… for a brighter future

UChicago ▶ Argonne LLC

A U.S. Department of Energy laboratory
managed by UChicago Argonne, LLC

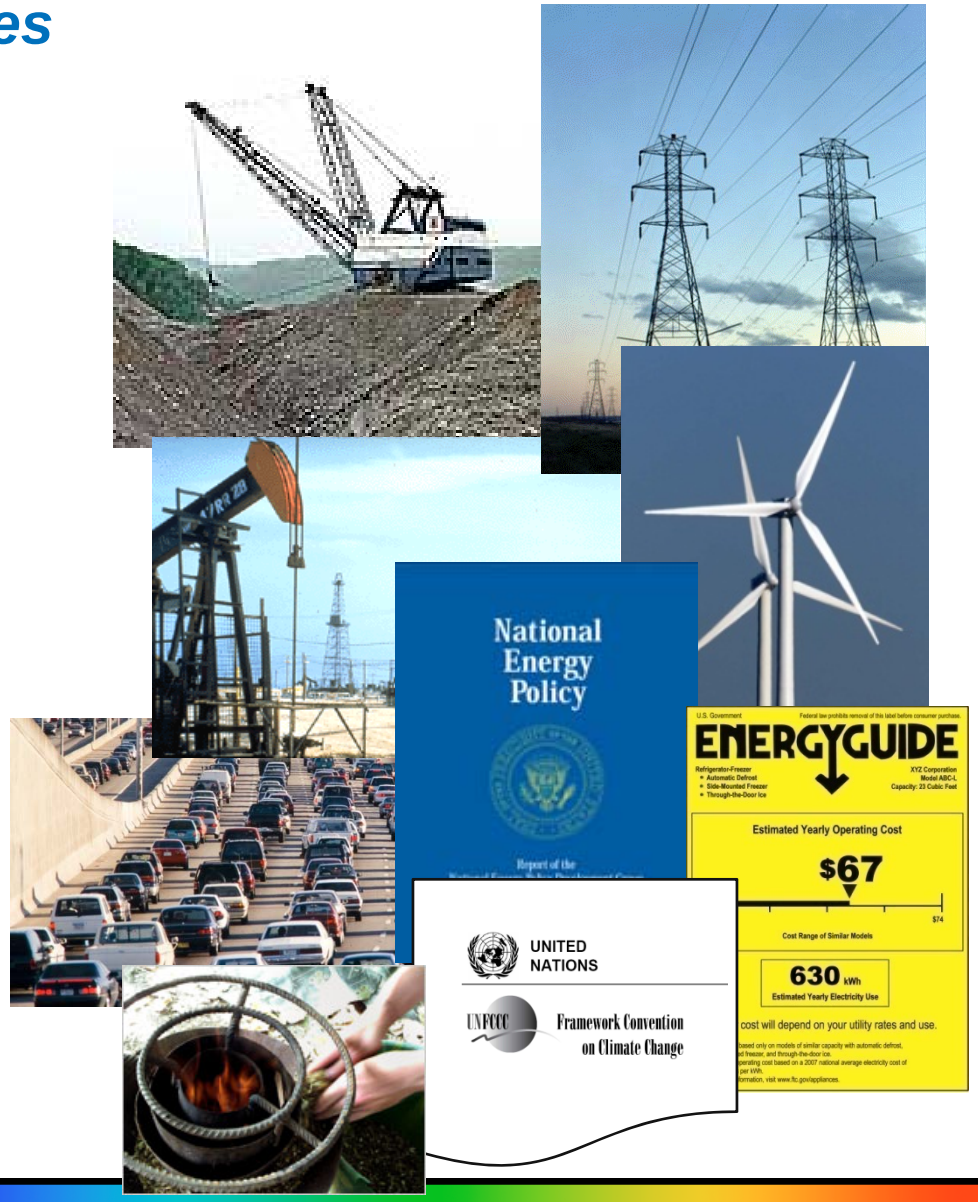
Resolving Mismatches in Energy Decision Making

International Atomic Energy Agency
Scientific Forum at the General Conference 2009
15-16 September 2009

Richard R. Cirillo
Director, Decision and Information Sciences Division
Argonne National Laboratory
Argonne, IL 60439
USA
phone: 630-252-5629
email: cirillor@anl.gov

Energy Decision Makers Are Regularly Confronted With Complex and Difficult Choices

- Energy policies
- Energy projects
- Supply technologies
- End use technologies
- Energy efficiency
- Environmental protection
- Energy security
- International agreements



Energy Decisions Are Difficult

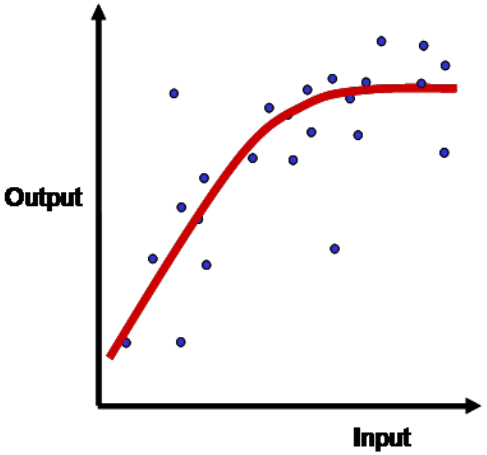
- **The energy system is:**
  - **Complex**
  - **Dynamic**
  - **Uncertain**

- **Energy decisions have:**
  - **Significant implications**
  - **Long lead times**
  - **Long lasting effects**

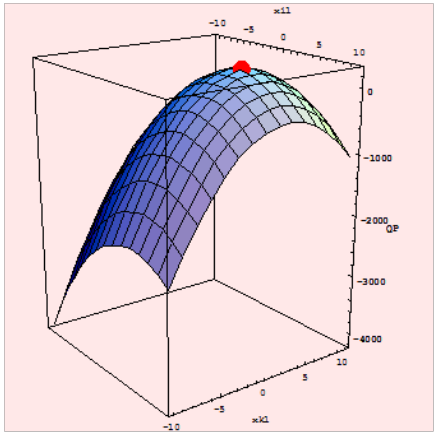
It is important to understand how decisions are made and how they can be made more effectively

Energy Decision Makers Rely on Information Provided by Energy Analysts

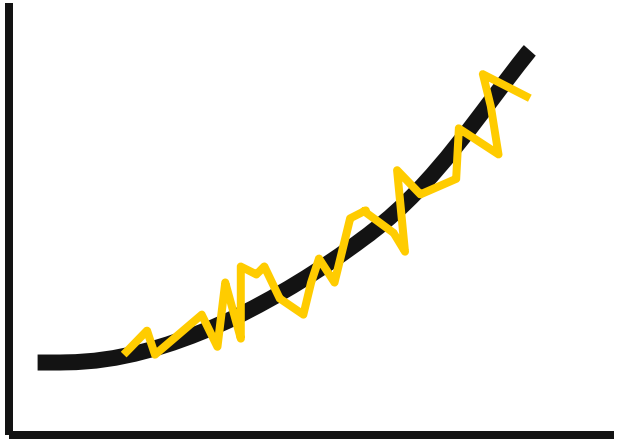
Trend Analysis



Optimization



Equilibrium Analysis



Good analysis can help in making good decisions

Good Analysis and Good Decisions Need to Recognize "Bounded Rationality"

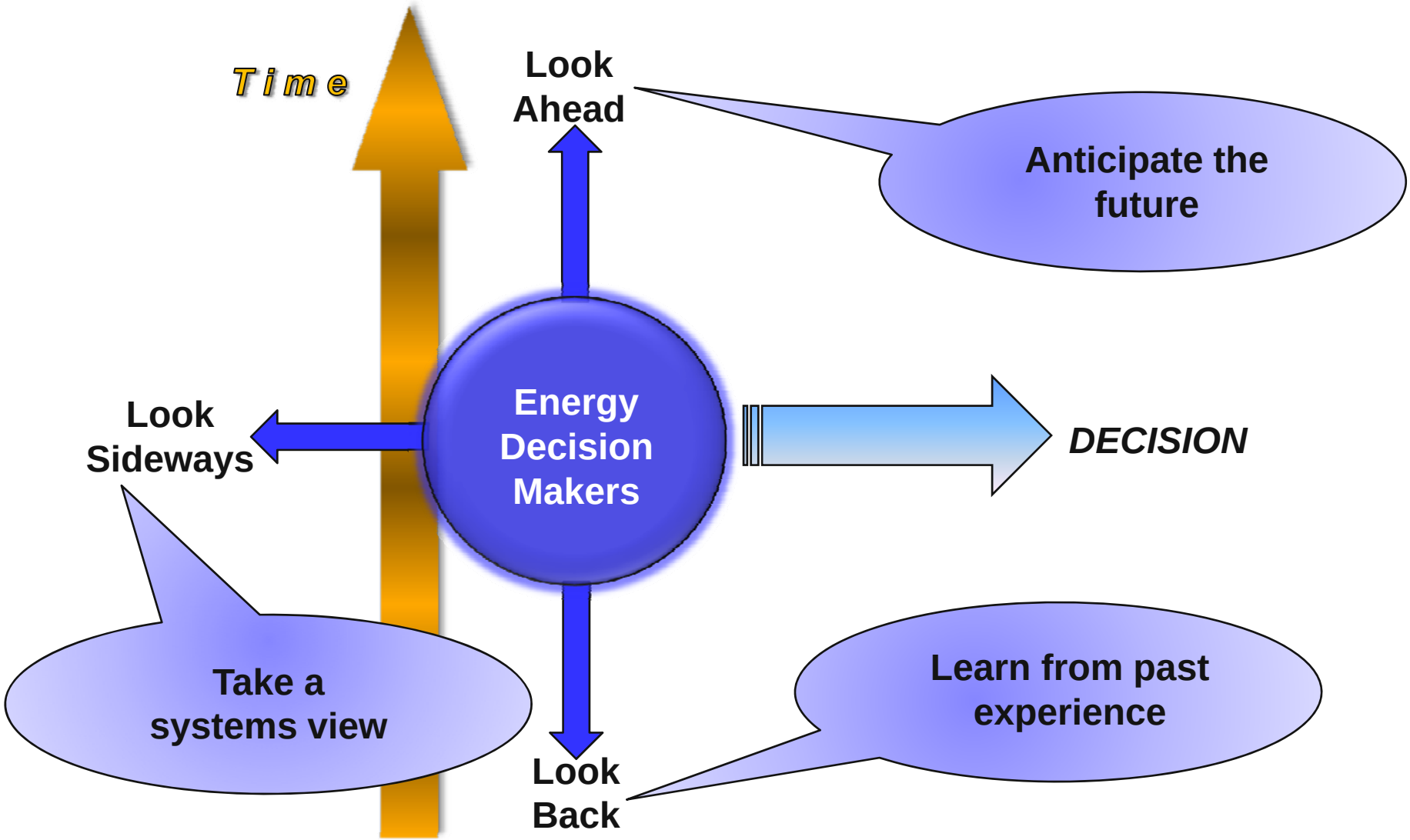
- **Decision Makers, no matter how smart or well-intentioned, are forced to make choices with:**
  - ***Limited, incomplete, sometimes unreliable information***
  - ***Limited ability to process large amounts of information***
  - ***Limited time to make a choice***

- **Decision Makers, in general, are not "optimizers" but rather "satisficers"[(a)]. Their decisions are:**
  - ***Suboptimal***
  - ***Satisfactory or "good enough"***

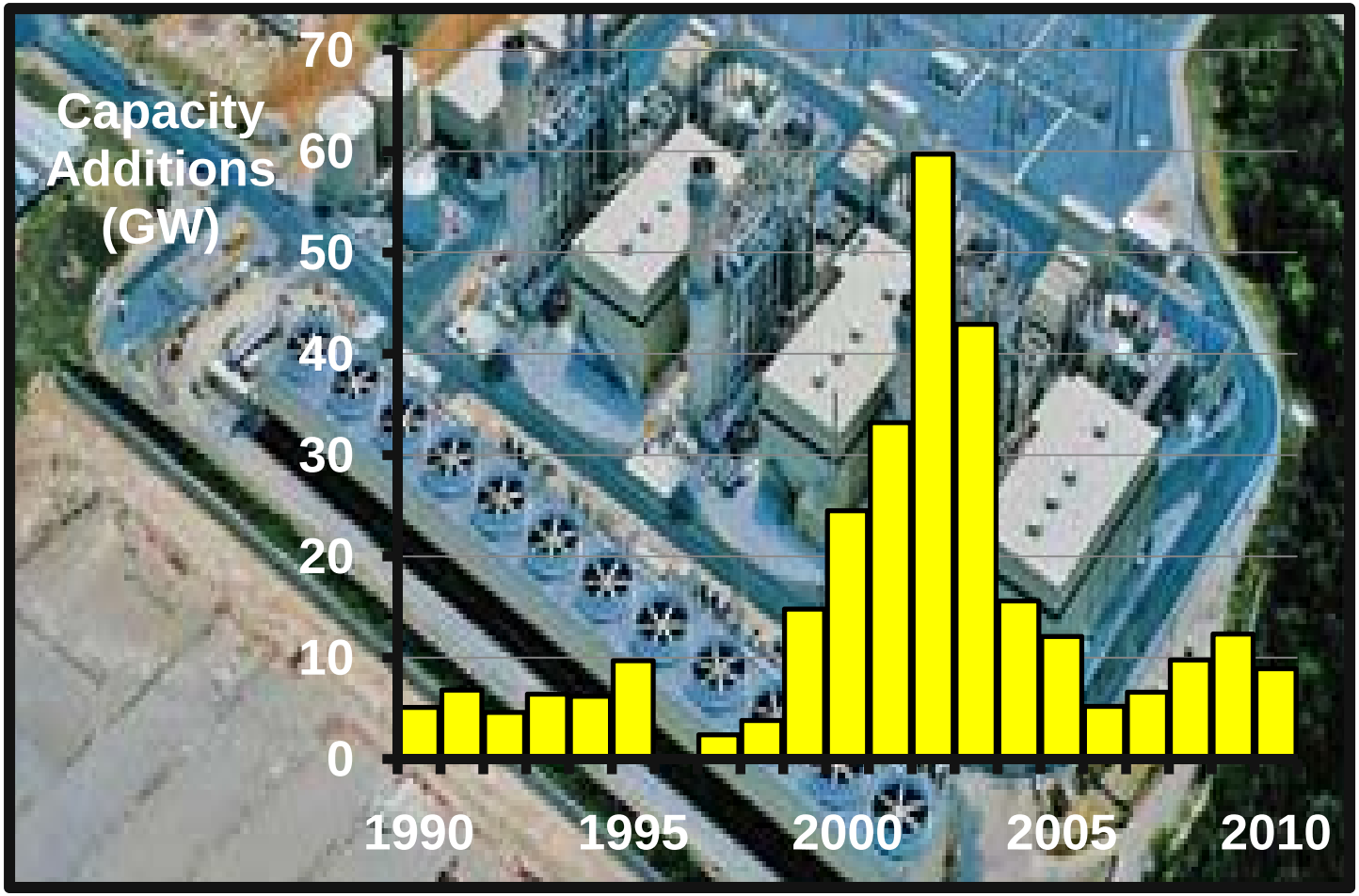
- **The ability to adapt and adjust is an important part of good decision making**

[(a)] Herbert Simon
Nobel Prize in Economics

Good Decisions Need to Be Built on Good Data and Analysis

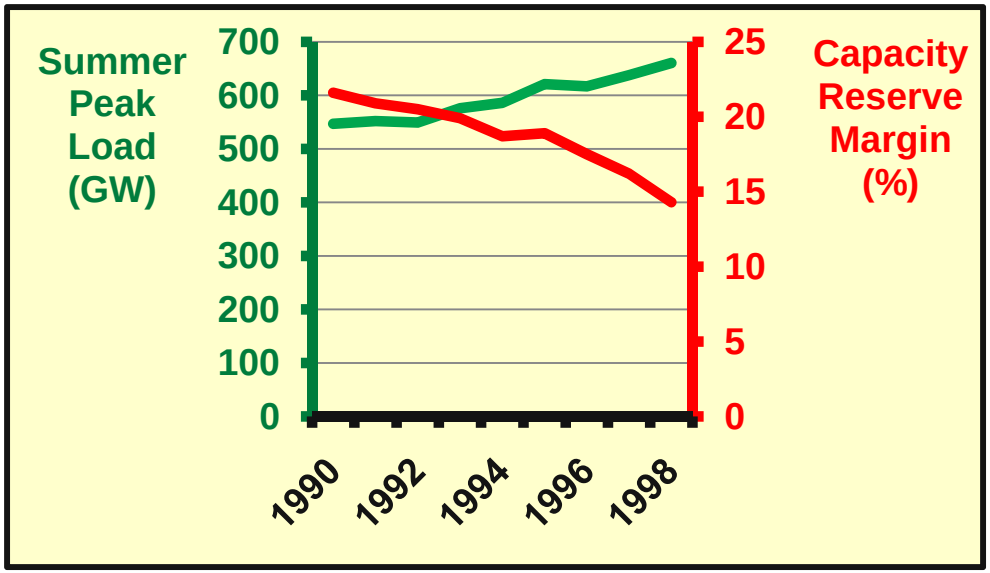


DECISION MAKING EXAMPLE:
U.S. Natural-Gas-Fired Power Plant Construction Had a Substantial Peak, Then It Leveled Off

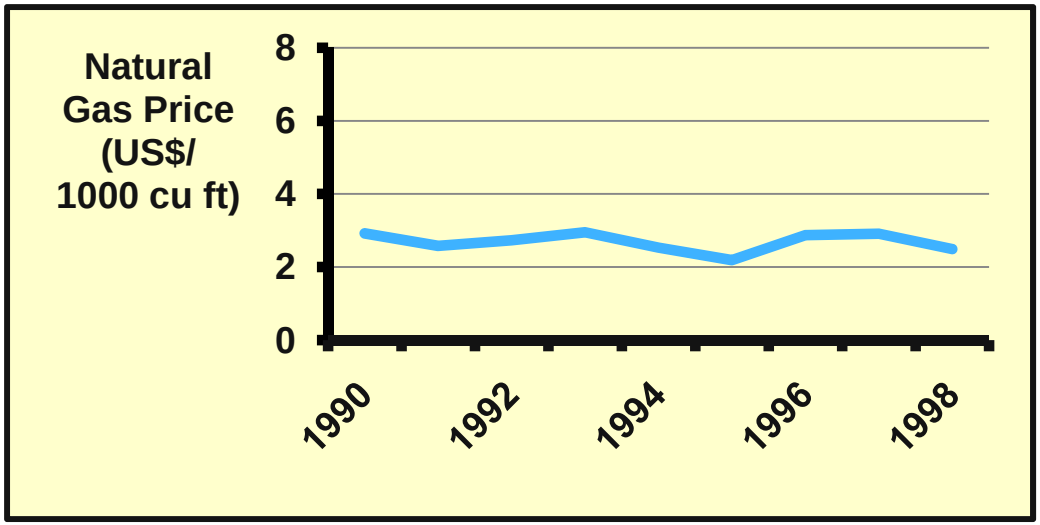


Factors That Affected Decisions in the 1999/2000 Period

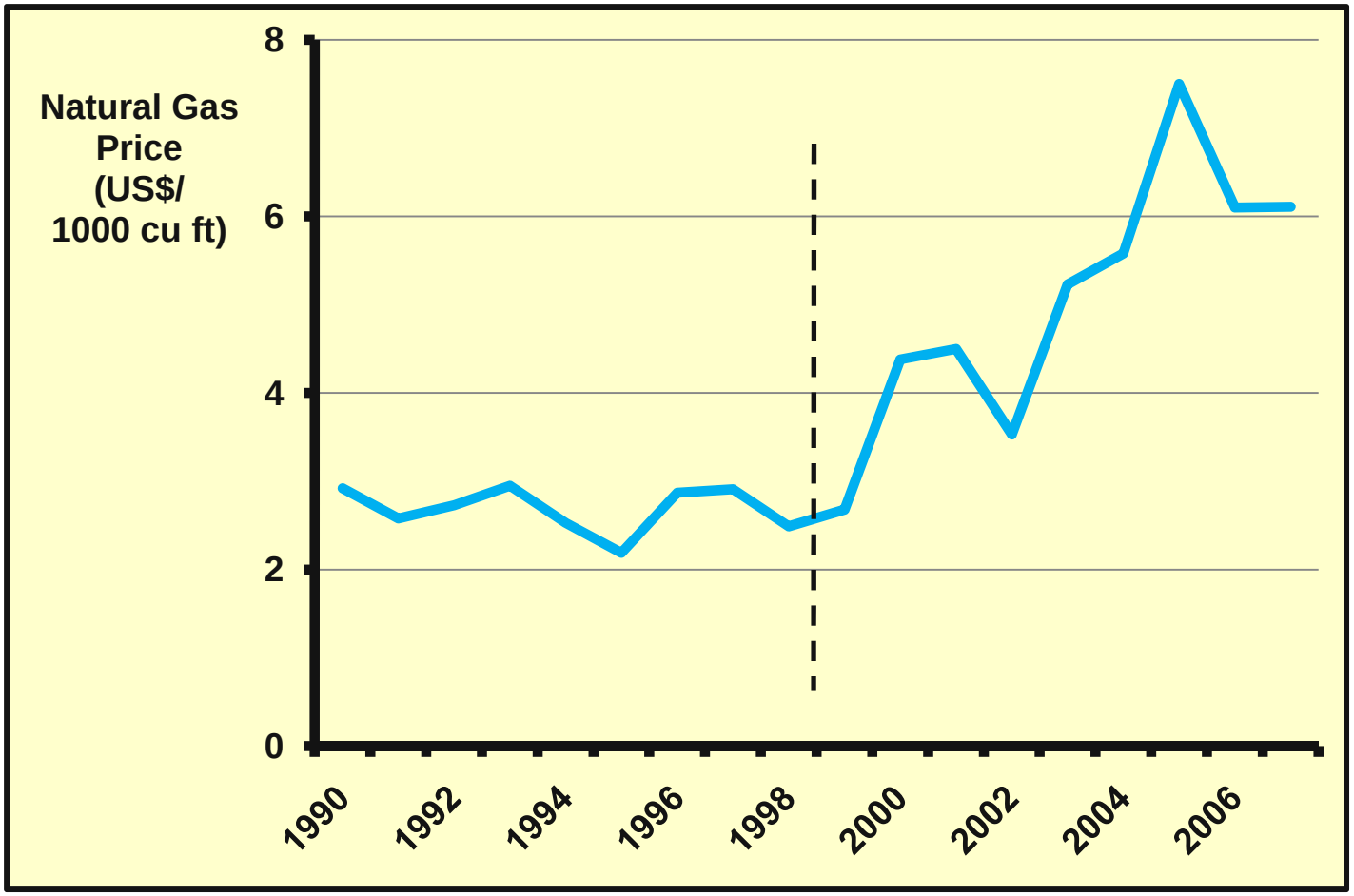
- **Looking Back**
  - **Increasing load**
  - **Limited capacity additions**
  - **Declining capacity reserve margins**
  - **Low natural gas prices**



- **Looking Ahead**
  - **Short construction time for natural gas units**
  - **Rapid payback on investment**
  - **Electricity deregulation beginning**

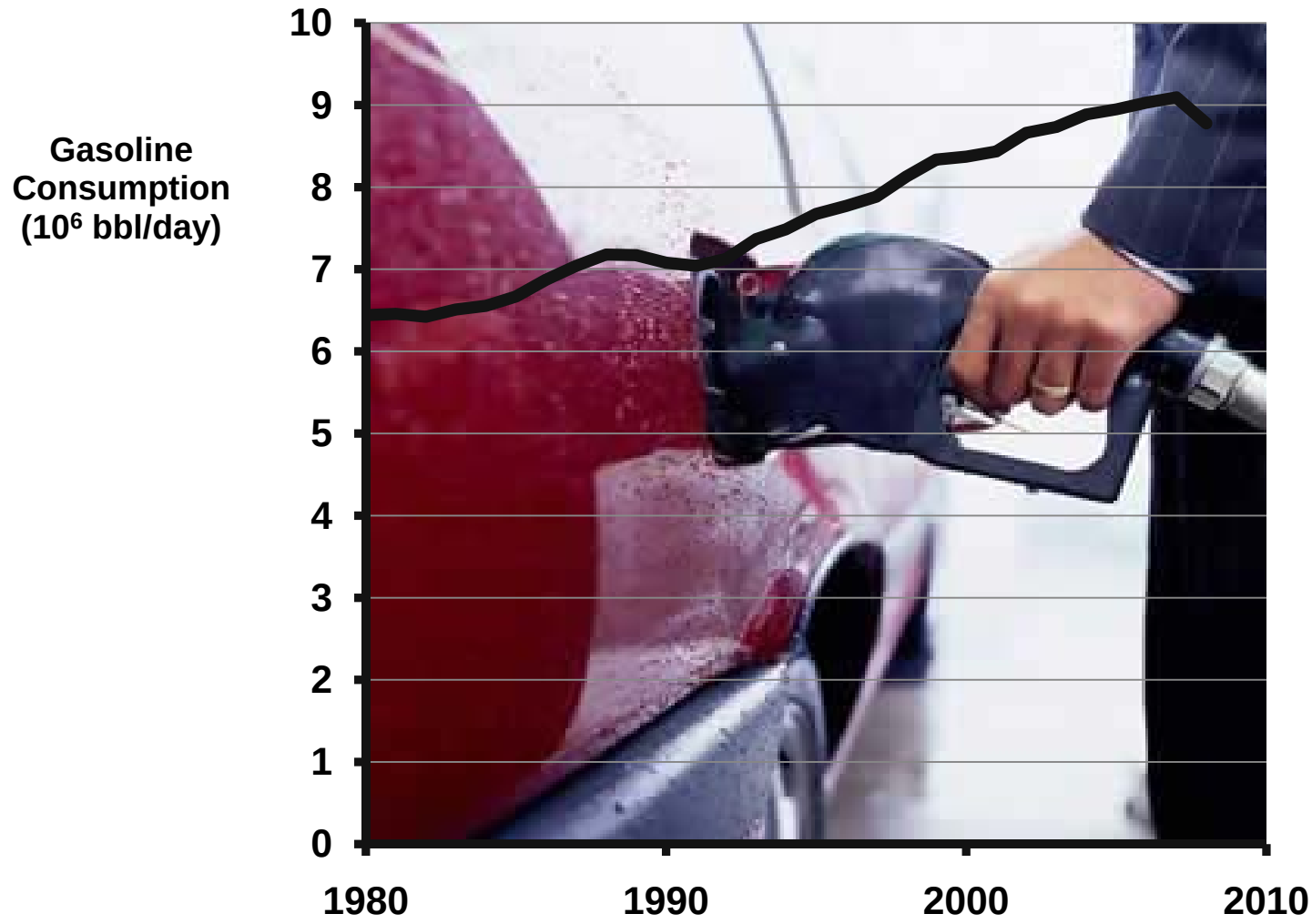


Some Things Were Not Foreseen
Increased Demand Caused Natural Gas Prices to Rise



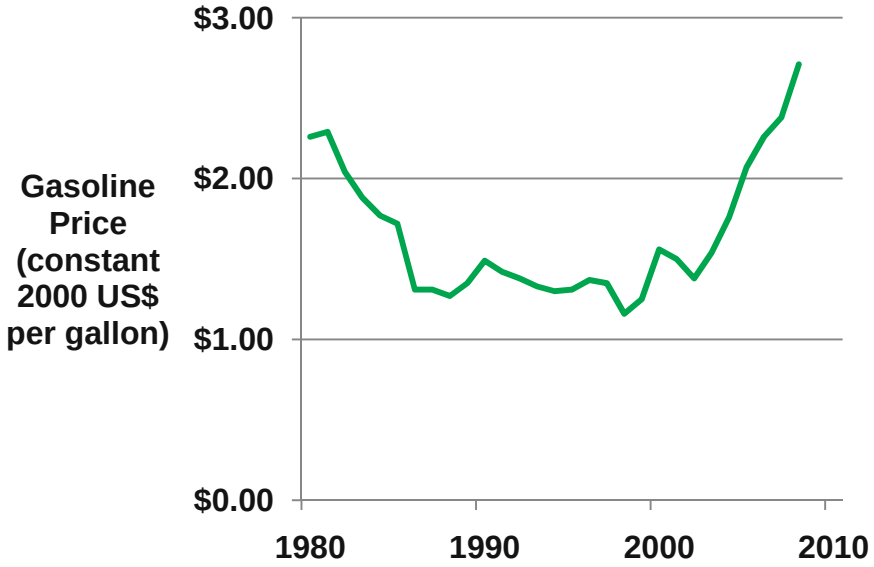
Many units were idled for a number of years

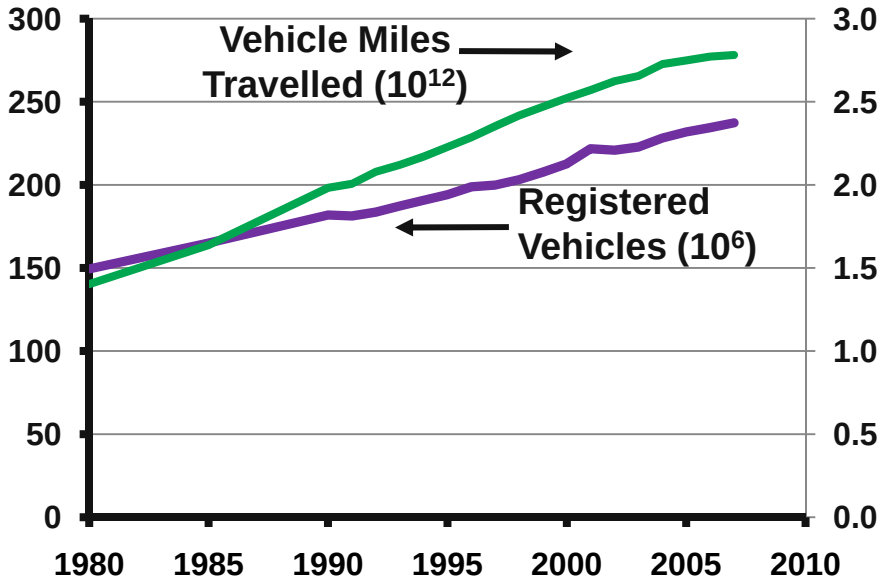
DECISION MAKING EXAMPLE:
Reduce Transportation Oil Demand and CO_2 Emissions

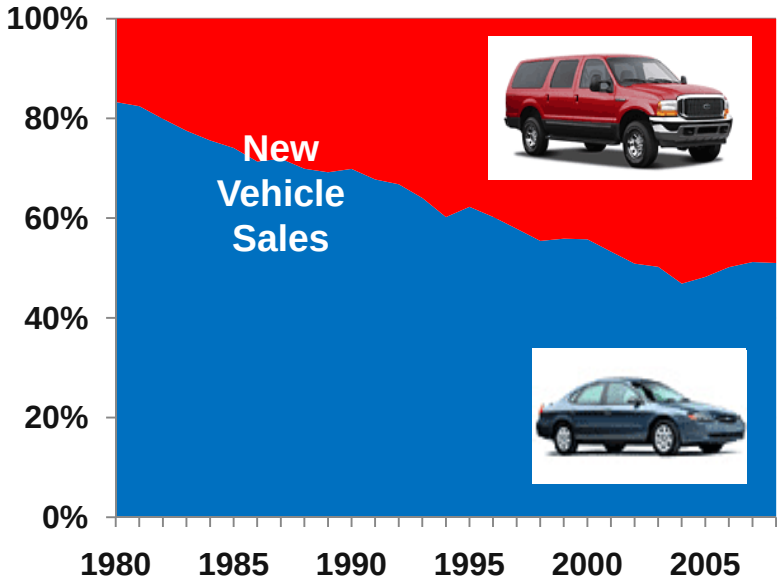


Looking Back

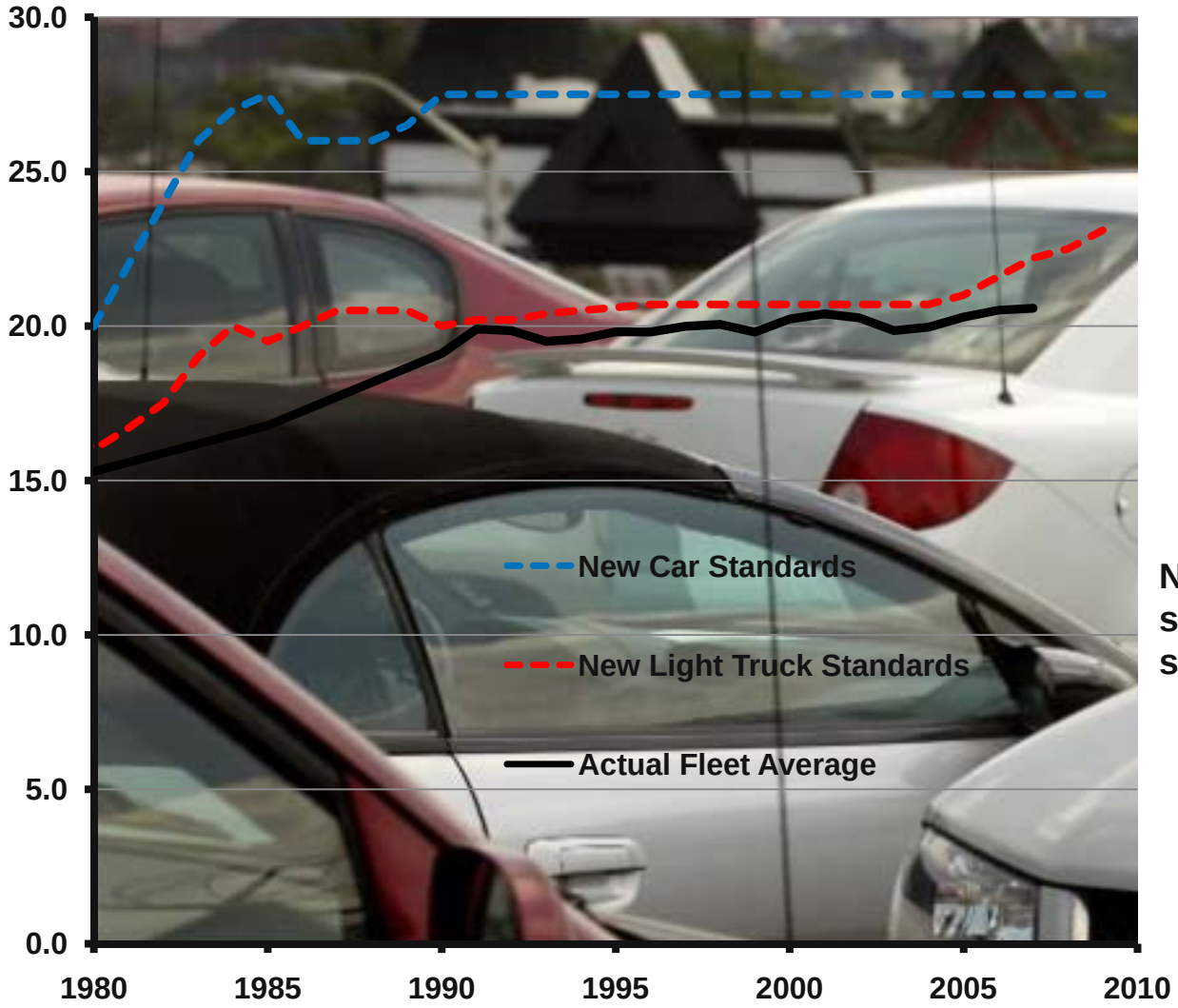
- Low gasoline prices
- Increased driving
- Vehicle mix changes





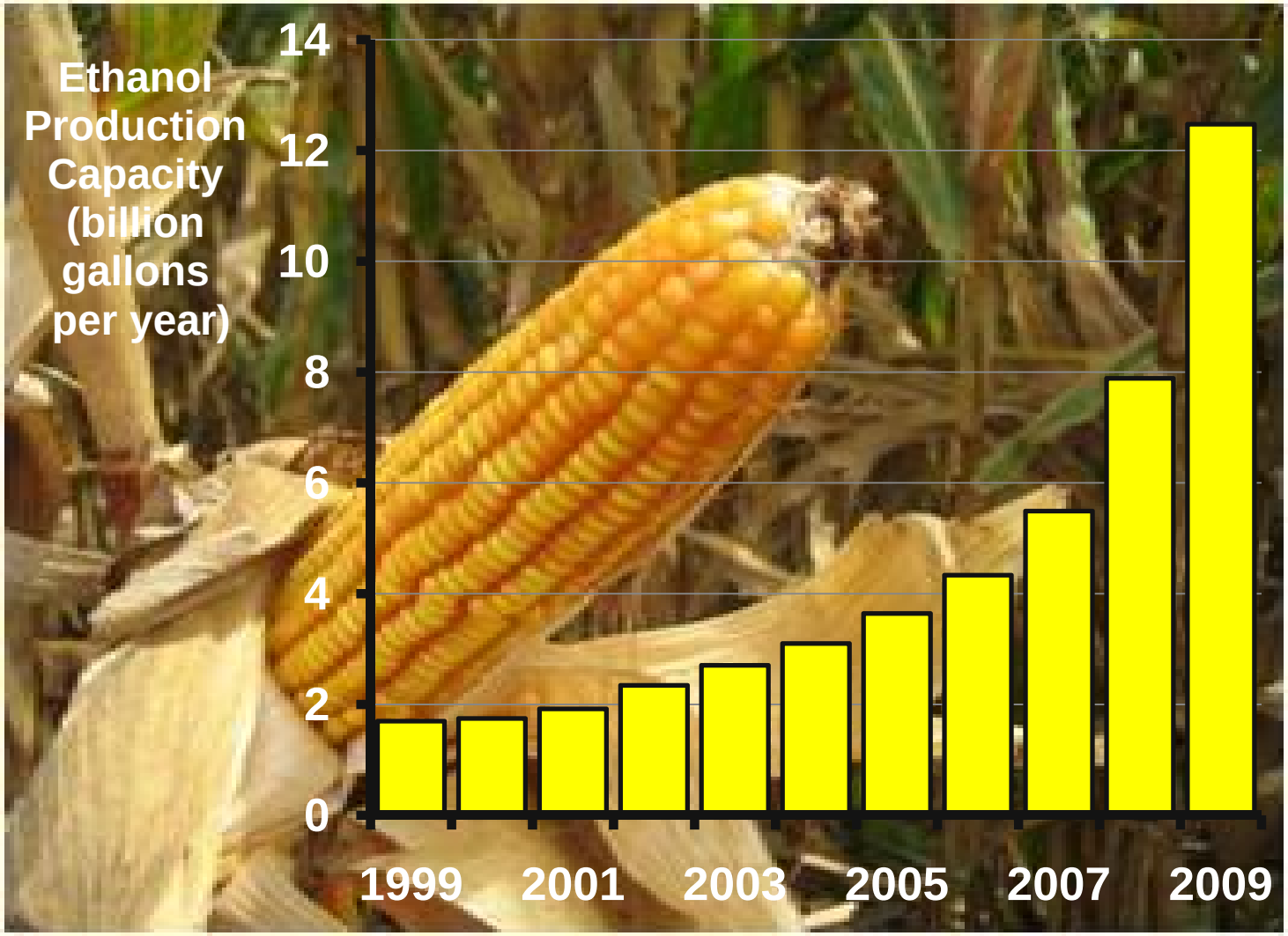


Option: Set Efficiency Standards – The Impact Is Affected by Vehicle Mix and Turnover Rates

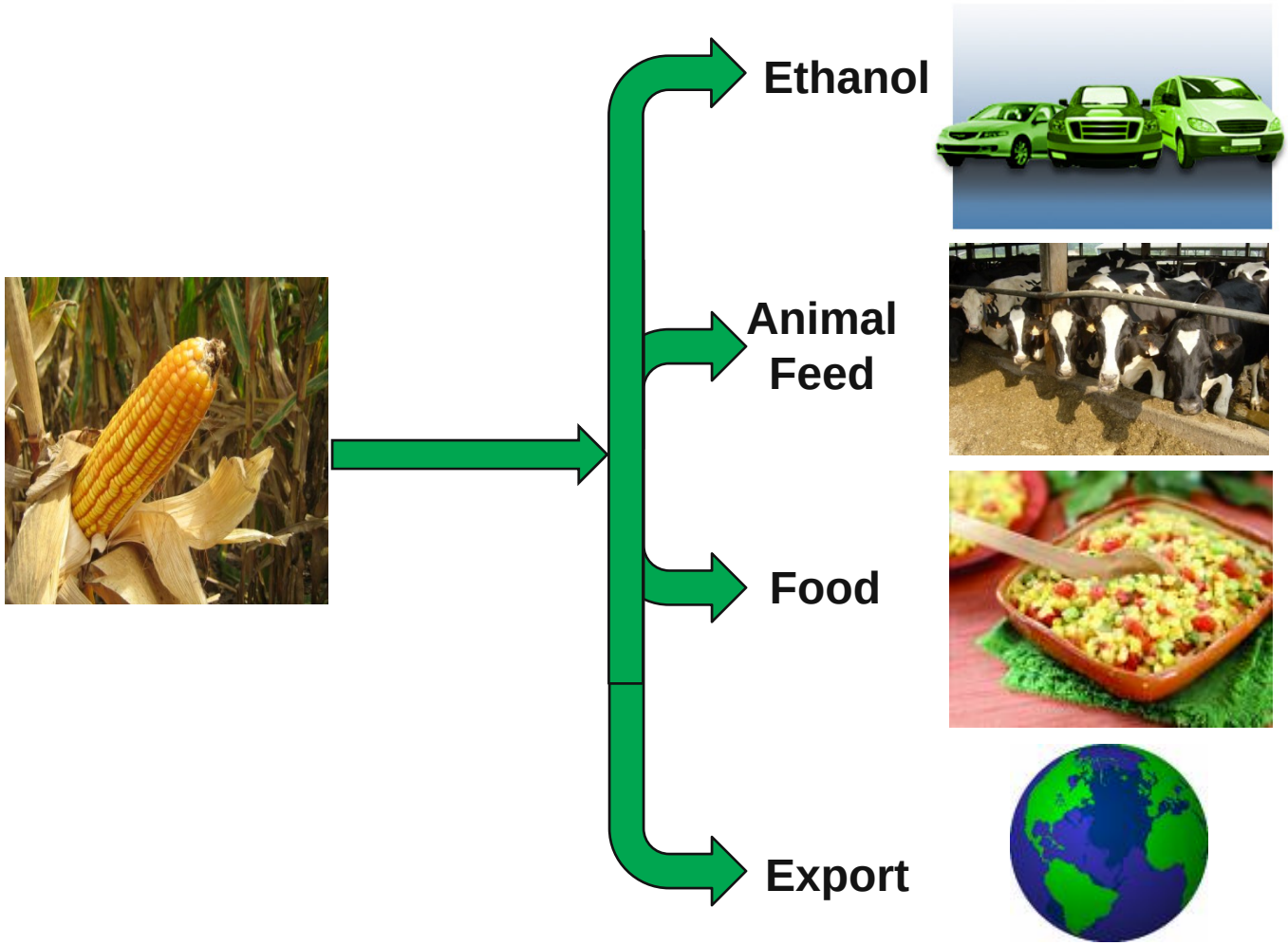


Note: New vehicle standards are to be set at 35 mpg by 2020

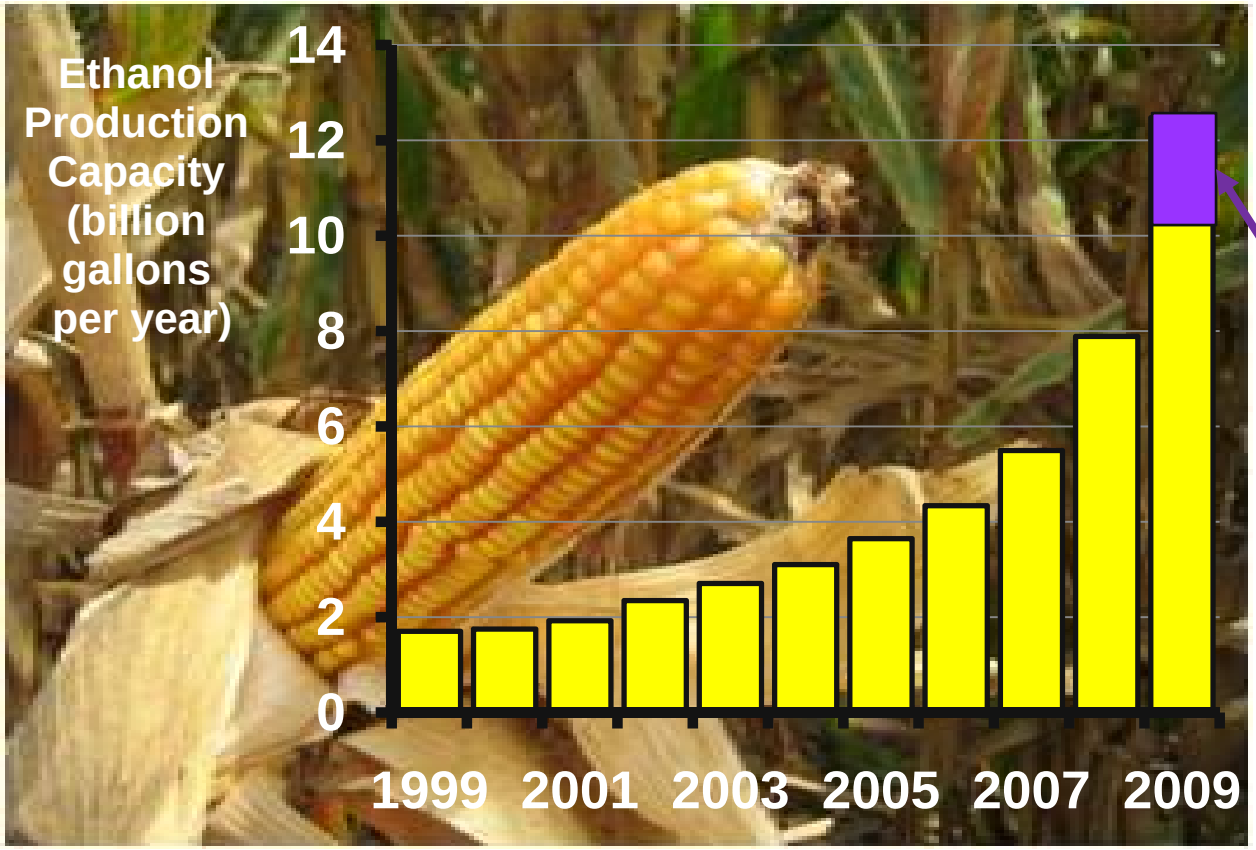
Option: Develop Alternative Fuels – Ethanol Production Capacity Has Been Growing Rapidly



Look Sideways: Corn Is Part of a Larger System That Affects Demand and Price



Higher Corn Prices, Lower Oil Prices Have Led to Idled Capacity, Bankruptcies



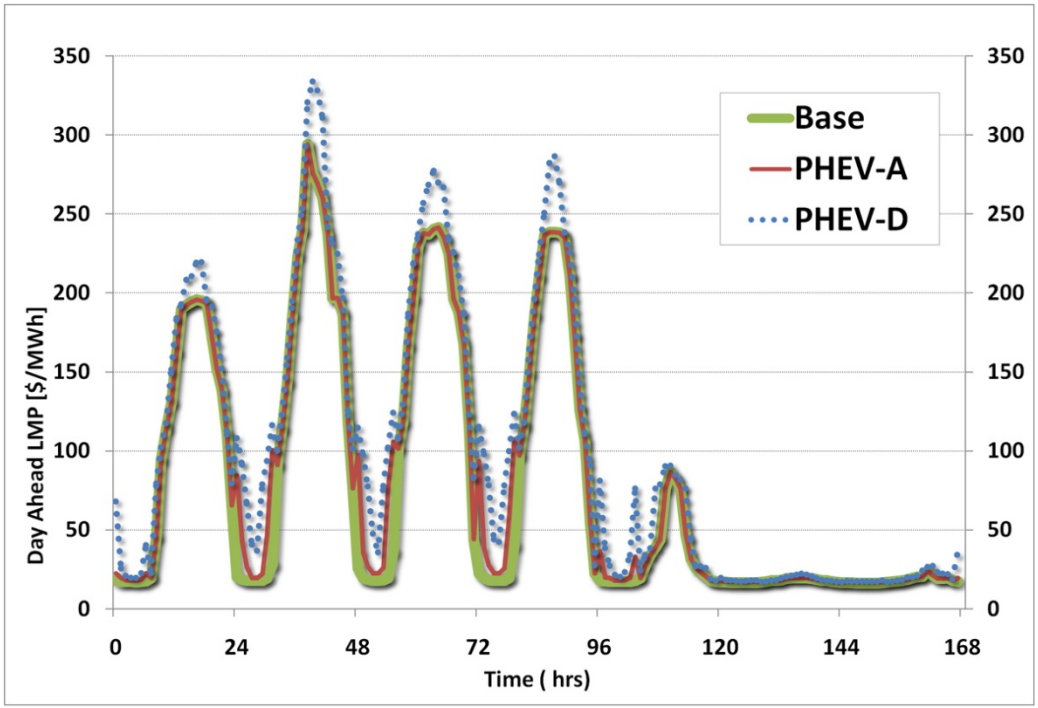
Research is underway on cellulosic ethanol production, which does not use corn

Option: Develop Advanced Vehicle Technology – Plug-In Hybrids Electric Vehicles Are Gaining Attention

- **Range of 40 miles (67 km) on a single battery charge**
- **Range with battery and gasoline engine is 300 miles (484 km)**
- **Planned availability in 2010**
- **Cost – not yet determined**
- **Announced efficiency – equivalent of 230 miles per gallon**

Look Sideways: Plug-In Hybrid Electric Vehicles Will Affect the Power Grid and Electricity Prices

Hourly electricity prices with plug-in hybrid vehicles

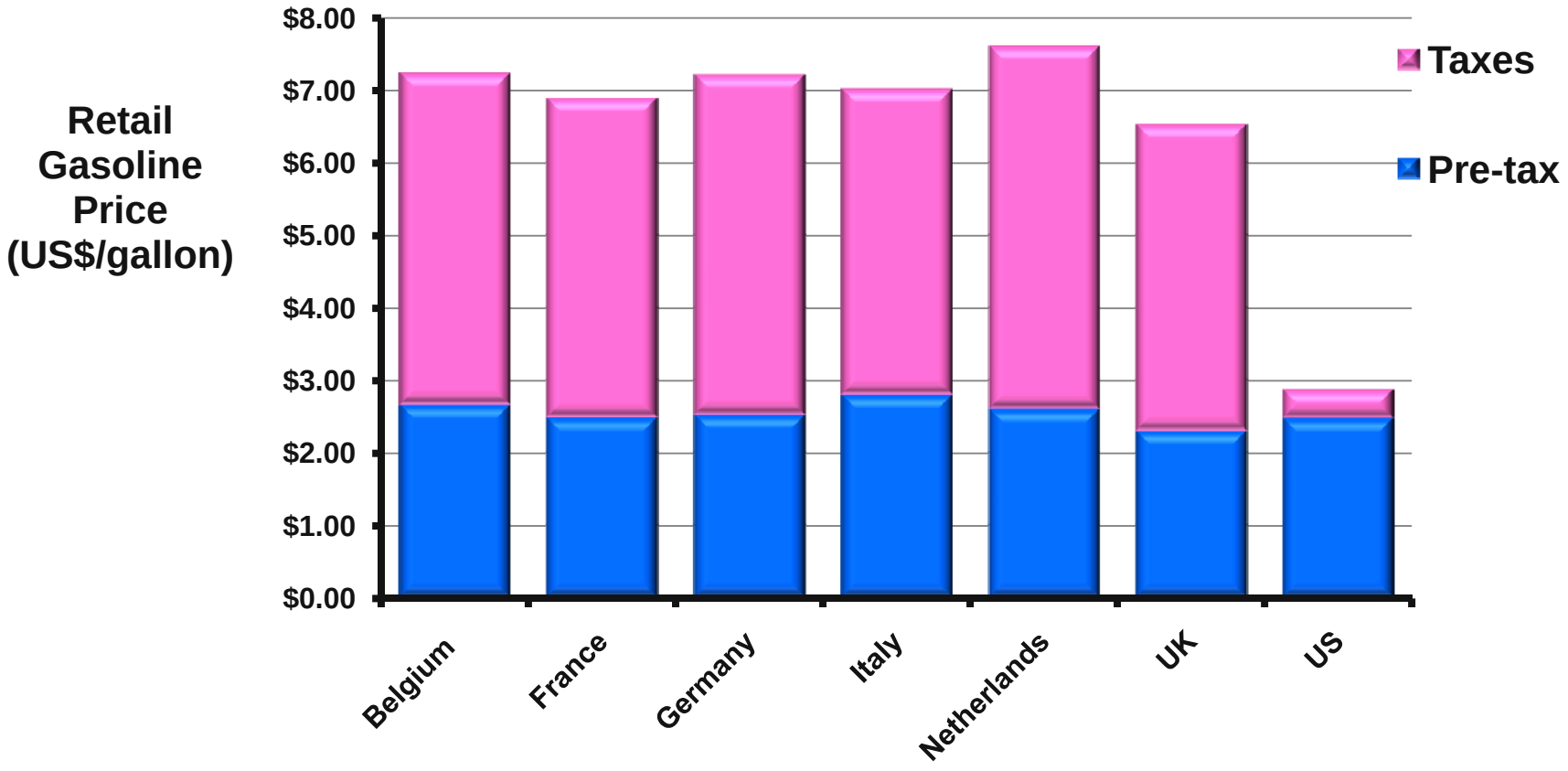


Source: Argonne National Laboratory

Plug-In Hybrid Electric Vehicles could:

- **Level the night-time load**
- **Increase daytime peak loads**
- **Raise prices**
- **Raise or lower CO_2 emissions**

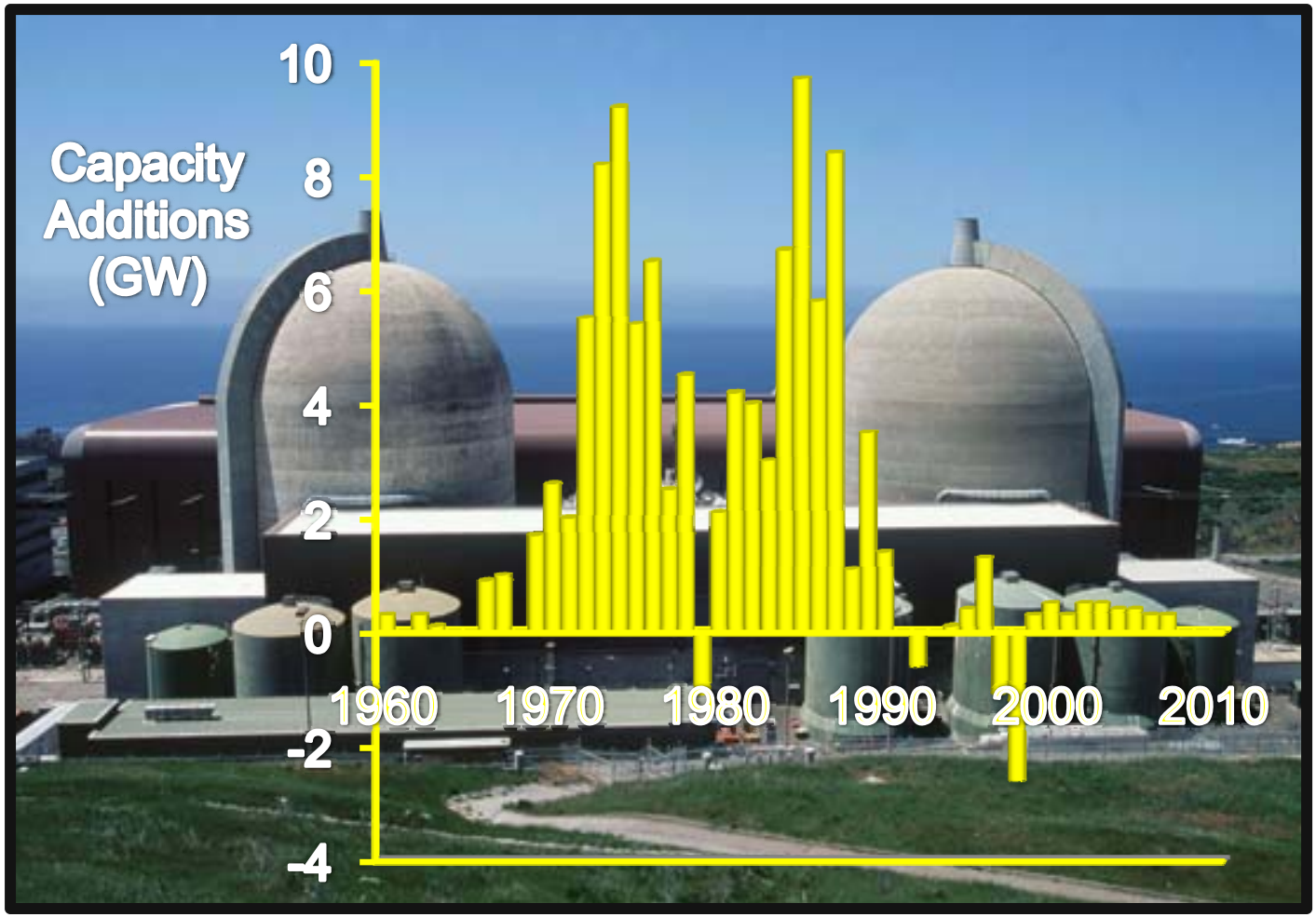
Option: Implement Gasoline Taxes



Source: US Energy Information Agency (August 2009)

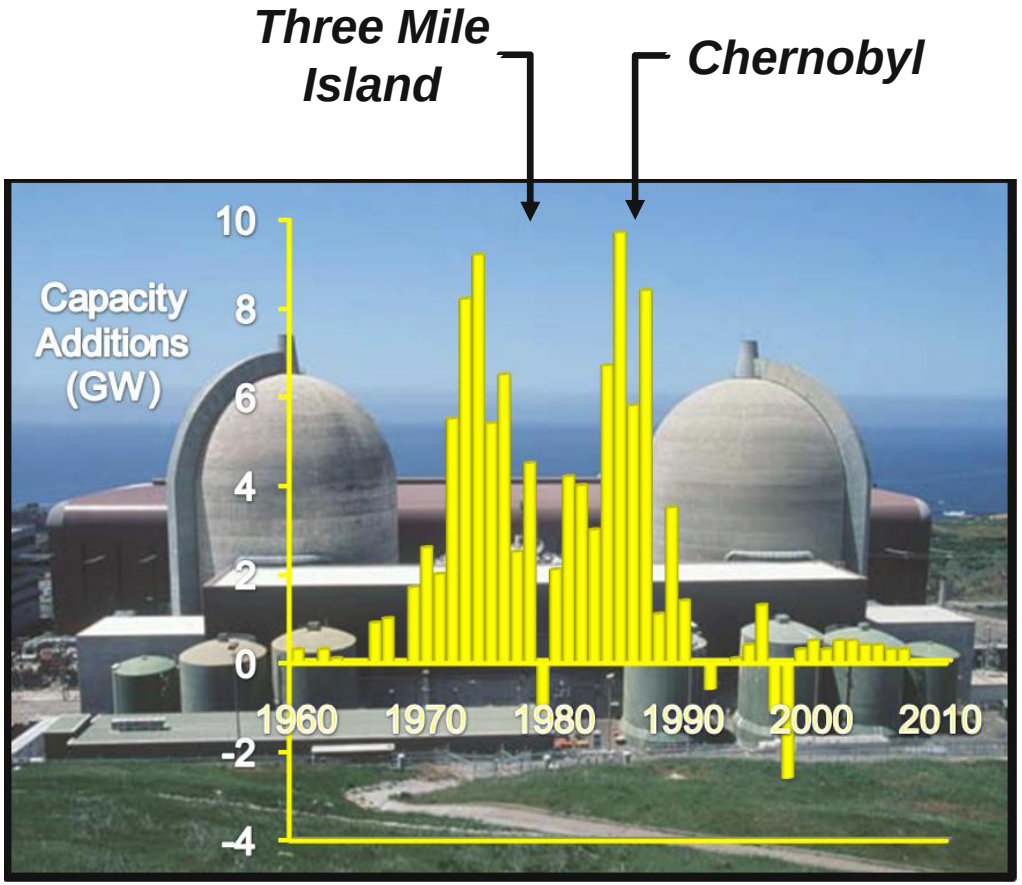
Look Sideways: Impact of tax increases on the economy

DECISION MAKING EXAMPLE:
Nuclear Power Plant Construction Had Peaks, Then It Stopped



Looking Back at Nuclear Power

- Issues affecting expansion decisions
  - Accidents
  - Public Opposition
  - High Capital Cost
  - Waste Management
  - Proliferation Concerns



Decisions were made by private utilities not to pursue new nuclear

Looking Ahead at Nuclear Power

- **Short term – issues remain**
  - **Financing**
  - **Waste management**
  - **Proliferation concerns**

- **Long term – issues foreseen**
  - **Profitability**
  - **Climate change**

"Exelon on Thursday said its first quarter earnings rose 23 percent, driven by increased output at its nuclear operations and higher rates." ABC News (April 2009)

"As [the U.S.] Congress debates whether to limit carbon-dioxide emissions … the nuclear-power industry is poised to reap a multibillion-dollar windfall if restrictions take effect." Wall Street Journal (May 2008)

Decisions on the future of nuclear in the U.S have not yet been made

Ways To Improve Energy Decision Making

"For every complex problem there is a solution that is simple, neat – and wrong."
Henry Louis Mencken, essayist

"Those who refuse to study history are condemned to repeat it."
George Santayana, philosopher

"Prediction is very difficult, especially about the future."
Niels Bohr, physicist

"Every thing affects everything else in one way or another, not always predictably."
John A. Woods, organization consultant

1. **Recognize that the energy system has no simple solutions, only choices.**
2. **Look Back – Learn from past experience.**
3. **Look Ahead – Evaluate the future, but don't be near-sighted.**
4. **Look Sideways – Treat energy decisions as systems decisions.**

Ways To Improve Energy Decision Making

"Insanity is doing the same thing over and over again and expecting different results."
Albert Einstein, physicist

"The perfect is the enemy of the good."
Voltaire, philosopher

"It isn't what we don't know that gives us trouble, it's what we know that isn't so."
Will Rogers, humorist

5. **Make energy decisions that are adaptable and adjustable.**
6. **Don't let the "optimum" get in the way of the "good enough".**
7. **Make good decisions using good data and analysis.**

Ways To Improve Energy Decision Making

1. **Recognize that the energy system has no simple solutions, only choices.**
2. **Look Back – Learn from past experience.**
3. **Look Ahead – Evaluate the future, but don't be near-sighted or far-sighted.**
4. **Look Sideways – Treat energy decisions as systems decisions.**
5. **Make energy decisions that are adaptable and adjustable.**
6. **Don't let the "optimum" get in the way of the "good enough".**
7. **Make good decisions using good data and analysis.**