Defining our energy future

ACEEE 30th Anniversary Policy Conference
December 8, 2010
Mike Davis
Associate Laboratory Director
Energy and Environment
Pacific Northwest National Laboratory

Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by **Battelle** *Since 1965*

A simplistic view of national energy models

▶ Purpose of models:
  ■ Inform decision-making
  ■ Inform policy

▶ Types of models
  ■ Projections – offer a view of the reality of where we are and projects a path forward
  ■ Predictions – often assert "doom and gloom" view of the future

▶ Getting consensus on models is nearly impossible

As a nation, innovation has led to remarkable progress…

▶ Safe, reliable, affordable and secure electric system

▶ Criteria emissions dramatically reduced in last 4 decades
  - Transportation
  - Electricity generation

▶ Renewable generation deployment on the rise

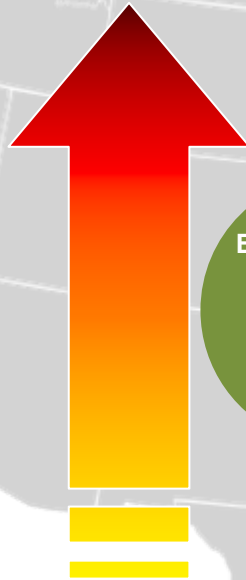## …However, we are not solving the big problems fast enough
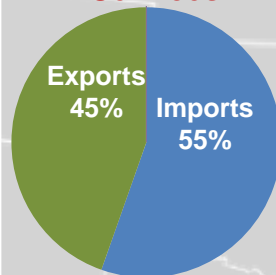
A snapshot of today's reality

Carbon Emissions

Domestic Content

Environmental Challenges
Reduce environmental effects of human activity and create sustainable systems

U.S. Goods and Services

Exports 45%
Imports 55%

U.S. Dependence on Imported Oil
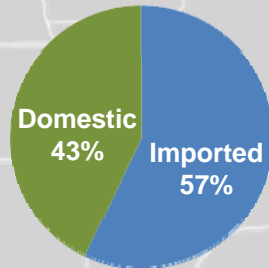
Domestic 43%
Imported 57%
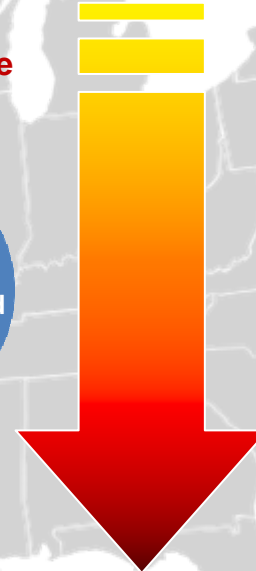
Energy Challenges
Increase U.S. energy capacity and reduce dependence on imported oil

How can science and technology provide a clearer understanding of these challenges *and* advance innovation to reverse the trends?

- ▶ **World population**
    - ☐ Today: 6 billion people, 1.5 billion without electricity
    - ☐ 2050: 9 billion people, doubling electricity customers
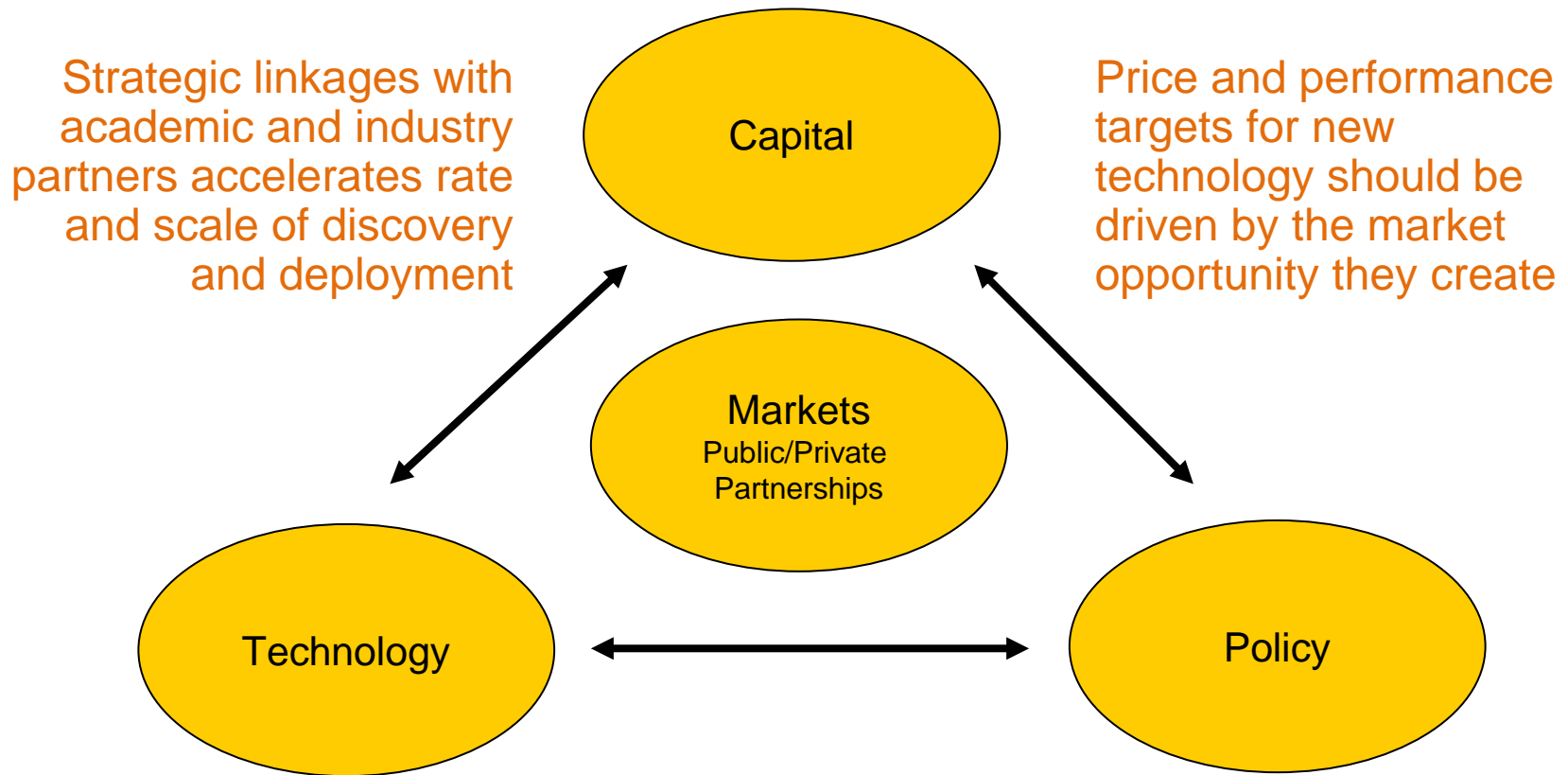- ▶ **Global energy use** projected to increase 49% (2007-2035)
    - ☐ India and China total energy consumption projected to grow from 20% of world's total in 2007 to 30% in 2035
    - ☐ The U.S. is projected to be at 5% of world's total in 2035
- ▶ **Fossil fuels** account for more than 80% of world's energy supply, a trend projected to 2025
- ▶ **Coal** is the largest source of domestic energy in U.S., China and India—these nations account for 88% of projected net increase in coal consumption

Aligning elements of change
Innovation can lead to outcomes

Strategic linkages with academic and industry partners accelerates rate and scale of discovery and deployment

Capital

Price and performance targets for new technology should be driven by the market opportunity they create

Markets
Public/Private
Partnerships

Technology

Policy

Research productivity will be enhanced
by moving beyond incremental advancements
in what we know, to the new thing we *need* to know

Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by **Battelle** *Since 1965*

Starts and Stops in Energy Technology Policy

VEHICLE TECHNOLOGY

- Virtually pollution-free car (Nixon 1970)
- Reinventing the Car (Carter 1977-1980)
- Partnership for a New Generation of Vehicles (Clinton 1993-2000)
- FreedomCar (Bush 2003)

COAL UTILIZATION

- Synthetic Fuels Corporation (1979-1985)
- Clean Coal Technology Program (1987)
- Clean Coal Power Initiative (2001)
- Future Gen (2003)

NUCLEAR TECHNOLOGY

- Clinch River Breeder Reactor (1970-1983)
- Advanced Liquid Metal Reactor Program (1989-1994)
- Global Nuclear Energy Partnership (2006)

BIOFUELS

- Alcohol fuels (Energy Security Act 1980)
- Oxygenated fuels (Clean Air Act Amendments 1990)
- Biofuels (EPAct 2005; EISA 2007)

Technology Attention Deficit Disorder

- The need to distinguish oneself from one's predecessors

- Focus is on advocating a particular technological solution, instead of solving an energy problem

- Excessively optimistic assumptions about technology costs and capabilities

- Limited consideration of interplay with other policy areas

- Under appreciation of the scale of the energy enterprise

We need to focus on outcomes
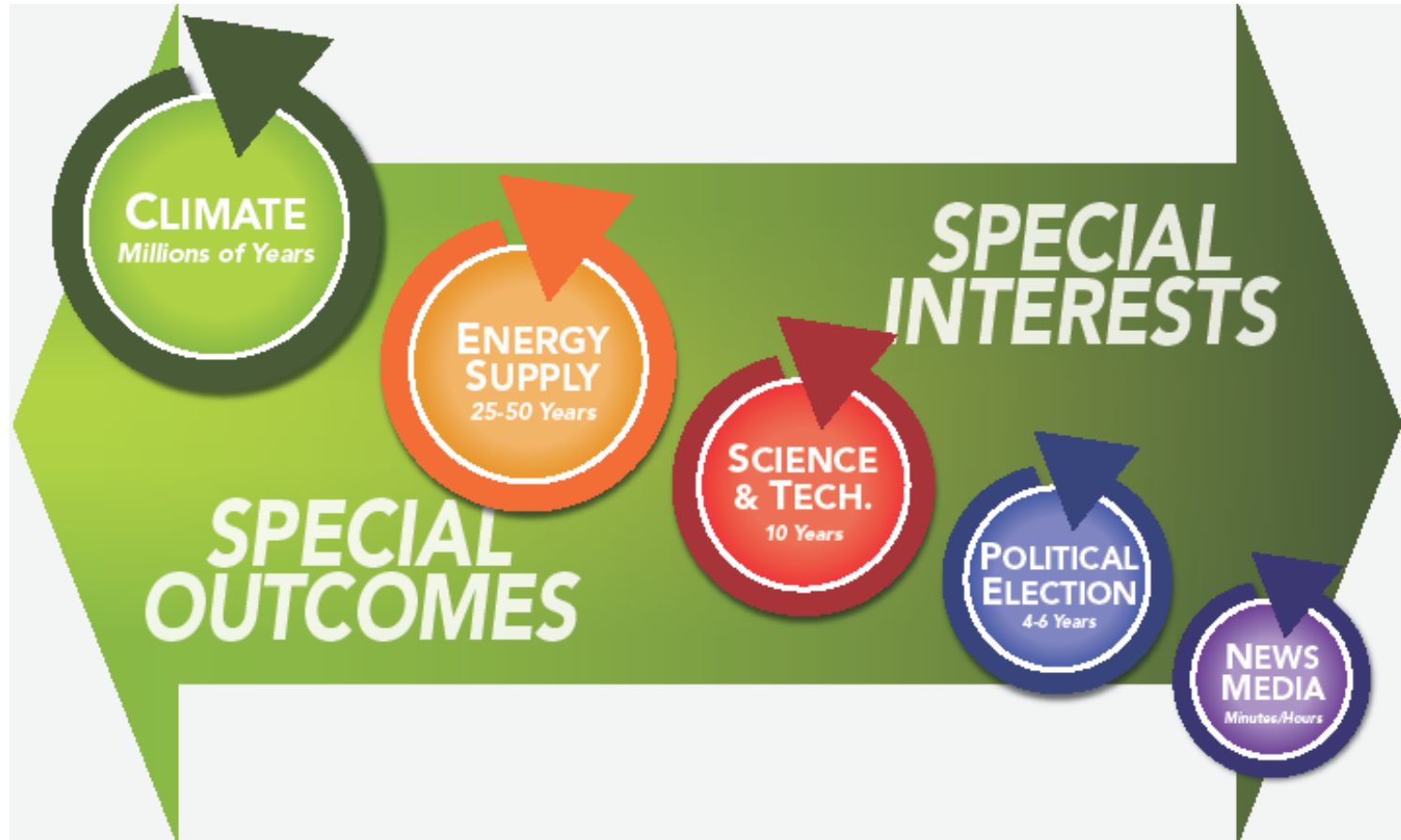
Models will remain an important part of shaping our energy future

▶ **Resources and impacts of generation**
- Real-time view of production and conversion of energy—and it's environmental impacts has greatly improved
- We know emission sources and rates
- Coupling the view of resources with the view of impacts can lead to better decision regarding technology, capital and policy

▶ **Grid modeling**
- Creating a view of the built infrastructure that incorporates dynamic, real-time data—a capability that didn't exist a decade ago
- Provides understanding of dynamic operation of grid—both supply and demand
- Can be used to explore "what ifs" and improve decision making

Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by Battelle *Since 1965*

Let's pick our shots…
Where can we invent the future?

▶ What innovations can revolutionize how nations with extensive coal reserves can meet growing energy demand while simultaneously reducing emissions?

▶ What can we do to transform the existing electricity generation and transmission infrastructure to optimize the assets we have today?

▶ How do we design the grid of the future to be amenable to intermittent and variable renewable generation?

▶ How can we use electricity and alternative fuels to cost-effectively meet the needs of a cleaner transportation sector while addressing our dependence on imported oil?

▶ Can we use information and communication technology to make end use both smart *and* efficient?

Backup slides
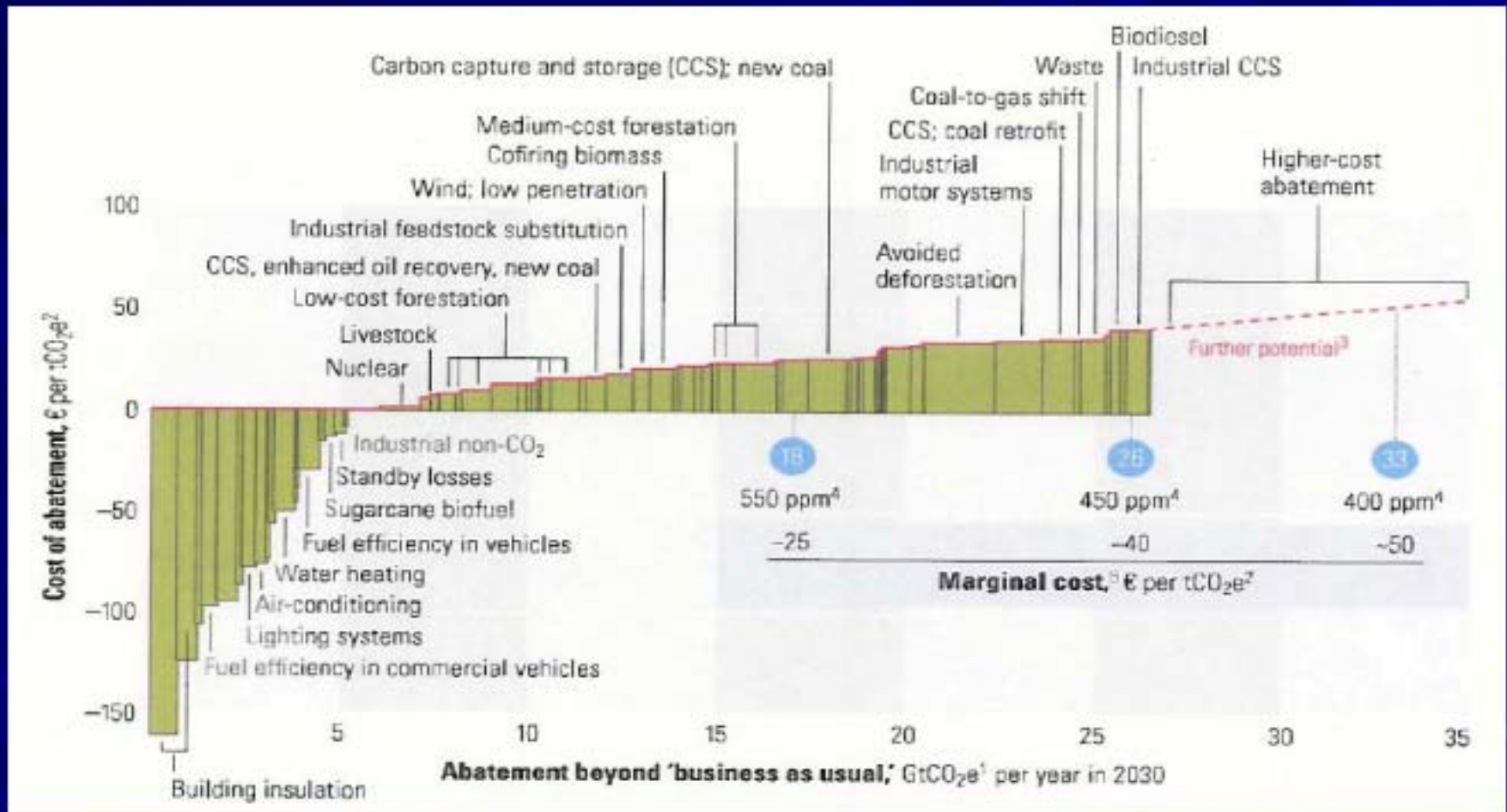
Overarching Themes/Messages (slide not to be part of presentation)

▶ U.S. modeling capabilities are among best in the world—yet we're not making the progress we need

▶ China is doing a good job of determining the future they want and driving implementation to regional and local levels

  ■ Taking smaller bites at the problem, but they're approach is sustainable and they're making progress

▶ We must make directionally correct progress while models continue to improve and inform decisions and actions

  ■ Things we already measure and know—absent perfect models, suggest rapid progress can and must be made

Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by **Battelle** *Since 1965*

One Exemplary Comparative Analysis

- Source: McKinsey & Company