is part of machines, equipment or furniture.except refrigerated case lighting.
3. Technical production lights in theaters.

Exterior Lighting:

Parking Area: ____________________
Outdoor Area: ____________________
Building Facade Area: ______________
Building Perimeter (linear foot):________

Discussion:____

Fixtures:

Fixture Type ID	**Notes**	**# of fixtures**	**Special Code Cat**	**Control Type**[1]
				P T AT PT S 24
				P T AT PT S 24
				P T AT PT S 24
				P T AT PT S 24
				P T AT PT S 24
				P T AT PT S 24
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				P T AT PT S 24
				P T AT PT S 24

[1]**P(**hotocell), **T**(ime clock), **AT**(astronomical time clock), **PT**(photocell/timeclock), **S**(witched), **24**(hour)

Mechanical

Individual Package equipment	[Yes]	[No]	[Unknown]				
Built up system	[Yes]	[No]	[Unknown]				
Single Zone equipment	[Yes]	[No]	[Unknown]				
Multi Zone equipment	[Yes]	[No]	[Unknown]				
Primary Sys Heating Fuel	[Gas]	[Oil]	[Electric]	[Heat Pump]	[	]	[Unknown]
Secondary Sys Heating Fuel	[Gas]	[Oil]	[Electric]	[Heat Pump]	[	]	[Unknown]
Reheat Fuel	[Gas]	[Oil]	[Electric]	[	]	[Unknown]	[None]

Designer (name,firm & #) _____

All Systems -Quickly describe the HVAC and controls. For multi-zone/build-up systems **describe with reference to boiler, chiller, and delivery system numbers and other components.**

_____
_____
_____
_____
_____
_____
_____

			Scheduling								
Space Or Sys Id	Thermostat Type[1]	EMS (y / n)	Setback (y/n/na)	Off days (y/n/na)	Occ. Override (y/n)	Fan Setting	Vent Reset[2]	Optimum Start (y/n/na)	Warmup OA lockout (y/n/na)	Humidity Control Var[3]	Humidity Devices[4]

1 – Programmable, Manual, or Slave (sensor for EMS)
2 – None, CO2, **Sch**edule, **O**ccupancy **S**ensor, Unknown
3 – None, RH, Humidity Ratio, Enthalpy, Unknown, Other (specify)
4 – None, Cooling Coil, Steam Injection, Unknown, Other (specify)

If EMS:

Programmer(name,co,#):_____

Manufacturer:_____

Duct Location and Insulation

Location (describe)	Amount of Duct Work[1]	Duct Insulation[2]
Interior		
Buffer Area		
Outside		

1 Amount of Duct Work - All, Some, None, NA, Unknown
2 Duct Insulation R-value, or yes/no

Package Equipment – ***(from plans, verified where possible in field)***

Unit Dsg[1]	Space ID[2]	Qty	Equip Type (see notes)	Fan HP (S/R)[3]	CFM	Min OA[4]	Econo (y/n)	Cooling Output Cap+Units	Cooling Eff+Units[5]	Heating Fuel	Heating Output Cap+Units	Heating Eff+Units
Brand, Model:												
Brand, Model:												
Brand, Model:												
Brand, Model:												
Brand, Model:												
Brand, Model:												
Brand, Model:												
Brand, Model:												

[1] Enter unit designation to be referred to by multizone form if equipment is part of built up or multizone system

[2] Enter SPACE ID if single zone package equipment. [3] Only for larger equipment or if very easily available.

[4] Specify minimum outside air fraction. Add "co2" for demand control ventilation equipment. [5] Enter CW if cooling provided by chilled water

EQUIPMENT TYPE NOTES	CAPACITY UNITS	HEATING FUELS
Codes can be found in references. ADD **WC** for water cooled, **EV** for evaporative cooled. ADD **IV** for inlet vane and **ASD** for adjustable speed drive.	KW, HP(*horsepower)* KBTU, TON MBTU, MMBTU IF CAPACITY IS INPUT ADD "**IN"** SUFFIX TO UNITS	E = ELECTRICITY G = NATURAL GAS HW = HOT WATER OIL = FUEL OIL / DIESEL P = PROPANE / BUTANE OTHER *(SPECIFY)*

MultiUse and Built Up Systems

Delivery System # ___: This system provides ___heat ___cool ___vent From Plans? Y / N
Field Verified? Y / N

Space ID Served: SPACE-
Description:

System Type: _____
Configuration [package] [built-up] [unknown]
Total CFM _____ MinOA_____ Enter fraction or cfm depending upon how controlled
Economizer [Yes] [No] [NA] [Unknown]
Economizer Type [air] [water] [NA] [Unknown]
Sub-Zone Reheat [Yes] [No] [NA] [Unknown] Reheat Fuel Type:_____
Humidifier [Yes] [No] [NA] [Unknown] Type:_____
Dehumidifier [Yes] [No] [NA] [Unknown] Type:_____

Heat Source(reference to boiler, or none): _____ _____
Cool Source (ref. to chiller/tower or none): _____ _____
Fans Serving (reference to fan number): _____ _____ _____ _____
Package Eq Number (ref. to pkg number): _____ _____ _____ _____
_____ _____ _____ _____
Terminal Units (ref. to terminal number): _____ _____ _____ _____
_____ _____ _____ _____

Control Strategies *(this system. Describe strategy. List duct static pressure and design deck temperature, and bounds of reset schedules if known)*
Description:

Specific items:
[ ] OA control [fixed pct] [fixed cfm] [Occ] [CO2] [Sch] [unknown][Other] _____
[ ] terminal minimum reset [Y] [N] [unknown]
[ ] Deck Temp. Reset [Y] [N] [n/a] [unknown]
[ ] Deck Pressure Reset [Y] [N] [n/a] [unknown]
[ ] Deck Reset Based on [OAT] [ZT] [BoxDamper] [unknown]] [Other] _____
[ ] Night Time "setback" [Y] [N] [n/a] [unknown]
Setback Duration_____
[ ] Terminal fan speed [Constant] [Variable] [n/a] [unknown]
[ ] Heat Recovery [Refrigeration] [Exhaust Air] [None] [unknown] [Other] _____

SYSTEM TYPE CODES		SYSTEM TYPE CODES, CONTINUED	
CV	CONSTANT VOLUME (REHEAT)	UAFD	UNDERFLOOR SYSTEM
VAV	VARIABLE AIR VOLUME	SPECIFY OTHER SYSTEMS	
SZVAV	SINGLE ZONE VARIABLE AIR VOLUME	**FUEL TYPE CODES**	
HPLP	HEAT PUMP LOOP	E	ELECTRICITY
VVT	VARIABLE VOLUME-TEMPERATURE	NG	NATURAL GAS
2PFC	TWO PIPE FAN COIL	OIL	FUEL OIL / DIESEL
4PFC	FOUR PIPE FAN COIL	HW	HOT WATER FROM BOILER
		OTHER *(SPECIFY)*	

Boilers

Unit Dsg	Qty	Fuel	Load Type	Boiler Type	Burner Type	Output Cap	Cap Units	Eff.	Eff Units	Control Type[1]
Make, Model:										
Make, Model:										
Make, Model:										
Make, Model:										
Make, Model:										
Make, Model:										

[1] include all applicable control strategies

Do steam condensate return and process hot water return [y] [n] [NA] Describe:

FUEL TYPE CODES
- E ELECTRICITY
- NG NATURAL GAS
- OIL FUEL OIL / DIESEL
- GO GAS/OIL (DUEL FUEL)
- P PROPANE / BUTANE
- WH WASTE
- ST STEAM *(purchased from outside)*
- OTHER *(SPECIFY)*

LOAD TYPES
- S SPACE HEAT ONLY
- SW SPACE HEAT AND WATER HEAT
- W WATER HEAT ONLY
- P PROCESS HOT WATER HEATING
- OTHER (*SPECIFY*)

BOILER TYPES
- HW HOT WATER
- S STEAM
- HWD DIRECT HOT WATER (NO HX)
- SD DIRECT STEAM (NO HX)

BURNER TYPE
- NAT = NATURAL DRAFT
- PWR = POWER DRAFT

CAPACITY UNITS
- KBTU
- MMBTU
- HP(*horsepower)*
- KW
- OTHER *(SPECIFY)*_____

CONTROL TYPE CODES
- B1 CYCLING
- B2 TEMPERATURE RESET
- B3 O2 TRIM CONTROL
- B4 MODULATING
- B5 STAGED

Chillers

Unit Dsg	Qty	Cap	Cap Units	Compressor Type	Eff	Eff Units	Heat Recovery (y/n)	Staged	Control Type[1]	Refrig-erant
Make, Model:										
Make, Model:										
Make, Model:										
Make, Model:										

[1] include all applicable control strategies

COMPRESSOR TYPE		CAPACITY UNIT CODES	
CENT	CENTRIFIGAL	KBTU	
SCREW	ROTARY SCREW CHILLER	MMBTU	
RECIP	RECIPROCATING	HP(*horsepower)*	
SCRO	SCROLL	TON	
ABO	ABSORPTION FROM OIL	OTHER *(SPECIFY)*_____	
ABG	ABSORPTION FROM GAS	**CONTROL TYPE CODES**	
ABW	ABSORPTION FROM WASTE HEAT	C1	TEMPERATURE RESET
ABS	ABSORPTION FROM STEAM	C2	MODULATING
OTHER *(SPECIFY)*		C3	MODULATING –VFD

Cooling Towers/Dry Cooler

Unit ID	Qty	Equip Type	GPM	Cap	Dt[1]	EWT	LWT	Temp Control	Cap Control	# of Fans[2]	Fan HP	Fan BHP	Fan Eff
Make, Model:													
Make, Model:													
Make, Model:													
Make, Model:													

1 approach temperature
2 enter zero for natural draft units

EQUIPMENT TYPE CODES		CAPACITY CONTROL CODES	
DC	DRY COOLER	SS	SINGLE SPEED
CT	COOLING TOWER - DIRECT	TS	TWO SPEED
CTHX	COOLING TOWER - INDIRECT	VS	MODULATING –VFD
TEMPERATURE CONTROL CODES		FB	FLUID BYPASS
FX	FIXED TEMPERATURE – NO RESET	STG	STAGED
WB	TEMPERATURE RESET ON WET BULB	OTHER *(SPECIFY)*_____	
DB	TEMPERATURE RESET ON DRY BULB		
OTHER *(SPECIFY)*_____			

Fans *(1HP and larger, from plans field verified where possible. Do not include fans in package units)*

Unit Dsg	Qty	HP	BHP	Work Type	Control[1]	------Motor------ Eff (plans)	Eff (fld)	Dsgn Flow	Ext. Dsgn dP	Vane Axial?	

[1] include all applicable control strategies

WORK TYPE	CONTROL TYPE CODES
AHU = SUPPLY&RETURN FAN	F1 = CONSTANT
SF = SUPPLY FAN	F2 = MULTI-SPEED MOTOR
RF = RETURN FAN	F3 = INLET VANES
EF = EXHAUST FAN	F4 = CONE
EFGR = GARAGE EXHAUST	F5 = ASD–VFD
CT= COOLING TOWER	F6 = DISCHARGE DAMPER
INTR = OTHER INTERMITTENT FAN	F7 = BYPASS DAMPER
CONT= OTHER CONTINUOUS FAN (>1000 HRS)	F8 = CYCLING ON THERMOSTAT
HOOD = KITCHEN/LAB EXHAUST HOOD	F9 = CYCLING ON AIR QUALITY
	F10 = VARIABLE PITCH

Pumps *(1HP and larger, from plans field verified where possible.)*

Unit Dsg	Qty	HP	BHP	Work Type	Control[1]	Eff (plans)	Eff (fld)	Dsgn Flow	Dsgn dP		

[1] include all applicable control strategies

WORK TYPE	CONTROL TYPE CODES
PCC= PRIMARY CHILLED WATER CIRCULATION	P1 = CONSTANT
SCC= SECONDARY CHILLED WATER CIRCULATION	P2 = CYCLING ON DEMAND
PHC= PRIMARY HOT WATER CIRCULATION	P3 = DISCHARGE VALVE
SHC= SECONDARY HOT WATER CIRCULATION	P4 = ASD-VFD
CN=CONDENSOR WATER	P5 = STAGED WITH OTHER PUMPS
HP=WATER SOURCE HEAT PUMP CIRCULATION	P6 = SPEEDS STAGED
INTR = OTHER INTERMITTENT PUMP	P7 = BYPASS VALVE
CONT= OTHER CONTINUOUS PUMP (>1000 HRS)	
DB = Domestic water booster pump	

Terminal Units *(fan powered boxes, vav boxes, HW unit heaters, fan coils, unit ventilators **READ NOTE 2**)*

Unit Dsg[1]	Terminal Type	Qty[2]	HP	BHP	Motor Type[3]	Terminal Fan Flow	Primary Air Max Flow	Primary Air Min Flow	Heat Cap	Heat Units	Make/Model

[1] best if not unique. Use same value for all units on the same system.

[2] FOR THIS PAGE ONLY – Units with different flows or heat capacity can be lumped together. Sum flows and heat capacity for all units in lump and enter the number of units. Lump units based upon terminal & motor type, motor HP, and presence of heat.

[3] std-standard or ECM

TERMINAL TYPE

VAV = FANLESS VAV BOX
INDUCT = FANLESS INDUCTION BOX
PARALLEL = VAV PARALLEL FAN POWERED BOX
SERIES = VAV SERIES FAN POWERED BOX
UV = UNIT VENTILATOR
UH = UNIT HEATER

Domestic/Service Hot Water

General System Type

[ ] None
[ ] Individual water heating tank(s)
[ ] Central Boiler(s) (for water heating only): Indicated Boiler #:_____
[ ] Central boiler (combined with space heating): Indicated Boiler #:_____
[ ] Other (Please specify)
[ ] Don't Know

Heat Exchanger to storage tank? [y] [n] [?]
Circulation Loop [y] [n] [?]

Water Uses *(Mark ALL boxes that apply)*

Kitchenette	1	Commercial Kitchen	6
Lavatory	2	Commercial Dishwasher	7
Showers	3	Sterilization	8
Laundry	4	Other (Please Specify)	9
Commercial Laundry	5	Don't Know	10

Service Hot Water Heater System Info (DHW tanks and storage tanks)

Qty	Fuel[1]	Storage (gallons)	Cap	Cap Units	Eff.	Eff Units	Space ID	Manu, Model

[1] Enter fuel code or boiler number

FUEL TYPE CODES		CAPACITY UNITS
E	ELECTRICITY	KBTU
NG	NATURAL GAS	MMBTU
OIL	FUEL OIL / DIESEL	HP(*horsepower)*
GO	GAS/OIL (DUEL FUEL)	KW
P	PROPANE / BUTANE	OTHER *(SPECIFY)*_____
WH	WASTE	
ST	STEAM *(purchased from outside)*	
OTHER *(SPECIFY)*		

Miscellaneous

Heat Recovery Equipment [Yes] [No] [NA] [Unknown]

From	To	Capacity/units

HR FROM TYPES	**HR TO TYPES**	**CAPACITY UNITS**
BUILDING EXHAUST AIR	SERVICE HOT WATER	CFM
COMBUSTION FLUE GASES	SPACE HEAT	BTU
LAUNDRY DRYER EXHAUST	OTHER *(SPECIFY)*	
WASTE WATER		
REFRIGERATION EQUIPMENT		
RANGE HOOD		
DISHWASHER HOOD		
OTHER *(SPECIFY)*		

Pools and Spas

Indicate the surface area of pools or spas. Indicate "None" if not present.

Equipment Spa/Pool/None	Surface Area	Indoor / Outdoor	Conditioned Space	Humidity Control	Cover Used	Heater Type	Fuel Type	Boiler Reference	Months Heated
		I O	Y N	Y N	Y N				
		I O	Y N	Y N	Y N				
		I O	Y N	Y N	Y N				
		I O	Y N	Y N	Y N				

HEATER TYPE CODES	**FUEL TYPE CODES**
CB CENTRAL BOILER	E ELECTRICITY
SAB STAND-ALONE BOILER	NG NATURAL GAS
RES ELECTRIC RESISTANCE	OIL FUEL OIL / DIESEL
HP HEAT PUMP	P PROPANE / BUTANE
NONE	WH WASTE
OTHER *(SPECIFY)*	ST STEAM *(purchased from outside)*
	OTHER *(SPECIFY)*

Specific Miscellania

Functional Use Type	Equipment		Space[1]		Space[1]		Space[1]	
Retail/ Grocery	Point-of-use terminals	(#)						
	Area of Mezzanines.							
	Area of Outdoor Compressor Building							
	Food Prep - Meat Dept.		Y	N	Y	N	Y	N
	Food Prep – Bakery		Y	N	Y	N	Y	N
	Food Prep – Deli		Y	N	Y	N	Y	N
Office	Occupants	(#)						
	PCs	(#)						
Warehouse	Forklifts – gas / propane (*circle fuel)*	(#)						
	Forklifts - electric	(#)						
	Non-forklift electric vehicles	(#)						
Health	Beds	(#)						
	Patient Nights	(#)						
	PCs	(#)						
	Labs	(SF						
	Laundry Facility		Y	N	Y	N	Y	N
Lodging & Fire Stations	Rooms	(#)						
	Averaqe occupancv	(%						
	Laundry Facility		Y	N	Y	N	Y	N
Residential	Units	(#)						
	Bedrooms	(#)						
School	Students	(#)						
	Student Capactiy (SPI)	(#)						
	Classrooms	(#)						
	PCs	(#)						
	Area of Mechanical Mezzanine							
ALL BUILDINGS	**Electric / Gas**		**Space:**		**Space:**		**Space:**	
Kitchens	Is Kitchen present?		Y	N	Y	N	Y	N
	Kitchen type: Full Service or **W**arming		F	W	F	W	F	W
	Number of Meals Served/day	(#)						
	Broilers	(SF)	E	G				
	Fryers (vats)	(#)	E	G				
	Griddle / Grill	(LF)	E	G				
	Oven - Baking	(CF)	E	G				
	Oven - Convection	(#)	E	G				
	Oven - General	(CF)	E	G				
	Range – Top	(#burners)	E	G				
	Steam Kettle	(#)	E	G				
	Food on washable plates		Y	N	Y	N	Y	N
	Dishwater Booster Heater	(#)	E	G				
Laundry	Is laundry facility present?		Y	N	Y	N	Y	N
	Dryer – Commercial	(#)	E	G				
	Drver – Residential	(#)	E	G				
	Washer – Commercial	(#)	E	G				
	Washer – Residential	(#)	E	G				
Misc Equipment	Air Compressors	(HP)	E	G				
	Kilns/Industrial Furnaces	(hcap)	E	G				
	Cogeneration	(MW)	E	G				
	Vehicle Refueling	(#)	E	G				
	Other *(Describe)*	(#)	E	G				
	Other *(Describe)*	(#)	E	G				
	Other *(Describe)*	(#)	E	G				
	Other *(Describe)*	(#)	E	G				

1 – Space here refers to specific ownership or metering. A school would have a single entry even though it would have several space IDs. A stripmall might have three entries.

REFRIGERATION EQUIPMENT

Walk-Ins/Prep Areas

Space Id	Unit Id	Description	Area	Height	Load kBtu	Doors ? (yes-# / no)	Temp[1] L/M/H	Evaporator Fan Type (ecm/std/?)?	Light Fixtures – Type & number

Refrigerated Display Cases *(list each case)*

Space Id	Unit Id	Description	Length	Load kBtu	Case Type[1]	Remote Comp (y / n)	Temp[2] L/M/H	Doors? (yes-# / no)	Anti-Sweat Controls? [3]	Fan Type (ecm/std)	Lights *(fixture reference and count)*

1 – Coffin, upright (back loading displays with walkin behind doors should have walkin and display case entry with note linking units.

2 – Low (freezer), Medium (30-40F), High (50-55F)

3 – No (watt doors), Low (watt doors), Std (standard doors), Unknown

REFRIGERATION EQUIPMENT

Condensers

Unit Id	Type[1]	Fan HP (single fan)	Fan VSD y / n	Number of Fans	Cap (kbtu)	Design dT	Make, model

1 – Air-cooled, Air-cooled w/Pre-cooler, Close-approach, Evap-cooled, Water-cooled

Compressors

Unit Id	Type[1]	Temp[2] L/M/H	Total HP in rack	Tot kbtu Cap	Num	Unloaders or VSD Compressor	Refrig-erant type	Floating Head Pressure (y/n)	Sub - Cool[3]	Heat Recovery[4]	Make, Model

1 – Reciprocating, Screw, Two-stage multiplex, Multiplex,Other---
2 – Low (freezer), Medium (30-40F), High (50-55F)
3 – Ambient, Mechanical, None
4 – None, Space heating/Reheat, Water heating, Other

_____

Contact For More Detailed Information Name/Number

_____

Component Area Take Offs - Gross Areas

WALLS					
Space ID[1]	Wall Type ID	Location	Gross Area	To Space ID[2]	Verified
SPACE-	WALL-				
CEILINGS/ROOFS					
SPACE-	ROOF-				

FLOORS						
Space ID	Type ID	Location	Gross Area	Perimeter	To Space ID[1]	Verified
SPACE-	FLR-					

[1] If no differences in conditioning, envelope can be for whole building. Leave space ID blank.
[2] For wall, roof/ceiling, floor to semi or unheated spaces only.

WINDOWS									
Space ID	In Wall Type ID	Window Type ID	Location	Area	Area Dir: _____	Area Dir: _____	Area: Dir: _____	Area Dir: _____	Verified
SPACE-	WALL-	WIN-							
SKYLIGHTS – *enter tilt in location (0=horizontal, 90=vertical)*									
SPACE-	ROOF-	WIN-							
DOORS									
Space ID	In Wall Type ID	Door Type ID	Location	Area					Verified
SPACE-	WALL-	DOOR-							

Wall Types ID:			
Plans U-Factor:			
Wall Type: AG-Above Grade BG-Below Grade, spec avg Depth (ft) BUF-Buffer RJ-Rim Joist Specify	AG BG _____ BUF RJ	AG BG _____ BUF RJ	AG BG_____ BUF RJ
Structure			
Framed – yes, no	□	□	□
Material: W-wood M-Metal U-Unknown Specify:	W M U	W M U	W M U
Thickness: 4 – 4 inches 6 – 6 inches Specify:	[2x4] [2x6]	[2x4] [2x6]	[2x4] [2x6]
Stud spacing	[16”] [24”] [48”] [n/a] [unknown]	[16”] [24”] [48”] [n/a] [unknown]	[16”] [24”] [48”] [n/a] [unknown]
Concrete	□	□	□
Thickness	[6”] [8”]	[6”] [8”]	[6”] [8”]
Concrete blocks	□	□	□
Thickness	[4”] [6”] [8”]	[4”] [6”] [8”]	[4”] [6”] [8”]
Brick	□	□	□
Thickness	[4”] [8”] [12”]	[4”] [8”] [12”]	[4”] [8”] [12”]
Curtain wall	□	□	□
Other (panels, foam forms, etc.) describe:			
Insulation Sum of installed R-value	R-_____	R-_____	R-_____
Batts - check if present. Specify R if known	□ R-_____	□ R-_____	□ R-_____
Rigid - check if present. Specify R if known	□ R-_____	□ R-_____	□ R-_____
Thickness (in.):	In-_____	In-_____	In-_____
Location: I-interior, E-Exterior	I E	I E	I E
Spray On R	□ R-_____	□ R-_____	□ R-_____
Thermal block between siding and purlin	□ R-_____	□ R-_____	□ R-_____
CMU Cores: UN-Uninsulated LF- Loosefill cores RI- Rigid Inserts	□ UN LF RI	□ UN LF RI	□ UN LF RI
Other: specify			
Metal Building	Y N	Y N	Y N
insulation compressed between siding & purlin	Y N	Y N	Y N
insulation fills between purlins	Y N	Y N	Y N
thermal block between siding and purlin	Y N	Y N	Y N
Sheet metal siding	Y N	Y N	Y N
Field Review:			
This component was checked in the field	Y N	Y N	Y N

Roof Types ID:			
Plans U-Factor:			
Structure			
WD -Wood Frame IJ - Wood I-joists MT -Metal Truss MP -Metal Purlins CON -Concrete UNK -Unknown Other Describe:	WD IJ MT MP CON UNK	WD IJ MT MP CON UNK	WD IJ MT MP CON UNK
Misc			
What is roof pitch?			
Is Attic space present	Y N	Y N	Y N
Insulation - Location			
AT - Attic BR - Built up roof CAV - Framed Cavity UND -Underside of roof – open cavity DROP-On dropped ceiling OP - Between purlin & exterior roof BET - Between purlins UNK -Unknown Other Describe:	Attic Built up Cavity Open Cav Drop Over Purlin Between Purlin Unk	Attic Built up Cavity Open Cav Drop Over Purlin Between Purlin Unk	Attic Built up Cavity Open Cav Drop Over Purlin Between Purlin Unk
Insulation Sum of installed R-value	R-_____	R-_____	R-_____
Batts - check if present. Specify R if known	☐ R-_____	☐ R-_____	☐ R-_____
Loose Fill - check if present. Specify R.	☐ R-_____	☐ R-_____	☐ R-_____
Rigid - check if present. Specify R if known Thickness (in.): Location: I-interior, E-Exterior	☐ R-_____ In-_____ I E	☐ R-_____ In-_____ I E	☐ R-_____ In-_____ I E
Spray On R	☐ R-_____	☐ R-_____	☐ R-_____
Blanket - check if present. Specify R if known	☐ R-_____	☐ R-_____	☐ R-_____

Thermal block between roofing and purlin	□ R-_____	□ R-_____	□ R-_____
Other: specify			
Metal Building	Y N	Y N	Y N
Sheet metal roofing	Y N	Y N	Y N
Field Review:			
This component was checked in the field	Y N	Y N	Y N

FLOORS

Floor Type ID: FLR- _____
Plans U-Factor: _____

Description: _____

[ ] Over Crawl or buffer

Structure

[ ] Frame
Material [lumber] [I-joists] [metal]

[ ] Concrete
Type [slab on grade] [below grade] [not in earth contact]
for below grade slabs depth: _____

[ ] Other (panels, etc.) describe: _____

Crawl Space

[ ] Venting [yes] [operable] [no] [unknown]
[ ] Insulation on perimeter wall R- _____

Frame Insulation

[ ] Batts in joists R- _____
[ ] Continuous Rigid R- _____
[ ] Continuous Spray On R- _____
[ ] other: _____

Slab/Concrete Insulation

[ ] none
[ ] perimeter: R- _____
[ ] center/underfloor: R- _____
[ ] extends to top of slab? [y] [n] [unknown]
[ ] inside or outside footing? [inside] [outside] [unknown]

Field Review:

This component was checked in the field [y] [n]

DOORS

Door Type ID:			
Plans U-Factor:			
Door Type WD -Wood door SD -Standard steel door OD -Standard overhead door CD -Coil door IMD -Insulated metal door IOD -Insulated overhead door Other specify	 WD SD OD CD ISD IOD	 WD SD OD CD ISD IOD	 WD SD OD CD ISD IOD
Glazing Percent Glazed Layers	Y N _____ 1 2	Y N _____ 1 2	Y N _____ 1 2
Automatic door controls describe	Y N	Y N	Y N
Field Review:	Y N	Y N	Y N

Door Type ID:			
Plans U-Factor:			
Door Type WD -Wood door SD -Standard steel door OD -Standard overhead door CD -Coil door ISD -Insulated steel door IOD -Insulated overhead door Other specify	 WD SD OD CD ISD IOD	 WD SD OD CD ISD IOD	 WD SD OD CD ISD IOD
Glazing Percent Glazed Layers	Y N _____ 1 2	Y N _____ 1 2	Y N _____ 1 2
Automatic door controls describe	Y N	Y N	Y N
Field Review:	Y N	Y N	Y N

WINDOWS

Window Type ID: _____

	Source: _____	Better Source: _____
U-Factor:		
Shade Coefficient:		
SHGC:		
VLT:		
Center of Glass	Y N ?	Y N ?

Opening

[ ] Window - Manufactured
[ ] Window – Site Built
[ ] Store Front
[ ] Curtain wall
[ ] Skylight
[ ] Other _____

Description/Notes: _____

Frame Material

[ ] unknown
[ ] vinyl
[ ] wood
[ ] aluminum [thermal break] [no thermal break]
[ ] other: _____

Glazing

Number of glazing layers:	[1]	[2]	[3]	[unknown]
Low-ε coating:	[y]	[n]	[unknown]	based on installer/documentation/or spacer
Tinted:	[y]	[n]	[unknown]	
Reflective	[y]	[n]	[unknown]	
Gas filled:	[y]	[n]	[unknown]	
Spacing:	[<=3/8”]	[>=1/2”]	[unknown]	

Low-E Meter Readings

Low-ε coating	[y]	[n]	[unknown]	based on low-e meter
Reading from INSIDE:	[clear]	[near]	[far]	
Reading from OUTSIDE:	[clear]	[near]	[far]	

Frame Manufacturer,model: _____

Glass Manufacturer,model (plans): _____

Sealed Unit Manufacturer,model (plans): _____

Installer: _____

General Contractor: _____

Typical Head Height – First Floor _____, Middle Floor _____, Top Floor _____

Percent Operable: _____ Type: slider casement awning sngl hung dbl hung

Glass Manu/spacer info (middle floor or so):

Glass Manu	Spacer Info

Shading

Orientation	Architectural Shade	Landscaping	Exposures
North			
East			
South			
West			

LANDSCAPING

NONE
SCRUBS (1ST FLOOR OBSTRUCTIONS)
TREES (1ST AND SECOND FLOOR)
FOREST (SHADING OF 3RD AND/OR 4TH FLOOR)

EXPOSURES

DO - DOWNTOWN – GENERALLY OPEN EXPOSURE. ADJACENT BUILDINGS SHORTER BY LESS THAN THAN ½ OF DISTANCE BETWEEN
DP - DOWNTOWN – PARTIALLY BLOCKED EXPOSURE. ADJACENT BUILDINGS OF SAME HEIGHT
DB - DOWNTOWN – BLOCKED EXPOSURE. ADJACENT BUILDINGS TALLER.BY 4 STORIES OR MORE
SO - SUBURBAN – GENERALLY OPEN. ADJACENT BUILDINGS/TREES NO HIGHER THAN ½ OF DISTANCE BETWEEN.
SP - SUBURBAN – PARTIALLY BLOCKED.
SB - SUBURBAN – BLOCKED. ADJACENT BUILDINGS/TREES 2 TIMES HIGHER THAN THE DISTANCE BETWEEN.

ARCHITECTURAL

EVE ON TOP FLOOR
EVE ON ALL FLOORS
AWNING
VERTICAL FINS ADJACENT TO WINDOWS
VERTICAL FINS OVER WINDOWS
HORIZONTAL FINS OVER WINDOWS
EXTERIOR BARS
INTERIOR BARS

Interior Shades

Space ID	Notes	North	East	South	West	Usage - % and timing

LS - LIGHT SHELF
VB - VENETIAN BLINDS
LV - LOUVERS
DR – DRAPES
IS - INTERIOR SIGNS/OBJECTS
ES - EXTERIOR SIGNS/OBJECTS

Footcandle Profile *(lights off, if possible)* Skycover _____

Space Identification, shade type & position, light status	Window		Time	Vertical (5')		Horizontal – at 3 foot height					
	Height	Dir		At window	at 2 feet	5 Feet	10 feet	15 feet	20 feet	25 feet	30 feet

Site Visit Checklist

_____	Verify main HVAC type and configuration	Pages 11-15
_____	Verify secondary systems type and configuration	Pages 11-15
_____	Get HVAC make and model	Pages 11-15
_____	Verify major pump motor size and control, and get efficiency	Page 16
_____	Verify major fan motor size and control, and get efficiency	Page 16
_____	Ask about commissioning? HVAC? Lighting?	Page 3
_____	Utility Meters and Release	Page 4
_____	Verify main lighting fixtures (assumes light takeoffs completed from plans)	Pages 6-8
_____	Determine lighting controls and schedule. Check local switching.	Page 8
_____	Footcandle measurements of major space, fixture height	Page 8
_____	Photos – Interior looking out,	
_____	Photos - Building Face and Exposure	
_____	Glass Specification	Page 29
_____	Glass Area, wall area	Page 28
_____	Server Rooms	Page 5
_____	Domestic Hot Water system Uses/cafeteria	Page 18
_____	Miscellaneous Loads/ cafeterias	Page 20

Project Contacts

Name	Company	Role	Phone	notes

Appendix B. Building Designer/Engineer Interview

Project Name: _____
Project ID: _____

Interviewees:

Design Role	ID		MT		OR		WA		Total	
	N	%	N	%	N	%	N	%	N	%
Architect/Envelope Designer	19	61	9	60	18	56	37	51	**83**	**55**
Mechanical Engineer	11	36	6	40	8	25	33	45	**58**	**38**
Mechanical Contractor	0	0	0	0	4	13	0	0	**4**	**3**
Other	1	3	0	0	2	6	3	4	**6**	**4**
Total	**31**	**100**	**15**	**100**	**32**	**100**	**73**	**100**	**151**	**100**

1. General Questions

First, we would like to obtain some general information about your firm.

1.1 How many employees are at your company?

Design Role	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
1-5	4	12.90	4	26.67	6	26.67	6	8.22	**20**	**13.25**
11-25	15	48.39	2	13.33	11	34.38	13	17.81	**41**	**27.15**
26-100	6	19.35	3	20.00	8	25.00	27	36.99	**44**	**29.14**
6-10	3	9.68	0	0.00	3	9.38	5	6.85	**11**	**7.28**
Over 100	3	9.68	6	40.00	4	12.50	22	30.14	**35**	**23.18**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**73**	**100.00**	**151**	**100.00**

1.2 What is your company's primary business?

Primary Business	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Architecture	19	61.29	9	60.00	18	56.25	34	46.58	**80**	**52.98**
Engineering	10	32.26	6	40.00	11	34.38	35	47.95	**62**	**41.06**
Other	0	0.00	0	0.00	0	0.00	3	4.11	**3**	**1.99**
Other Design Built	1	3.23	0	0.00	0	0.00	0	0.00	**1**	**0.66**
Specialty Contractor	1	3.23	0	0.00	3	9.38	1	1.37	**5**	**3.31**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**73**	**100.00**	**151**	**100.00**

1.3 How many projects do you estimate your firm completes annually?

Primary Business	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
1-5	1	3.23	0	0.00	0	0.00	4	5.56	**5**	**5.56**
11-25	1	3.23	1	6.67	4	12.50	9	12.50	**15**	**10.00**
26-100	14	45.16	6	40.00	15	46.88	16	22.22	**51**	**34.00**
6-10	1	3.23	0	0.00	2	6.25	5	6.94	**8**	**5.33**
Don't know	0	0.00	1	6.67	0	0.00	0	0.00	**1**	**.67**
Over 100	14	45.16	7	46.67	11	34.38	38	52.78	**70**	**46.67**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**72**	**100.00**	**150**	**100.00**

1.3 a What (estimated) square footage does this represent?

Square Footage	Freq.	Percent	Cum.
<500,000	26	17.22	17.22
500,000-1,000,000	21	13.91	31.13
1,000,000-5,000,000	46	30.46	61.59
>5,000,000	58	38.41	100.00
Total	**151**	**100.00**	

Square Footage	ID	MT	OR	WA	Total
<500,000	3	3	10	10	**26**
500,000-1,000,000	8	3	4	6	**21**
1,000,000-5,000,000	10	4	8	24	**46**
>5,000,000	10	5	10	33	**58**
Total	**31**	**15**	**32**	**73**	**151**

1.3 b What is the estimated dollar value?

Dollar Value	Freq.	Percent	Cum.
<$10,000,000	15	9.93	9.93
$10,000,000-100,000,000	32	21.19	31.13
$100,000,000-500,000,000	41	27.15	58.28
>$500,000,000	63	41.72	100.00
Total	**151**	**100.00**	

Project value	ID	MT	OR	WA	Total
<$10,000,000	3	1	8	3	**15**
$10,000,000-100,000,0	7	4	8	13	**32**
$100,000,000-500,000,	11	3	6	21	**41**
>$500,000,000	10	7	10	36	**63**
Total	**31**	**15**	**32**	**73**	**151**

1.4 Does your firm specialize in any type of commercial buildings (i.e. retail, grocery, office)?
Yes [ ] No [ ]

Special Type	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	18	58.06	7	46.67	19	61.29	35	47.95	**79**	**52.67**
Yes	13	41.94	8	53.33	12	38.71	38	52.05	**71**	**47.33**
Total	**31**	**100.00**	**15**	**100.00**	**31**	**100.00**	**73**	**100.00**	**150**	**100.00**

1.4 a **If yes**, what type?

Special Type	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Mixed Use	0	0.00	1	11.11	1	5.00	2	3.92	**4**	**3.84**
Office	1	4.16	0	0.00	4	20.00	4	7.84	**9**	**8.65**
Schools (K-12)	3	12.50	1	11.11	3	15.00	7	13.72	**14**	**13.46**
Retail	1	4.16	0	0.00	5	25.00	9	17.64	**15**	**14.42**
Medical	5	20.83	5	55.55	1	5.00	8	15.68	**19**	**18.26**
Government	6	25.00	1	11.11	2	10.00	7	13.72	**16**	**15.38**
Education	8	33.33	1	11.11	2	10.00	13	25.49	**24**	**23.07**
Warehouse	0	0.00	0	0.00	2	10.00	1	1.96	**3**	**2.88**
Total	**24**	**100.00**	**9**	**100.00**	**20**	**100.00**	**51**	**100.00**	**104**	**100.00**

1.5 Who is the primary decision-maker responsible for energy code and energy efficiency decisions for the following components?

1.5 a Building Shell:

Decision Maker: Building Shell	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Architect	15	48.39	6	40.00	18	56.25	30	41.10	**69**	**45.70**
Code	4	12.90	0	0.00	5	15.63	9	12.33	**18**	**11.92**
Consultant	0	0.00	0	0.00	0	0.00	1	1.37	**1**	**0.66**
Corporate Manager	0	0.00	0	0.00	0	0.00	1	1.37	**1**	**0.66**
Other	0	0.00	0	0.00	0	0.00	3	4.11	**3**	**1.99**
Owner	0	0.00	1	6.67	4	12.50	5	6.85	**10**	**6.62**
Structural Engineer	0	0.00	1	6.67	0	0.00	0	0.00	**1**	**0.66**
Team (owner/arch/ME)	12	38.71	7	46.67	5	15.63	24	32.88	**48**	**31.79**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**73**	**100.00**	**151**	**100.00**

1.5 b Mechanical System

Decision Maker: Mechanical Systems	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Architect	0	0.00	0	0.00	1	3.13	2	2.74	**3**	**1.99**
Code	3	9.68	0	0.00	1	3.13	5	6.85	**9**	**5.96**
HVAC Contractor	1	3.23	0	0.00	0	0.00	0	0.00	**1**	**0.66**
Mechanical Engineer	16	51.61	4	26.67	16	50.00	34	46.58	**70**	**46.36**
Other	0	0.00	0	0.00	0	0.00	2	2.74	**2**	**1.32**
Owner	0	0.00	2	13.33	3	9.38	6	8.22	**11**	**7.28**
Team (owner/arch /ME)	11	35.48	9	60.00	11	34.38	24	32.88	**55**	**36.42**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**73**	**100.00**	**151**	**100.00**

1.5 c Lighting System

Decision Maker: Lighting Systems	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Architect	0	0.00	1	6.67	3	9.68	9	12.33	**13**	**8.78**
Code	4	13.79	0	0.00	1	3.23	8	10.96	**13**	**8.78**
Consultant	0	0.00	0	0.00	0	0.00	1	1.37	**1**	**0.68**
Electrical Engineer	11	37.93	6	40.00	11	35.48	30	41.10	**58**	**39.19**
Lighting Contractor	0	0.00	0	0.00	1	3.23	0	0.00	**1**	**0.68**
Other	0	0.00	0	0.00	0	0.00	1	1.37	**1**	**0.68**
Owner	1	3.45	1	6.67	2	6.45	3	4.11	**7**	**4.73**
Team (owner/arch/ME)	13	44.83	7	46.67	13	41.94	21	28.77	**54**	**36.49**
Total	**29**	**100.00**	**15**	**100.00**	**31**	**100.00**	**73**	**100.00**	**148**	**100.00**

Practices and Attitudes Related to the Energy Code

2.1 What energy code(s) applies to your projects?

What Code	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
ASHRAE 90.1	2	6.45	1	6.67	0	0.00	0	0.00	**3**	**1.99**
IECC 2000	14	45.16	4	26.67	0	0.00	0	0.00	**18**	**11.92**
IECC 2003	6	19.35	5	33.33	1	3.13	0	0.00	**12**	**7.95**
None	9	29.03	5	33.33	0	0.00	0	0.00	**14**	**9.27**
Oregon	0	0.00	0	0.00	31	96.88	0	0.00	**31**	**20.53**
Seattle	0	0.00	0	0.00	0	0.00	18	24.66	**18**	**11.92**
Washington	0	0.00	0	0.00	0	0.00	55	75.34	**55**	**36.42**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**73**	**100.00**	**151**	**100.00**

2.2 Were energy codes or standards mentioned as part of the building department's review of the project (e.g. energy forms, direct notes on plans, questions at counter, etc.)?

Yes [ ] No [ ]

Codes Mentioned	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Don't Remember	0	0.00	1	6.67	0	0.00	1	1.37	**2**	**1.32**
N/A	2	6.45	0	0.00	0	0.00	0	0.00	**2**	**1.32**
No	12	38.71	5	33.33	8	25.00	11	15.07	**36**	**23.84**
Yes	17	54.84	9	60.00	24	75.00	61	83.56	**111**	**73.51**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**73**	**100.00**	**151**	**100.00**

2.2 a If yes: Did you receive any feedback on this project from plan reviewers or building officials for this project?

Yes [ ] No [ ]

Receive Feedback	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Don't Remember	0	0.00	0	0.00	0	0.00	4	6.56	**4**	**3.67**
No	13	76.47	4	57.14	13	54.17	25	40.98	**55**	**50.46**
Yes	4	23.53	3	42.86	11	45.83	32	52.46	**50**	**45.87**
Total	**17**	**100.00**	**7**	**100.00**	**24**	**100.00**	**61**	**100.00**	**109**	**100.00**

2.3 Does you firm you hire a consultant to help specifically with energy code or energy efficiency issues?

Yes [ ] No [ ]

Hire Consultant	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	30	96.77	13	86.67	19	59.38	43	59.72	**105**	**70.00**
Yes	1	3.23	2	13.33	13	40.63	29	40.28	**45**	**30.00**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**72**	**100.00**	**150**	**100.00**

2.3a Did such a person participate in this project?

Yes [ ] No [ ]

Consultant on this Project	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	28	93.33	12	80.00	24	75.00	50	71.43	**114**	**77.55**
Yes	2	6.67	3	20.00	8	25.00	20	28.57	**33**	**22.45**
Total	**30**	**100.00**	**15**	**100.00**	**32**	**100.00**	**70**	**100.00**	**147**	**100.00**

2.4 Do you remember what compliance path was used for:

2.4 a Mechanical

Mechanical Path	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Building Modeling	0	0.00	0	0.00	0	0.00	1	1.39	**1**	**0.68**
Complex System	0	0.00	0	0.00	0	0.00	1	1.39	**1**	**0.68**
Component Performance	7	24.14	5	33.33	4	13.33	36	50.00	**52**	**35.62**
Don't Remember	6	20.69	4	26.67	0	0.00	4	5.56	**14**	**9.59**
N/A	5	17.24	0	0.00	0	0.00	0	0.00	**5**	**3.42**
Prescriptive Path	11	37.93	6	40.00	26	86.67	29	40.28	**72**	**49.32**
Whole Building Analysis	0	0.00	0	0.00	0	0.00	1	1.39	**1**	**0.68**
Total	**29**	**100.00**	**15**	**100.00**	**30**	**100.00**	**72**	**100.00**	**146**	**100.00**

2.4 b Lighting

Lighting Systems	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Building Modeling	0	0.00	0	0.00	0	0.00	1	1.41	**1**	**0.69**
Component Performance	7	25.00	5	33.33	4	13.33	34	47.89	**50**	**34.72**
Don't Remember	6	21.43	4	26.67	0	0.00	4	5.63	**14**	**9.72**
N/A No Energy Code	5	17.86	0	0.00	0	0.00	0	0.00	**5**	**3.47**
N/A Residential Bldg	1	3.57	0	0.00	0	0.00	0	0.00	**1**	**0.69**
Prescriptive Path	9	32.14	6	40.00	26	86.67	31	43.66	**72**	**50.00**
Whole Building Analysis	0	0.00	0	0.00	0	0.00	1	1.41	**1**	**0.69**
Total	**28**	**100.00**	**15**	**100.00**	**30**	**100.00**	**71**	**100.00**	**144**	**100.00**

2.4 c Building envelope

Building Envelope	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Building Modeling	0	0.00	0	0.00	0	0.00	1	1.41	**1**	**0.69**
Component Performance	7	25.00	5	33.33	4	13.33	38	53.52	**54**	**37.50**
Don't Remember	6	21.43	4	26.67	0	0.00	4	5.63	**14**	**9.72**
N/A No Energy Code	5	17.86	0	0.00	0	0.00	0	0.00	**5**	**3.47**
Prescriptive Path	10	35.71	6	40.00	26	86.67	27	38.03	**69**	**47.92**
Whole Building Analysis	0	0.00	0	0.00	0	0.00	1	1.41	**1**	**0.69**
Total	**28**	**100.00**	**15**	**100.00**	**30**	**100.00**	**71**	**100.00**	**144**	**100.00**

2.5 Was energy code compliance a particularly challenging problem for any aspect of the building (envelope, mechanical, lighting) systems?
Yes [ ] No [ ]

Challenge	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
N/A	4	12.90	0	0.00	0	0.00	0	0.00	**4**	**2.68**
No	23	74.19	13	86.67	28	90.32	53	73.61	**117**	**78.52**
Yes	4	12.90	2	13.33	3	9.68	19	26.39	**28**	**18.79**
Total	**31**	**100.00**	**15**	**100.00**	**31**	**100.00**	**72**	**100.00**	**149**	**100.00**

2.5 a If yes, why?

Why Hard	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Lighting	1	33.33	1	50.00	1	33.33	3	16.67	**6**	**23.08**
Envelope	1	33.33	0	0.00	0	0.00	4	22.22	**5**	**19.23**
Glazing	0	0.00	0	0.00	0	0.00	3	16.67	**3**	**11.54**
Ventilation	0	0.00	1	50.00	0	0.00	2	11.11	**3**	**11.54**
Code Language	0	0.00	0	0.00	1	33.33	4	22.22	**5**	**19.23**
Other	1	33.33	0	0.00	1	33.33	2	11.11	**4**	**15.38**
Total	**3**	**100.00**	**2**	**100.00**	**3**	**100.00**	**18**	**100.00**	**26**	**100.00**

2.6 Are there any elements of the energy code that you feel are not cost-effective or are poorly thought out?
Yes [ ] No [ ]

Elements Not Cost Effective	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
N/A	2	6.45	2	13.33	0	0.00	1	1.43	**5**	**3.38**
No	14	45.16	10	66.67	19	59.38	32	59.38	**75**	**50.68**
Yes	15	48.39	3	20.00	13	40.63	37	52.86	**68**	**45.95**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**70**	**100.00**	**148**	**100.00**

2.6 a If yes: What are they?

Code Problems	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Too Strict	9	45.00	2	50.00	4	15.38	28	58.33	**43**	**43.87**
Too Lenient	2	10.00	0	0.00	4	15.38	1	2.08	**7**	**7.14**
Poor Wording	1	5.00	1	25.00	7	26.92	7	14.58	**16**	**16.32**
Internal Conflicts	5	25.00	0	0.00	3	11.54	7	14.58	**15**	**15.30**
Not Enforced	1	5.00	0	0.00	0	0.00	2	4.17	**3**	**3.06**
Flexible	0	0.00	0	0.00	1	3.85	0	0.00	**1**	**1.02**
Good Code	0	0.00	0	0.00	2	7.69	0	0.00	**2**	**2.04**
Deficient Coverage	2	10.00	1	25.00	5	19.23	3	6.25	**11**	**11.22**
Total	**20**	**100.00**	**4**	**100.00**	**26**	**100.00**	**48**	**100.00**	**98**	**100.00**

2.6 b Did you still implement them into your design?
Yes [ ] No [ ]

Still Implement	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	1	20.00	0	0.00	1	12.50	5	20.00	**7**	**17.07**
Yes	4	80.00	3	100.00	7	87.50	20	80.00	**34**	**82.93**
Total	**5**	**100.00**	**3**	**100.00**	**8**	**100.00**	**25**	**100.00**	**41**	**100.00**

2.6 c If no: Why?

Why	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Not a Big Problem with this Building	0	0.00	0	0.00	1	100.00	0	0.00	**1**	**20.00**
Not Cost Effective	0	0.00	0	0.00	0	0.00	1	33.33	**1**	**20.00**
Not Needed in this Building	0	0.00	0	0.00	0	0.00	1	33.33	**1**	**20.00**
Received a Letter from US DOE Saying Economizer is not Cost Effective on Water Source Heat Pumps	1	100.00	0	0.00	0	0.00	0	0.00	**1**	**20.00**
Waste of Time Especially with Water Economizer	0	0.00	0	0.00	0	0.00	1	33.33	**1**	**20.00**
Total	**1**	**100.00**	**0**	**0.00**	**1**	**100.00**	**3**	**100.00**	**5**	**100.00**

2.7 Do you use any software package (such as ENVstd or DOE2®) to demonstrate compliance with energy codes?
Yes [ ] No [ ]

Use Software	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	1	3.23	5	33.33	20	66.67	43	58.90	**69**	**46.31**
Yes	30	96.77	10	66.67	10	33.33	30	41.10	**80**	**53.69**
Total	**31**	**100.00**	**15**	**100.00**	**30**	**100.00**	**73**	**100.00**	**149**	**100.00**

2.7 a If yes: What is your opinion on its use and outcome?

Software Used	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Com Check	24	85.71	6	66.67	0	0.00	4	14.81	**34**	**45.95**
DOE2	0	0.00	0	0.00	2	20.00	4	14.81	**6**	**8.11**
Equest	0	0.00	0	0.00	0	0.00	1		**1**	**1.35**
Trace	1	3.57	0	0.00	0	0.00	1	3.70	**2**	**2.70**
Com Check Equest Trace	0	0.00	1	11.11	0	0.00	0	0.00	**1**	**1.35**
DOE2 Trace	0	0.00	0	0.00	0	0.00	3	11.11	**3**	**4.05**
Equest Trace	1	3.57	0	0.00	0	0.00	1	3.70	**2**	**2.70**
Unknown	2	7.14	2	22.22	8	80.00	13	48.15	**25**	**33.78**
Total	**28**	**100.00**	**9**	**100.00**	**10**	**100.00**	**27**	**100.00**	**74**	**100.00**

3. Energy Efficient Design Criteria

3.1 Did you incorporate any energy efficiency measure(s) in this project beyond what is minimally required by an energy code? (If yes, please describe).

Lighting: Yes [ ] No [ ]

Lighting	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	19	65.52	11	73.33	15	51.72	36	51.43	**81**	**56.64**
Yes	6	20.69	4	26.67	13	44.83	30	42.86	**53**	**37.06**
Don't Remember	2	6.90	0	0.00	1	3.45	4	5.71	**7**	**4.90**
N/A	2	6.90	0	0.00	0	0.00	0	0.00	**2**	**1.40**
Total	**29**	**100.00**	**15**	**100.00**	**29**	**100.00**	**70**	**100.00**	**143**	**100.00**

What Lighting Measures	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Daylighting	3	42.85	1	25.00	5	38.46	14	38.88	**23**	**38.33**
Controls	3	42.85	2	50.00	4	30.76	14	38.88	**23**	**38.33**
Reduced Wattage Efficient Ballasts	1	14.28	1	25.00	4	30.76	8	22.22	**14**	**23.33**
Total	**7**	**100.00**	**4**	**100.00**	**13**	**100.00**	**36**	**100.00**	**60**	**100.00**

HVAC: Yes [ ] No [ ]

HVAC	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	16	51.61	8	53.33	14	45.16	33	45.83	**71**	**47.65**
Yes	12	38.71	7	46.67	17	54.84	38	52.78	**74**	**49.66**
Don't Remember	1	3.23	0	0.00	0	0.00	0	0.00	**1**	**0.67**
N/A	2	6.45	0	0.00	0	0.00	1	1.39	**3**	**2.01**
Total	**31**	**100.00**	**15**	**100.00**	**31**	**100.00**	**72**	**100.00**	**149**	**100.00**

What HVAC Measures	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Heat Recovery	4	40.00	0	0.00	3	18.75	8	20.00	**15**	**21.42**
Higher Efficient Equipment	6	60.00	2	50.00	9	56.25	21	52.50	**38**	**54.28**
Controls	0	0.00	1	25.00	2	12.50	8	20.00	**11**	**15.71**
Natural Technology (Solar, natural ventilation	0	0.00	1	25.00	2	12.50	3	7.50	**6**	**8.57**
Total	**10**	**100.00**	**4**	**100.00**	**16**	**100.00**	**40**	**100.00**	**70**	**100.00**

Envelope: Yes [ ] No [ ]

Envelope	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	16	55.17	9	60.00	20	68.97	39	53.42	**84**	**57.53**
Yes	9	31.03	6	40.00	9	31.03	34	46.58	**58**	**39.73**
Don't Remember	2	6.90	0	0.00	0	0.00	0	0.00	**2**	**1.37**
N/A	2	6.90	0	0.00	0	0.00	0	0.00	**2**	**1.37**
Total	**29**	**100.00**	**15**	**100.00**	**29**	**100.00**	**73**	**100.00**	**146**	**100.00**

What Envelope Measures	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Increased Insulation	9	81.81	6	100.00	5	62.50	24	75.00	**44**	**77.19**
Changed Glazing	1	9.09	0	0.00	2	25.00	6	18.75	**9**	**15.78**
Passive Solar Strategies	1	9.09	0	0.00	1	12.50	2	6.25	**4**	**7.01**
Total	**11**	**100.00**	**6**	**100.00**	**8**	**100.00**	**32**	**100.00**	**57**	**100.00**

3.1 a Why did you incorporate these measures?

Why Incorporate Energy Efficiency Measures?	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Owner Request	3	25.00	2	22.22	5	22.73	15	21.74	**25**	**22.32**
Architect Request	0	0.00	0	0.00	2	9.09	1	1.45	**3**	**2.68**
Cost Effective	4	33.33	3	33.33	9	40.91	15	21.74	**31**	**27.68**
Right Thing to Do	0	0.00	1	11.11	4	18.18	6	8.70	**11**	**9.82**
LEED	0	0.00	0	0.00	2	9.09	10	14.49	**12**	**10.71**
Normal Work	5	41.67	3	33.33	0	0.00	17	24.64	**25**	**22.32**
Receiving Rebates Incentives	0	0.00	0	0.00	0	0.00	5	7.25	**5**	**4.46**
Total	**12**	**100.00**	**9**	**100.00**	**22**	**100.00**	**69**	**100.00**	**112**	**100.00**

3.1 b. How important was incorporating energy efficient features to other members of the design team?

Importance to Team	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Don't Know	0	0.00	0	0.00	1	3.57	0	0.00	**1**	**0.70**
Moderate	7	23.33	6	42.86	3	10.71	21	30.00	**37**	**26.06**
Not at All	16	53.33	2	14.29	12	42.86	18	25.71	**48**	**33.80**
Very	7	23.33	6	42.86	12	42.86	31	44.29	**56**	**39.44**
Total	**30**	**100.00**	**14**	**100.00**	**28**	**100.00**	**70**	**100.00**	**142**	**100.00**

3.2 Did the building owner request energy efficiency in the building design?
Yes [ ] No [ ]

Request Efficiency	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	20	64.52	8	53.33	17	53.13	29	39.73	**74**	**49.01**
Yes	11	35.48	7	46.67	15	46.88	44	60.27	**77**	**50.99**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**73**	**100.00**	**151**	**100.00**

3.2 a If yes**,** did the owner request a LEED certification as part of this project?
Yes [ ] No [ ]

Request LEED®	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	30	100.00	15	100.00	26	86.67	6	84.72	**132**	**89.80**
Yes	0	0.00	0	0.00	4	13.33	11	15.28	**15**	**10.20**
Total	**30**	**100.00**	**15**	**100.00**	**30**	**100.00**	**72**	**100.00**	**147**	**100.00**

3.3 Was a performance analysis of the energy requirements of this building done as part of the design or code compliance process?
Yes [ ] No [ ]

Performance Analysis	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	17	56.67	9	60.00	20	62.50	27	37.50	**73**	**48.99**
Yes	10	33.33	6	40.00	12	37.50	45	62.50	**73**	**48.99**
N/A	3	10.00	0	0.00	0	0.00	0	0.00	**3**	**2.01**
Total	**30**	**100.00**	**15**	**100.00**	**32**	**100.00**	**72**	**10.00**	**149**	**100.00**

3.4 What were the main barriers to including energy efficiency in the design of this project?

Barriers	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
First Costs	15	48.38	6	40.00	17	51.51	34	47.22	**72**	**48.00**
None	15	48.38	8	53.33	8	24.24	29	40.27	**60**	**40.00**
Other	1	3.22	1	6.66	6	18.18	9	12.50	**17**	**11.00**
N/A	0	0.00	0	0.00	2	6.06	0	0.00	**2**	**1.00**
Total	**31**	**100.00**	**15**	**100.00**	**33**	**100.00**	**72**	**100.00**	**151**	**100.00**

4. Support and Information Requirements

4.1 What 2 or 3 sources do you use to obtain information on energy efficiency designs and technology in new building construction?

Information Sources	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
ASHRAE	10	14.29	4	12.90	5	8.62	23	15.23	**42**	**13.55**
Internet	13	18.57	5	12.90	6	10.34	17	11.26	**41**	**13.23**
Professional Publications	16	22.86	6	19.35	12	20.69	22	14.57	**56**	**18.06**
USGBC	7	10.00	4	12.90	8	13.79	17	11.26	**36**	**11.61**
Manufacturers	5	7.14	1	3.23	10	17.24	22	14.57	**38**	**12.26**
Seminars	9	12.86	4	12.90	6	10.34	8	5.30	**27**	**8.71**
Conferences	0	0.00	0	0.00	0	0.00	3	1.99	**3**	**0.97**
Consultants	6	8.57	3	9.68	9	15.52	19	12.58	**37**	**11.94**
In-house staff	2	2.86	2	6.45	2	3.45	11	7.28	**17**	**5.48**
Energy Code	2	2.86	2	6.45	0	0.00	9	5.96	**13**	**4.19**
Total	**70**	**100**	**31**	**97**	**58**	**100**	**151**	**100**	**310**	**100**

4.2 Do you believe you had enough information to implement energy efficiency into this project?
Yes [ ] No [ ]

Enough Information	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	4	12.90	1	6.67	3	9.38	2	2.74	**10**	**6.62**
Yes	25	80.65	14	93.33	29	90.63	71	97.26	**139**	**92.05**
N/A	2	6.45	0	0.00	0	0.00	0	0.00	**2**	**1.32**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**73**	**100.00**	**151**	**100.00**

4.2 a If no: What information would have aided in the design?

What Information	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
LEED®	0	0.00	0	0.00	1	33.33	0	0.00	**1**	**12.50**
Cost	0	0.00	0	0.00	1	33.33	0	0.00	**1**	**12.50**
Green Building	0	0.00	0	0.00	0	0.00	1	100.00	**1**	**12.50**
Product	1	33.33	0	0.00	0	0.00	0	0.00	**1**	**12.50**
Ventilation	1	33.33	0	0.00	0	0.00	0	0.00	**1**	**12.50**
Lighting and Heat Recovery	0	0.00	1	100.00	0	0.00	0	0.00	**1**	**12.50**
Owner Interest	0	0.00	0	0.00	1	33.33	0	0.00	**1**	**12.50**
Team Interest	1	33.33	0	0.00	0	0.00	0	0.00	**1**	**12.50**
Total	**3**	**100.00**	**1**	**100.00**	**3**	**100.00**	**1**	**100.00**	**8**	**100.00**

4.2 b Who would you expect to provide this information?

Who should provide info.	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
ASHARE	1	50.00	0	0.00	0	0.00	0	0.00	**1**	**16.67**
Architects and Consultants	0	0.00	0	0.00	1	50.00	0	0.00	**1**	**16.67**
Consultants	0	0.00	0	0.00	1	50.00	0	0.00	**1**	**16.67**
Design Team Members	0	0.00	0	0.00	0	0.00	1	100.00	**1**	**16.67**
Venders	1	50.00	0	0.00	0	0.00	0	0.00	**1**	**16.67**
Venders and Engineers	0	0.00	1	100.00	0	0.00	0	0.00	**1**	**16.67**
Total	**2**	**100.00**	**1**	**100.00**	**2**	**100.00**	**1**	**100.00**	**6**	**100.00**

4.3 Do you believe you had enough information on the energy code as it applied to this project?
Yes [ ] No [ ]

Enough Information	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	0	0.00	1	6.67	0	0.00	2	2.74	**3**	**2.03**
Yes	23	76.67	12	80.00	30	100.00	71	97.26	**136**	**91.89**
N/A	7	23.33	1	6.67	0	0.00	0	0.00	**8**	**5.41**
Don't Know	0	0.00	1	6.67	0	0.00	0	0.00	**1**	**0.68**
Total	**30**	**100.00**	**15**	**100.00**	**30**	**100.00**	**73**	**100.00**	**148**	**100.00**

4.3 a If no: What information would have aided in the design?

What Information	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Better Understanding of WA code	0	0.00	0	0.00	0	0.00	1	50.00	**1**	**33.33**
Montana Needs a State Code	0	0.00	1	100.00	0	0.00	0	0.00	**1**	**33.33**
More Generic Code Information	0	0.00	0	0.00	0	0.00	1	50.00	**1**	**33.33**
Total	**0**	**00.00**	**1**	**100.00**	**0**	**0.00**	**2**	**100.00**	**3**	**100.00**

4.3 b Who would you expect to provide this information?

Who	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Don't Know	0	0.00	0	0.00	0	0.00	1	50.00	**1**	**33.33**
State of WA	0	0.00	0	0.00	0	0.00	1	50.00	**1**	**33.33**
State of MT	0	0.00	1	100.00	0	0.00	0	0.00	**1**	**33.33**
Total	**0**	**00.00**	**1**	**100.00**	**0**	**0.00**	**2**	**100.00**	**3**	**100.00**

5. General Attitudes and Suggestions for Improvement

5.1 In your opinion, has client demand for an energy efficient design changed your design practices in general?

Yes [ ] No [ ]

Changed Practice	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
No	9	29.03	6	40.00	12	37.50	24	32.88	**51**	**33.77**
Yes	22	70.97	9	60.00	20	62.50	49	67.12	**100**	**66.23**
Total	**31**	**100.00**	**15**	**100.00**	**32**	**100.00**	**73**	**100.00**	**151**	**100.00**

5.1 a If yes, what design elements?

Design Elements	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Lighting	2	7.69	0	0.00	8	21.62	6	7.32	**16**	**10.06**
HVAC	2	7.69	2	14.29	9	24.32	16	19.51	**29**	**18.24**
Envelope	0	0.00	2	14.29	7	18.92	7	8.54	**16**	**10.06**
Client Requesting Energy Efficiency	14	53.85	5	35.71	4	10.81	29	35.37	**52**	**32.70**
Pushing Their Clients to Energy Efficiency	1	3.85	3	21.43	1	2.70	10	12.20	**15**	**9.43**
LEED®	2	7.69	2	14.29	3	8.11	7	8.54	**14**	**8.81**
Holistic Team Approach	1	3.85	0	0.00	4	10.81	3	3.66	**8**	**5.03**
Clients Looking at Long Term not Just First Costs	4	15.38	0	0.00	1	2.70	4	4.88	**9**	**5.66**
Total	**26**	**100.00**	**14**	**100.00**	**37**	**100.00**	**82**	**100.00**	**159**	**100.00**

5.2 Is LEED® requested ?

Yes [ ] No [ ]

LEED® Requested	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
N/A	0	0.00	0	0.00	0	0.00	1	1.37	**1**	**0.67**
No	7	22.58	2	13.33	4	12.90	14	19.18	**27**	**18.00**
Yes	24	77.42	13	86.67	27	87.10	58	79.45	**122**	**81.33**
Total	**31**	**100.00**	**15**	**100.00**	**31**	**100.00**	**73**	**100.00**	**150**	**100.00**

5.2 a If yes, by what percentage of your clients?

Percent of Clients	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Fewer than 20%	18	72.00	10	76.92	15	53.57	17	28.81	**60**	**48.00**
20-50%	5	20.00	2	15.38	5	17.86	22	37.29	**34**	**27.20**
50-75%	1	4.00	1	7.69	4	14.29	18	30.51	**24**	**19.20**
More than 75%	0	0.00	0	0.00	3	10.71	1	1.69	**4**	**3.20**
None	1	4.00	0	0.00	1	3.57	1	1.69	**3**	**2.40**
Total	**25**	**100.00**	**13**	**100.00**	**28**	**100.00**	**59**	**100.00**	**125**	**100.00**

5.3 What do you feel is the best way to promote energy efficiency or respond to the demands for energy efficient design?

Best Way	Idaho		Montana		Oregon		Washington		Total	
	N	%	N	%	N	%	N	%	N	%
Education	24	77.42	8	57.14	23	57.50	51	60.71	**106**	**62.72**
Money	3	9.68	1	7.14	10	25.00	11	13.10	**25**	**14.79**
LEED	1	3.23	0	0.00	2	5.00	1	1.19	**4**	**2.37**
Keep-up / Peer Pressure	0	0.00	1	7.14	3	7.50	1	1.19	**5**	**2.96**
Stronger Code	1	3.23	2	14.29	1	2.50	8	9.52	**12**	**7.10**
Enforce Code	0	0.00	0	0.00	0	0.00	2	2.38	**2**	**1.18**
Costs	1	3.23	2	14.29	0	0.00	5	5.95	**8**	**4.73**
Technology	1	3.23	0	0.00	1	2.50	5	5.95	**7**	**4.14**
Total	**31**	**100.00**	**14**	**100.00**	**40**	**100.00**	**84**	**100.00**	**169**	**100.00**

Appendix C. Case Weights and Stratification

The tables in this appendix summarize the various samples and weights used in this study. The first table in each set (Table C#A) illustrates the sample size as drawn from the Dodge® database. The actual sample differs from these samples by one or two cases depending on the uncertainty of the recruiting and participation. As can be seen, the strata are sampled with a roughly equal sample size so that the case weights are much larger for the smaller buildings and much smaller for the larger buildings (since those populations are sampled with very high frequency).

The second table in each set (Table C#B) shows the strata boundary developed from the original stratification but modified by the observed building area from the audit. The areas that are shown here identify the largest building area in each strata. In some cases the building audited was significantly different from the Dodge® data. In those cases, the case weight was assigned from the strata originally assigned since that remains the sampling probability for that point.

Each sample shown here overlaps the remaining samples. Some portion of each sample differs but depending on the summary the weights in the third table (Table C#C) allow the summary to focus on the particular subset. The weights are generally the inverse of the sampling probability in each strata and sample. For each sample (utility, building type, state) the weights are independent of any other weight the building might have. In some cases the building may have a weight that is derived from each of the samples as well as an overall population weight.

The individual samples shown here are:

C.1: The samples drawn to represent each state.

C.2: The samples drawn to represent each utility area:

- Energy Trust of Oregon (which is the only an enhanced sample of the whole state of Oregon);
- Idaho Power (which is an enhanced sample for the Idaho power service territory);
- Puget Sound not Seattle (which is a single sample encompassing three utilities PSE, TPU, and SnoPUD);
- Seattle City Light (which is designed to give the same level of statistical rigor as the state samples)

C.3: The samples that represents a regional assessment of four building types (Grocery, Hospital, Retail, Schools K-12).

C.4: Finally, combination of all samples weighted across all building types and states

C.1 State Samples

Table C1A: Stratification, State Sample.

State	Strata			Total
	1	2	3	
ID	15	18	15	**48**
MT	8	10	10	**28**
OR	17	21	21	**59**
WA	21	26	30	**77**
Total	**61**	**75**	**76**	**212**

Table C1B: Strata Boundaries, Square Feet.

State	Strata		
	1	**2**	**3**
ID	67967	184507	369137
MT	11791	80068	132267
OR	21720	140000	607160
WA	25750	148008	680593

Table C1C: Mean Cell Weight, State Sample.

State	Strata		
	1	**2**	**3**
ID	47.87	11.72	3.67
MT	16.00	4.70	1.50
OR	36.45	9.29	1.98
WA	84.57	17.41	2.37

C.2 Utility Samples

Table C2A: Utility Samples by Strata.

Utility Groups	Strata			Total
	1	2	3	
ETO	29	34	35	**98**
IPCO	16	17	12	**45**
PSNS	15	21	29	**65**
SCL	5	10	11	**26**
Total	**65**	**82**	**87**	**234**

Table C2B: Strata Boundaries, Square Feet.

Utility Groups	Strata		
	1	2	3
ETO	21720	140000	607160
IPCO	67967	56369	369137
PSNS	25750	136138	1121129
SCL	21300	148008	333800

Table C2C: Case Weights, Utility Samples.

Utility Groups	Strata		
	1	2	3
ETO	36.41	9.26	2.00
IPCO	35.50	8.24	3.08
PSNS	48.53	10.38	1.38
SCL	30.60	5.18	1.45

C.3. Building Type Samples

Table C3A: Building Type Sample Sizes.

Building Type Groups	Strata			Total
	1	2	3	
Grocery	6	5	7	**18**
Hospital	11	13	6	**30**
Retail	14	17	32	**63**
Schools	22	23	23	**68**
Total	**53**	**58**	**68**	**179**

Table C3B: Building Type Strata Boundaries.

Building Type Groups	Strata		
	1	2	3
Grocery	24394	62931	169205
Hospital	47058	125111	449537
Retail	16490	148008	450000
Schools	43422	98926	274289

Table C3C: Case Weights, Building Type Samples.

Building Type Groups	Strata		
	1	2	3
Grocery	10.17	7.00	1.63
Hospital	7.91	1.62	1.17
Retail	40.43	6.81	2.03
Schools	15.36	7.09	2.26

C.4. Combined Weights, All Samples

Table C4A: All Samples by State, State Strata Design.

State	Strata			Total
	1	2	3	
ID	24	24	16	**64**
MT	9	10	10	**29**
OR	32	38	37	**107**
WA	36	61	48	**145**
Total	**101**	**133**	**111**	**345**

Table C4B: Strata Boundaries by Overall Strata.

State	Strata		
	1	2	3
ID	67967	184507	369137
MT	11791	80068	132267
OR	21720	140000	607160
WA	40957	187040	1121129

Table C4C: Cases Weights, All Samples.

State	Strata		
	1	2	3
ID	29.92	8.67	3.44
MT	11.89	3.90	1.50
OR	33.03	8.18	1.95
WA	49.31	7.15	1.46

Appendix D. Supplemental Component Tables

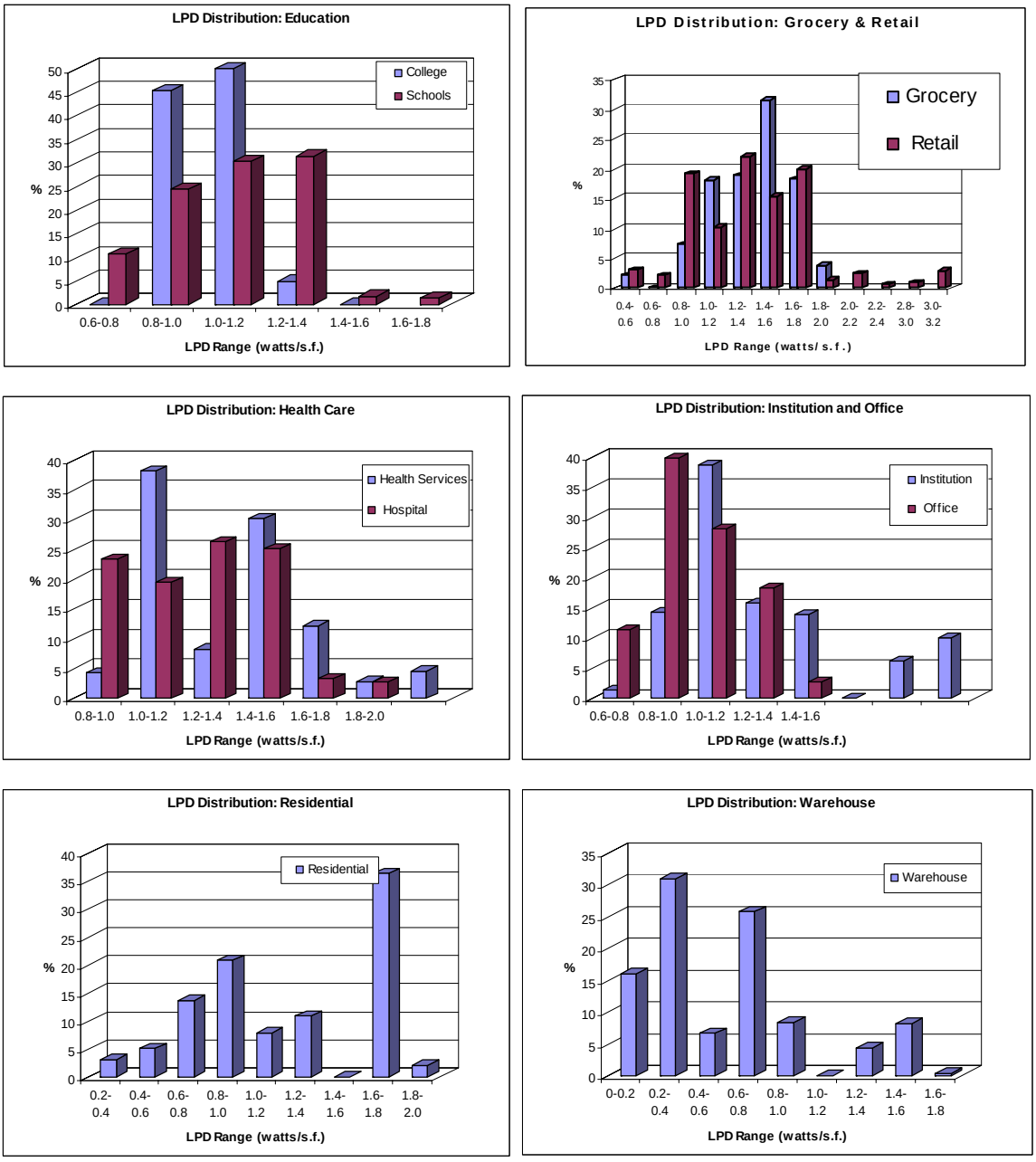
Appendix D.1. Lighting

Table D1 presents the distribution of floor area by whole building LPD. Fully 50% of the office building floor area had LPD's less then 1 watt/s.f.. In retail, 92% of the floor area had LPDs (general plus display) less the 1.8 watt/s.f., and 84% were less than 1.6 watt/s.f.. This table is summarized in extended histograms that describe the distribution of LPDs within the individual building types. These bins include all subareas that are within the 0.2 watts/s.f..

Table D1: LPD bin distribution by building type

LPD Category	Assembly	College	Education	Grocery	Health Se	Hospital	Institution	Office	Other	Residential	Restaurants	Retail	Warehouse	Total
0-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.9	**3.2**
0.2-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.0	0.0	30.9	**6.4**
0.4-0.6	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	17.5	5.1	0.0	3.1	6.6	**2.6**
0.6-0.8	0.0	0.0	10.6	2.2	0.0	0.0	14.3	11.3	34.0	13.7	0.0	2.2	25.7	**11.1**
0.8-1.0	39.1	45.3	24.4	0.0	4.2	23.3	38.6	39.9	22.0	20.8	28.4	19.1	8.3	**21.7**
1.0-1.2	48.4	49.9	30.2	7.3	38.1	19.4	15.7	28.0	21.2	7.9	0.0	10.2	0.0	**16.9**
1.2-1.4	12.5	4.9	31.4	18.1	8.2	26.2	13.8	18.2	3.0	10.9	13.2	22.1	4.3	**16.4**
1.4-1.6	0.0	0.0	1.7	18.9	30.1	25.1	0.0	2.7	2.3	0.0	21.6	15.3	8.1	**8.1**
1.6-1.8	0.0	0.0	1.4	31.4	12.1	3.3	6.2	0.0	0.0	36.3	11.8	19.9	0.3	**9.3**
1.8-2.0	0.0	0.0	0.0	18.3	2.8	2.7	10.0	0.0	0.0	2.1	25.0	1.4	0.0	**2.5**
2.0-2.2	0.0	0.0	0.3	3.9	4.5	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	**0.9**
2.2-2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	**0.1**
2.8-3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	**0.2**
3.0-3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	**0.6**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Figure D.1: LPD Distribution of Building Types.



Appendix D.2 HVAC

A large variety of HVAC equipment was reviewed in the audit process. These tables summarize the measures that were not reviewed directly in the main report. These tables show the distribution of efficiency in the categories of the Code tables with the ASHRAE code values as reference (highlighted cells). It is important to remember that different standards were used by different states and jurisdictions so these code values are fro reference only.

Heating efficiency

Table D2a: Distribution of Combustion Furnace and Unit Heater Efficiency (% of COP).

Heating efficiency (%)	N	Furnace			Unit heater	Total
		<225 Kbtu	>225 Kbtu	Duct		
77	1	0.0	0.0	0.0	0.0	**0.0**
78	20	1.3	0.0	15.6	0.0	**1.6**
79	11	0.8	0.0	0.0	0.0	**0.5**
80	433	59.9	52.3	71.2	59.7	**59.0**
81	175	20.1	15.6	1.7	2.1	**15.9**
82	41	4.0	6.2	0.0	17.5	**6.1**
83	23	0.5	20.7	0.0	19.9	**6.9**
84	3	0.2	0.0	0.3	0.0	**0.1**
86	1	0.0	0.0	0.4	0.0	**0.0**
90	33	4.4	0.0	0.0	0.8	**2.8**
91	1	0.0	4.3	0.0	0.0	**0.8**
92	19	2.7	0.1	10.8	0.0	**2.3**
93	25	3.7	0.7	0.0	0.0	**2.4**
94	8	2.3	0.0	0.0	0.0	**1.4**
98	1	0.2	0.0	0.0	0.0	**0.1**
Total	**795**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table D2b: Distribution of Heat Pump Heating Efficiency (% of Cap.).

COP (heating efficiency)	Heat Pump		Total
	5-11 tons	11-20 tons	
2.5	65.3	58.5	**63.0**
3.0	0.5	0.0	**0.4**
3.5	34.1	41.5	**36.6**
Total	**100.0**	**100.0**	**100.0**

Table D2c: Distribution of Water Source Heat Pump Efficiency (% of Capacity).

COP	Ground Source		Water Source				Total
	Ground	Water	<1.5 tons	1.5-5 tons	5-11 tons	>11 tons"	
3.0	1.2	0.0	0.0	0.0	0.0	0.0	**0.3**
3.5	81.2	37.5	0.0	0.5	0.0	0.0	**23.9**
4.0	17.6	62.5	0.0	14.1	2.2	0.0	**10.7**
4.5	0.0	0.0	88.8	14.4	69.8	100.0	**38.4**
5.0	0.0	0.0	11.3	70.0	20.1	0.0	**26.1**
5.5	0.0	0.0	0.0	1.0	7.9	0.0	**0.6**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Code	**3.4**	**3.4**	**3.8**	**3.8**	**3.8**	**4.2**	

Cooling Efficiency

Table D2d: Distribution of Air Cooled Air Conditioner Efficiency.

SEER/EER	Air Cooled AC						Total
	<5 tons split	<5 tons package	5-11 tons	11-20 tons	20-60 tons	>60 tons	
8	0.1	0.0	0.4	0.0	0.0	0.0	**0.1**
9	1.3	0.5	14.8	22.5	11.1	56.1	**10.4**
10	58.1	31.4	10.3	14.8	25.4	32.9	**34.2**
11	14.4	52.2	45.3	25.4	56.7	1.0	**33.3**
12	8.3	1.7	9.9	34.9	6.7	0.0	**10.0**
13	17.8	14.1	19.3	1.4	0.1	0.0	**11.5**
14	0.0	0.0	0.0	1.0	0.0	10.0	**0.5**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.00**
Code	**10.0**	**9.7**	**8.9**	**8.5**	**8.5**	**8.2**	

Table D2e: Distribution of Air Cooled Heat Pump Cooling Efficiency.

SEER/EER	Air Source Heat Pumps				Total
	<5 tons, split	5-11 tons	11-20 tons	>20 tons	
9	1.4	0.0	0.0	100.0	**1.4**
10	58.9	46.5	66.7	0.0	**53.2**
11	9.2	51.4	33.3	0.0	**31.6**
12	1.5	2.1	0.0	0.0	**1.6**
13	29.1	0.0	0.0	0.0	**12.2**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Code	**10.0**	**8.9**	**8.5**	**8.7**	

Table D2f: Distribution of Package Terminal Cooling Efficiency.

SEER	Total
10	**28.6**
11	**39.0**
12	**32.4**
Total	**100.0**

Table D2g: Distribution of Water Source Heat Pump Efficiency (% of capacity).

SEER/EER	Ground Source		Water Source				Total
	Ground	Water	<1.5 tons	1.5-5 tons	5-11 tons	>11 tons"	
11	0.0	0.0	0.0	0.7	0.0	0.0	**0.3**
12	8.4	0.0	1.3	18.1	0.0	15.4	**9.4**
13	17.6	0.0	94.3	13.0	35.6	0.0	**39.0**
14	1.2	0.0	0.0	3.0	28.4	0.0	**2.8**
15	72.9	0.0	1.1	15.0	1.4	84.6	**25.8**
16	0.0	0.0	0.3	5.0	34.7	0.0	**3.6**
17	0.0	100.0	0.2	2.4	0.0	0.0	**2.8**
18	0.0	0.0	0.0	30.0	0.0	0.0	**10.9**
19	0.0	0.0	2.9	12.1	0.0	0.0	**5.3**
20	0.0	0.0	0.0	0.9	0.0	0.0	**0.3**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Code	**11.0**	**11.0**	**9.3**	**9.3**	**10.5**	**9.6**	

Appendix E. Building Type Specifics

There were several building types where the nature of the building or the goals of NEEA and the utilities were more focused. Four such building types were specifically sampled beyond the level that would happen by default in the main sampling. In these cases specific observation are both possible and more representative of the general conditions in these types. This section discusses the specifics of our findings on these building types. In general most of these feature were mentioned elsewhere in the report but the effort here is to gather the observations for these building types in one section.

E.1. Hospitals

The hospital sector was very interesting. No single sector had more enticing conservation opportunities. Healthcare systems are typically nearly constant volume with hot water re-heat and typically were on 24 hours a day even in outpatient clinics.

Scheduling and zoning

There were lots of critical zone issues and mixing of 24 hour with non-24 hour spaces. The basic use mix in hospitals is often oriented on patient group lines rather then cooling or schedule issues. A woman's health department, for example, will have patient education, offices, a gift shop, outpatient exam rooms, and possibly overnight patient care. These are often on the same system even though the zones operation on very different schedules.

Other examples include a UPS room amongst office space requiring the HVAC to run 24/7 and requiring 55°F cold deck temperatures or a continuously operating x-ray department or overnight patient care area on same system as outpatient clinics with no isolation dampers. In these cases, even when operators realize the importance of turning off lights and HVAC systems in these areas they are unlikely to have the means to do so. In at least one building the isolation dampers had been value engineered out of the project even though the simple payback was determined to be 2 years.

There were also several cases where designers included zone dampers that would allow different schedules in some zones, but no one was in a position to carefully review the zone status and schedules to determine which areas could be shut down and which zone dampers could be used to accomplish the change. This could be very complex given the pressure and zoning requirements in the hospital.

Design

It is very clear that hospitals get special treatment in the enforcement of energy codes. The need to meet health department regulations and other design standards, often trump any energy code restriction. Much more care is required to separate these patient critical functions from conventional office and educational activities that occupy large fractions of these buildings. Both designers and code officials could help improve the overall efficiency of this sector by introducing these distinctions into their designs.

One solution here is to design air flows in two operational modes. One for full operation and one for night or off hour operation. If that were done the Test and Balance would be asked to provide assurance that the dampers and fan speeds required to meet these alternative flows would be part of system operation.

In hospital and other health care settings, all zones should have low leak shut off dampers, and the project engineers should be strongly encouraged to determine separate lower unoccupied flow rates where possible. Due to the likelihood of cold deck temperatures driven by some other area, OS control of zones should be implemented where possible.

E.2. Grocery

Energy use in the grocery sector is dominated by the refrigeration system. Heat transfer from the refrigerated cases drives most of the space conditioning demands and circumscribes most of the comfort conditions in the stores. Beyond this important feature the store is designed like any retail store. Big box retail stores often have 20 to 30 percent of their floor area devoted to grocery. In this sense the size of the grocery area in these stores is similar to stand alone groceries. Most of the measures and comments are applicable to some of these chains.

Heat recovery

It is very surprising that these stores do not use heat recovery from the refrigeration systems to offset their space heating needs. Only one of the chains and one independent store included heat recovery coils for space heat in their installation. At least one other store included it in their plans but it was valued engineered out at the time of installation. This is clearly an area where many stores are contemplating a change in their systems. All stores use a heat recovery system in their hot water tanks but there is much more heat available in these systems than is currently recovered from this system.

Lighting

The grocery sector should be considered as a typical retail operation. Thus the development of efficient lighting systems especially display lighting would be effective. This sector had the largest lighting LPD of any of our building types but in general it did not have a very unusual back ground lighting system.

Controls

Grocery stores have fairly sophisticated controls for their refrigeration systems. These controls have remote sensing and often tied to remote sites where conditions in the cases and compressor racks can be closely monitored. In about a third of the stores reviewed this level of control or scheduling was not available for space heating or lighting. Lighting systems were manually switched and temperature control was accomplished with thermostats. Essentially none of the national chains settled for this level of control but in the independent stores or the small local chains the control systems were very simple.

HVAC

The Mechanical systems used in this sector were very similar to any retail store. These systems had the capability to provide cooling to the store under all circumstances but for the most part the cooling equipment was redundant with the refrigeration system and the refrigerated case losses.

The use of non compensating exhaust is common in the grocery sector. We saw almost no cases where that was a standard. The result is that outside air dampers are set to make up a large quantity of air for these hoods. As a result there is effective no incremental control offered by CO_2 sensors. The primary measures here would have to both include substantial compensation in the deli, baking, and other food prep hoods coupled with ventilation control. This combination would reduce outside air and the demands on the heating and cooling capacity.

E.3. Schools

The most striking aspect of this sample is the degree to which designers and school officials were willing to experiment with "high performance" design standards. There was some evidence, however, that these experiments had uneven success.

A general observation here is that in the school setting more so than almost any other building type the need to adapt zone controls and temperature, ventilation, and lighting settings to individual classroom zones cannot be overestimated. Teachers and their classrooms need become the dominant conditions that a building operator must accommodate and if they are unsuccessful even the most sophisticated control will be overridden or replaced. Moreover, it very unlikely that there will ever be a successful school design standard where the classroom and teachers area can be offered less conditioning and control than the administrative offices in the same building. We had three schools where mechanical cooling was installed in the office area and not in the classroom. In two of these cases the cooling was retrofit by the time we conducted the audit less than two years after the school was occupied.

Lighting

Schools were the most likely to use advanced side daylighting controls. This presented a complication at the individual zones for both set-up and operation. Most of the Daylighting controls that we noted as disabled or overridden were in the schools in the study. This suggests a willingness to use these techniques but a failure in operator training or design specification in this application. Clearly more intervention here would be helpful but the need to have this occur not in the design phase but in the early operation and training of building operators could start the process of integrating these advanced controls into the successful operation of the school.

Occupancy sensors control of classroom lighting was very common but common area lighting was typically manually switched by custodial staff. Areas such as gyms, multi-purpose rooms, cafeterias all have much more intermittent occupancy and could benefit from

occupancy sensors to control lights. Some schools had implemented common area OS control and found it worked well.
Security lighting in schools has become a large separate usage. Many buildings reported the emergency circuit was always on. Especially in this application where a fairly large fraction of the lighting is on the emergency circuit, the effect is of negating the savings from the 10 or 15 percent reduction seen in lighting power. Our observation is that security lighting should be controlled with occupancy sensors.

HVAC
OS control of vent air is common and should be the minimum implemented everywhere especially in spaces like gyms and multi-purpose rooms. Such a system would allow more scheduling control in the spaces that are not classrooms and are often operated with the rest of the school even though they have different use patterns.

There are several schools that were designed without mechanical cooling. This was the norm as recently as 10 years ago. Various criteria have intervened however to make the use of cooling almost mandatory in the design of school HVAC systems. These include the real or imagined goal of year round school operation. While this has been mentioned in almost every survey conducted in the last twenty years none of the schools in this survey were more than lightly used during the summer and most were not used at all. It would appear that this building type would be most easily adapted to a moderated cooling design or to economizer or evaporative cooled system that avoided mechanical cooling. In this context the use of integrated design techniques that include sun control and careful glazing design as well as ventilation control and operable windows could be successful in developing a school design that would be successful without significant mechanical cooling. It is clear, however, that an ad hoc approach to this problem will not result in any significant performance improvement.

E.4. Retail

In this sample there was a striking dominance of big box chains. Many of these chains seem to have an unusual construction program that corresponded to our sampling window. In this study a much higher fraction of the large chains participated. The most significant thing about this participation is the degree to which these operations have integrated the design decisions into a central design approach which is meant to inform virtually all store designs. Thus once the store design includes an efficiency measure (high performance T-8s, for example) it is likely to be integrated to all the store designs. Moreover, while these measures may receive incentives from local utility programs the use of these program will probably be an after the fact incentive to include measures that were already part of their designs. There may be some specific control improvements that could be affected by utility efforts but rarely would the design process for a particular store be open to some sort of local adaptation based on utility incentives.

Another important part of this sector (that to some extent pervades all the decision-making in the entire sample) is the background of ever rising energy costs and the perception that these costs will continue to rise. This has focused the attention of the large chains in a way that was not typical in any previous review. In principle this should make the larger chains much

more receptive to energy efficiency but it also brings up the problem of influencing national decisions from the relative isolation of the Pacific Northwest.

Lighting

The use of High Performance T-8 fixture should be a very easy adoption for the retail sector. They would provide a 10 to 15 percent reduction in lighting power

There is a clear move to embrace "top daylighting" into the design of their store. Several chains have successfully implemented this strategy. With the development of designs that use skylights to provide better ambience in the large stores the use of daylighting controls is an easy measure. There is evidence that some technical assistance might be welcomed in these designs especially in smaller chains without the design resources.

HVAC

The big box HVAC designs are based on single zone package equipment to the exclusion of almost any other design. This is very cost effective since it allows a single spec to be negotiated with a manufacture with the benefit of using the large buying power of the chain to secure the lowest price.

The fact that these stores use a constant fan operation to ventilate the store regardless of conditioning requirements suggests that the need for a lower fan setting or a more diversified control to insure that enough air is introduced without over ventilation and significant penalties for fan energy. A VFD fan drive would allow a lower ventilation only setting. Alternatively some fraction of the package units could be designated as ventilation units and the remaining units could be set to minimum make up air settings to provide any additional conditioning that was required by the thermostat.

Envelope

Envelope designs and detailing for these buildings types is significantly different from most commercial buildings. The walls are typically constructed with CMU or a tilt-up concrete detail. Insulation is provided by furring in the walls or by inserts in the CMU voids. There is a tendency in virtually all jurisdictions (especially under the IECC code) to remove as much of this insulation as would be allowed by the building inspector. A constant minimum standard would help solve some of the gaming typical in this building type. This problem extends to the slab edge which is often detailed with thermal breaks and perimeter insulation but is difficult to verify in the absence of on-site inspection.

Probably a code requirement would be much more effective in this area than incentives or "design assistance." The individual designs are always adapted to local codes and most often the vagaries of local enforcement are not of great concern to the national chains.