



GovEnergy

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A River of Energy Solutions

Net Zero Buildings: Is There an App For That?

Mr. Dave Robau

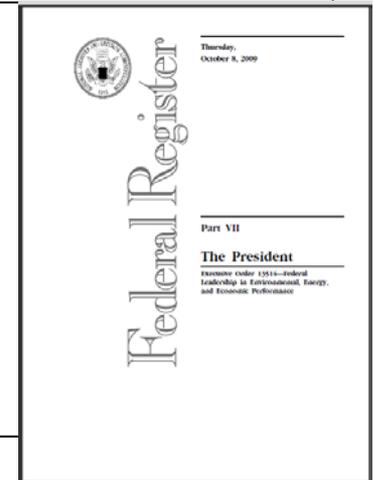
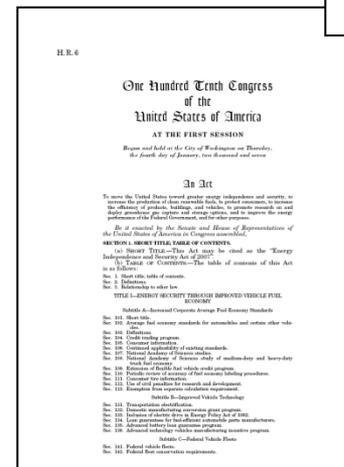
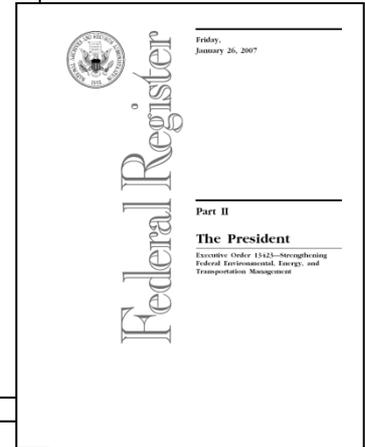
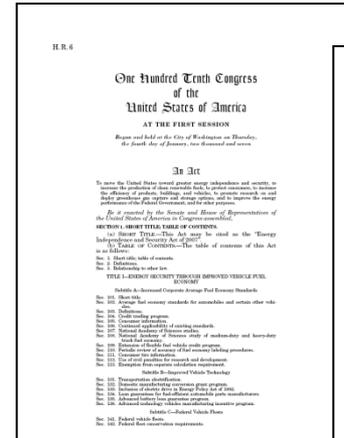
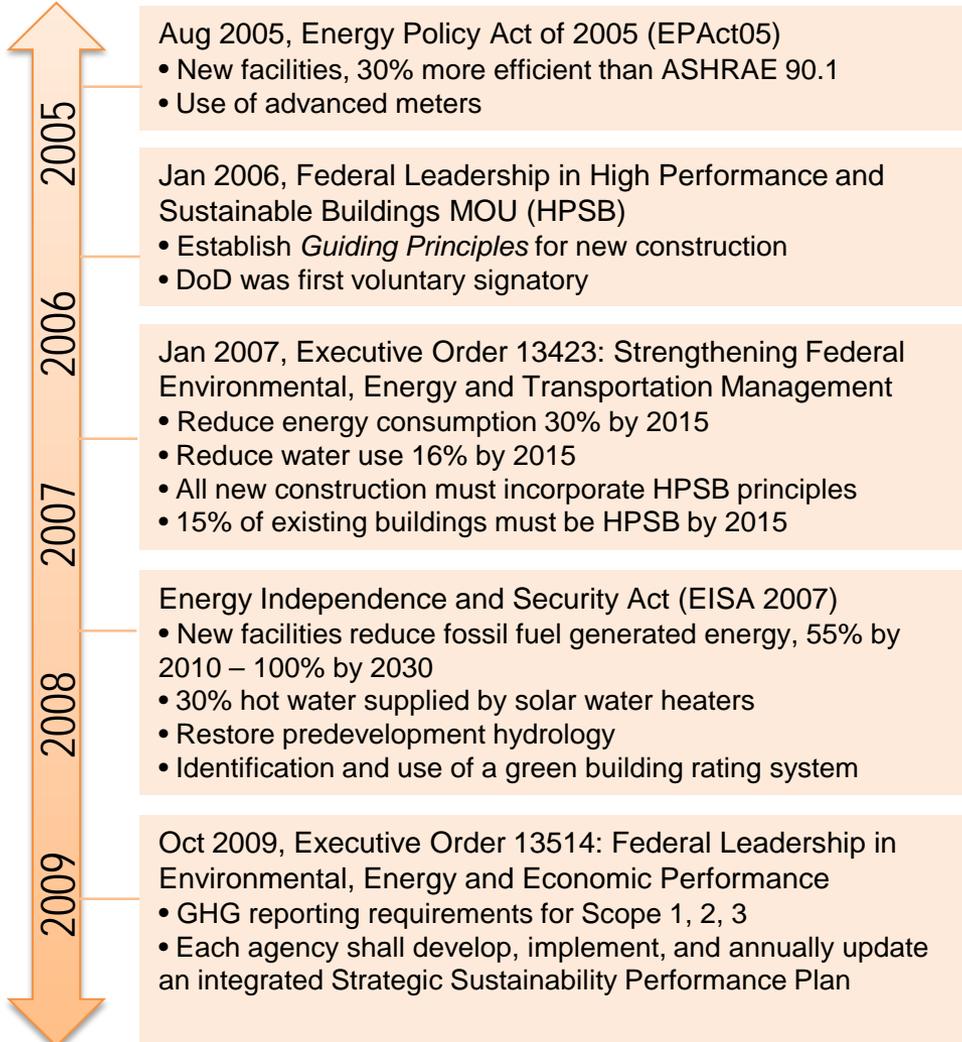
Session Intent

Gain in-depth knowledge of net-zero/high-performance sustainable building planning and construction.

Introduction

- ❑ Policy Drivers and Executive Orders
- ❑ Discuss high-performance sustainable or net-zero building with today's technologies and occupant expectations
- ❑ A Critical Definition of Net-Zero Buildings
- ❑ Overarching Elements to Success:
 - ❑ Strategic Vision & Goal Setting
 - ❑ Energy-Efficient Design
 - ❑ Energy Generation
- ❑ Success Stories

Current Directives



Current Directives

Revision of policy memorandum nearing final draft

All construction that meets the USGBC LEED 2009 Minimum Program Requirements (MPRs) *will receive formal LEED Silver Certification* as the minimum certification level

Incorporates requirements of DoD Infrastructure Sustainability Policy memo (draft) – *minimum of 20 points in energy and water*

- Incorporates Federal High Performance and Sustainable Building (HPSB) requirements of EPLA 05, EO 13423, EISA 07, and EO 13514
- Requires life-cycle cost analysis
- Provides sustainable benchmarks for other project types – Horizontal, Utility, and Industrial
- Installations shall use AF MILCON Requirements Scoresheet to track and report HPSB and LEED status at four key milestones

Executive Orders

EO 13514, *Leadership in Environmental, Energy, and Economic Performance*

Reinforces and expands requirements of EO 13423

GHG reporting requirements for Scope 1, 2, & 3

Federal facilities planned after 2020 shall be net zero-energy

Each agency shall develop, implement, and **annually** update an integrated Strategic Sustainability Performance Plan and will **prioritize** agency actions based on **lifecycle return on investment**

Sec. 3. Agency Strategic Sustainability Performance Plan. Each agency shall develop, implement, and annually update an integrated Strategic Sustainability Performance Plan that will prioritize agency actions based on lifecycle return on investment. Each agency Plan and update shall be subject to approval by the OMB Director under section 4 of this order. With respect to the period beginning in fiscal year 2011 and continuing through the end of fiscal year 2021, each agency Plan shall:

(a) include a policy statement committing the agency to compliance with environmental and energy statutes, regulations, and Executive Orders;

(b) achieve the sustainability goals and targets, including greenhouse gas reduction targets, established under section 2 of this order;

(c) be integrated into the agency's strategic planning and budget process, including the agency's strategic plan under section 3 of the Government Performance and Results Act of 1993, as amended (5 U.S.C. 306);

(d) identify agency activities, policies, plans, procedures, and practices that are relevant to the agency's implementation of this order, and where necessary, provide for development and implementation of new or revised policies, plans, procedures, and practices;

(e) identify specific agency goals, a schedule, milestones, and approaches for achieving results, and quantifiable metrics for agency implementation of this order;

(f) take into consideration environmental measures as well as economic and social benefits and costs in evaluating projects and activities based on lifecycle return on investment;

(g) outline planned actions to provide information about agency progress and performance with respect to achieving the goals of this order on a publicly available Federal website;

(h) incorporate actions for achieving progress metrics identified by the OMB Director and the CEQ Chair;

(i) evaluate agency climate-change risks and vulnerabilities to manage the effects of climate change on the agency's operations and mission in both the short and long term; and

(j) identify in annual updates opportunities for improvement and evaluation of past performance in order to extend or expand projects that have net lifecycle benefits, and reassess or discontinue under-performing projects.

Why LEED?

IMPACTS OF U.S. BUILDINGS ON RESOURCES

40% primary energy use*

72% electricity consumption*

39% CO₂ emissions*

13.6% potable water consumption**

- Global CO₂ Emissions By Sector:
 - #1 Buildings
 - #2 Transportation
 - #3 Industry

Sources:
*Environmental Information Administration (2008). EIA Annual Energy Outlook.
** U.S. Geological Survey (2000). 2000 data.

Defining ZEB

A net zero-energy building (ZEB) is a residential or commercial building with greatly reduced energy needs through efficiency gains such that the balance of energy needs can be supplied with renewable technologies*

The way the zero energy goal is defined affects the choices designers make to achieve this goal and whether they can claim success*

*** Zero Energy Buildings: A Critical Look at the Definition**

Paul Torcellini, Shanti Pless, and Michael Deru, National Renewable Energy Laboratory Drury Crawley, U.S. Department of Energy, National Renewable Energy Laboratory

Defining ZEB

Electricity consumption in the commercial building sector doubled between 1980 and 2000, and is expected to increase another 50% by 2025*

- Energy consumption in the commercial building sector will continue to increase until buildings can be designed to produce enough energy to offset the growing energy demand of these buildings
- The DOE has established an aggressive goal to create the technology and knowledge base for cost-effective zero-energy commercial buildings (ZEBs) by 2025

* EIA. (2005). *Annual Energy Review 2004*. www.eia.doe.gov/emeu/aer/contents.html. Washington, DC: U.S. Department of Energy, Energy Information Administration

Defining ZEB

Things to Keep In Mind:

We know that a ZEB starts with greatly reduced energy needs (energy efficiency) so that the balance of the energy load can be supplied by (onsite/offsite) renewable technologies

- Zero-Energy Buildings: Boundary Definitions and Energy Flows
- Grid Connection Is Allowed and Necessary for Energy Balances
- Prioritize Supply-Side Technologies to Those Available On Site and within the Footprint

Defining ZEB

ZEB Renewable Energy Supply Option Hierarchy

Option Number	ZEB Supply-Side Options	Examples
0	Reduce site energy use through low-energy building technologies	Daylighting, high-efficiency HVAC equipment, natural ventilation, evaporative cooling, etc.
On-Site Supply Options		
1	Use renewable energy sources available within the building's footprint	PV, solar hot water, and wind located on the building
2	Use renewable energy sources available at the site	PV, solar hot water, low-impact hydro, and wind located on-site, but not on the building
Off-Site Supply Options		
3	Use renewable energy sources available off site to generate energy on site	Biomass, wood pellets, ethanol, or biodiesel that can be imported from off site, or waste streams from on-site processes that can be used on-site to generate electricity and heat
4	Purchase off-site renewable energy sources	Utility-based wind, PV, emissions credits, or other "green" purchasing options. Hydroelectric is sometimes considered

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Elements to Success

Strategic Vision & Goal Setting

- What are you trying to accomplish?
- Seek input from all stakeholders

Energy-Efficient Design Elements

- Take what the site gives you
- Reduce demand - focus on the “negawatt”

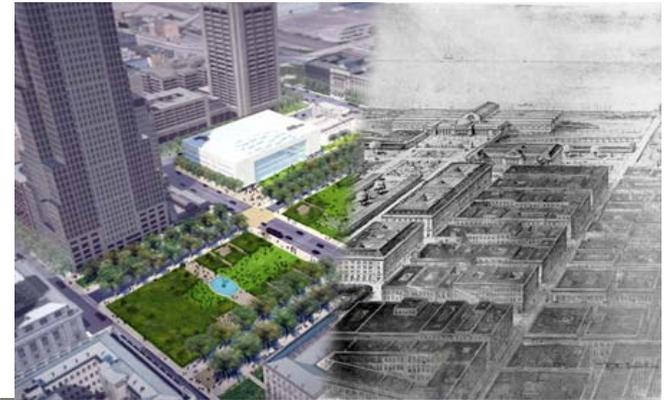
Energy Generation

- Think globally, generate locally
- Consider total cost of ownership - Life Cycle Cost Assessment

Elements to Success

Strategic Vision & Goal Setting

- Develop the objectives, define the target
- Reverse engineer the solution
- Market the vision & communicate the message
- Build the coalition



Elements to Success

Energy-Efficient Design (It's sexier than you think)

- Take advantage of “free” energy
- Look beyond “first cost” and take a more holistic approach
- Take advantage of technology
- Use LEED® as a “roadmap” and not a checklist



Elements to Success

Energy Generation*

- Look beyond “first cost”
- Evaluate total cost of ownership
- Consider maintenance and long-term costs
 - Life Cycle Cost Assessment

* Not every kilowatt is “created” equally



High Performance Database

DOE's Energy Efficiency & Renewable Energy ZEB Database: <http://zeb.buildinggreen.com/>

- Searchable database that highlights projects from across the country
- Provides *inspiration* for your next project
- Offers in-depth information about the design and construction process, financing, energy use, materials, indoor environment, and more...

Success Stories

Adam Joseph Lewis Center for Environmental Studies. Oberlin, Ohio

Overview:

Building type: Higher education

New construction

Size: 13,600 ft²

Completed: January 2000

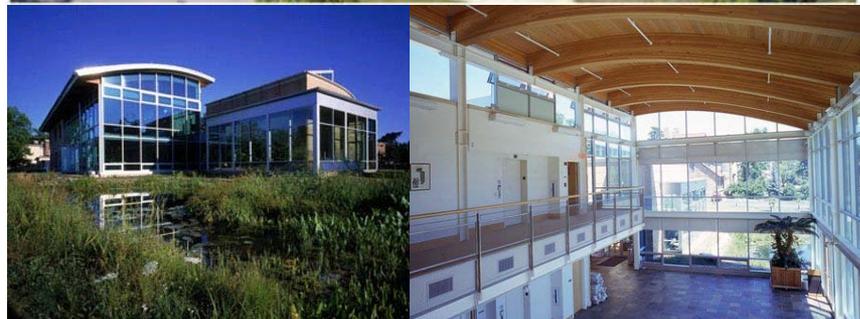
Rating: Green Building Challenge

Rating: Zero Energy Building

60kW PV system (Roof)

100 kW PV system (Parking lot)

<http://www.oberlin.edu/ajlc/ajlcHome.html>



Success Stories

Aldo Leopold Legacy Center, Baraboo, Wisconsin

Overview:

Building type: Interpretative Center

New construction

Size: 11,900 ft²

Completed: April 2007

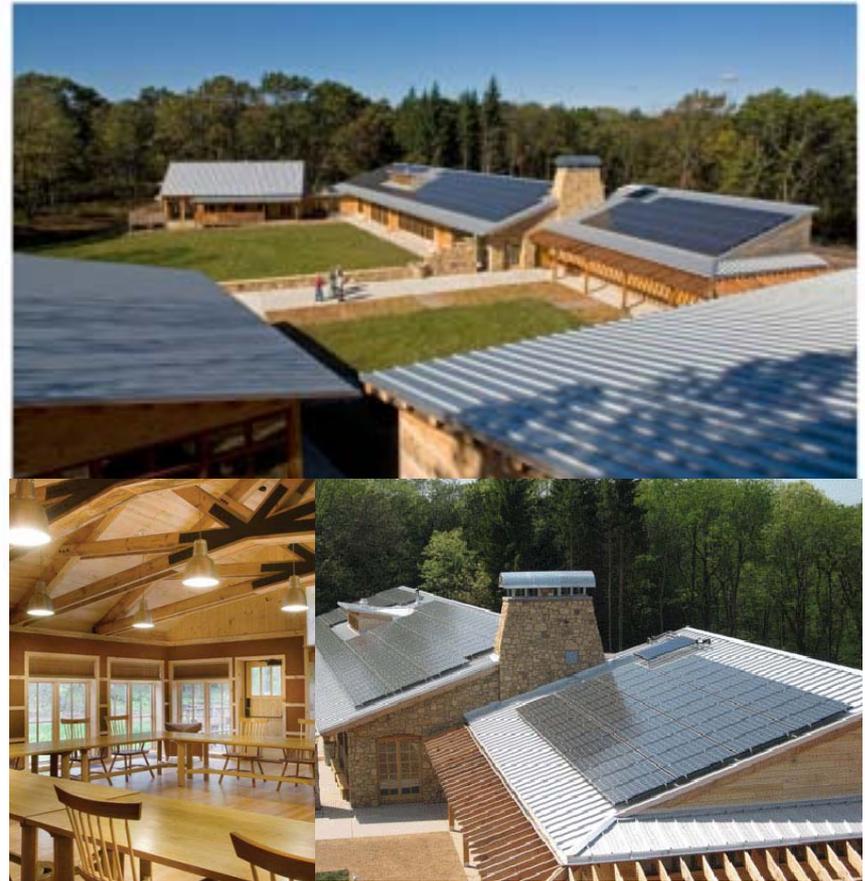
Rating: LEED® Platinum (61 points)

Rating: Zero Energy Building

40kW PV system (Roof)

- 70% less energy
- GSHP
- No irrigation

www.aldoleopold.org/Visit/leopoldcenter.shtml



Success Stories

The Coliseum (The Colosseum) Rome, Italy

Overview:

Building type: Entertainment Center

New construction

Size: 157ft (H), 620ft (L), 510ft (W)

Completed: 80 AD

Rating: Zero Energy Building

- No PVs at all!
- 100% Native Plants
- 100% Daylight Harvesting
- 100% Regionally Resourced Materials



Recycled water used to flood the arena to simulate naval battles

Success Stories

Audubon Center at Debs Park, Los Angeles, CA

Overview:

Building type: Interpretative Center

Size: 5,020 ft²

Completed: November 2003

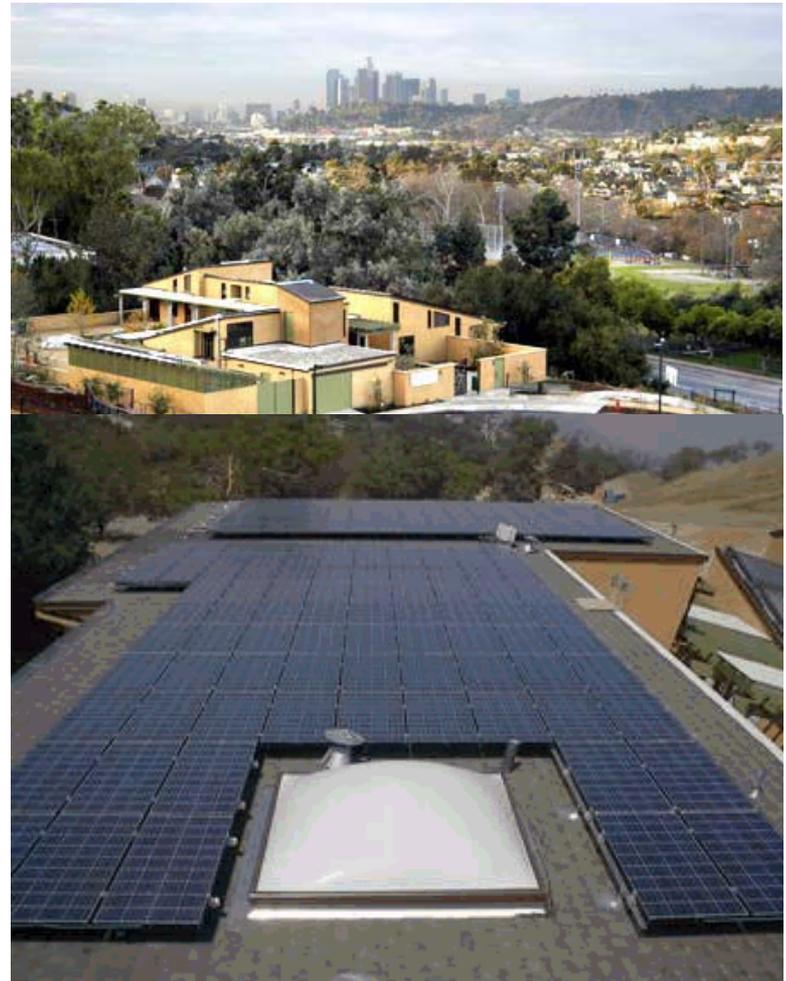
Rating: LEED® Platinum (53 points)

Rating: Near Zero Energy Building

40kW PV system (Roof)

- Off Grid
- 25,000 kWh (5 kWh/ft²)
- First LEED® Platinum v2 Building
- 70% less water, 97% recycling rate

<http://oikos.com/library/showcase/audubon/index.html>



Success Stories

NREL's Research Support Facility, Golden, CO

Overview:

Building type: Commercial Office

Size: 222,000 ft²

Completed: June 2010

Rating: LEED® Platinum (59 points)

Rating: Zero Energy Building

1.6MW PV system (Roof/parking area)

- Nation's largest ultra-efficient building
- Strict time and performance goals
- 50% less energy (ASHRAE 90.1-2004)
- 35,000 Btu/ft²
- LEED® Platinum v2 Building
- 800 occupants



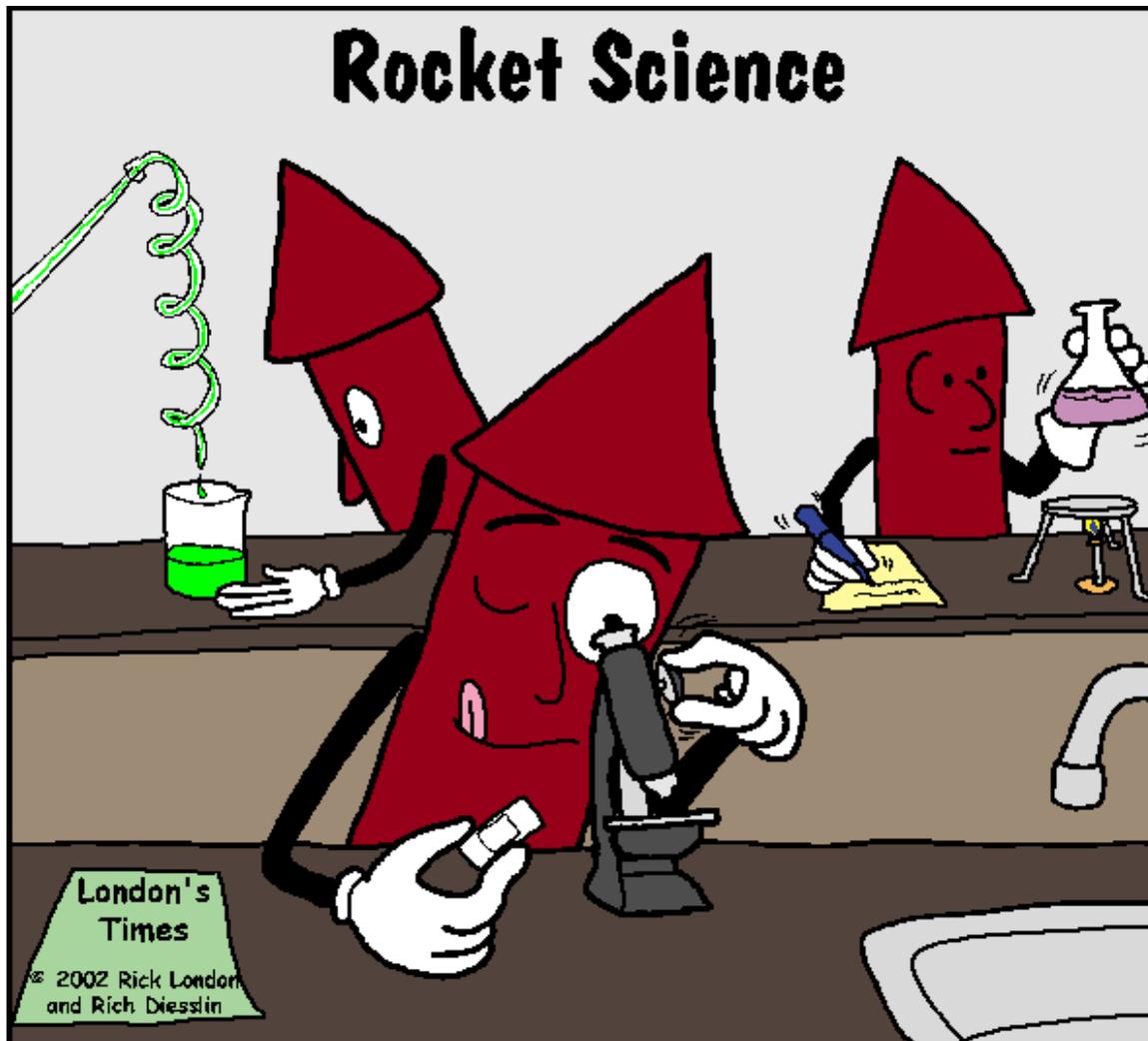
In Conclusion...

ZEB is NOT Rocket Science



This is

Rocket Science



Questions

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