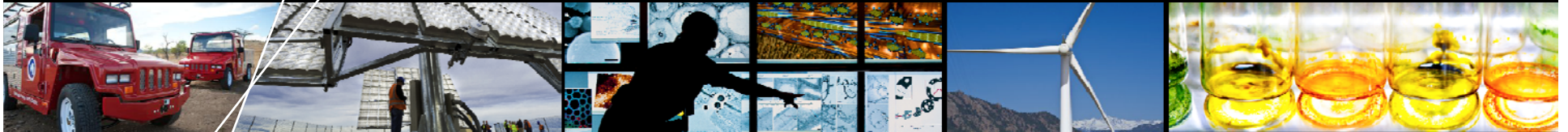




U.S. DEPARTMENT OF  
**ENERGY** | Energy Efficiency &  
Renewable Energy



# Owner Commitment: *High Level Decisions*



## NASA Net Zero Workshop

**Jeffrey M. Baker**

**Director, Office of Lab Ops  
Golden Field Office**

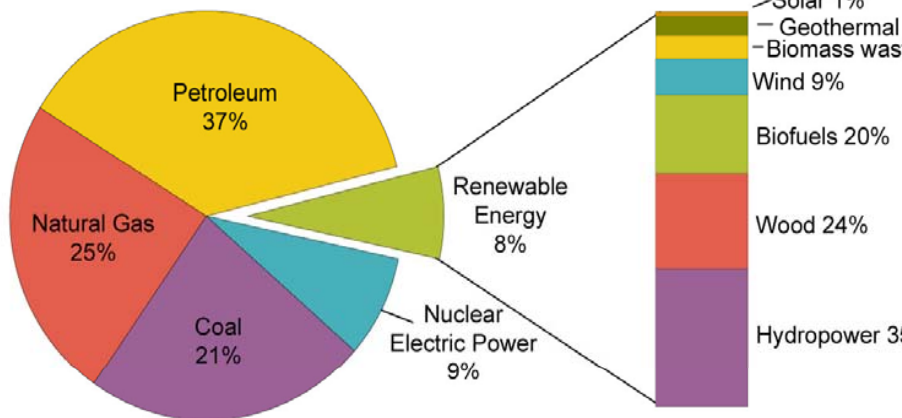
*June 5, 2012*

# Energy Drives National Security, Competitiveness, and Environmental Quality

## Energy Supply

U.S. Energy Consumption by Energy Source, 2009

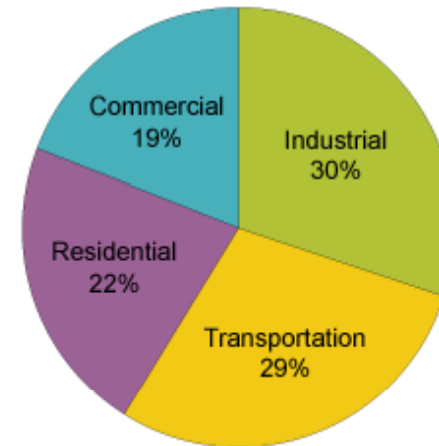
Total = 94.578 Quadrillion Btu



Note: Sum of components may not equal 100% due to independent rounding.  
Source: U.S. Energy Information Administration, *Annual Energy Review 2009*, Table 1.3, Primary Energy Consumption by Energy Source, 1949-2009 (August 2010).

## Energy Consumption

Share of Energy Consumed by Major Sectors of the Economy, 2009



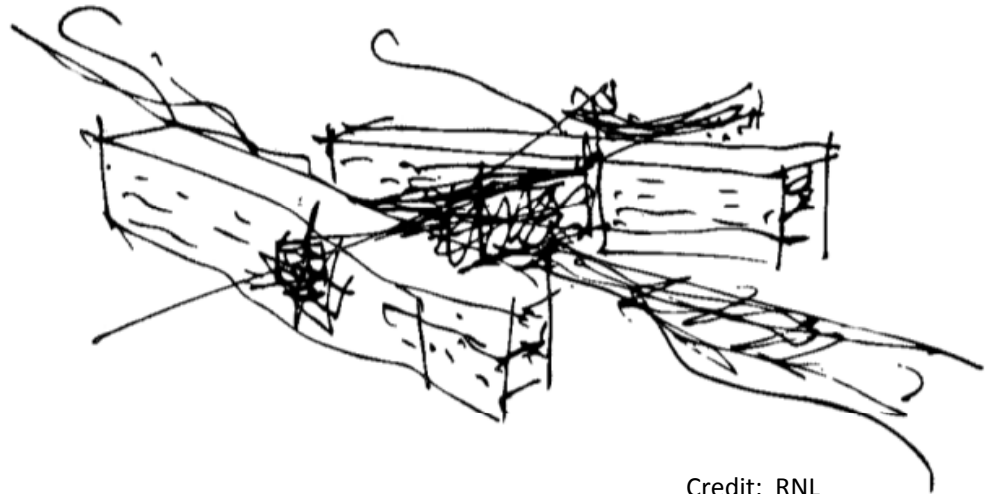
Source: U.S. Energy Information Administration, *Annual Energy Review 2009*.

## Department of Energy's Mission:

*"The mission of the Energy Department is to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions."*

# Opportunities

- **Create A Benchmark for Affordable, Sustainable, High Performance Buildings**
- **Deliver Project at Cost, Scope, and Schedule and at Lower Risk to All Parties**
- **Redefine High Performance Building Design and Construction on Private Sector Terms for Others to Emulate**



Credit: RNL

# Challenges

- **Institutional Barriers**
  - Industry Belief that High Performance Buildings are Costly and Complex
  - Debilitating Focus on Project Risk (Real or Perceived)
  - DOE and Private Sector Project Culture Resistant to Change
  - Historically Limited Role of Owner
  - Fixed Appropriations and Tight Schedule
- **Aggressive Project Requirements**
  - Chairs for 800
  - At least 50% Better Performance than ASHRAE 90.1
  - World's Most Energy Efficient Building
  - LEED Platinum/Net-Zero Energy
- **National Leadership Obligation**
  - DOE On Display
  - No Cost Premium to the Market
  - Once-In-A-Lifetime Opportunity to Change the National Dialogue

# DOE and Industry Standard Practice

- **Performance-Based Design, Bid, Build**
  - Treats Buildings as Commodities vs. Unique Problems to Solve
  - Rigid Acquisition Approach Trades Innovative Solutions for (Perceived) Risk Reduction
  - Debilitating “Us vs. Them” Owner, Designer, and Constructor Relationship
  - Standard Project Delivery Takes 5 to 7 Years
- **Initial Market Reaction to RSF Requirements Discouraging**
  - Looking through the Lens of Standard Practice a Belief that We Were Asking too Much and Offering too Little
- **Conclusion: Changing the Industry Required an Alternative Approach**

# Changing the Rules to Create Extraordinary Value

- **Performance-Based Design Build**
  - Fundamental Change in Acquisition Strategy
    - Traditional: Here's a Design, What's the Cost?
    - RSF: Here's the Objectives, What's the Design?
  - Performance-Based Design-Build Basics
    - Two-Phased Acquisition (Reduces Risk to All Parties)
    - Performance-Based (DB Team Optimizes Design/Cost)
    - Firm-Fixed Price Contract (Risk Management)
    - Incentives (Keeps DB Team Focused)
  - Deliberately Structured to Allow Innovation and Optimization
    - DB Team Was Free to Explore Solutions and Optimize Design/Cost to Meet Performance Objectives
  - Requires Owner/DB Team to Work Collaboratively Over the Life of the Project

# Change Starts with the Owner

- **Keys to Successful High Performance Buildings through PBDB**
  - Executive Leadership and Involvement from Start to Finish
  - Challenging the Entrenched Internal Culture
  - Extensive Early Planning
  - Aggressive But Achievable Performance Objectives
  - Iterative Energy Modeling
  - Whole Building Design
  - Contractor Freedom to Optimize Design/Costs to Create Best Value
  - Strict Control of Changes – No Changing Your Mind Once Papers Signed!
  - Earned Value Tracking and Reporting
  - Collaborative vs. Confrontational Owner/Contractor Relationship
  - Understanding Private Sector Perspective and Challenges
  - Commitment to Reducing Overall Project Risk for All Parties
  - Admitting What you Don't Know: Use of Owner's Representatives
  
- **How Did We Do?**

# RSF Achieves All Performance Goals

NREL-Research Support Facilities		PART 1-PROCEDURES	
Solicitation No. RFJ-8-77550		Attachments to Proposal Form	
<b>PROJECT OBJECTIVES CHECKLIST</b>			
This Project Objectives Checklist is to be submitted with the Proposal Form for evaluation purposes. Offeror's proposal must meet all Mission Critical Objectives in order to be "responsive". Objectives noted as "Highly Desirable" or "If Possible" will be evaluated as part of the Best Value Selection process. Write either "included" or "not included" corresponding to each objective your proposal will achieve or not achieve respectively. Each of the "included" objectives must have a corresponding narrative (one or two paragraphs) on how your proposal achieves the objective.			
<b>MISSION CRITICAL</b>			
Attain Safe Work Performance/Safe Design Practices			
LEED™ Platinum			
ENERGY STAR First "Plus", unless other system outperforms			
<b>HIGHLY DESIRABLE</b>			
Up to 800 Staff Capacity			
25 kBtu/sf/year			
Architectural Integrity			
Honor "Future Staff" Needs			
Measurable ASHRAE 90.1-50% plus			
Support culture and amenities			
Expandable building			
Ergonomics			
Flexible workspace			
Support future technologies			
Documentation to produce a "How to" manual			
"PR" campaign implemented in real-time for benefit of DOE/NREL and DB			
Allow secure collaboration with outsiders			
Building information modeling			
Substantial Completion by May 2010			
Appendix A: Conceptual Documents		Page 42 of 299	
February 6, 2008			

NREL-Research Support Facilities		PART 1-PROCEDURES	
Solicitation No. RFJ-8-77550		Attachments to Proposal Form	
<b>IF POSSIBLE</b>			
Net Zero/Design approach			
Most energy efficient building in the world			
LEED™ Platinum Plus			
ASHRAE 90.1 plus 50%+			
Visual displays of current energy efficiency			
Support public tours			
Achieve national and global recognition and awards			
Support personnel turnover			

- Aggressive but Achievable Performance Objectives Energy and Substantiation Criteria
  - Defines the Design-Build Team's Value Challenge
  - Primary Responsibility of Owner and Critical to Success



# RSF Achieves LEED Platinum

## Final LEED® Project Scorecard



Project Name: NREL Research Support Facilities  
 AEC Project # 08-163 Level Pursuing: Platinum, LEED-NCv2.2

Date: June 3, 2011

Y	M	N	Sustainable Sites	
Y			Prerequisite 1	Construction Activity Pollution Prevention
X			Credit 1	Site Selection
		X	Credit 2	Development Density & Community Connectivity
		X	Credit 3	Brownfield Redevelopment
X			Credit 4.1	Alternative Transportation: Public Transportation Access
X			Credit 4.2	Alternative Transportation: Bicycle Storage & Changing Rooms
X			Credit 4.3	Alternative Transportation: Low-Emitting & Fuel Efficient Vehicles
X			Credit 4.4	Alternative Transportation: Parking Capacity
X			Credit 5.1	Site Development: Protect or Restore Habitat
X			Credit 5.2	Site Development: Maximize Open Space
X			Credit 6.1	Stormwater Design: Quantity Control
X			Credit 6.2	Stormwater Design: Quality Control
X			Credit 7.1	Heat Island Effect: Non-Roof
X			Credit 7.2	Heat Island Effect: Roof
X			Credit 8	Light Pollution Reduction
12	0	2	14 Possible	

Y	M	N	Water Efficiency	
X			Credit 1.1	Water Efficient Landscaping: Reduce by 50%
		X	Credit 1.2	Water Efficient Landscaping: No Potable Water Use or No Irrigation
X			Credit 2	Innovative Wastewater Technologies
X			Credit 3.1	Water Use Reduction: 20% Reduction
X			Credit 3.2	Water Use Reduction: 30% Reduction
4	0	1	5 Possible	

Y	M	N	Energy and Atmosphere	
Y			Prerequisite 1	Fundamental Commissioning of the Building Energy Systems
Y			Prerequisite 2	Minimum Energy Performance
Y			Prerequisite 3	Fundamental Refrigerant Management
X			Credit 1.1	Optimize Energy Performance, 10.5% new, 3.5% existing
X			Credit 1.2	Optimize Energy Performance, 14% new, 7% existing
X			Credit 1.3	Optimize Energy Performance, 17.51% New 10.5% Existing
X			Credit 1.4	Optimize Energy Performance, 21% New 14% Existing
X			Credit 1.5	Optimize Energy Performance, 24.51% New 17.5% Existing
X			Credit 1.6	Optimize Energy Performance, 28% New 21% Existing
X			Credit 1.7	Optimize Energy Performance, 31.5% New 24.5% Existing
X			Credit 1.8	Optimize Energy Performance, 35% New 28% Existing
X			Credit 1.9	Optimize Energy Performance, 38.5% New 31.5% Existing
X			Credit 1.10	Optimize Energy Performance, 42% New 35% Existing
X			Credit 2.1	On-Site Renewable Energy: 2.5%
X			Credit 2.2	On-Site Renewable Energy: 7.5%
X			Credit 2.3	On-Site Renewable Energy: 12.5%
X			Credit 3	Enhanced Commissioning
X			Credit 4	Enhanced Refrigerant Management
X			Credit 5	Measurement & Verification
X			Credit 6	Green Power: 35%
17	0	0	17 Possible	

Y	M	N	Materials and Resources	
Y			Prerequisite 1	Storage & Collection of Recyclables
		X	Credit 1.1	Building Reuse: Maintain 75% of Existing Walls, Floors & Roof
		X	Credit 1.2	Building Reuse: Maintain 95% of Existing Walls, Floors & Roof
		X	Credit 1.3	Building Reuse: Maintain 50% of Interior Non-Structural Elements
X			Credit 2.1	Construction Waste Management: Divert 50% From Disposal
X			Credit 2.2	Construction Waste Management: Divert 75% From Disposal
		X	Credit 3.1	Materials Reuse: 5%
		X	Credit 3.2	Materials Reuse: 10%
X			Credit 4.1	Recycled Content: 10% (post-consumer + 1/2 pre-consumer)
X			Credit 4.2	Recycled Content: 20% (post-consumer + 1/2 pre-consumer)
X			Credit 5.1	Regional Materials: 10% Extracted, Processed & Manufactured Locally
X			Credit 5.2	Regional Materials: 20% Extracted, Processed & Manufactured Locally
		X	Credit 6	Rapidly Renewable Materials, 2.5%
X			Credit 7	Certified Wood
7	0	6	13 Possible	

Y	M	N	Indoor Environmental Quality	
Y			Prerequisite 1	Minimum IAQ Performance
Y			Prerequisite 2	Environmental Tobacco Smoke (ETS) Control
X			Credit 1	Outside Air Delivery Monitoring
X			Credit 2	Increased Ventilation
X			Credit 3.1	Construction IAQ Management Plan: During Construction
X			Credit 3.2	Construction IAQ Management Plan: Before Occupancy
X			Credit 4.1	Low-Emitting Materials: Adhesives & Sealants
X			Credit 4.2	Low-Emitting Materials: Paints & Coatings
X			Credit 4.3	Low-Emitting Materials: Carpet Systems
X			Credit 4.4	Low-Emitting Materials: Composite Wood & Agrifiber Products
X			Credit 5	Indoor Chemical & Pollutant Source Control
X			Credit 6.1	Controllability of Systems: Lighting
		X	Credit 6.2	Controllability of Systems: Thermal Comfort
X			Credit 7.1	Thermal Comfort: Design
X			Credit 7.2	Thermal Comfort: Verification
X			Credit 8.1	Daylight and Views: Daylight 75% of spaces
X			Credit 8.2	Daylight and Views: Views for 90% of Spaces
14	0	1	15 Possible	

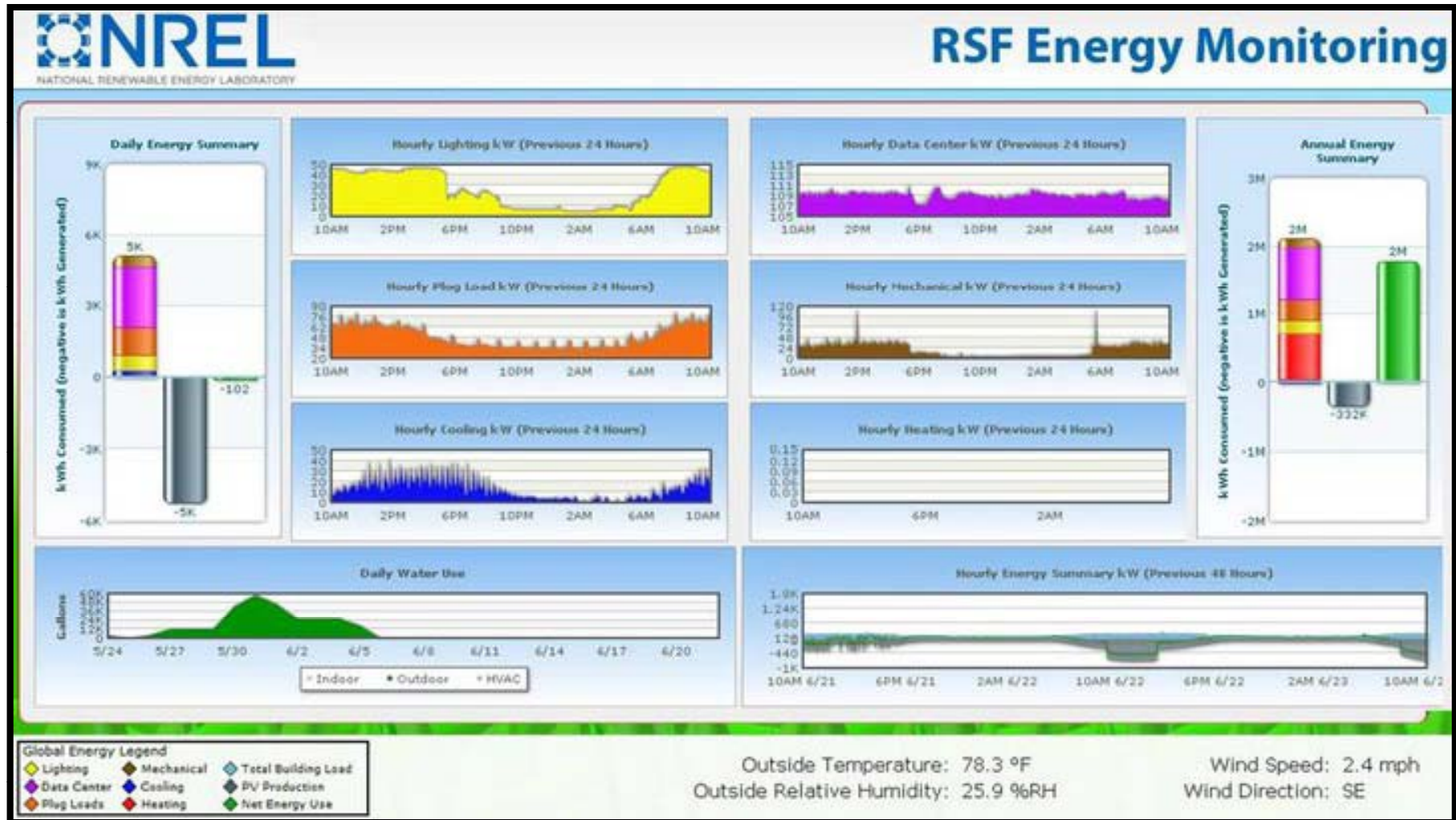
Y	M	N	Innovation & Design Process	
X			Credit 1.1	Exemplary Performance, 40% Water Use Reduction
X			Credit 1.2	Buildings That Teach / Educational Outreach
X			Credit 1.3	Exemplary Performance, Maximize Open Space
X			Credit 1.4	Exemplary Performance, Optimize Energy Performance
X			Credit 2	LEED® Accredited Professional
5	0	0	5 Possible	

	0 - 25	Insufficient
	26 - 32	Certified
	33 - 38	Silver
	39 - 51	Gold
	52 - 69	Platinum

Project Points	Maybe
59	0
Platinum	

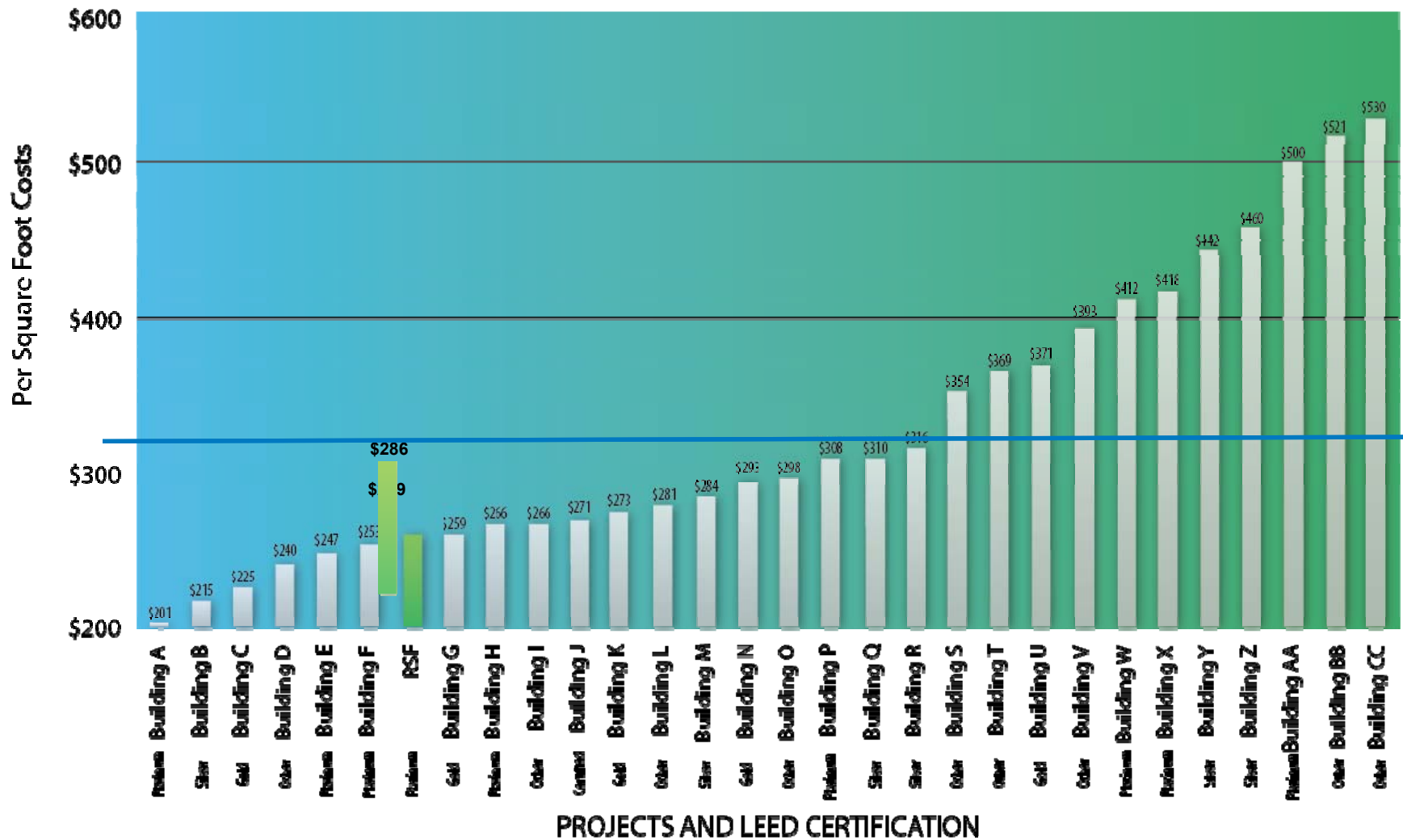
Top 25 in LEEDs Points Over 9000 Projects Worldwide!

# RSF Achieves Net Zero Energy Status



# RSF Achieves Low Construction Costs

COMMERCIAL CONSTRUCTION BUILDING COSTS - By Cost Per Square Foot



# RSF Achieves All Baselines at Lower Risk

Management Reserve/Contingency Use as an Indicator of Project Risk			
Project	Total Project Cost	Planned Use MR/Contingency	Actual Use MR/Contingency
RSF I	\$80.0M	3.95%	0.62%
RSF II	\$67.7M	10.0%	0.53%
IBRF I	\$20.8M	2.4%	0.42%
IBRF II	\$13.4M	3.72%	2.21%
Infrastructure I	\$7.3M	4.42%	0.16%
Infrastructure II	\$13.0M	3.85%	1.66%
Ingress/Egress	\$44.0M	8.64%	4.2%*
ESIF	\$135.0M	6.73%	0.4%*

\* Projects in Progress