Is Energy Efficiency Being Overlooked as a Carbon-Abatement Solution?

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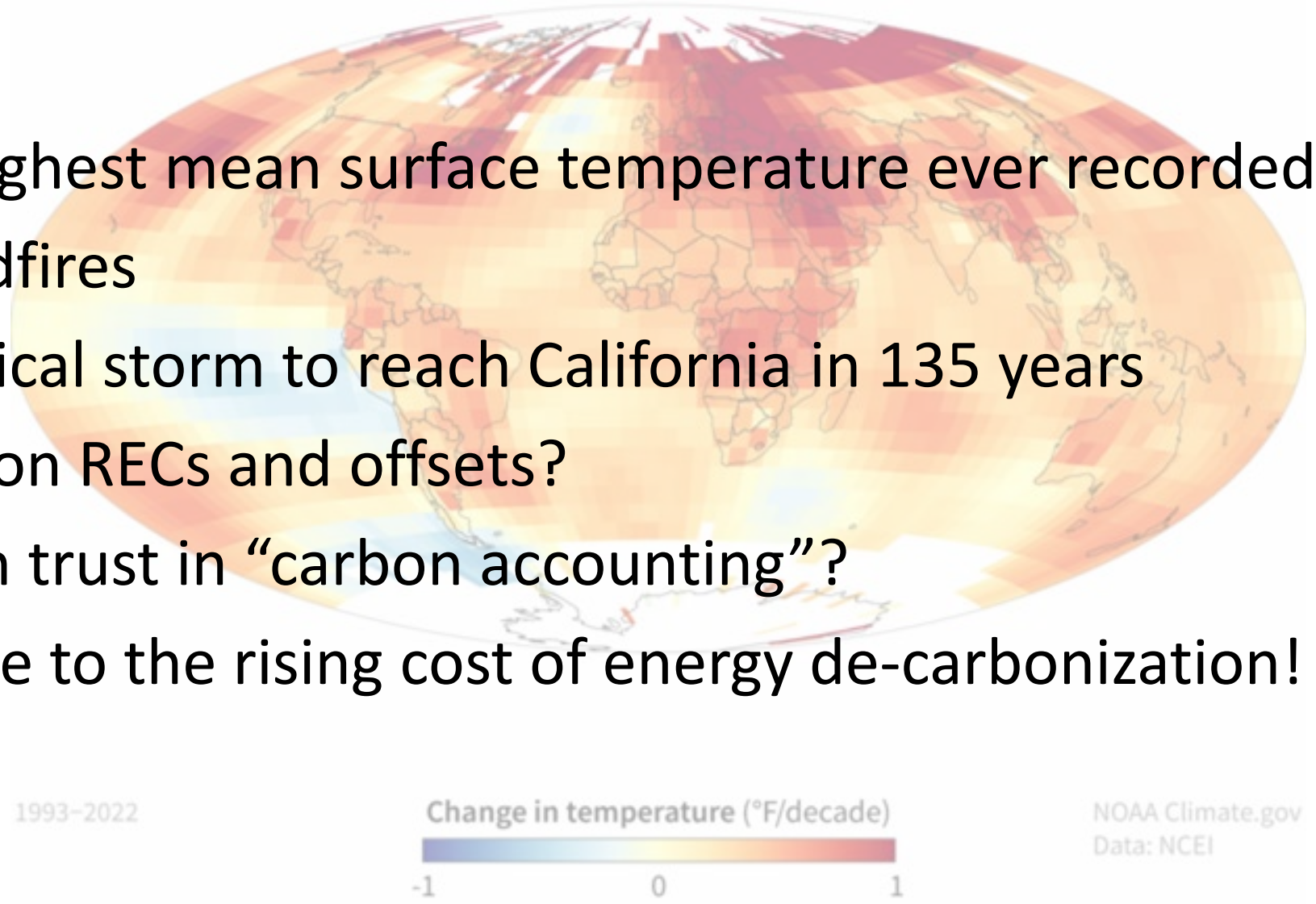
Are We at a Critical Stage?



- Earth's highest mean surface temperature ever recorded
- Maui wildfires
- First tropical storm to reach California in 135 years
- Reliance on RECs and offsets?
- Too much trust in "carbon accounting"?
- Resistance to the rising cost of energy de-carbonization!

How Long Will Climate Solutions Take to Mature?

- Fusion?
- Fission reactors acceptable to the public?
- Seasonal/long-duration storage?
- Deep energy efficiency?

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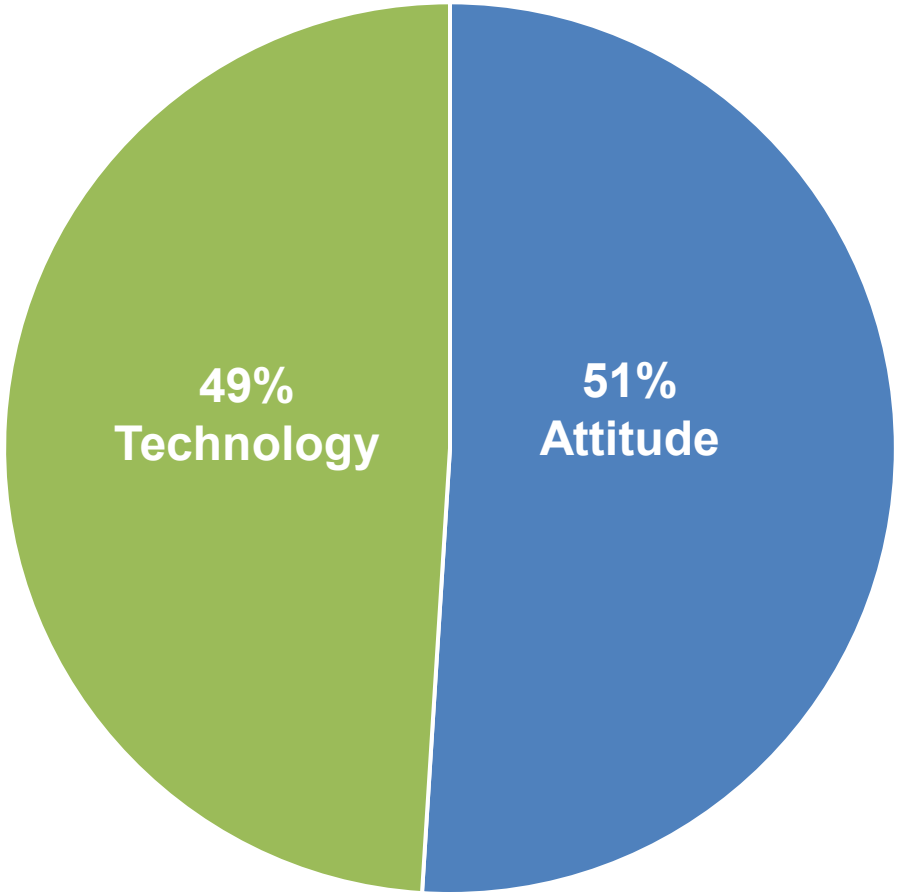
- Seasonal/long-duration storage - 20 years?
- Deep energy efficiency - **5 years!**

Key Factors Enable *Deep* Energy Efficiency



Engineers Challenged Culture of “Best Practices”

For example…

“more is better”

“___ is a standard design practice”

“always done that way”

What Is “Deep” Energy Efficiency?

“Deep” means challenge status quo assumptions and practices:

- A “good” energy project yields **10-15% efficiency improvement**
- A **3-year payback** is a “good” energy efficiency project or retrofit
- **“More is better”** when it comes to ventilation, exhaust, and lumens
- **RECs and offsets** are a credible alternative to an efficiency upgrade.

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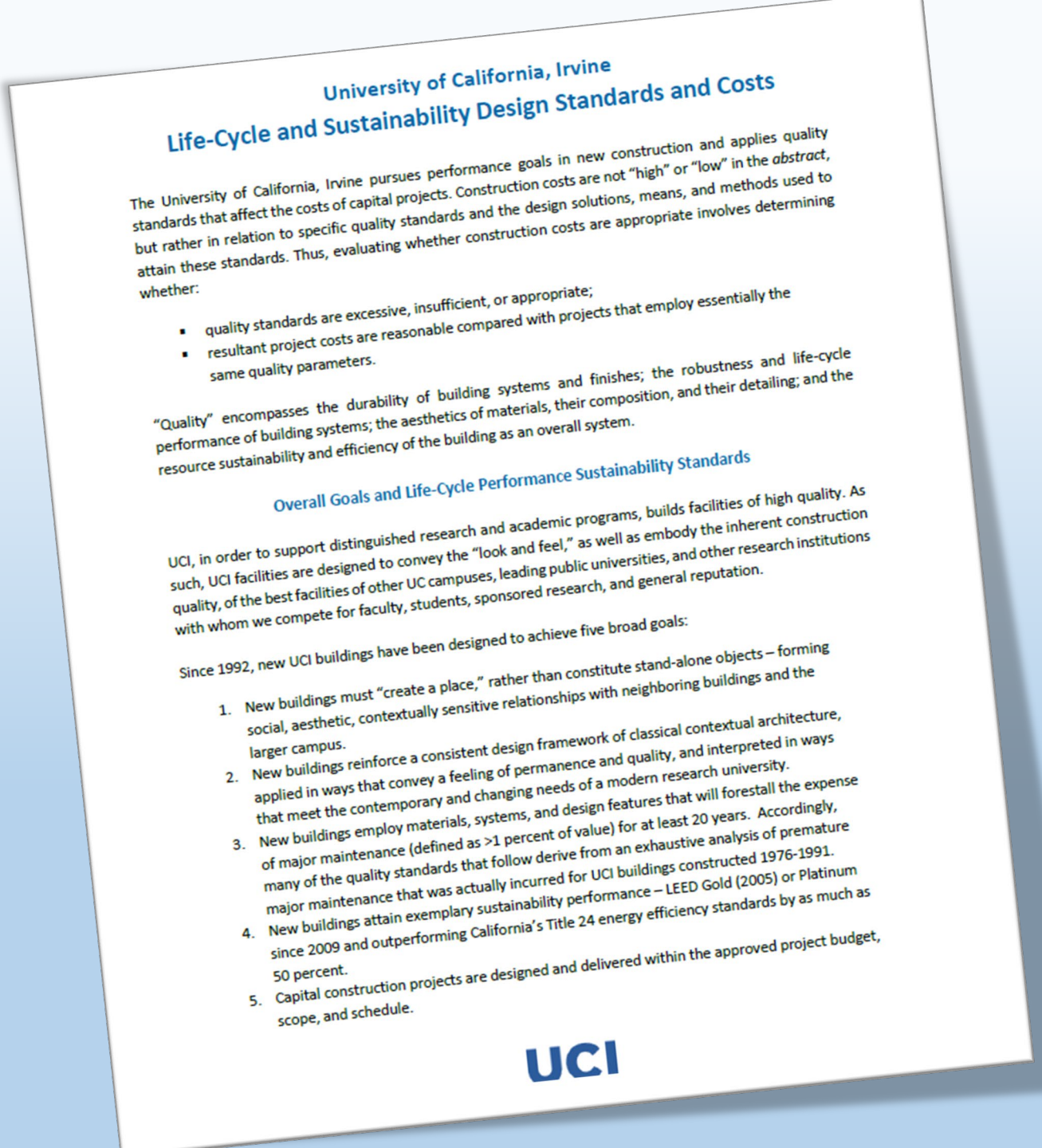
- RECs and offsets are temporary outsourcing of de-carbonization, which is **no substitute for a permanent efficiency upgrade**.

Three Forms of Financing

- “Energy bonds” 15 year revenue bonds
- Internal borrowing from cash reserves
- Different design priorities for new construction.



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Life-Cycle and Sustainability Design Standards and Costs

The University of California, Irvine pursues performance goals in new construction and applies quality standards that affect the costs of capital projects. Construction costs are not "high" or "low" in the *abstract*, but rather in relation to specific quality standards and the design solutions, means, and methods used to attain these standards. Thus, evaluating whether construction costs are appropriate involves determining whether:

- quality standards are excessive, insufficient, or appropriate;
- resultant project costs are reasonable compared with projects that employ essentially the same quality parameters.

"Quality" encompasses the durability of building systems and finishes; the robustness and life-cycle performance of building systems; the aesthetics of materials, their composition, and their detailing; and the resource sustainability and efficiency of the building as an overall system.

Overall Goals and Life-Cycle Performance Sustainability Standards

UCI, in order to support distinguished research and academic programs, builds facilities of high quality. As such, UCI facilities are designed to convey the "look and feel," as well as embody the inherent construction quality, of the best facilities of other UC campuses, leading public universities, and other research institutions with whom we compete for faculty, students, sponsored research, and general reputation.

Since 1992, new UCI buildings have been designed to achieve five broad goals:

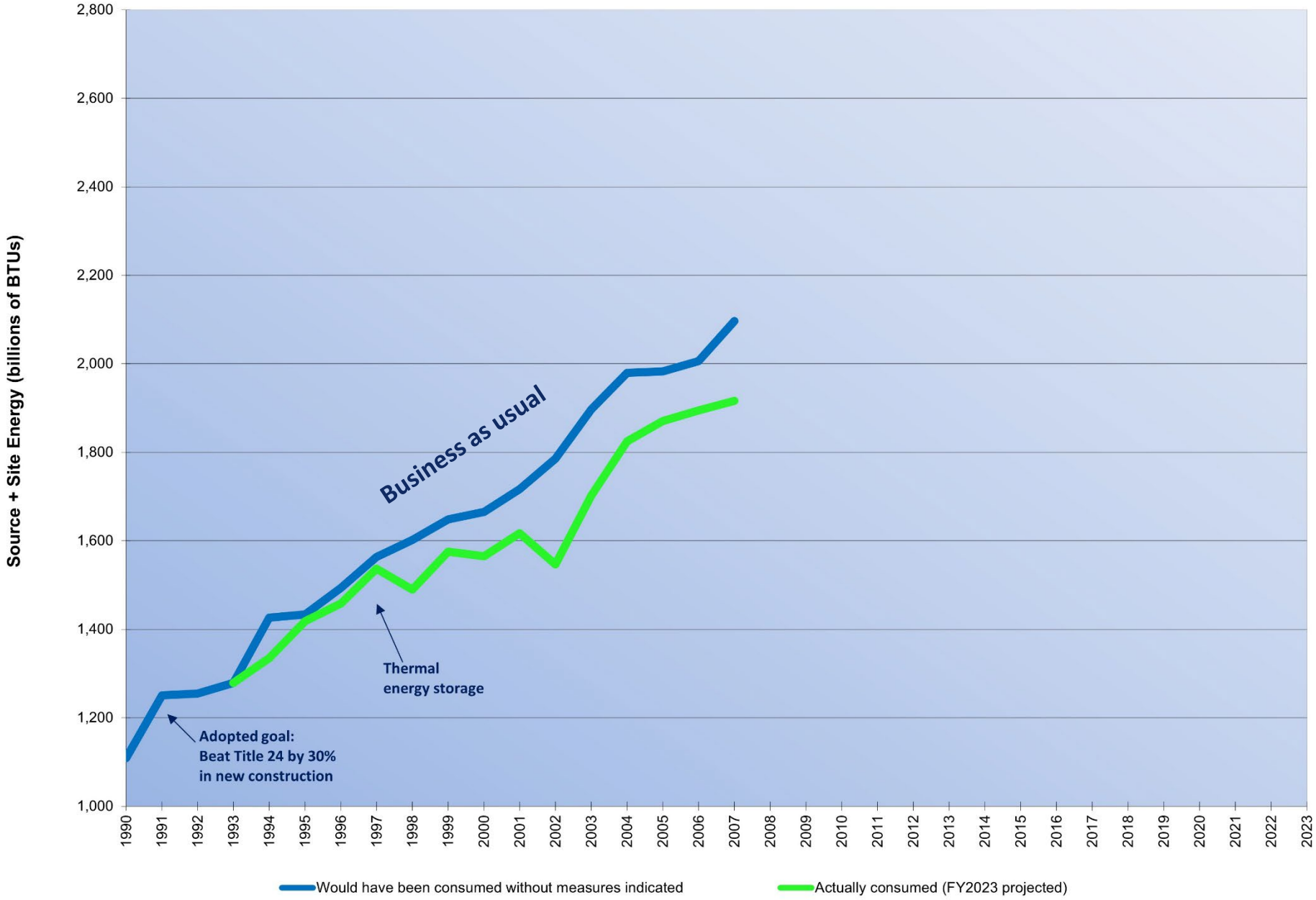
1. New buildings must "create a place," rather than constitute stand-alone objects – forming social, aesthetic, contextually sensitive relationships with neighboring buildings and the larger campus.
2. New buildings reinforce a consistent design framework of classical contextual architecture, applied in ways that convey a feeling of permanence and quality, and interpreted in ways that meet the contemporary and changing needs of a modern research university.
3. New buildings employ materials, systems, and design features that will forestall the expense of major maintenance (defined as >1 percent of value) for at least 20 years. Accordingly, many of the quality standards that follow derive from an exhaustive analysis of premature major maintenance that was actually incurred for UCI buildings constructed 1976-1991.
4. New buildings attain exemplary sustainability performance – LEED Gold (2005) or Platinum since 2009 and outperforming California's Title 24 energy efficiency standards by as much as 50 percent.
5. Capital construction projects are designed and delivered within the approved project budget, scope, and schedule.

UCI

- Building Organization and Massing
- Life-Cycle Design Concepts
- Structural and Foundation Systems
- Building Mechanical Systems
- Lighting Design Standards
- Management of Solar Heat Gain
- Roofing and Flashing
- Site Development
- Exterior Cladding and Interior Finishes
- Priorities and Trade-offs
- Benefits and Cost-Control Strategies
- Results

www.youtube.com/watch?v=6tK9MYwwPcI

What Evidence Do We Have That These Strategies Work?



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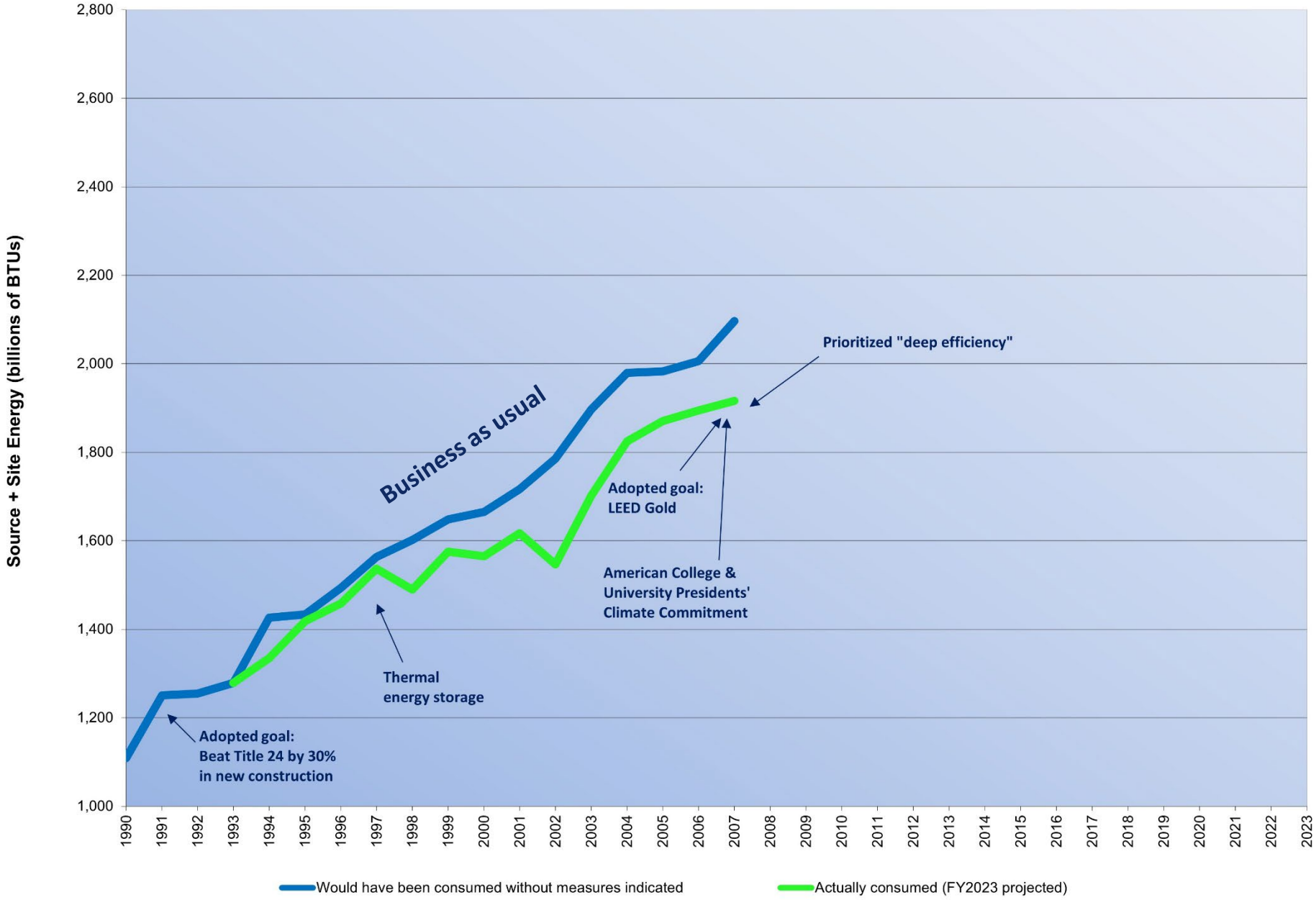
Three Decades of Energy Efficiency



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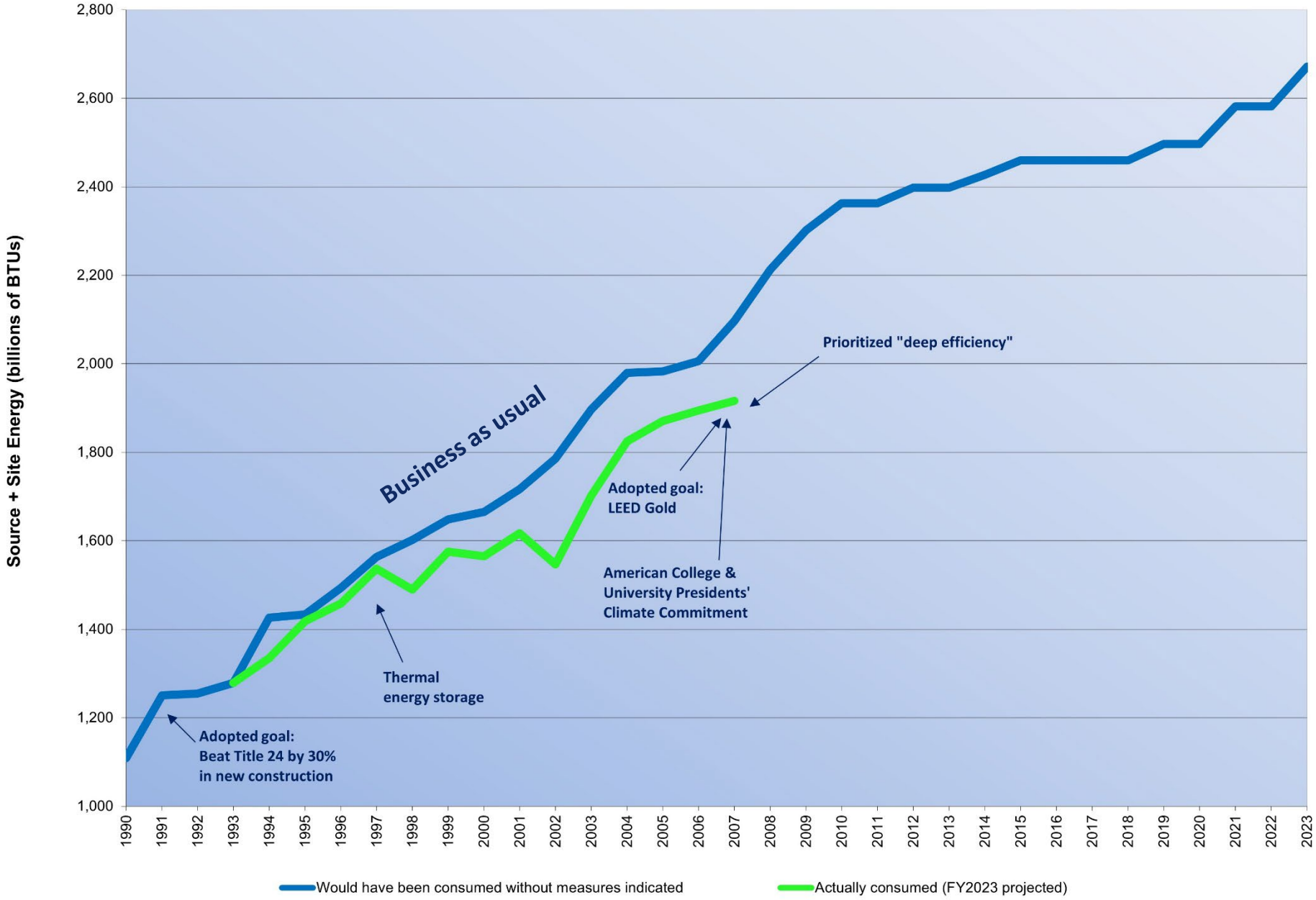

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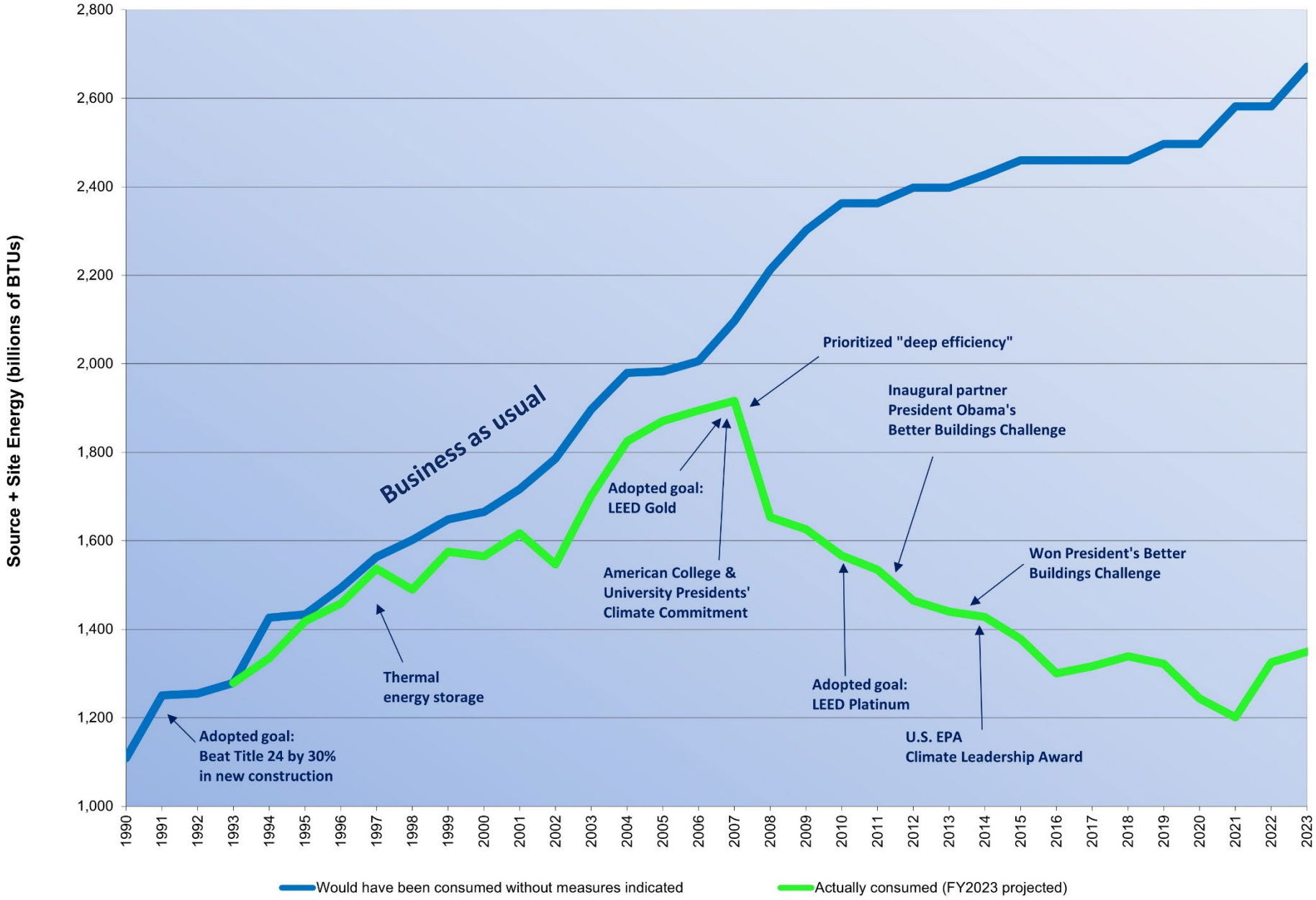

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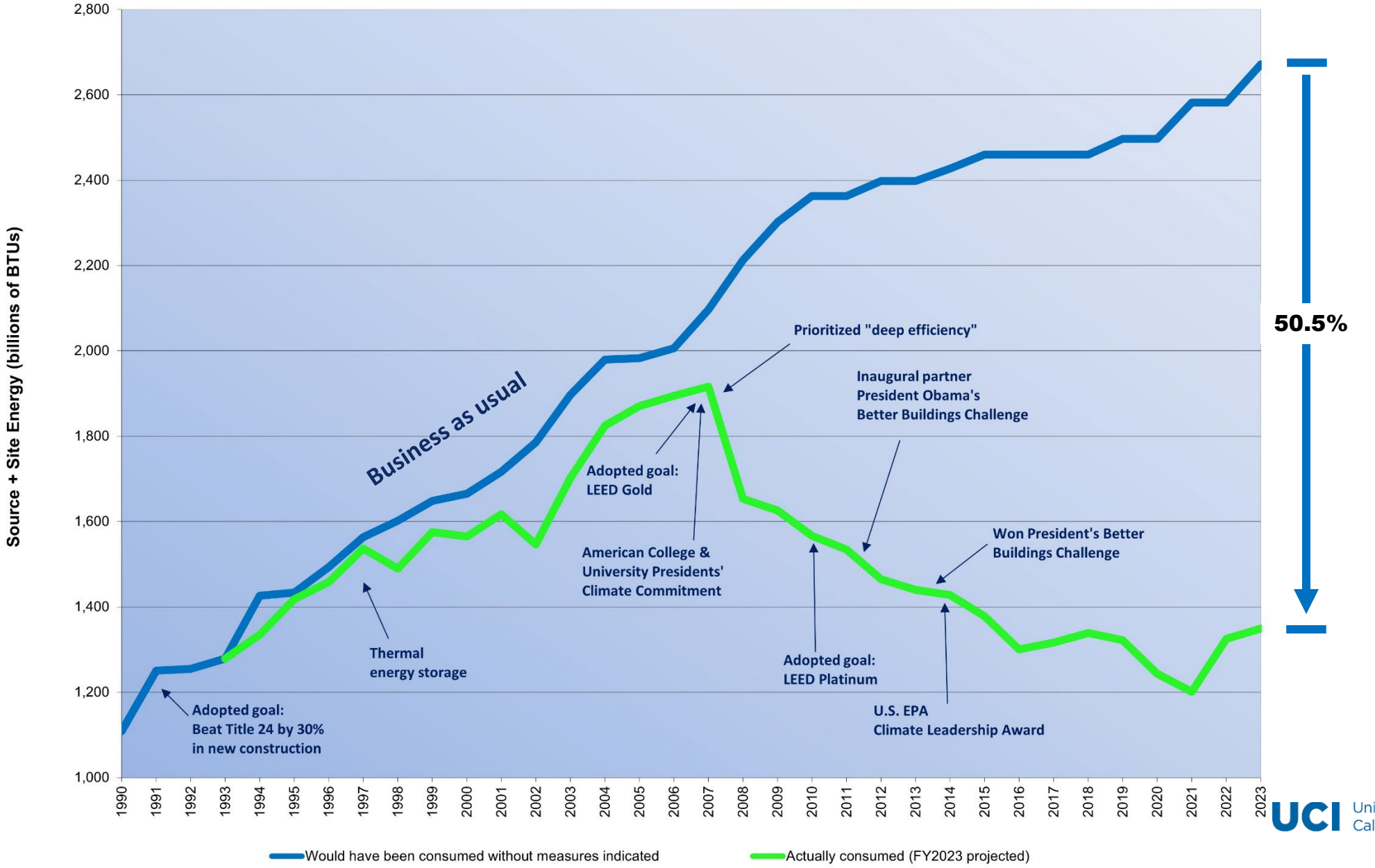

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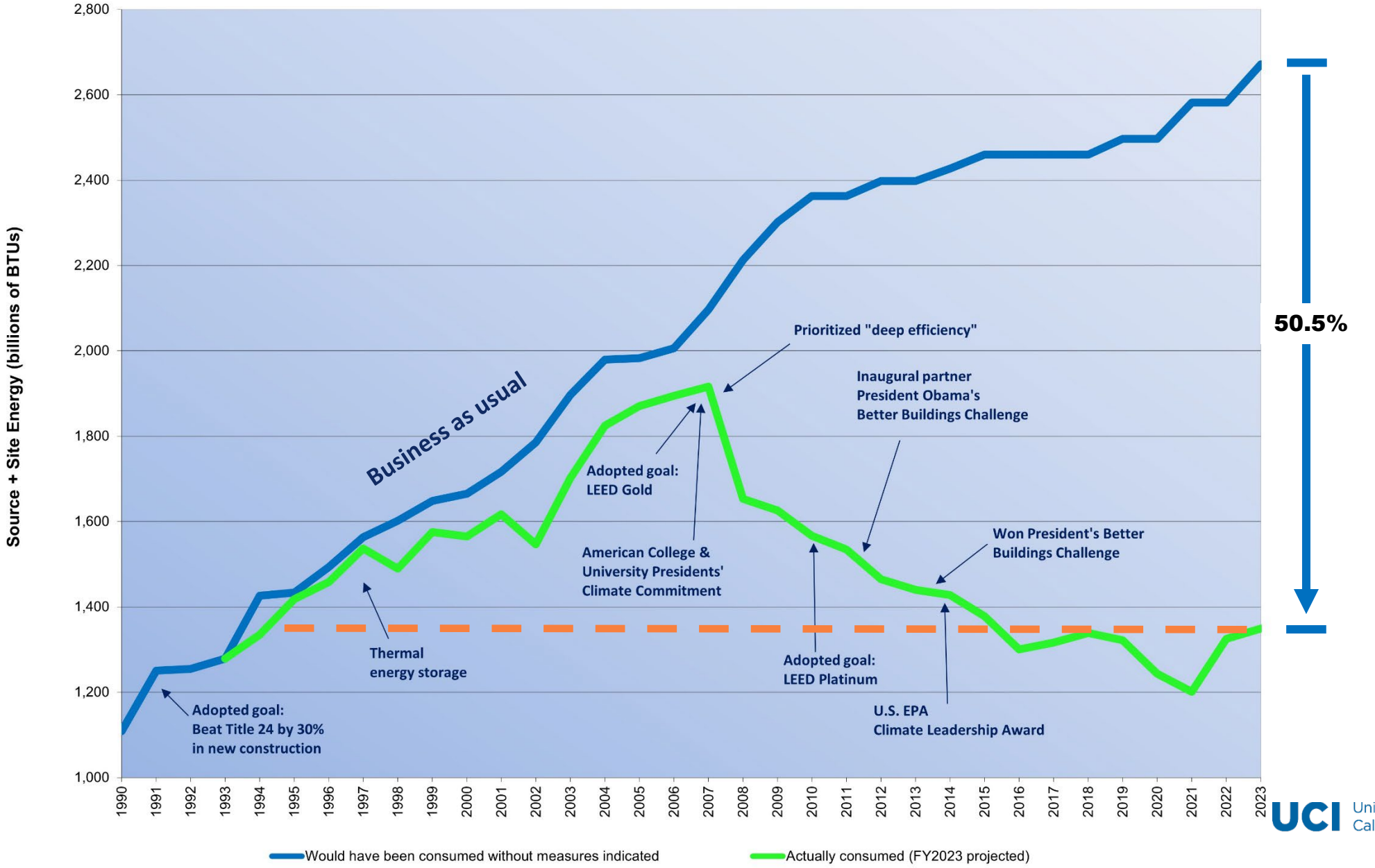

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Cross-Checking Evidence that these Strategies Work

	1994	2023	30-year △
Campus total GSF	5.88 million SF		
Fall FTE enrollment	15,800		
Total energy consumed	1.33 x 10^{12} BTU		

Cross-Checking Evidence that these Strategies Work

	1994	2023	30-year △
Campus total GSF	5.88 million SF	12.68 million SF	
Fall FTE enrollment	15,800	36,587	
Total energy consumed	1.33 x 10^{12} BTU	1.35 x 10^{12} BTU	

Cross-Checking Evidence that these Strategies Work

	1994	2023	30-year △
Campus total GSF	5.88 million SF	12.68 million SF	+115%
Fall FTE enrollment	15,800	36,587	+132%
Total energy consumed	1.33 x 10^{12} BTU	1.35 x 10^{12} BTU	+1.5%

Most Co-Benefits Yield Additional Economic Savings

- Real-time commissioning and rapid fault-detection
- Laboratories are safer
- Longer service life for reduced-speed, cooler mechanical components
- Cleaner indoor air and improved infection control
- Reduced costs for chillers, boilers, upstream infrastructure
- Avoided carbon costs
- Reduced operations and maintenance expense
- Deferred maintenance fixed/funded through energy savings
- Improved reliability of research environment.

Results and Conclusions

- Campus doubled size in 3 decades, but consumes no more energy
- Deep energy efficiency proven viable
- Zero budget augmentation for energy efficiency
- Many co-benefits attained in addition to energy savings
- **The lowest cost form of de-carbonization possible – ZERO!**

Life-Cycle and Sustainability Design Standards and Costs

https://www.designandconstruction.uci.edu/_pdf/uci-life-cycle-design-standards-and-costs.pdf

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