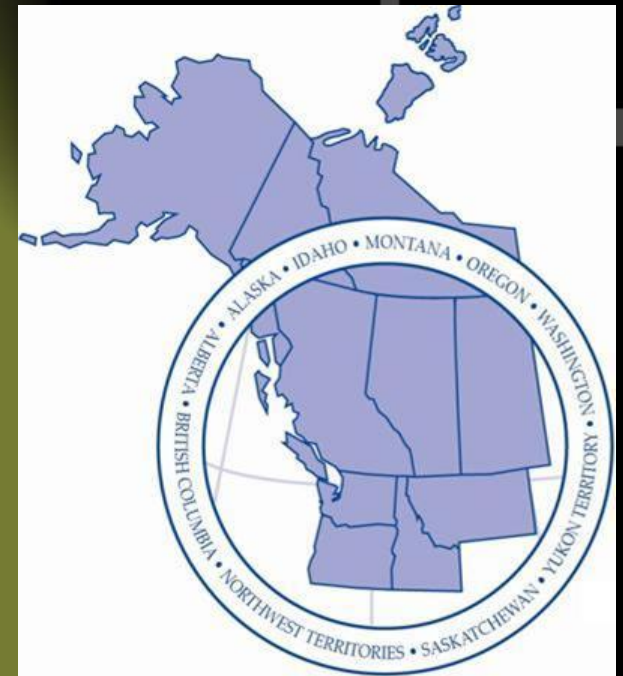


Roadmap to Resilient, Net Zero Energy Buildings and Deep Energy Retrofits – Case Studies

PNWER WEBINAR – JUNE 23, 2015

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Agenda

- Overview of Roadmap
- Case Study Buildings
- Synthesis of Case Studies
- PNWER Summit
- Sponsorship Options





Learning Objectives

- Gain awareness of examples (case studies) of buildings across PNWER jurisdictions
- Appreciate the value of high-performance buildings
- Understand how your sector can participate in the roadmap development process



Roadmap to Resilient, Net Zero Energy Buildings and Deep Energy Retrofits



→ What is the Roadmap?

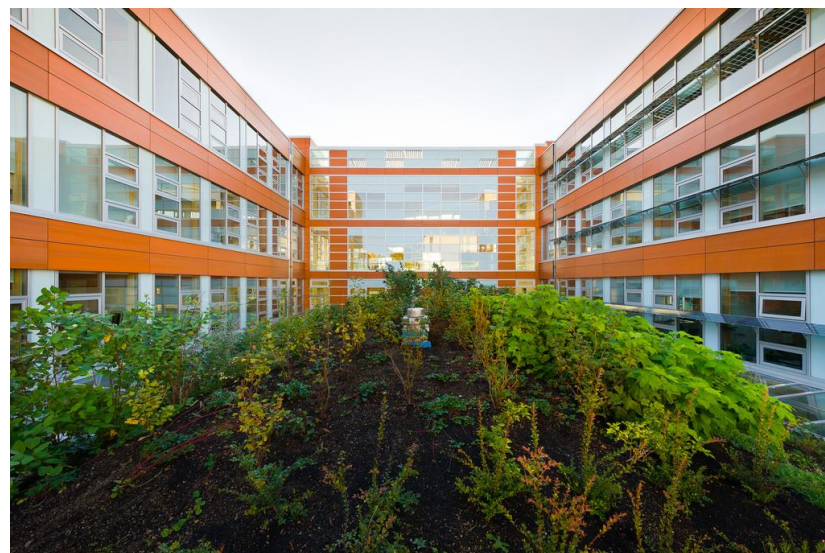
- Document to be developed and endorsed by private sector and government leaders from 10 northwest jurisdictions (see map on right)
- Focuses on two targets for buildings:
 - › Facilitate the achievement of net zero emissions for new construction by 2030, including achievement of an energy efficiency target and use of clean energy supplies
 - › Encourage "deep" energy retrofits of existing buildings that optimize the economics of energy efficiency upgrades to lower energy bills and emissions





→ Resilient Buildings

- Affordable
- Durable
- Adaptable
- Comfortable
- Healthy
- Energy efficient
- Use local energy resources
- Sustainable





→ Key Elements for Case Studies

- Net-zero ready new construction, zero-emissions, including use of renewable natural gas
- Deep Energy Retrofits (30-70% reduction)
- Measured utility data

→ White Paper to support Roadmap:

- Review best practices of market and policy measures
- Document Case Studies
- Extrapolate case study data to predict impacts in each of the 10 jurisdictions
- Estimate job creation



Net-Zero Case Studies

- 16 new and existing buildings across four sectors and 10 PNWER jurisdictions
- More Detailed Review:
 - › Bullitt Center (Seattle)
 - › Factor 9 Home (Regina)
 - › Belmont Building (Vancouver)



→ Critical Elements

- Building Summary Items (name, location, type, etc.)
- Energy use (measured)
- Construction Costs

→ Base Elements

- Design details (heating, ventilation, envelope, etc.)

→ Desired Elements

- Construction and commissioning details
- Financing details
- Resilience upgrades (seismic, extreme heat, indoor air quality, etc.)



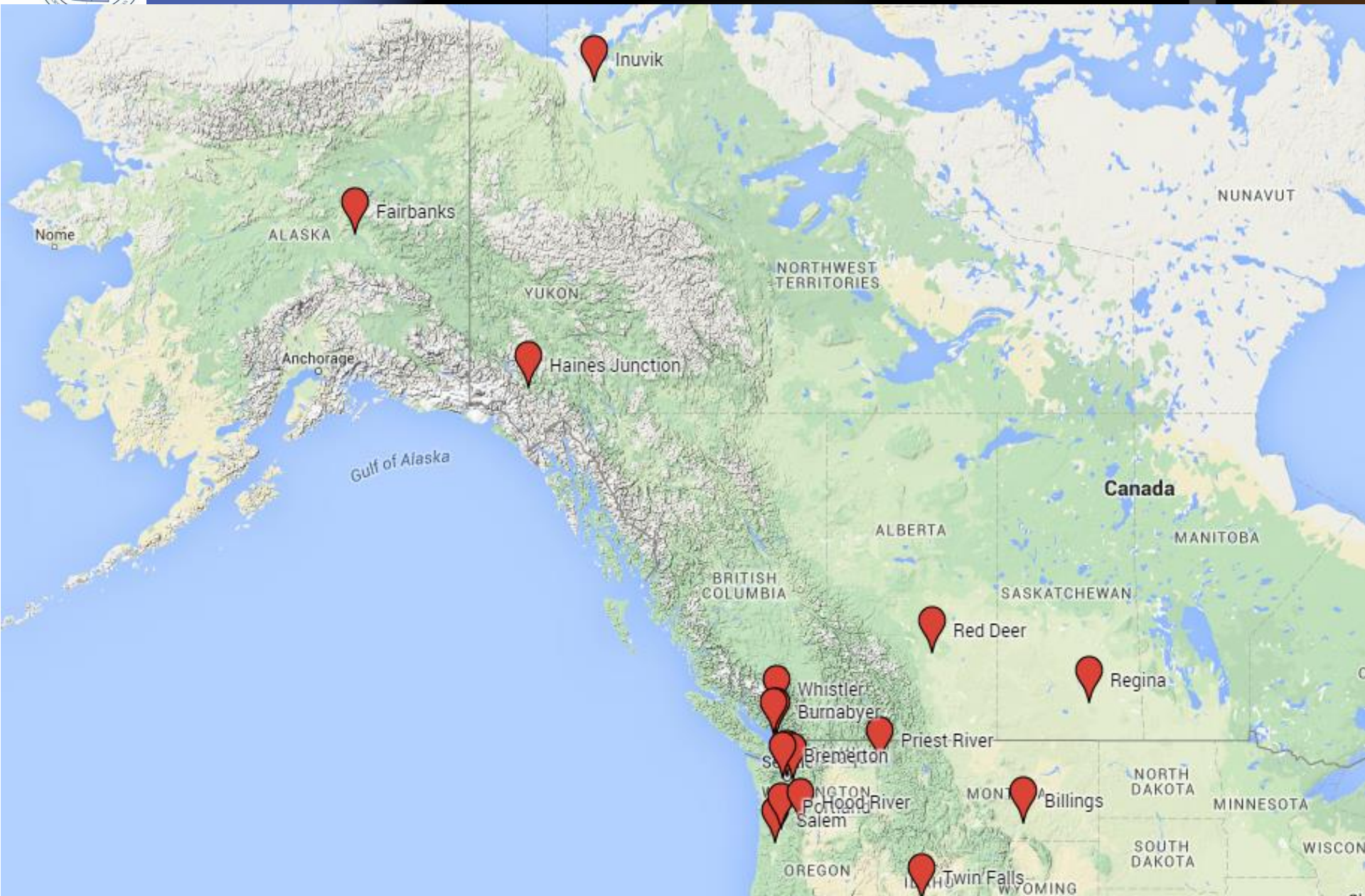
Case Study Overview



Building Name	Building Type	Construction Type	City	Jurisdiction
Factor 9 Home	House	New	Regina	SK
Discover 3 House	House	New	Red Deer	AB
Rainbow House	House	New	Whistler	BC
Harmony House	House	New	Burnaby	BC
Northern Sustainable House	House	New	Inuvik	NWT
Hutshi House	House	New	Haines Junction	YK
CoSI HS&HS Building	Educational	New	Twin Falls	ID
Hood River M.S	Educational	New	Hood River	OR
Zhome	MURB	New	Issaquah	WA
Belmont Building	MURB	Retrofit	Vancouver	BC
Bullitt Center	Office	New	Seattle	WA
Home on the Range	Office	Retrofit	Billings	MT
Lovejoy Building	Office	Retrofit	Portland	OR
Rice Fergus Miller Office	Office	Retrofit	Bremerton	WA
Painter's Hall	Office, Mixed-use	Retrofit	Salem	OR
Beardmore	Office, Mixed-use	Retrofit	Priest River	ID



Case Study Overview





Discussion Questions

- What are common design features of successful net-zero buildings?
- How consistently are net-zero targets met and maintained?
- What is the relative contribution of energy efficiency and generation?
- Can existing buildings meet net-zero standards?



Case Study: Bullitt Center, Seattle

RDH





Case Study: Bullitt Center, Seattle

→ Key design features:

- **Envelope:**
High R-value walls & roof, automated triple glazed windows and shades
- **Lighting:**
Daylight integrated electric lighting
- **Information systems and occupant engagement:**
Occupants sign agreement to meet energy and water targets, floor by floor electricity meter and display provided





Case Study: Bullitt Center, Seattle

→ Energy Use and Finances:

	Energy Use (kWh/m ²)		Construction Cost (\$/m ²)	
	Case Study	Baseline	Case Study	Baseline
Site	30.5	205.2		
PV	52.3	0.0		
Net	-21.8	205.2	3897	1936

→ Financing, Construction and Occupancy

→ Leased spaces

→ Resilience and Non-Energy Benefits

- Seismic resilience included in design
- Reduced heat island effect due to trees and PV array
- Rainwater used to replenish aquifer
- Low VOC building as per LBC



Case Study: Factor 9 Home, Regina



Factor 9 Home:
A New Prairie Approach

2006 Completion
The Factor 9 Home will
offer 200 sq. ft. more and
50% less value for a
comparable 2000 home.

Features:
10' of Space
Hardwood Floor Cover
Kitchen
Bathroom
Stainless Steel
Cabinets
Stainless Steel
Appliances

CSRC



Case Study: Factor 9 Home, Regina

→ Key design features:

- **Space Heating:**
Solar heating with storage tank, fan coil with water heating
- **Envelope:**
Super-insulated - double the levels
- **Information systems and occupant engagement:**
Electricity use monitoring and display
- **Water conservation:**
Rainwater collection for toilets and irrigation, low flow toilets and fixtures, low water plants for landscaping





Case Study: Factor 9 Home, Regina

→ Energy Use and Finances:

	Energy Use (kWh/m ²)		Construction Cost (\$/m ²)	
	Case Study	Baseline	Case Study	Baseline
Site	29.8	163.4		
PV	0	0.0		
Net	29.8	163.4	1992	1732

→ Financing, Construction and Occupancy

→ Owner-occupied

→ Resilience and Non-Energy Benefits

→ Reduced site runoff by 60%, native plants

→ Low VOC materials



Case Study: Belmont Building, Vancouver





Case Study: Belmont Building, Vancouver



→ Key design features:

- **Space Heating:**
Electric baseboard perimeter in suite, gas in corridors and lobby
- **Ventilation:**
Pressurized corridor with rooftop make-up air unit
- **Envelope:**
Upgraded exterior walls from R-4 to R-16 effective. Upgraded windows from R-1 to R-5 effective. Reduced air leakage by 55%





→ Energy Use and Finances:

	Energy Use (kWh/m ²)		Construction Cost (\$/m ²)	
	Case Study	Baseline	Case Study	Baseline
Site	176.2	221		
PV	0	0.0		
Net	176.2	221	756	

→ Financing, Construction and Occupancy

- Owner-occupied
- Extensive energy simulations for energy efficiency measure payback calculations
- Air tightness testing



→ Common Design Features

- Building design features reviewed from case studies
- # of occurrences of common design features counted
- Details from public data
- List is not exhaustive but indicates trends



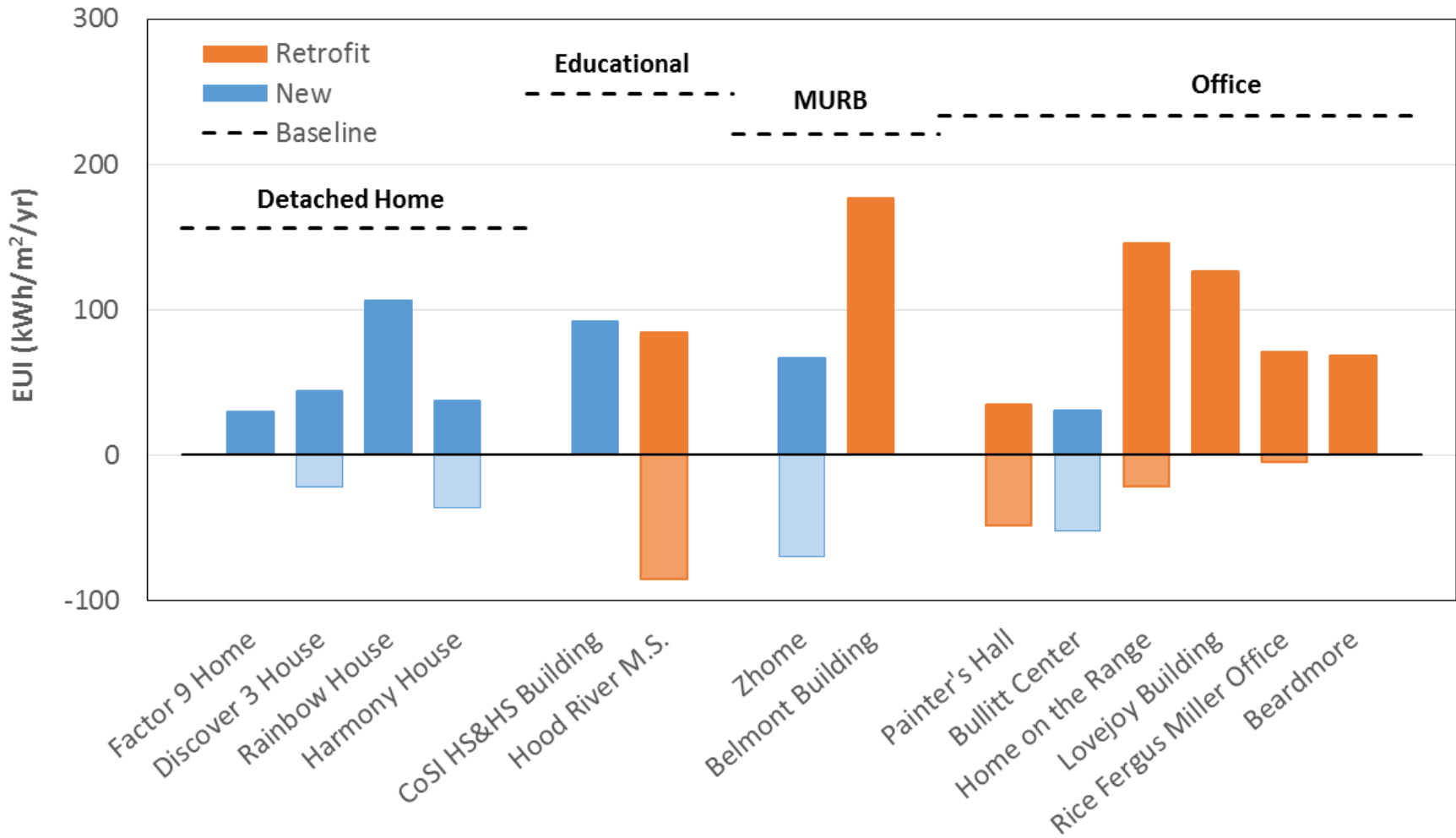
Common Design Features



Design Area	Design Feature	Total (16)	New (10)	Retrofit (6)
Space Heating	Heat pump	9	6	3
	Radiant Slab	7	5	2
	Electric resistance	6	5	1
Space Cooling	Heat pump	9	6	3
	Radiant Slab	5	4	1
Ventilation	HRV/ERV	11	10	1
	Natural Ventilation	9	6	3
	Demand Controlled	8	4	4
Envelope	High R-value envelope	15	10	5
	High performance Windows	13	10	3
	Air tightness	6	4	2
	Solar shading	7	4	3
	Automated windows	2	1	1
	Thermal Mass	6	2	4
	Reflective or Green Roof	3	1	2
Lighting	Natural lighting	14	9	5
	Energy efficient Fixtures	14	9	5
	Light Sensors	6	3	3
	Occupant Sensors	7	4	3
Engagement	Energy Dashboard	6	4	2
	Submetering	6	3	3
Plug loads	Any efficiency measure	6	5	1
Energy Generation	PV Cells	9	5	4
Construction	Commissioning	11	7	4
IAQ	Low VOC materials	7	5	2



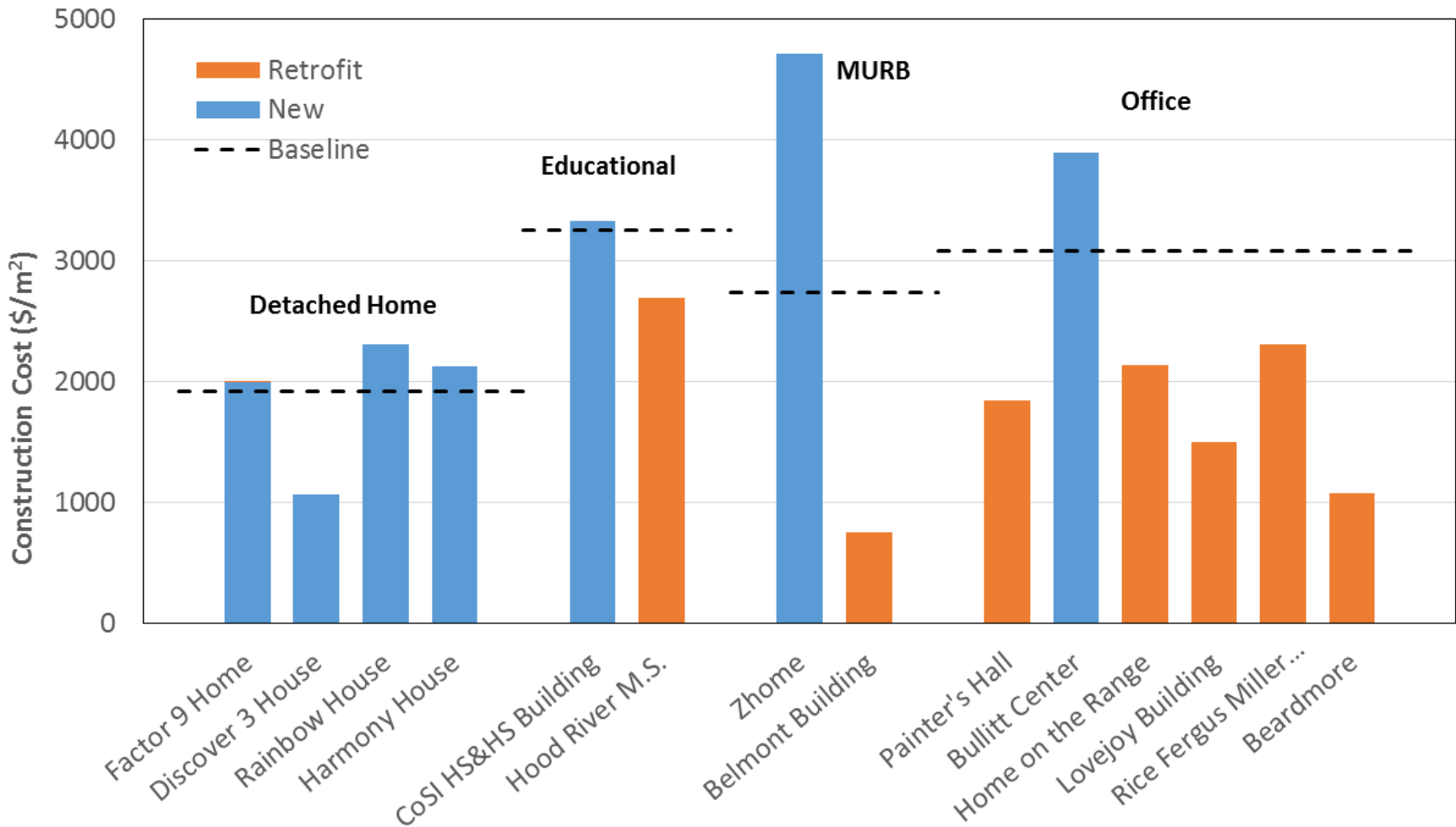
Building Energy Use



- Baseline is average from building specific from SHEU, SCIEU, CBECS
- Energy consumption is above 0 line, production is below the line
- Both new and retrofits can have “net-zero ready” efficiency (<90)



Construction Costs



- Construction costs adjusted for inflation to 2015\$
- Next steps: life cycle costing (with energy bill reductions)
- Significant variability, many feature costs are declining



PNWER Summit 2015

- Big Sky, Montana
- Energy and Environment Working Group Session
 - Tuesday, July 14
 - Morning



Agenda – Part I on Roadmap to Net-Zero

- Introduction
- Progress report on White Paper for Roadmap
- Legislative leads and “Net-Zero Networks” of key stakeholders
- Industry Perspectives Panel
 - Speaking opportunities still available
- Legislative Perspectives Panel

Part II – Utility of the Future

- Resource planning for distributed generation



Sponsorship Options

→ Founding sponsors



Preparation of White Paper

- 5 founding sponsors sought to prepare “White Paper”
 - Basis for discussions at PNWER 2015 Economic Leadership Forum in Yellowknife
 - Foundation for PNWER “Roadmap” by July 2016
- Benefits
 - Prospective sponsors offered speaking engagement at PNWER Summit 2015 and poster display at session
 - Visibility among energy efficiency professionals, advocacy organizations, and businesses
 - Logo placement on PNWER website and referenced in the White Paper



Questions and Discussion

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- Case Study Buildings
- Synthesis of Case Studies
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