

# Applying Quality to Research and Development: Helping NREL Succeed and Thrive



Thursday, February 25, 2010  
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Presentation for ASQ Boulder  
Section

# What was advertised



- The application of quality tools started in manufacturing and helped many industrial companies succeed. Pioneers in the field found that quality tools were able to make the transition to help other sectors of the American economy, including service companies, government agencies, and educational institutions.
- But what about research? What can quality tools do to help R&D personnel succeed? Come to the February meeting and hear about the practice of quality at the National Renewable Energy Laboratory (NREL), the nation's flagship organization for advancing the science of technology of renewable energy

# Part 1



**National Renewable Energy Laboratory**

*Innovation for Our Energy Future*

# What is NREL?



National Renewable Energy Laboratory; Golden, Colorado

- Nation's premier laboratory dedicated to renewable energy and energy efficiency R&D
- Established by U.S. Department of Energy in 1977
- Programs span basic science to technology implementation; solar, wind, and buildings to fuels and vehicles

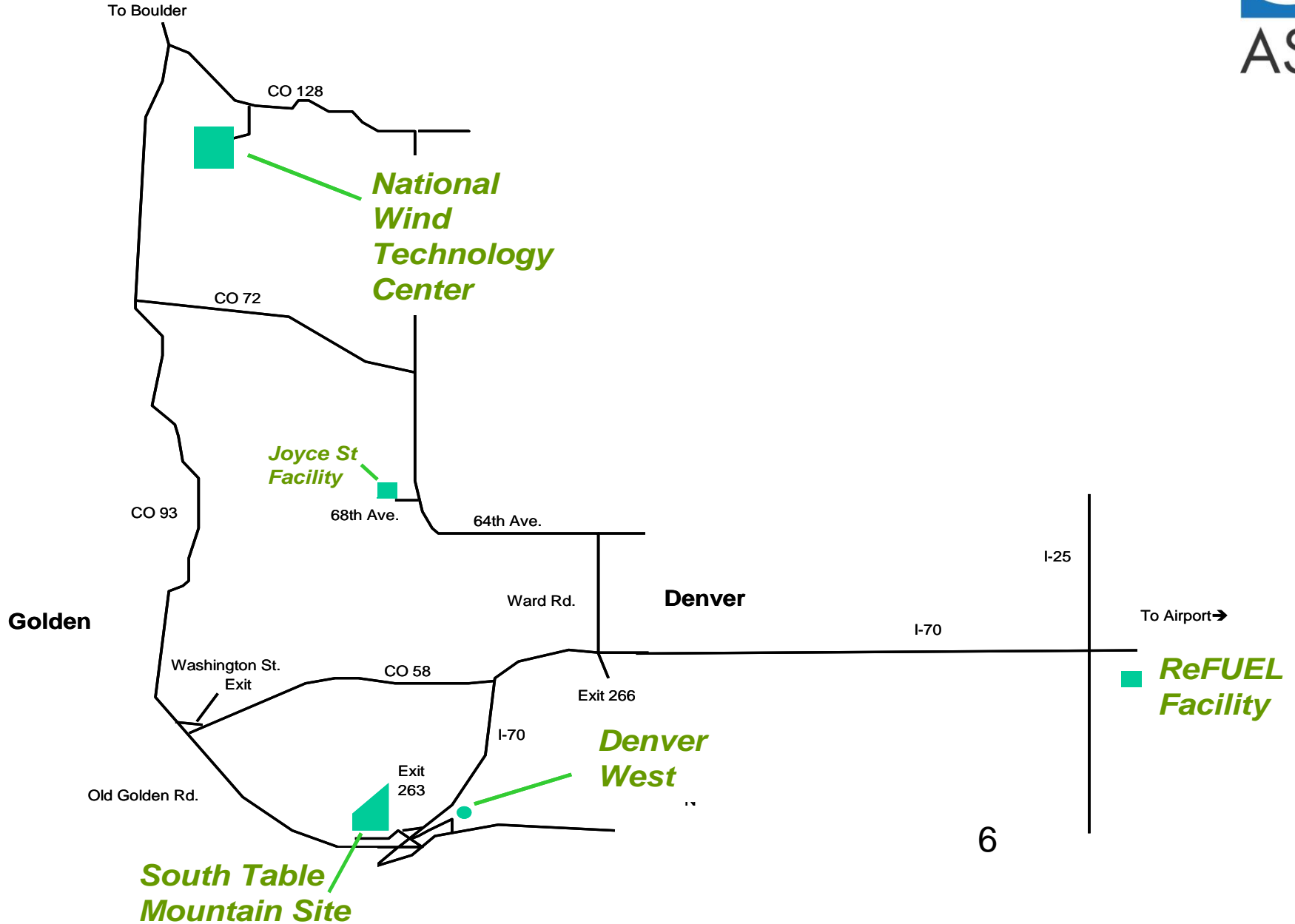
# What is NREL?



Nation's premier laboratory dedicated to renewable energy and energy efficiency R&D

- **NREL's Mission:** NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations to address the nation's energy and environmental goals.
- **NREL's Strategy:** NREL has forged a focused strategic direction to increase its impact on the U.S. Department of Energy's (DOE) and our nation's energy goals by accelerating the research path from scientific innovations to market-viable alternative energy solutions.

# Location of NREL Sites



# South Table Mountain site



# National Wind Technology Center



# What is NREL?

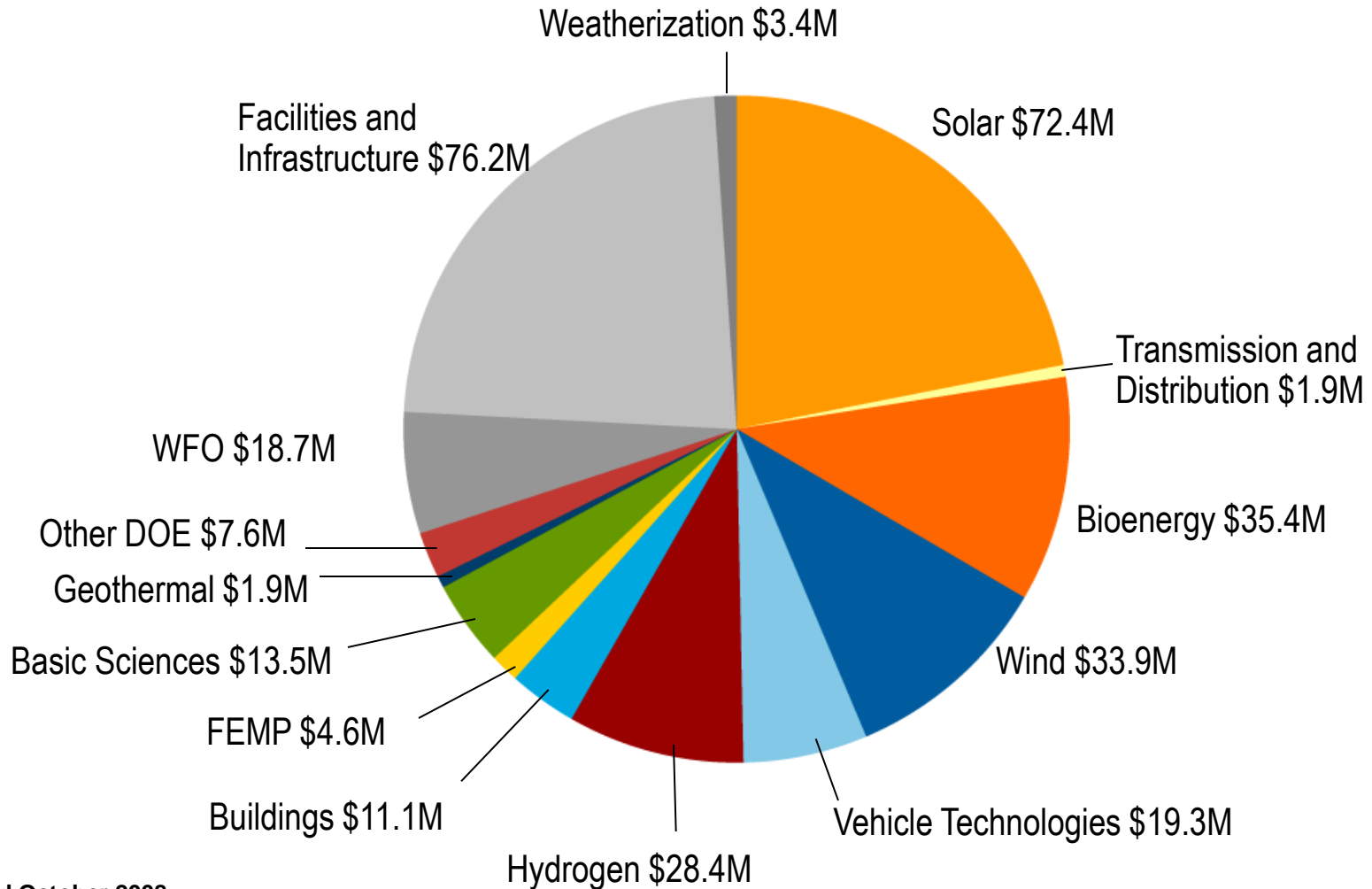
NREL's R&D competencies are:

- Renewable electricity conversion and delivery systems
- Renewable fuels formulation and delivery
- Efficient and integrated energy systems
- Strategic energy analysis



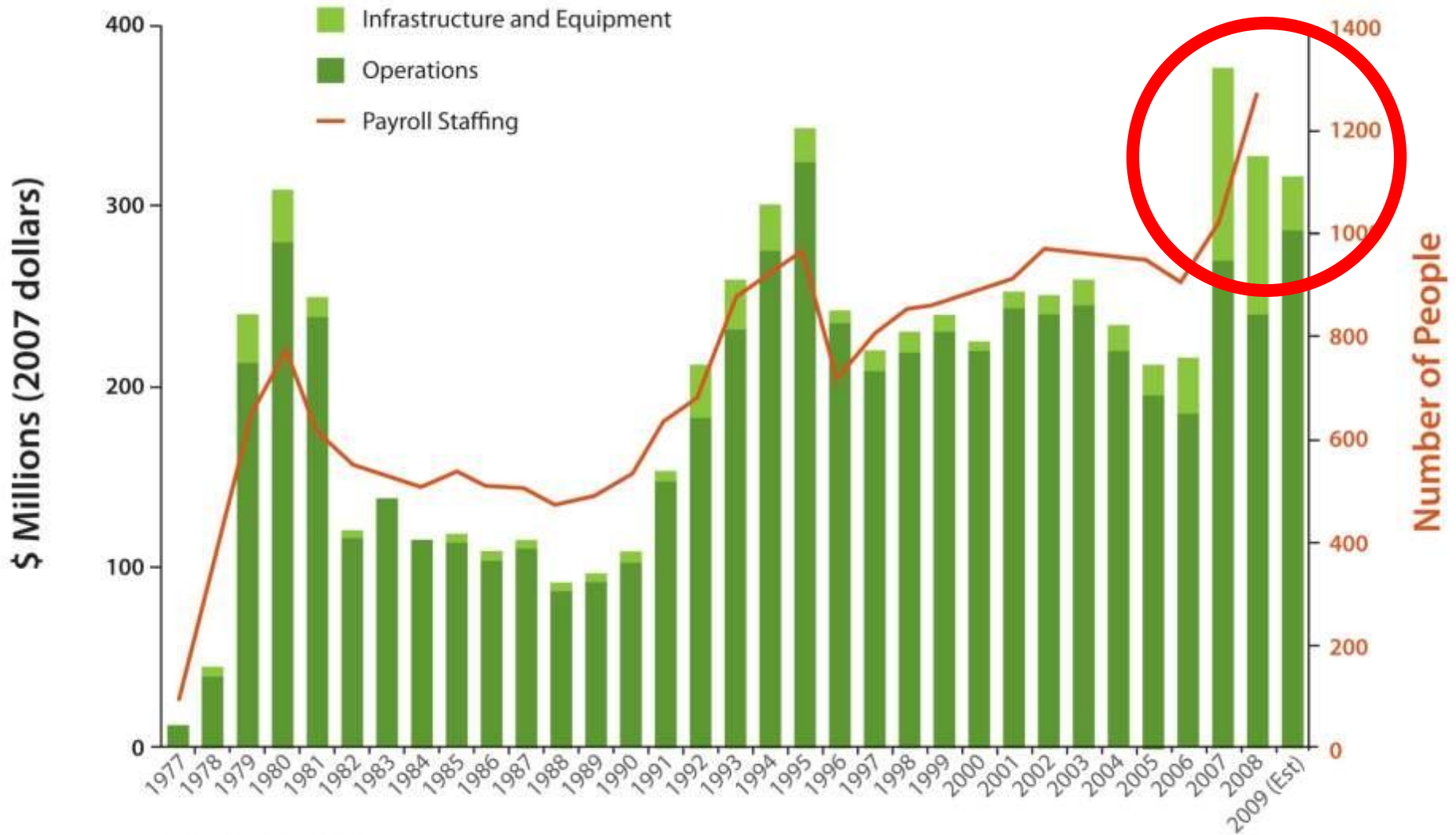
# NREL FY2008 Program Portfolio

## Actual \$328.3 Million



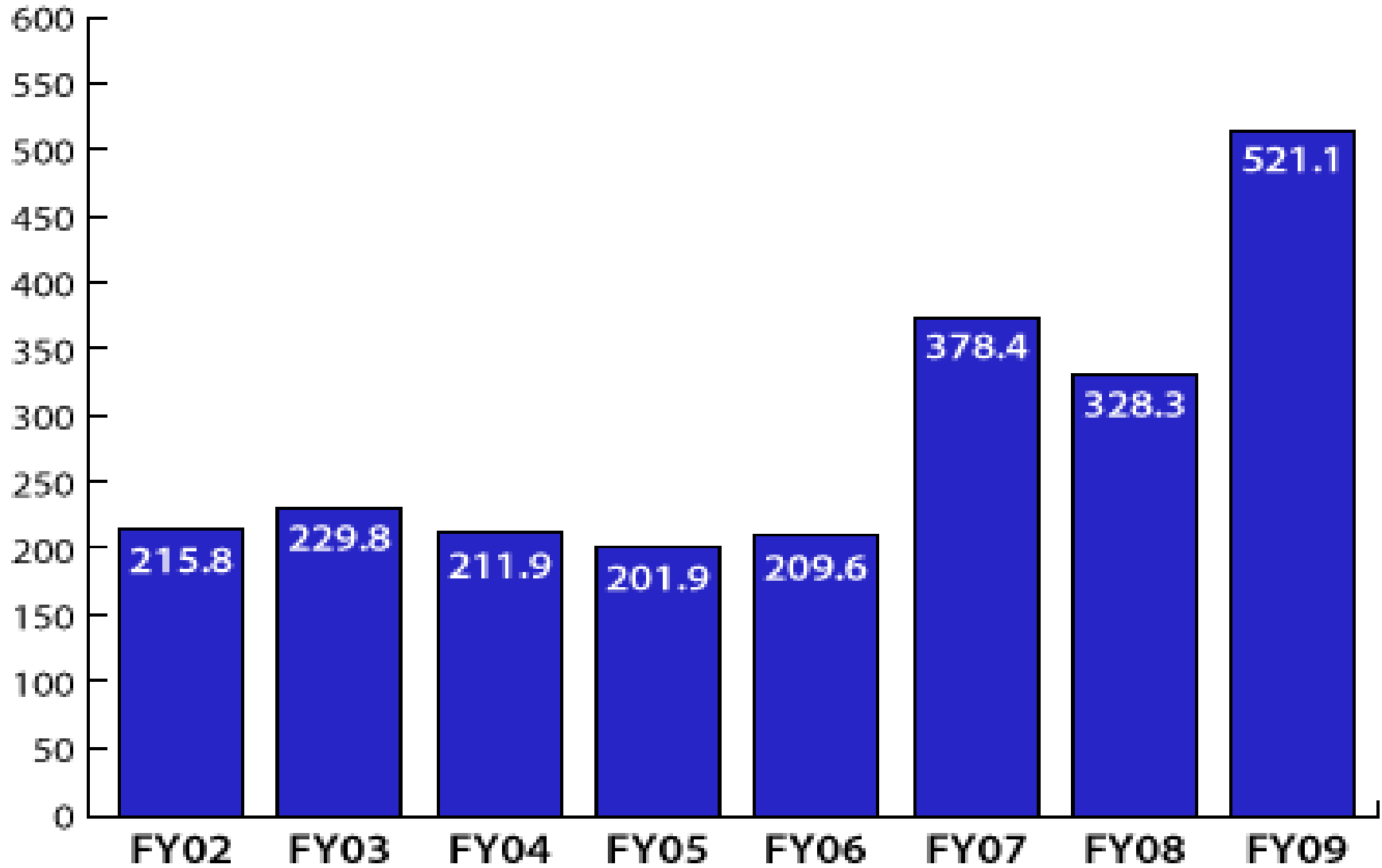
Updated October 2008

# NREL Funding and Staffing

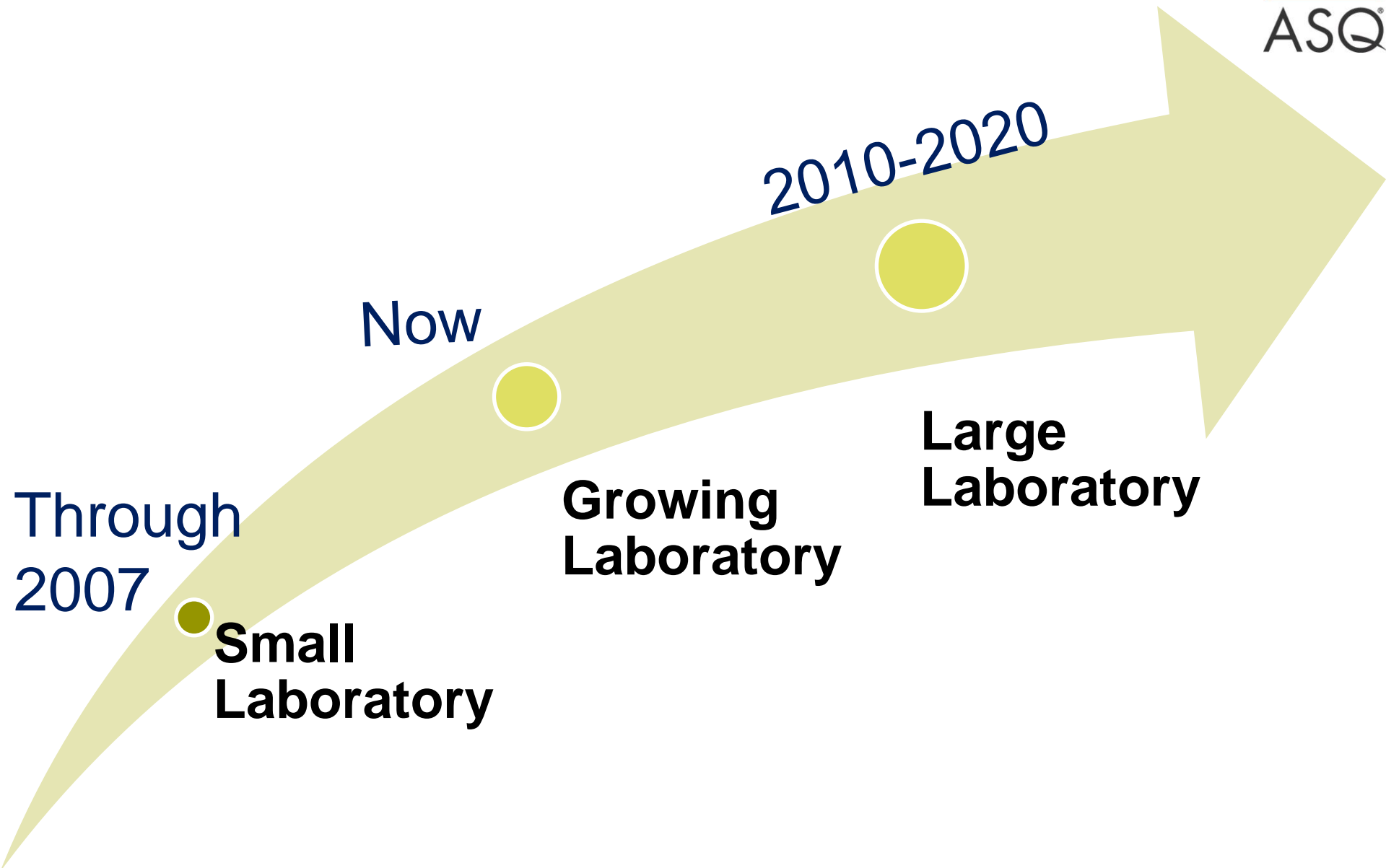


Updated December 2008

# NREL Funding



# NREL is Transitioning ...



Through  
2007

**Small  
Laboratory**

Now

**Growing  
Laboratory**

2010-2020

**Large  
Laboratory**

# NREL: Leadership by Example



## TEAM Initiative

- DOE's effort to maximize energy efficiency and renewable energy generation across the DOE national laboratory complex

## Science and Technology Facility achieves LEED 'Platinum'

- First Federal building to do so

## NREL Site is "Carbon Neutral"

- Onsite renewables (Mesa Top and NWTC PV)
- Renewable Energy Certificate (REC) purchases

## Renewable Fuel Heating Plant

- Offsets 75% of current South Table Mountain campus natural gas use

## Energy Policy Act and Executive Order Requirements

- Currently exceeding EAct requirements
- Meet or exceed new Executive Order requirements

## Vehicle Fleet

- 48 vehicles, 34 (71%) are alternatively fueled
- Fleet petroleum reduced ~45% since 2000



**So, how does Quality  
support research at NREL?**

# Part 2: Quality and the Scientific Method

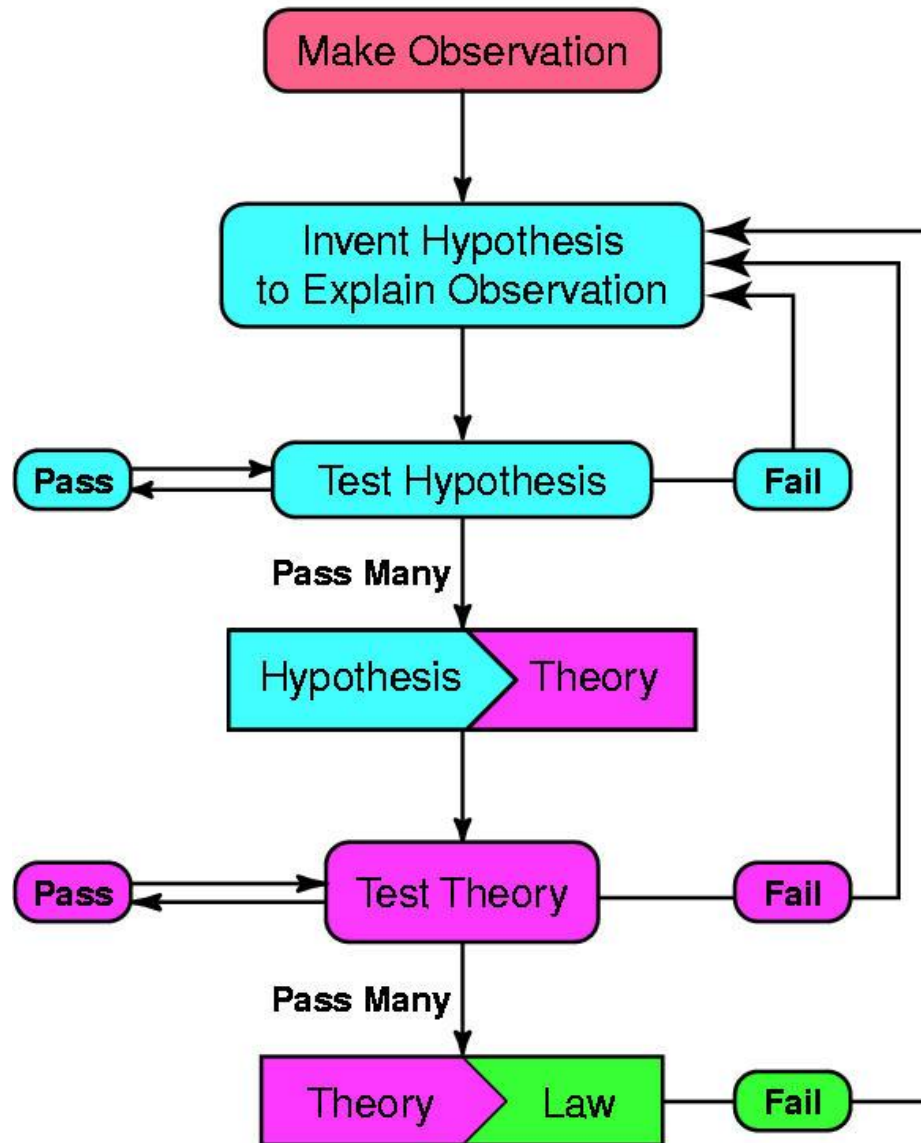
# Scientific Method

**Scientific method** is a body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge, including:

- a method of inquiry based on gathering observable, empirical, and measurable evidence subject to specific principles of reasoning; and
- the collection of data through observation and experimentation and the formulation and testing of hypotheses.

# Scientific method: graphically

## Scientific Method



# The scientific method and the quality method



## Quality Method

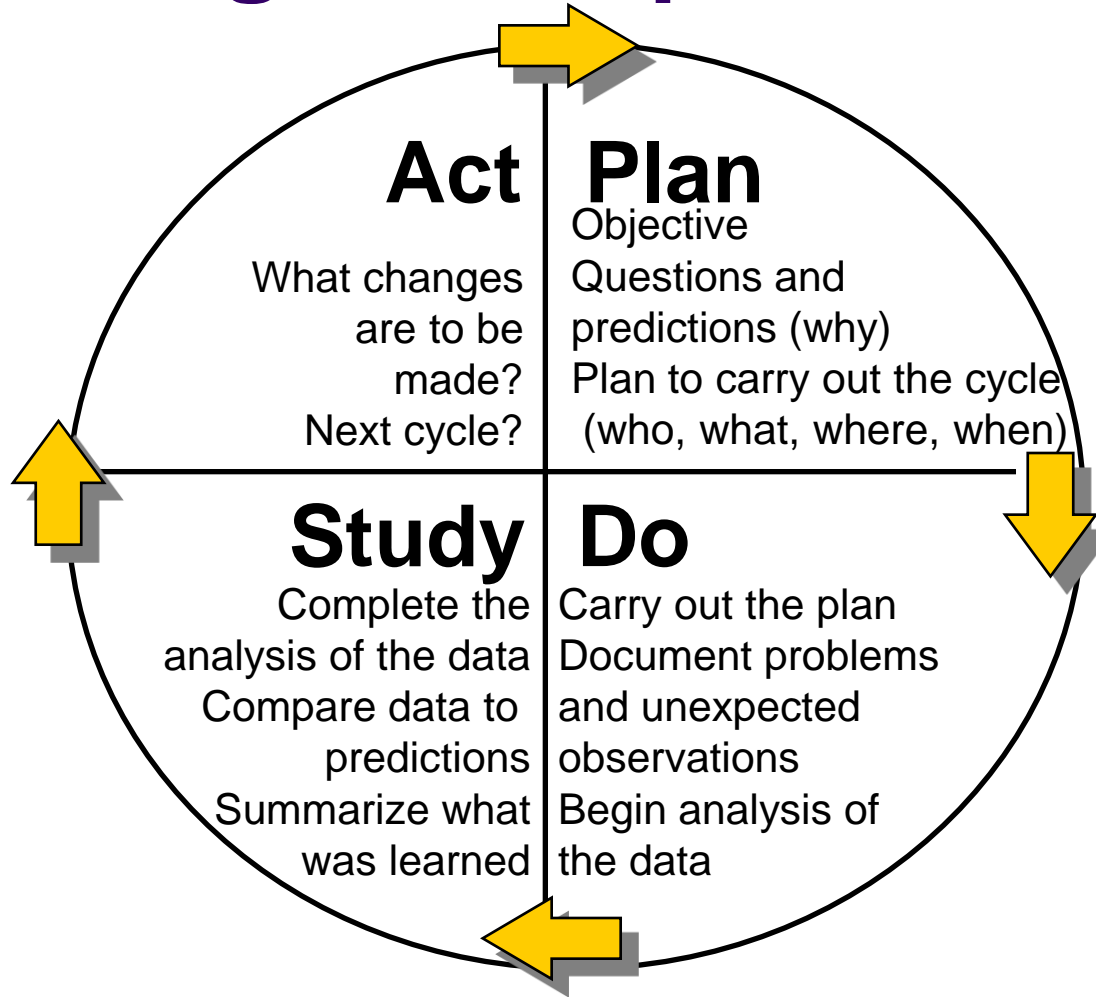
- PDSA cycle

<b>Act</b>	<b>Plan</b>
<b>Study</b>	<b>Do</b>

## Scientific Method

<b>Draw Conclusions</b>	<b>State Hypothesis</b>
<b>Study Results</b>	<b>Make Observations &amp; Test Hypothesis</b>

# The PDOSA cycle for learning and improvement

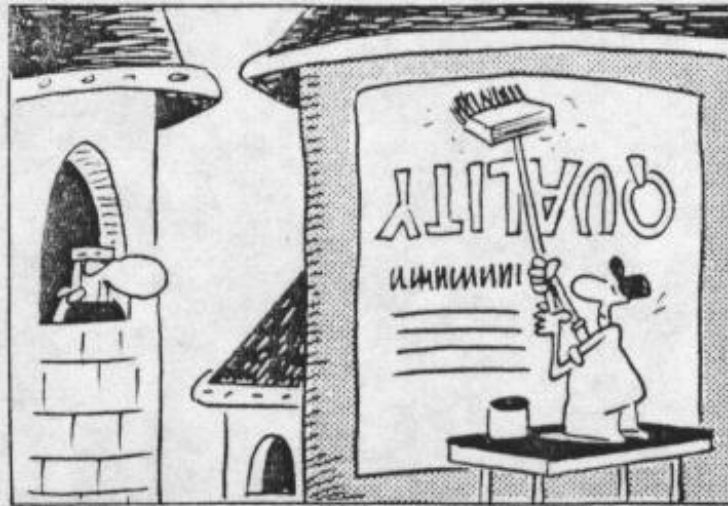


**Is a great fit for a National Lab!**

# So, what does Quality do at NREL?

# Part 3: Quality at NREL

# THE WIZARD OF ID By Brant Parker and Johnny Hart



# Quality plays an important role at NREL



***Vision:*** *The Quality Management Systems and Assurance group is recognized for our value-added activities that contribute to NREL's success in achieving its mission*

***Mission:*** *The Quality Management Systems and Assurance group will provide the quality infrastructure, procedures, processes, training, and support that will facilitate a quality culture that promotes continuous improvement lab-wide.*

# Quality at NREL

Partnering with research and other staff, for:

- Process development and control
- Process improvement

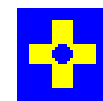
# Process development

# Process Development – Integrated QMS



Lead the overall effort to obtain ISO 9001, ISO 14001 and OHSAS18001 certifications

- Completed cross-walk matrix of the requirements from all three standards
- Integrated considerations from the Baldrige program



Occupational Health & Safety Standards

# ISO 17025 Accreditation

- NREL calibrates primary reference cells for in-house use and for use by other national laboratories.
- Provide our clients and partners with a path for traceability to standards. NREL is one of only four facilities in the world certified to calibrate reference cells in accordance with the world photovoltaic scale.
- These measurements are accredited to International Organization for Standardization (ISO) 17025 standards



# ISO 17025 Accreditation



ISO 17025:2005—General Requirements for Calibration Laboratories

**National Wind Technology Center:** reaffirmed accreditation through 12/2010

**National Center for Photovoltaics:** Accredited; expanded scope of calibration accreditation submitted



# Process Development – Integrated QMS



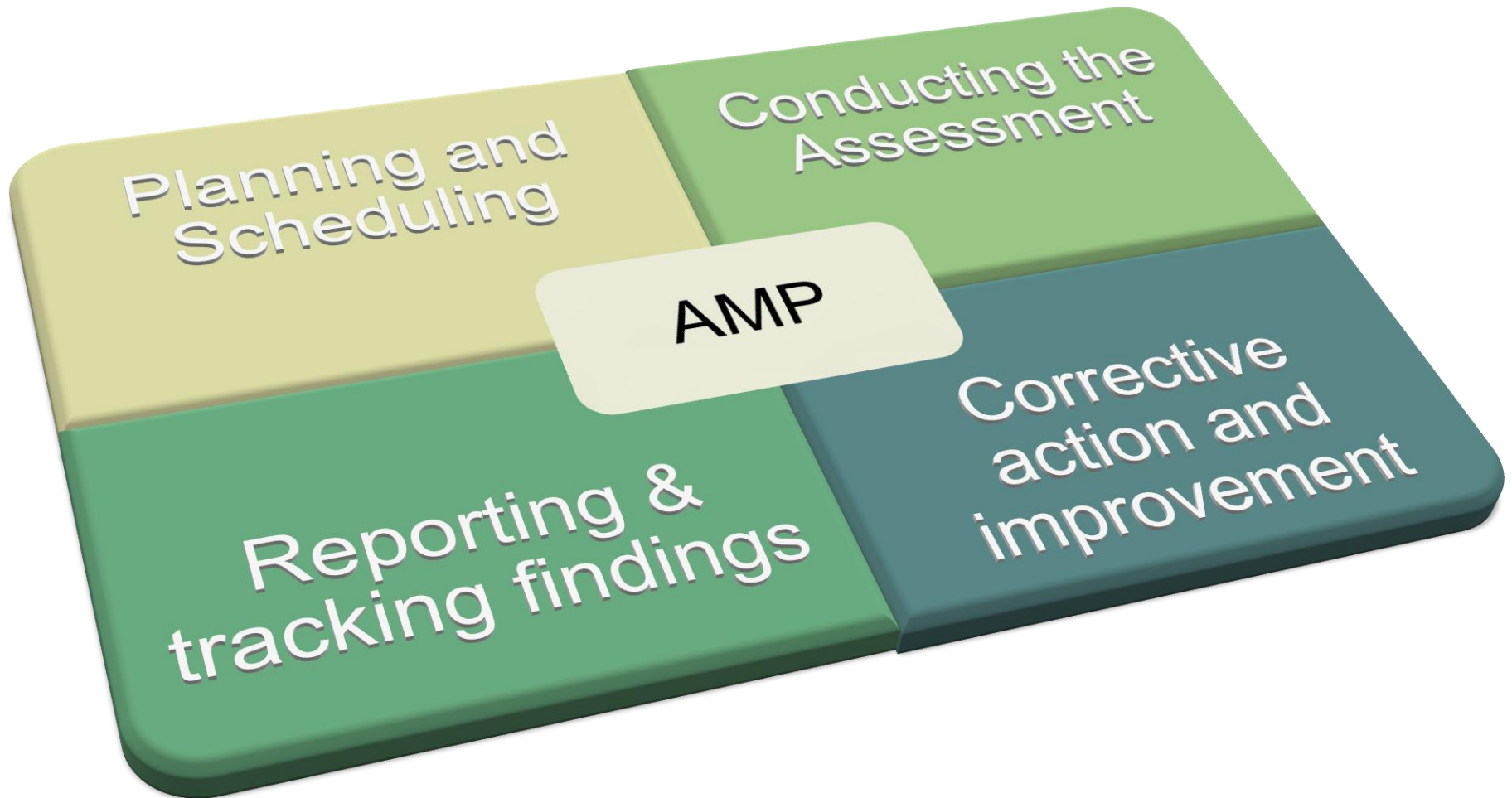
Lead the overall effort to obtain ISO9001/14001 and OHSAS18001 certification

- Cross-walk matrix of the requirements from all three standards
- Integrate with best practices from Baldrige



Occupational Health & Safety Standards

# Assessment Management Program



# Integrated Construction Mgt.



## Goal Statement

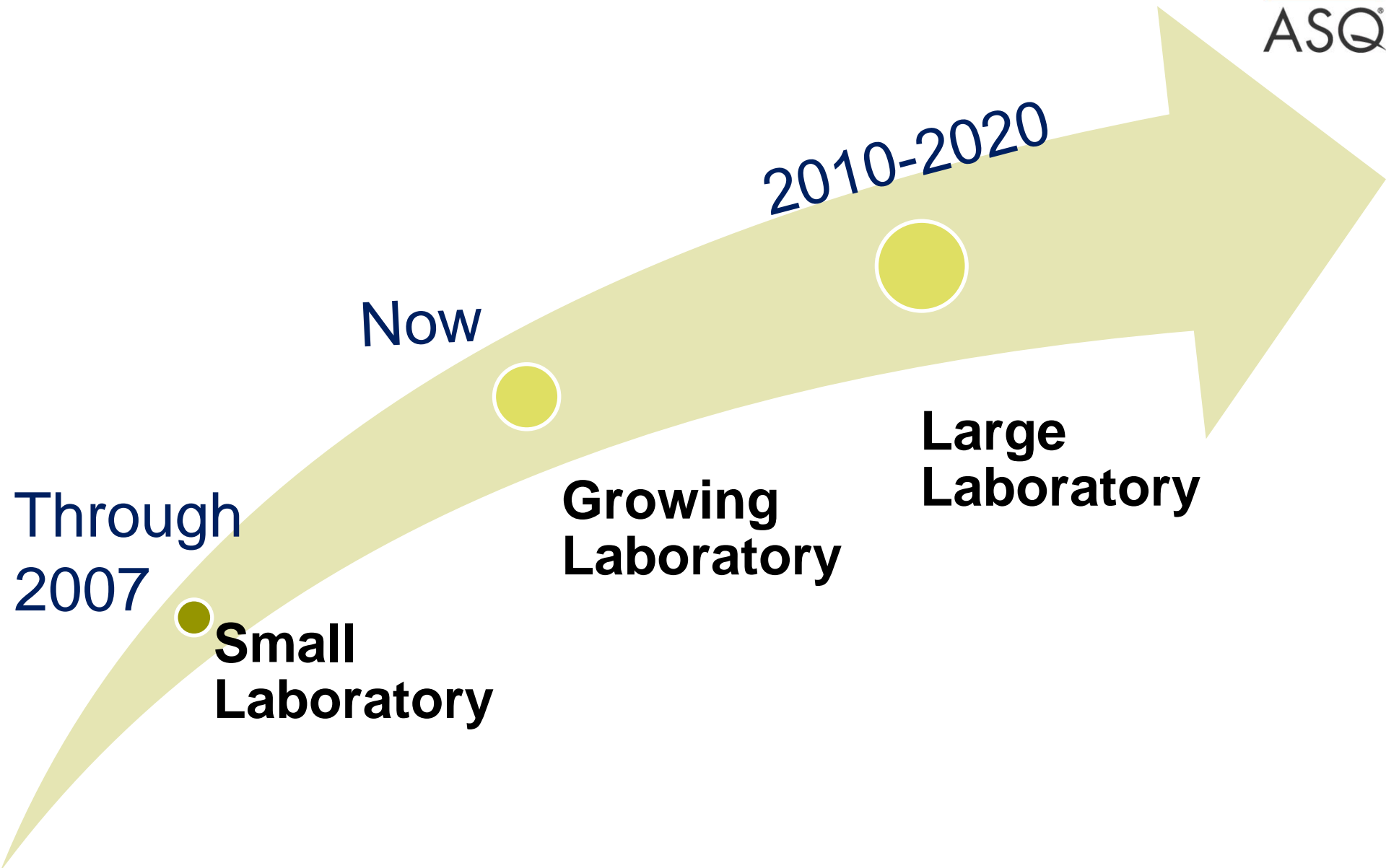
A Integrated Construction Management Program that defines the Core requirements that are essential to any construction project, independent of the “type” of facility being constructed.

## Deliverables

- ✓ The contract documents comprise a clear, complete, and accurate description of the facility to be constructed, correctly conveying the intent of NREL regarding the characteristics of the facility needed to meet the mission.
- ✓ The contract documents define a constructed facility considered acceptable under applicable regulatory codes and standards of professional practice, in terms of its reliability, the durability of its materials and operating systems, and the life safety afforded its users.
- ✓ The facility is constructed in accordance with those documents.

# Process improvement

# NREL is Transitioning ...



# Process improvement and transition



*Investing in effective process improvements and a delivery system will improve efficiency, mitigate risk, and foster a supportive work environment for NREL as it grows*

2010-2020

Now

**Invest**

Through 2007

**Small Laboratory**

*Adequate management systems*

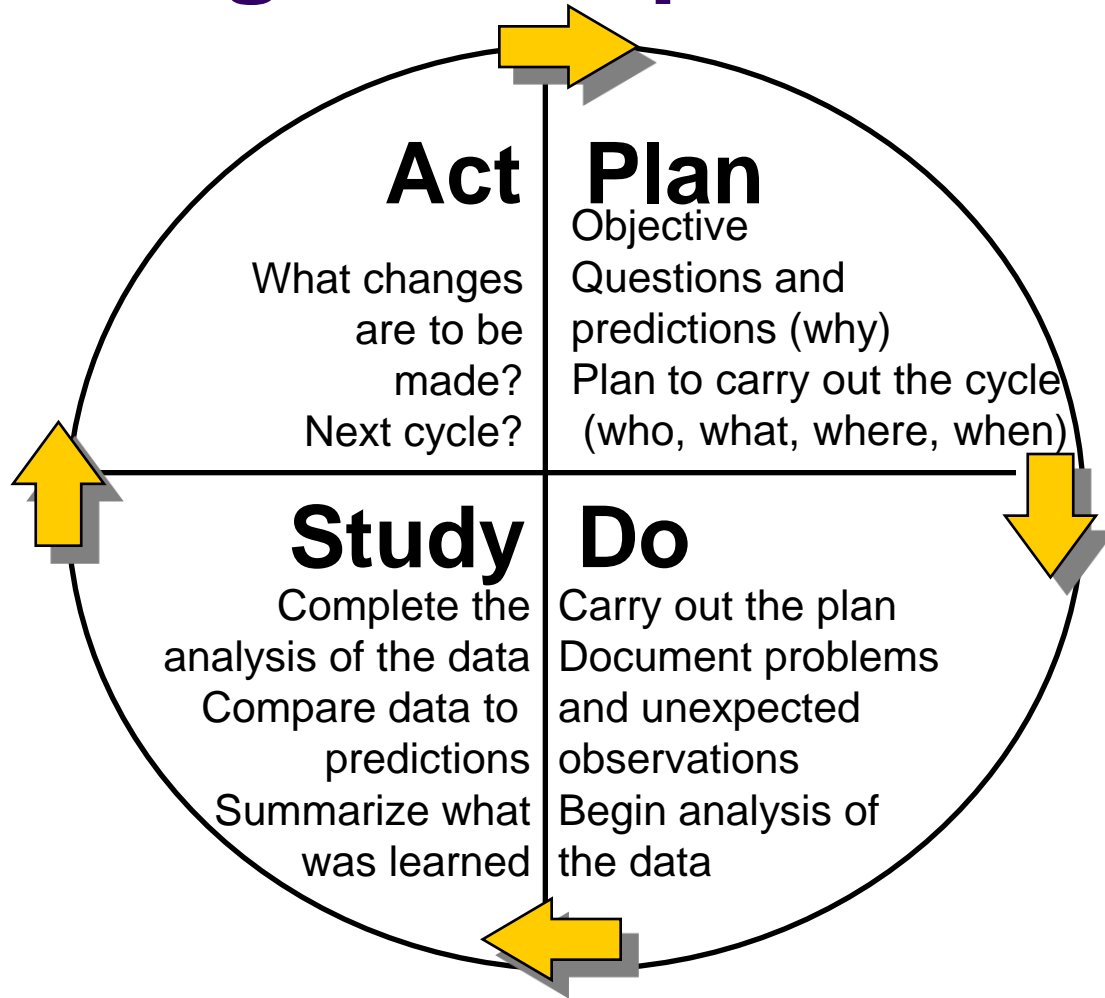
**Growing Laboratory**

*Stretched management systems*

**Large Laboratory**

*Robust, effective, efficient, and scalable management systems*

# The PDOSA cycle for learning and improvement



Is a great fit for a National Lab

# Process improvement: approach

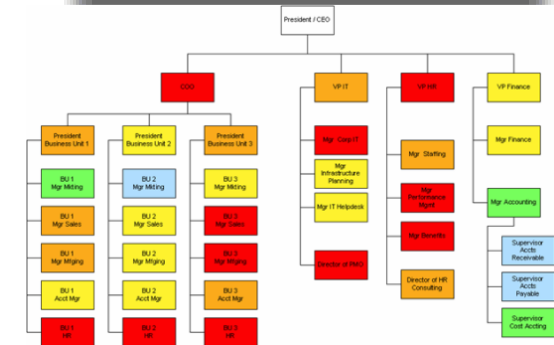
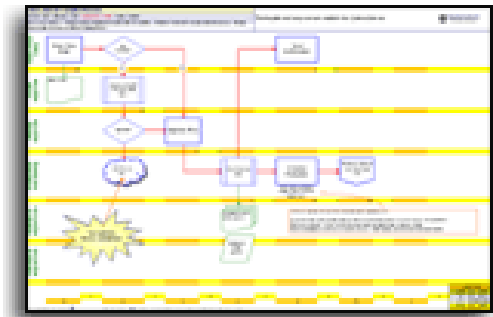
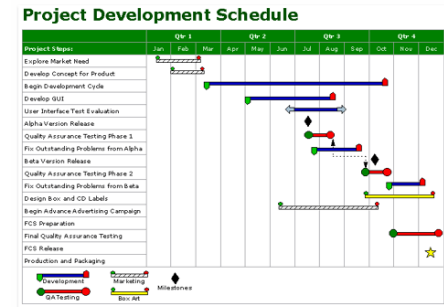


Identify projects and executive sponsors

Charter projects

Provide targeted training

1. Project management methodology
2. Process characterization tools and techniques
3. Creativity tools
4. Process improvement tools and techniques
5. Change management tools and techniques



# Setting priorities and communicating clearly is key



**Including creativity tools**

# “Anti-Solution” Brainstorming

- Fun approach to idea generation
- Fits well with research
- Good at breaking tension
- Process:
  - Brainstorm ways to make the situation “worse”
  - Once list completed, evaluate each “idea”
  - Consider ways to make it better
- Example: Real objective-- “Develop better thesis sentences”
  - Anti-solution Objective-- “Develop weaker thesis sentences”
- Strategic variant: Kill the company
  - If I were a competitor, how would I (legally) kill our company?
  - Then, develop countermeasures

# Designated Curmudgeon (Devil's Advocate)



- Someone who brings up and defend a minority point of view or an unusual idea. He or she may not necessarily agree with that view, but may choose or be assigned to represent it as strenuously as possible.
- The goal: expose conflicting interpretations and show how alternative assumptions and images make the world look different.
- Requires time, energy, and commitment to see how the world looks from a different perspective.

# Thinking Backwards

## NREL's Center for Inverse Design



*Dr. Alex Zunger*

"The development of a technology based on accidentally discovered materials normally takes about 20 years because it takes a long time to figure out what is it exactly that we discovered by accident ..."

"... use an inverse design approach to develop materials for solar energy conversion ..."

"... To replace trial-and-error methods used in the development of materials for solar energy conversion with an inverse design approach powered by theory and computation ..."

"... starting point will be articulating what would the properties of a "dream material" ..."

# Which steps (process improvement)?

<b>Root cause(s) known ?</b>	<b>Yes</b>	(60) Skip measure, analyze – full improve and control steps	Skip measure & analyze, and first part of improve – focus on implementation analysis, and full control step
	<b>No</b>	(30) Full problem solving methodology	(the nonsense case)
		(0) <b>No</b> (30)	<b>Yes</b> (60)

**Solution known?**

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