The Power of "And"

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What is the Question?

Lessons

- A ***and*** B usually better than A ***or*** B
- Ask ***"and"*** rather than "***or***" questions
- Focus on the whole
- Pursue integrated opportunities

“And” Versus “Or”

“And”

- Add
- Combine
- Connect
- Synergy
- Integrate
- Portfolio
- System
- Complement
- Transform
- Whole
- Innovate

“Or”

- Subtract
- Separate
- Select
- Trade-off
- Differentiate
- Choice
- Component
- Compete
- Compromise
- Parts
- Accept

The Power of "And"

The ***sustainable energy and mobility future*** that results from ***thinking and acting synergistically*** with a ***common understanding and collective will***

"Or" Questions ….

- Should we invest in biofuels or electric vehicles?
- Are advanced batteries or fuel cells more important?
- Should we place priority on solar or wind energy?
- Will consumers prefer plug-in hybrid electric vehicles or extended-range electric vehicles?
- Should biomass be used to make ethanol or butanol or electricity or hydrogen?
- Do diesel engines or gasoline engines or hybrids hold more promise?
- Should we focus on improving the efficiency of mechanically driven vehicles or enabling electrically driven vehicles?
- Does it make more sense to deploy battery swapping stations or rapid recharging stations?
- Should we compress natural gas for combustion engines or reform it to make hydrogen for fuel cell-electric vehicles or use this natural gas to generate electricity for plug-in electric vehicles?

…. result in "friction" that is wasteful and slows progress

The Power of "And"

Three examples

- Personal Mobility
- Energy Systems & Policy
- Integrated Community Energy Systems

Personal Mobility

Automobiles

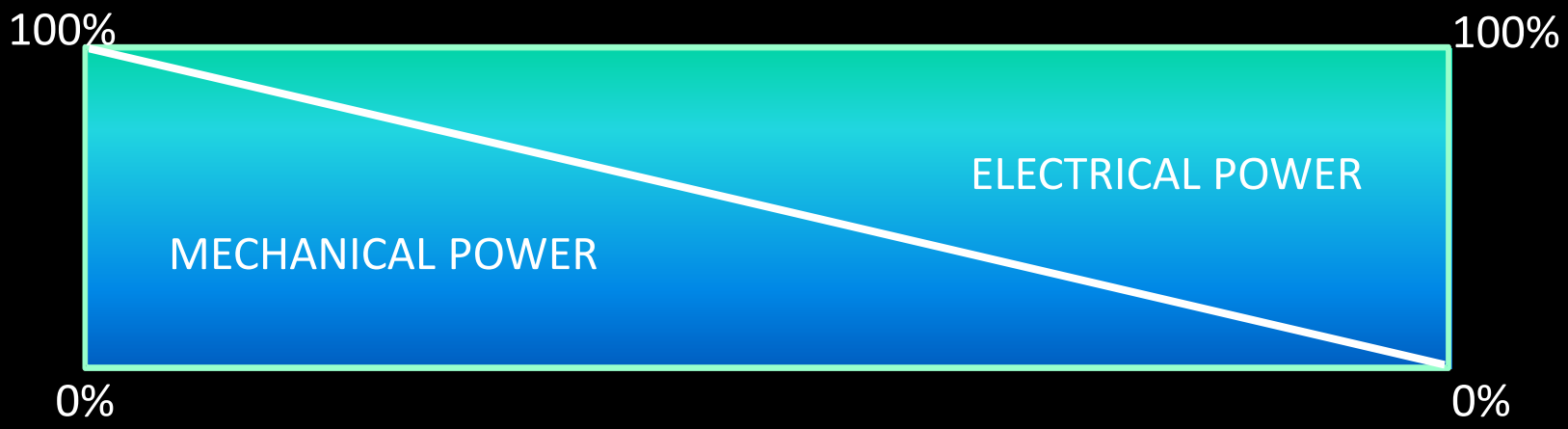
Historical "DNA"

- Combustion Engines
- Oil-based Fuels
- Mechanical & Hydraulic
- Human Operated
- Stand-alone

New "DNA"

- Electric Motors
- Diverse Energy Sources
- Electronic & Digital
- Autonomously Operated
- "Connected"

Propulsion Technology



Internal Combustion Engine (ICE)	Hybrid (HEV) Plug-In Hybrid (PHEV)	Extended Range Electric (EREV)	Battery Electric (BEV) Fuel Cell Electric (FCEV)
Mechanical Drive	Mechanical Drive with Electrical Assist	Electrical Drive with Mechanical Assist	Electrical Drive

Self-Driving Cars

DARPA Urban Challenge

Google Self-Driving Car

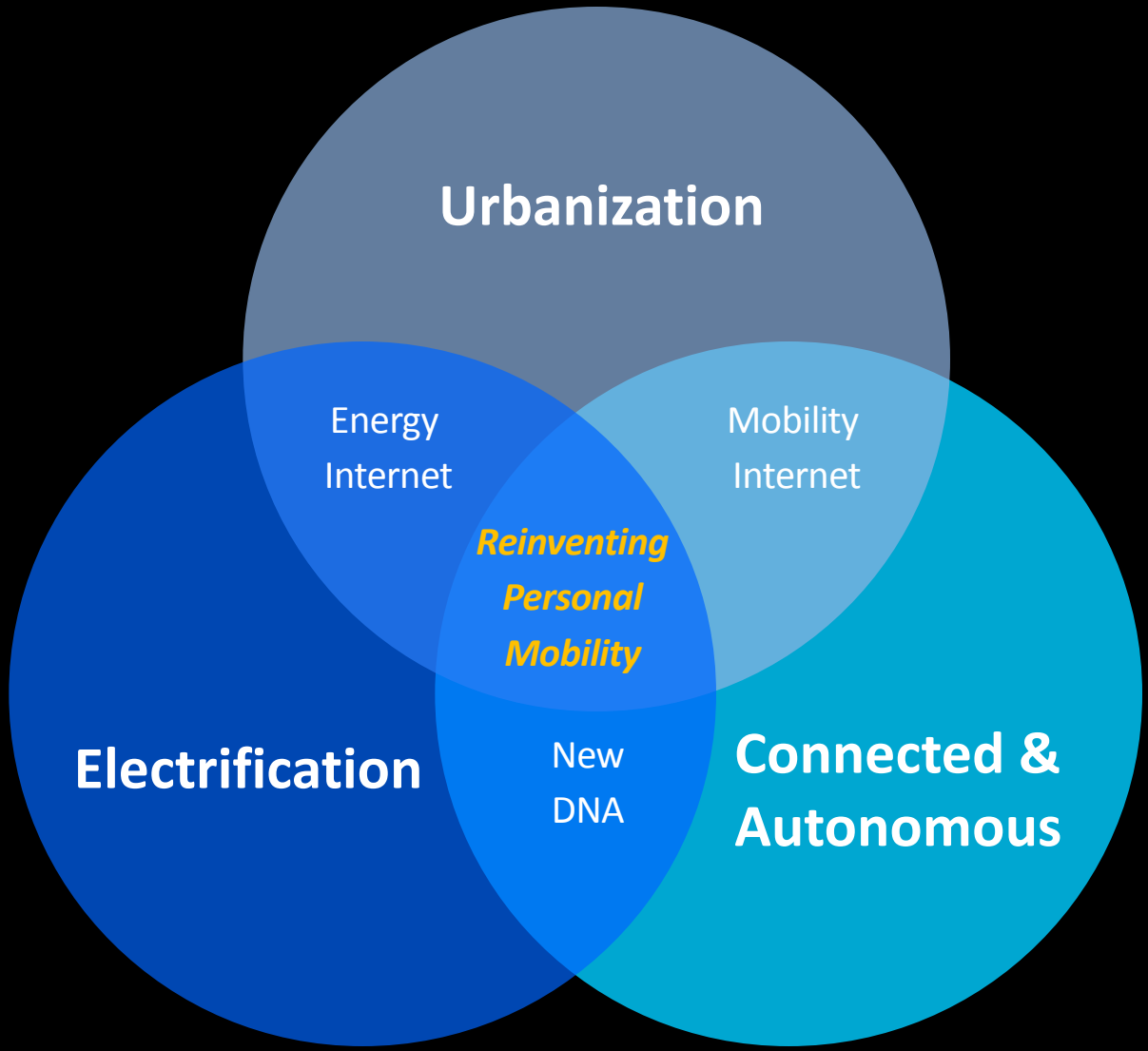
Autonomous Vehicles Are Compelling

- More value from time in vehicles
  - ”driving is a distraction!”
  - 1 hr/day X $25/hr X 250 days/yr = $6,250/yr
  - 1 hr/day X $50/hr X 250 days/yr = $12,500/yr
- Vehicles that don’t crash
  - eliminate roadway fatalities, injuries and property damage
  - enable lighter vehicles
- Lighter vehicles
  - enhance energy efficiency
  - enable better use of batteries (both plug-in and hydrogen)

Mobility Internet

- Enhances how people and goods move around and interact
- Does for vehicles what the Information Internet did for computers
- Manages huge amounts of spatial and temporal “connectivity” data
  - people
  - goods
  - vehicles
  - infrastructure
- Coordinates precisely
  - “millimeters and milliseconds”
  - “mega-meters and hours”
- Optimizes
  - safe traffic flow
  - road space use
  - parking space use
  - shared vehicles
  - commercial fleets
  - energy supply
- Creates opportunities for innovative “apps”

The Power of "And"



Transformational Synergy

Information Internet

+

Energy Internet

+

Mobility Internet

Transformational Change in
How We Live Our Daily Lives

The Whole is More Than the Sum of the Parts

Converging Ideas

Electrically Driven & Connected

+

Mobility Internet

+

Clean, Smart Energy

+

Pricing Markets

=

Transformational Change in Personal Mobility

+ Zero emissions
+ Renewable Energy
+ Crash Avoidance
+ Safe Social Networking While Driving
+ Fun Driving and Autonomous Driving
+ Fashionable Design
+ Shorter, More Predictable Travel Times
+ Space-and Time-Efficient Parking
+ Increased Roadway Throughput
+ Quieter Cities
+ Safer Pedestrians & Bicyclists
+ More Equitable Access
+ Lower Cost

=

Enhanced Freedom

+

Sustainable Mobility

+

Sustainable Economic Growth and Prosperity

15 X

10 X

5 X

5 X

0 X

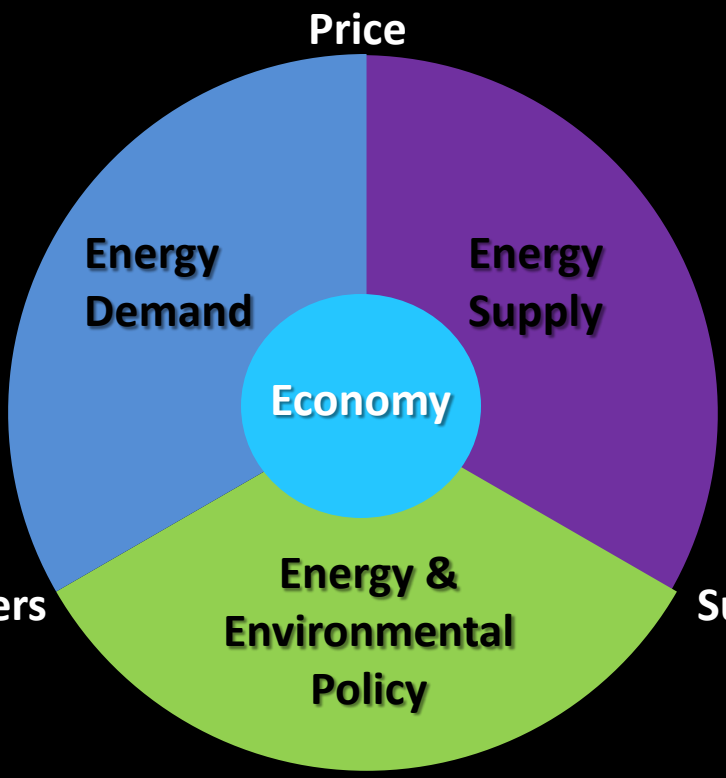
Energy Systems & Policy

Fundamental Concerns

Economy + Energy + Environment

+ U.S. Economic Growth
+ U.S. Jobs Growth
+ U.S. Position as a Global Leader
+ U.S. Oil 67% Imported
+ U.S. Trade Deficit 50% from Imported Oil
+ U.S. Transportation 96% from Oil
+ U.S. Electricity 50% from Coal
+ Coal and Oil Carbon Intensive

Energy Systems & Policy Framework



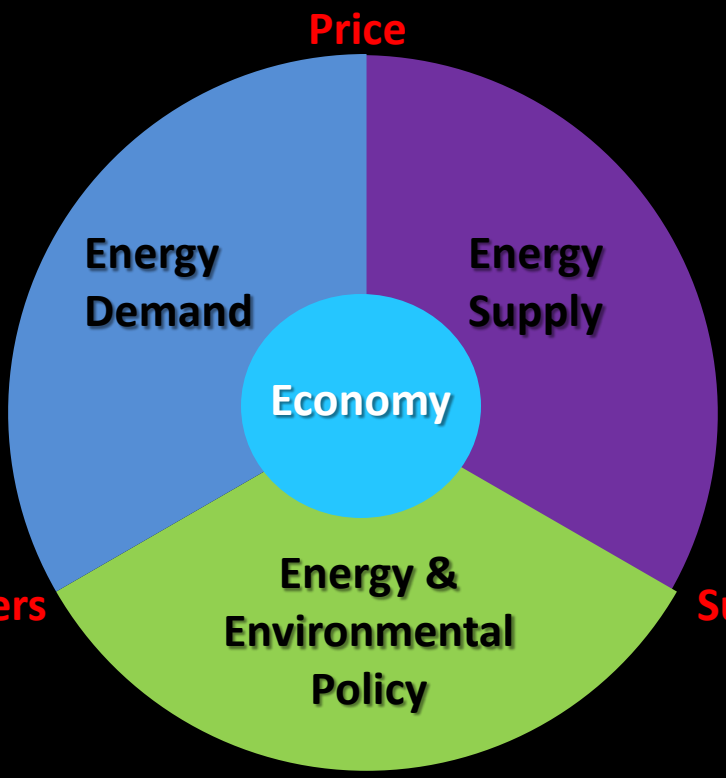
- Efficiency
- Conservation
- Technology

- Sustainability
- Security
- Technology

- Regulations
- Taxes

- Subsidies
- R & D

Energy Systems & Policy Framework



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Market "Tipping Point": Consumer Value > Market Price > Supplier Cost

“Headlines”

- Plenty of energy exists to grow the U.S. economy and plenty of technology exists to do so sustainably
- Americans using energy and businesses enabling this use must be fully comprehended by U.S. energy policy
- Coal for electricity, oil for transportation and wasted energy are the primary concerns that must be addressed
- These concerns can be eliminated through integrated energy system design, proper risk management, common understanding and collective will

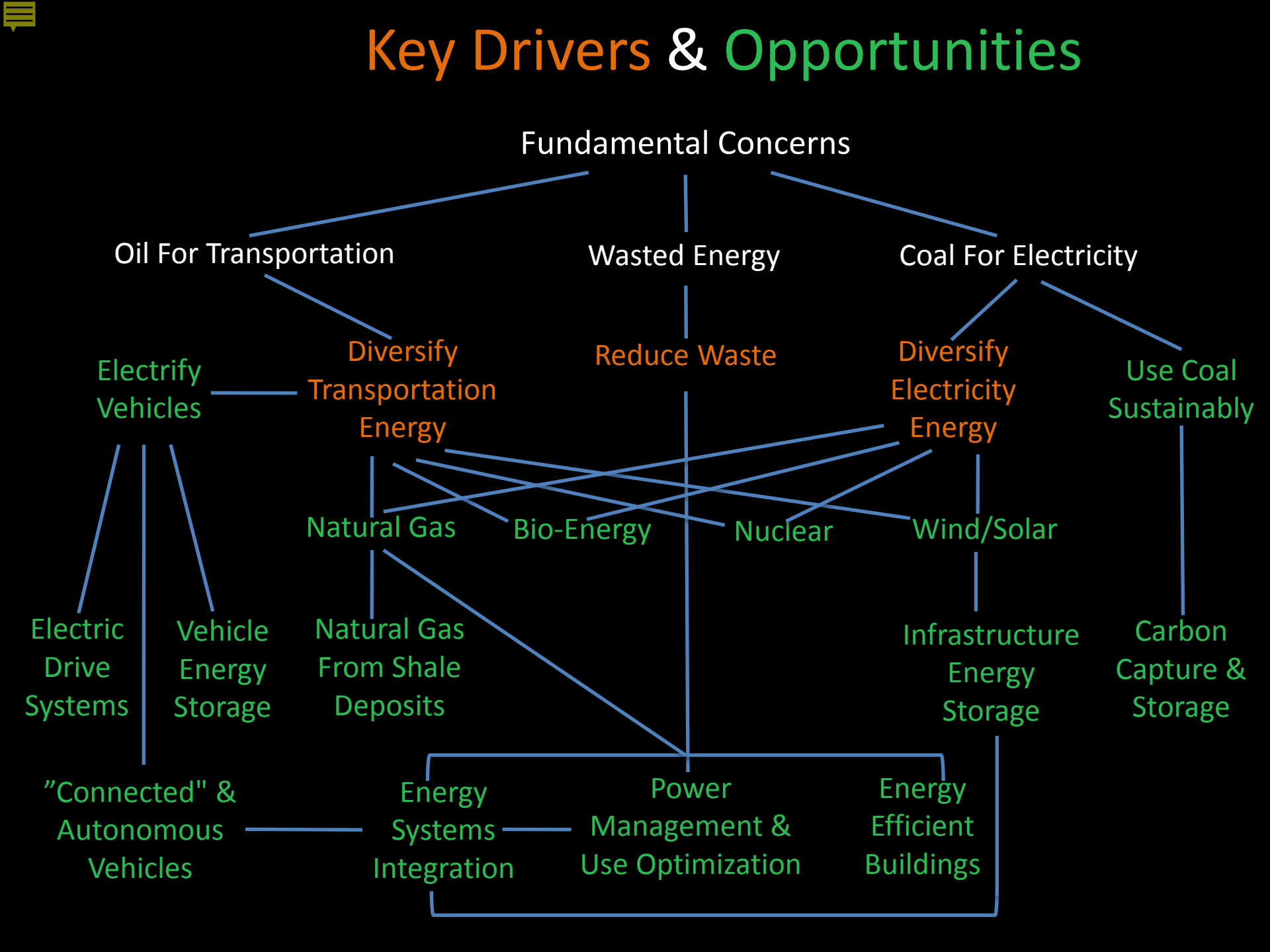
Energy Use

Energy is Woven into the Fabric of Everything We Do

Energy Supply

- The energy supply industry
  - is huge, complex, dynamic and uncertain
  - has enormous inertia, significant capital requirements and strong vested interests
- There is plenty of “raw” (primary) energy from several sources, but every source has sustainability issues
- Energy supply issues should be viewed as ***risks to manage vs. evils to do away with***

Key Drivers & Opportunities



Seminar Series Conclusions

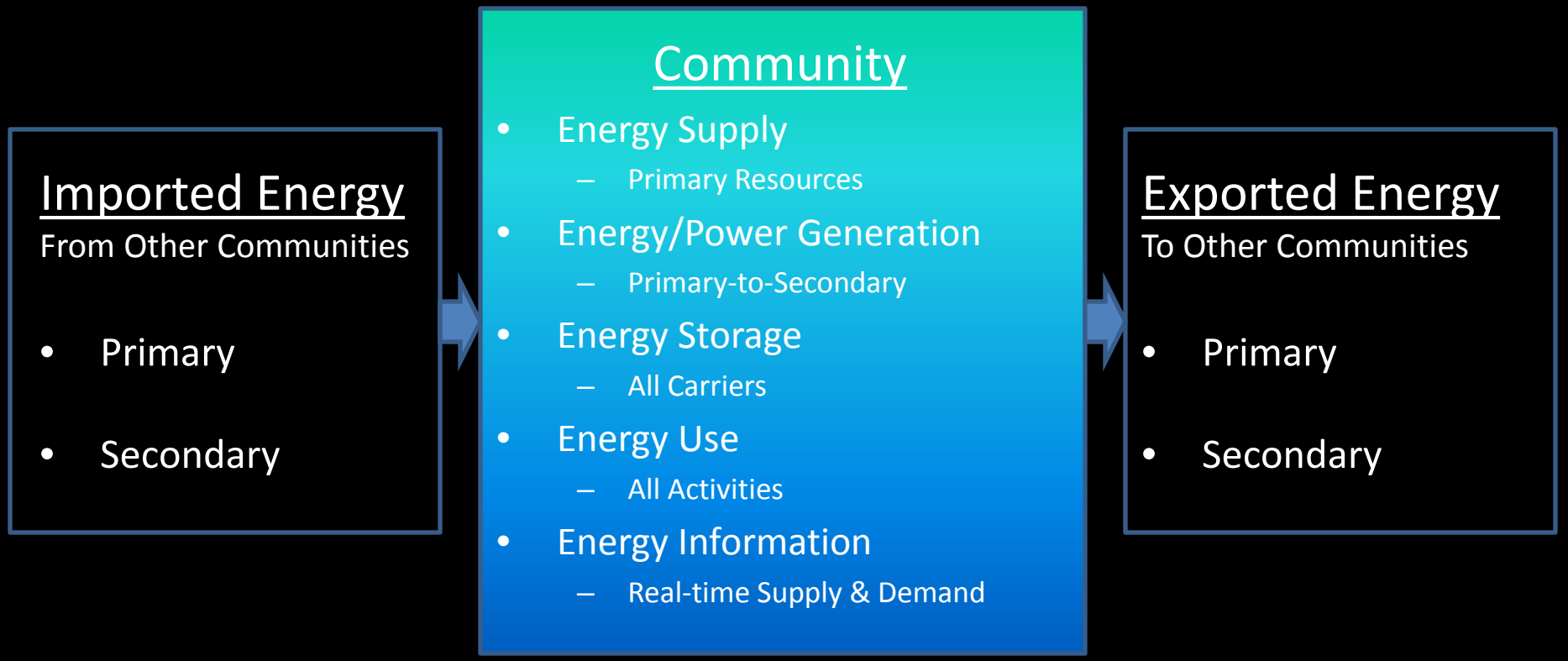
The U.S. faces energy ***system design*** and energy ***risk management*** challenges that can be met through

- A deep, fact-based understanding of why and how people and enterprises use energy
- An “and” mindset
- A “system-of-systems” approach
- Policies that positively motivate consumers, suppliers and investors
- Strong leadership

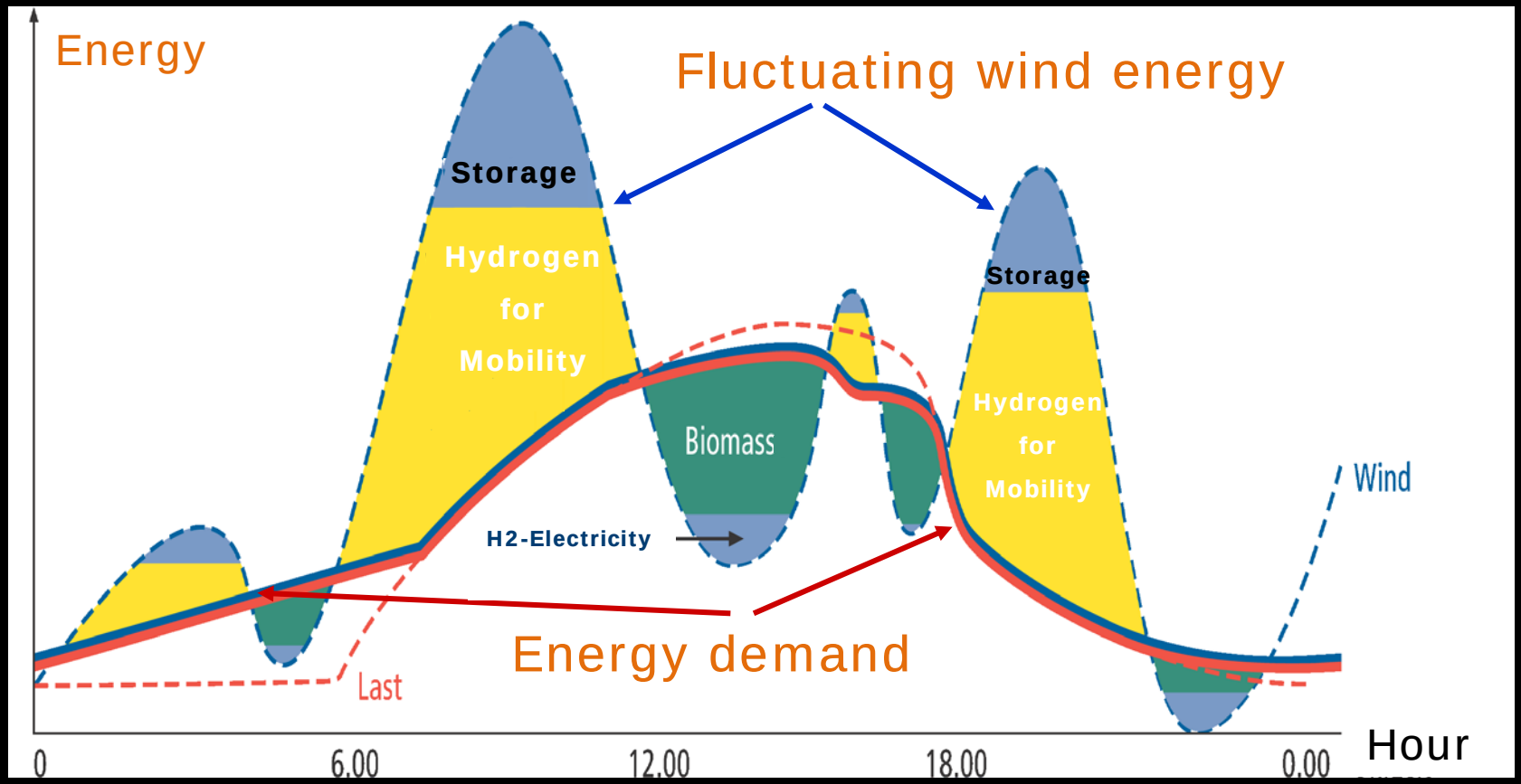
Integrated Community Energy Systems

Integrated Community Energy Systems

Optimized for All Energy Sources & Uses

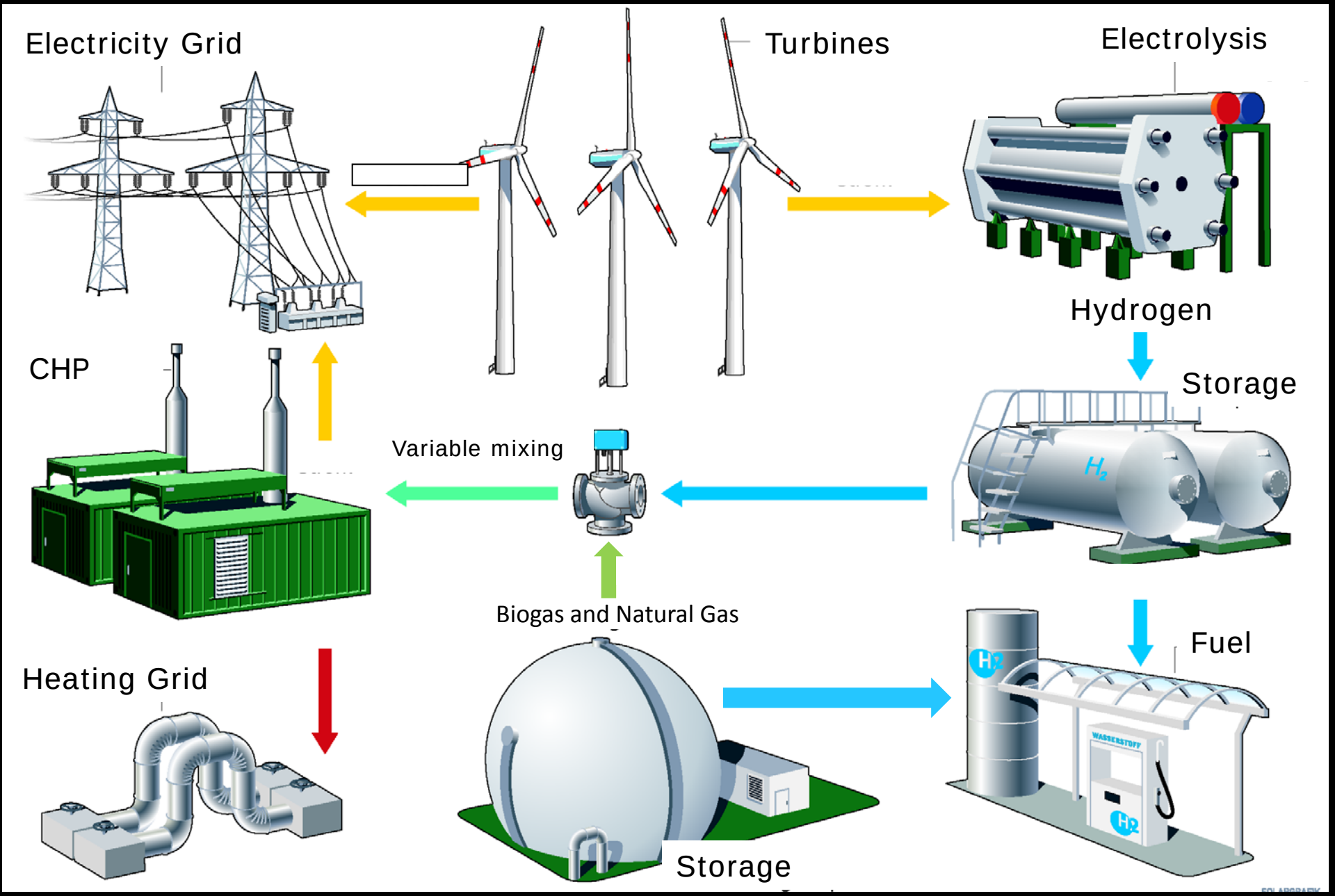


Integrated Energy System Opportunity



Optimized Using Real-time Information on Energy Supply, Demand and Storage

Integrated Community Energy Systems



Implications

- Integrated community energy systems
  - reduce waste
  - enable renewables
- Technology should be assessed in terms of integrated systems, not standalone
- Energy storage and real-time information are key enablers
- Portfolio of energy efficiency, energy diversity and systems integration opportunities must be comprehended together

Conclusions from Examples

- Energy challenge is not due to a lack of resources or knowledge
  - plenty of raw energy exists to grow the world's economies
  - plenty of technology exists to do so sustainably

- Energy challenge is due to
  - a lack of integrated systems
  - the enormous inertia of the installed base
  - leadership that is driven by vested interests

- By combining our abundant fossil and renewable energy resources with a broad portfolio of promising technology, integrated system opportunities surface that have the potential to enable sustainable development

- ***The Power of "And"*** is a key to realizing a secure, low cost and low carbon energy future

Realizing *The Power of "And"*

- Energy and mobility history is fraught with
  - self-interest
  - ruthless politics
  - myopic and inefficient outcomes
- Nevertheless, the "prize" of a sustainable future makes ***The Power of "And"*** a worthwhile pursuit
- While formidable, the challenge is one of behavior, politics and economics, not science and invention
  - Knowing solutions are within our grasp is central to *transitioning* to a sustainable future
- ***The Power of "And"*** requires
  - innovative system design
  - proactive risk management
  - extraordinary leadership

Leaders Must…..

1. Properly frame questions

Leaders Must…..

1. Properly frame questions
2. See the whole challenge

Leaders Must…..

1. Properly frame questions
2. See the whole challenge
3. Lever ***The Power of "And"***

New Technology “Improves” Existing Technology

- Aluminum has driven improvements in steel auto bodies
- Electric vehicles are driving improvements in internal combustion engines
- Plentiful natural gas will drive improvements in coal and renewables

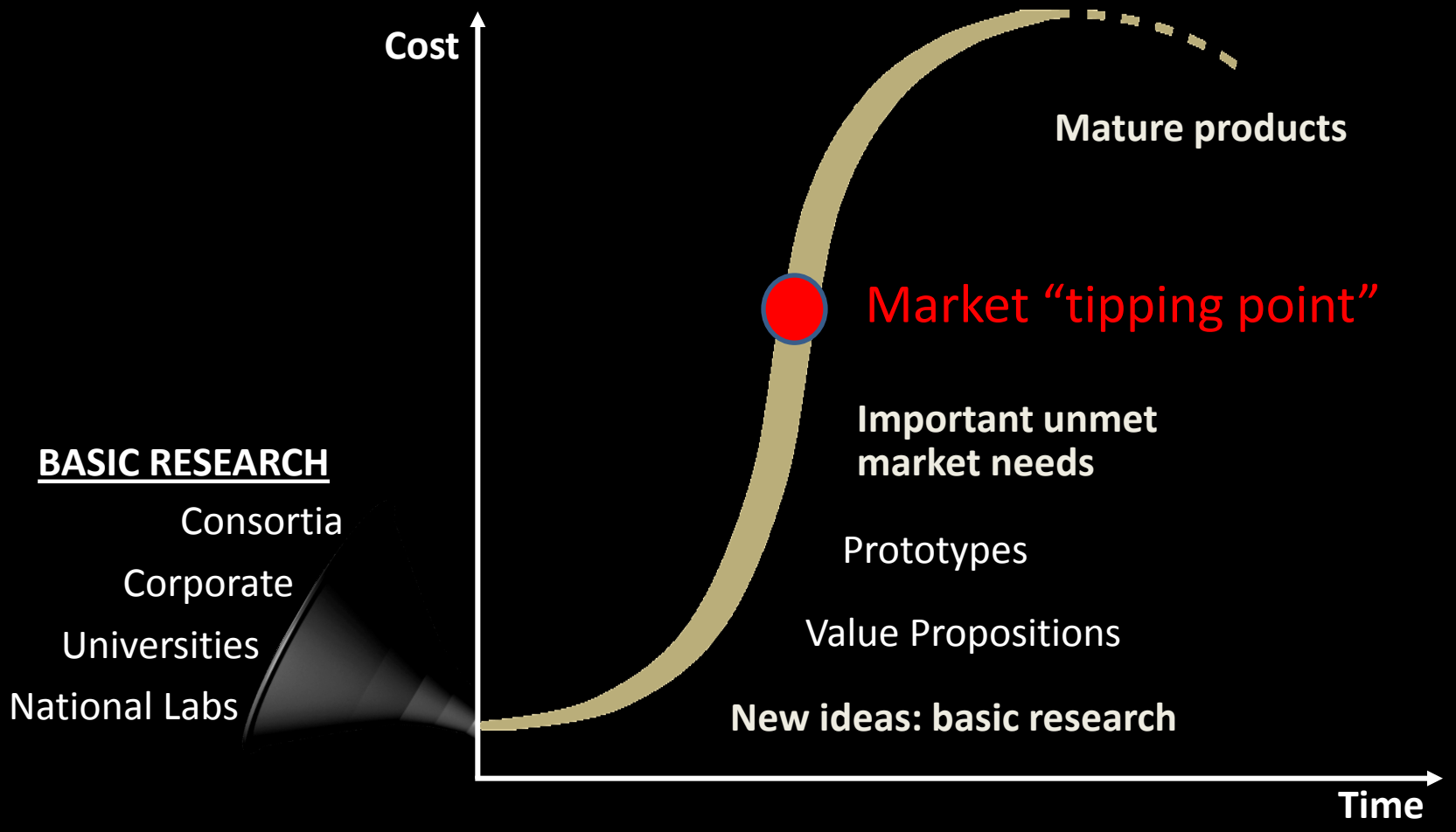
Technology and Geo-Political Leverage

- Proven transformational options can impact geo-political dynamics prior to large scale transformation
- To show OPEC it has a viable and scalable option to importing oil, the United States should
  - deploy 10,000 electric vehicles (fuel cell and/or plug-in)
  - in one U.S. community
  - using plentiful U.S. natural gas & bio-mass as a source of hydrogen and electricity

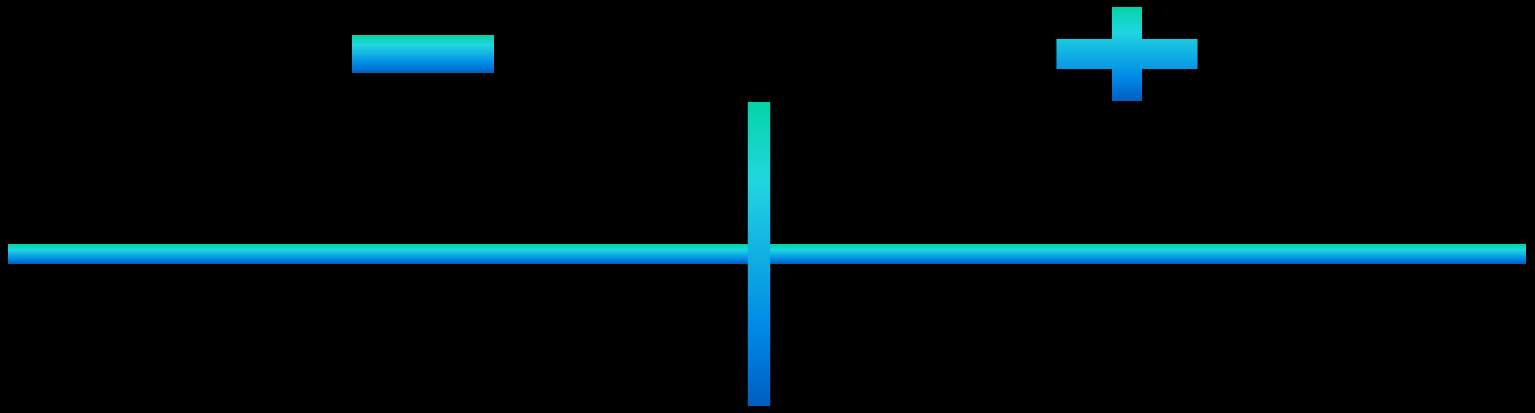
Leaders Must…..

1. Properly frame questions
2. See the whole challenge
3. Lever ***The Power of "And"***
4. Target market "tipping points"

The Value Creation Curve



Total Customer Experience

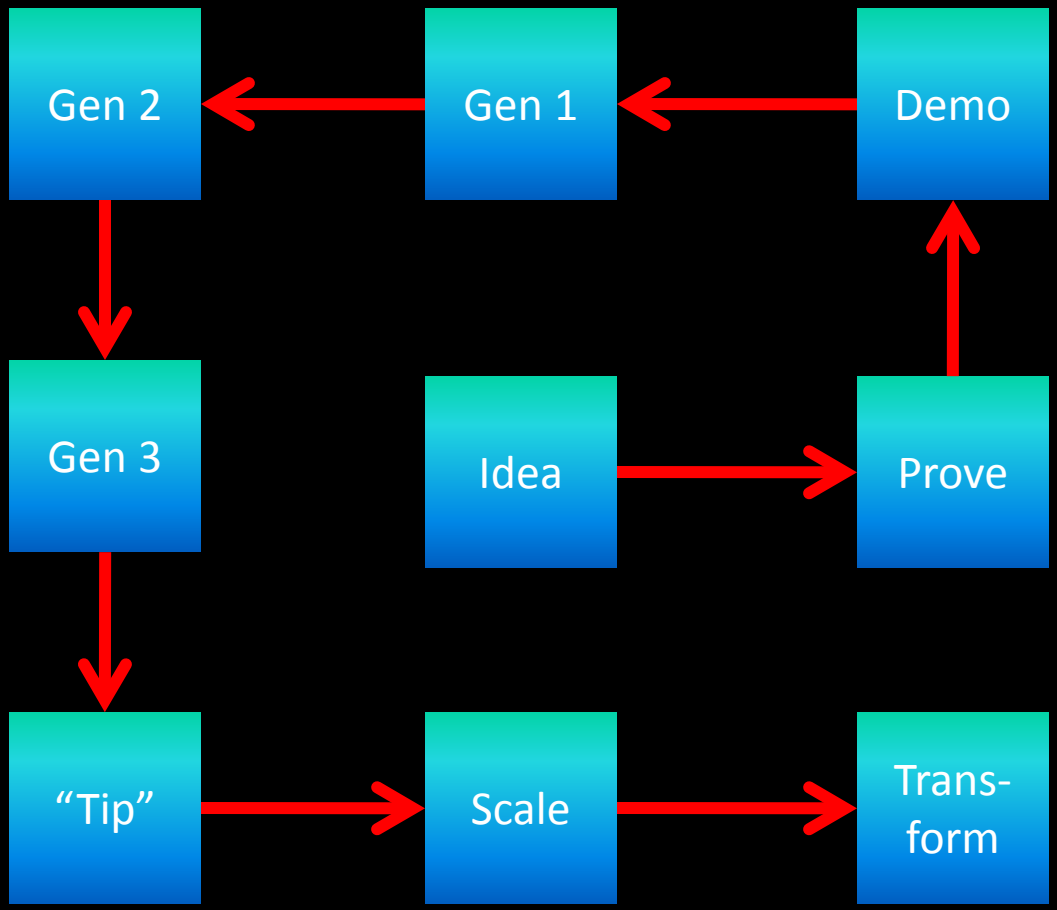


Must be Deeply Understood

&

Consistently Positive

Learning is Key to Transformational Change



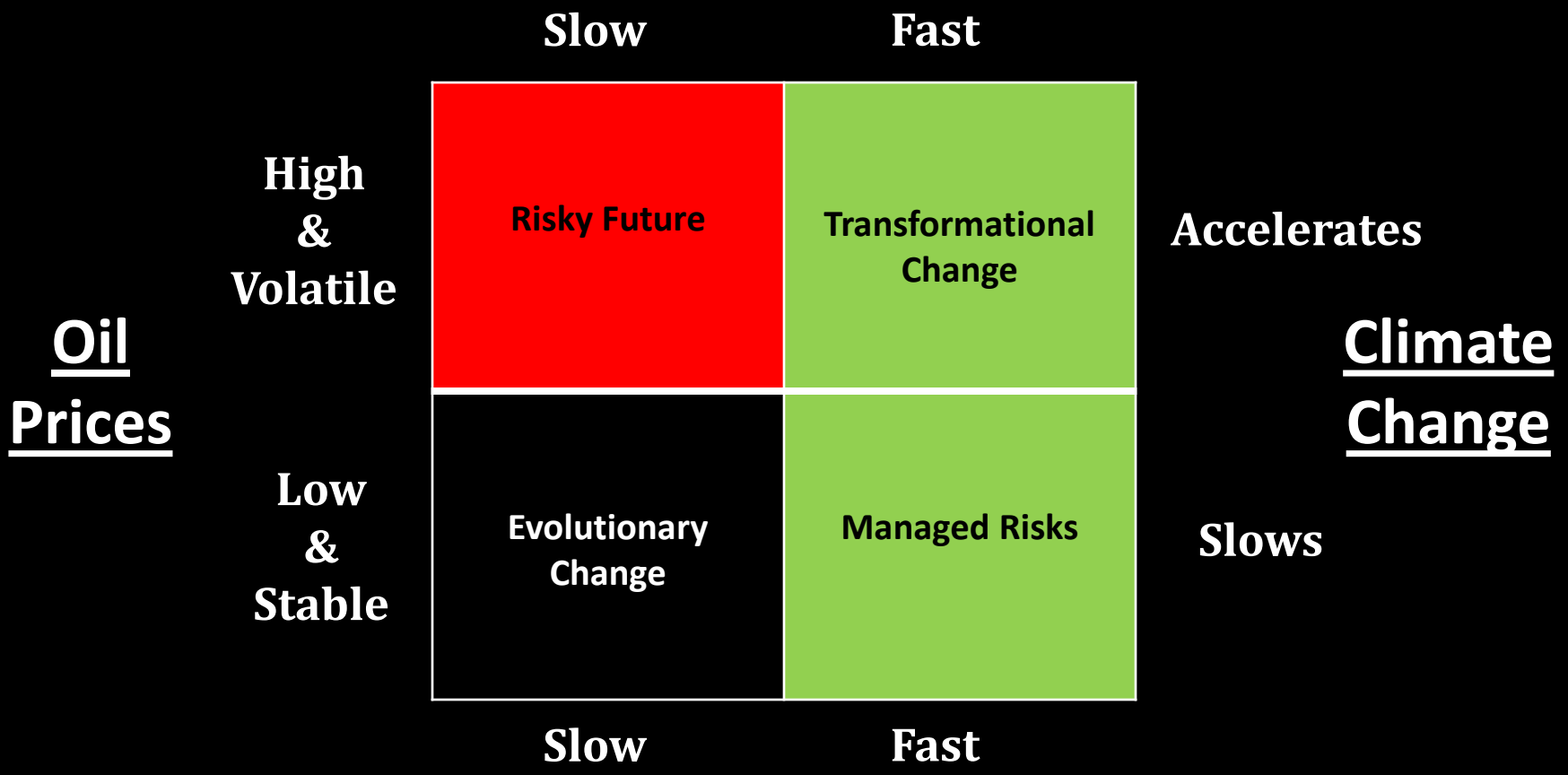
Learn about technology, customers and supply processes

Leaders Must…..

1. Properly frame questions
2. See the whole challenge
3. Lever ***The Power of "And"***
4. Target market "tipping points"
5. Drive common understanding and collective will

Scenarios

Technology Commercialization



Political Action

Leaders Must…..

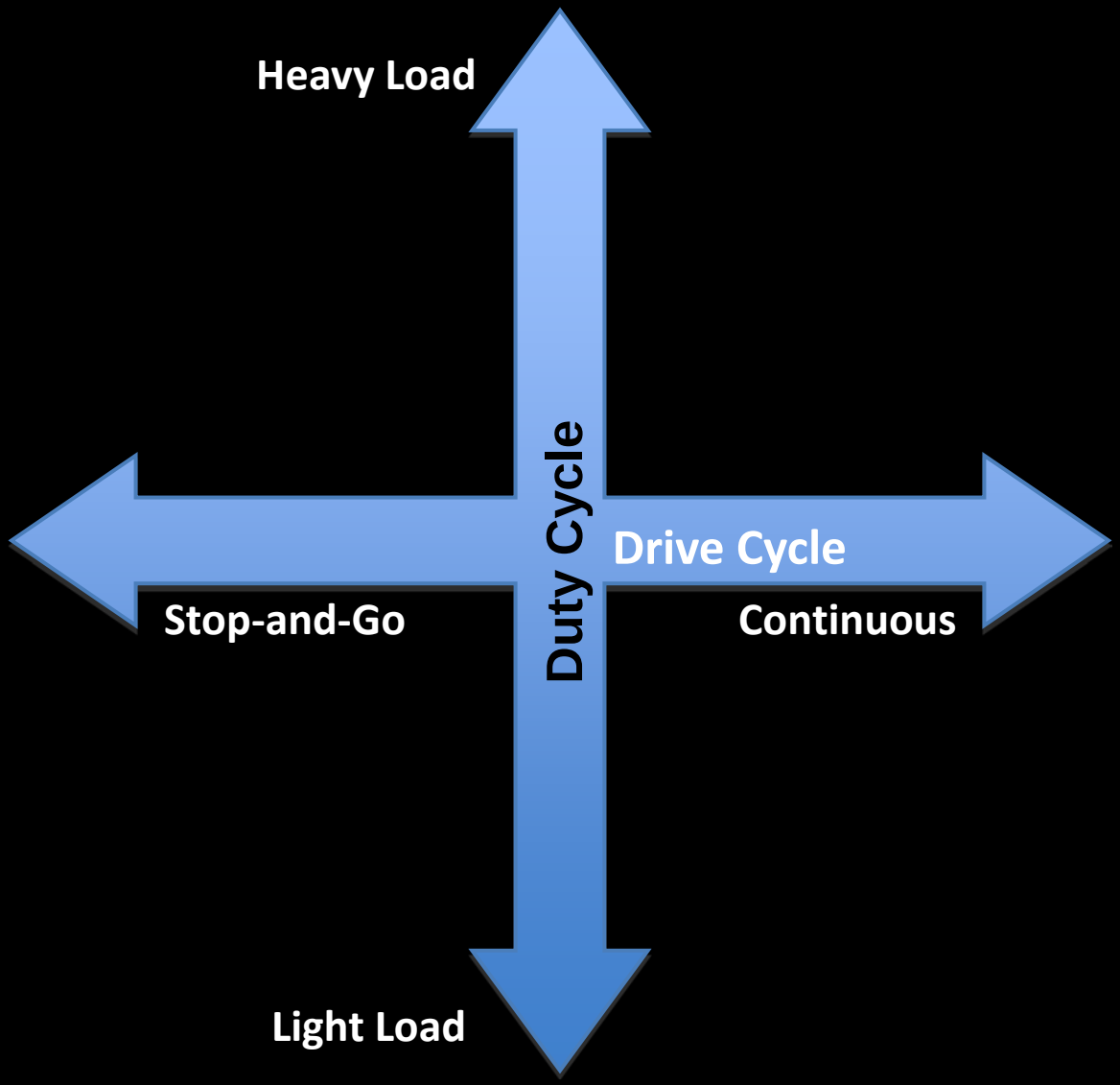
1. Properly frame questions
2. See the whole challenge
3. Lever ***The Power of "And"***
4. Target market "tipping points"
5. Drive common understanding and collective will

So, What is the Question?

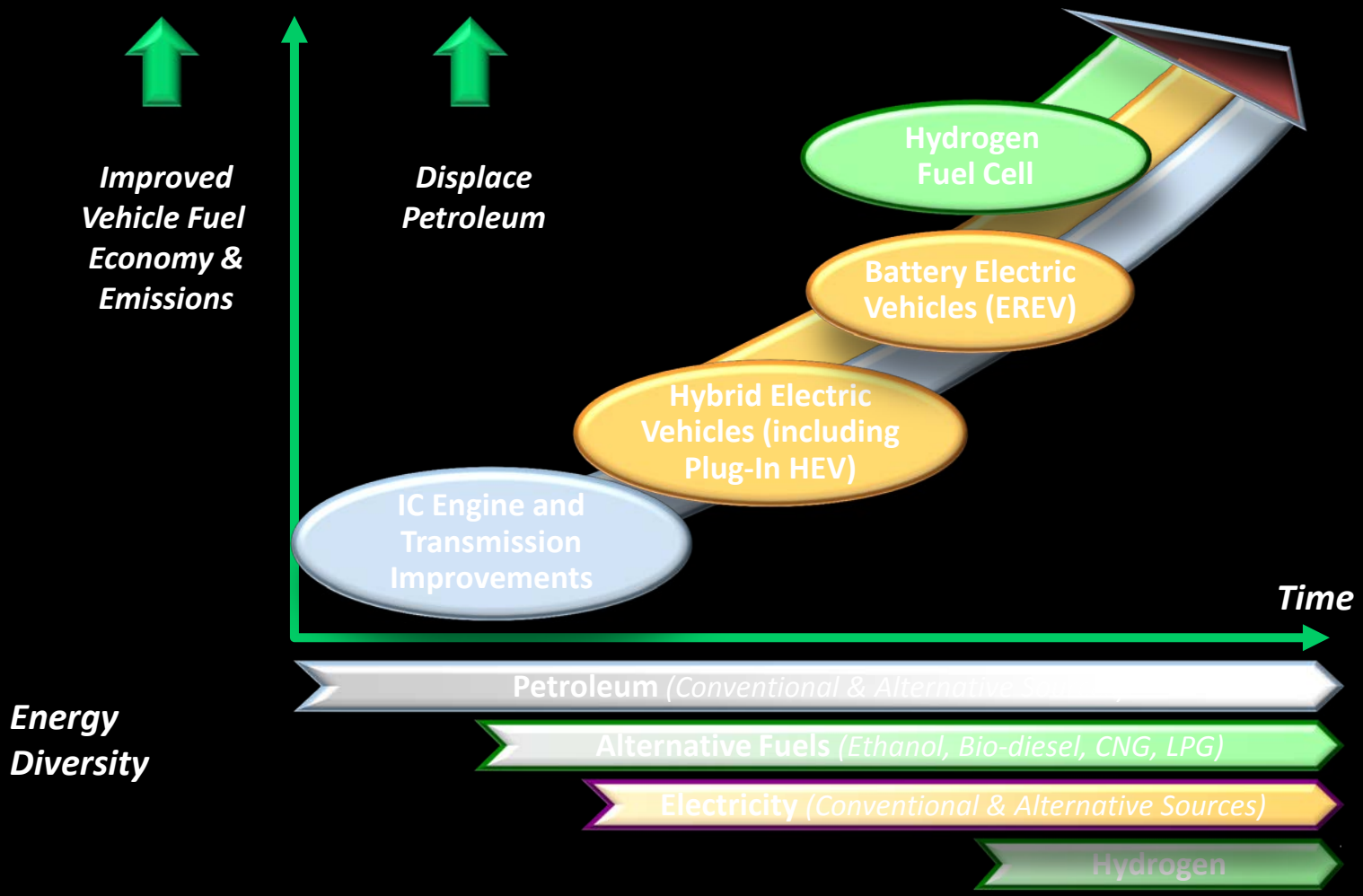
How can we work together to enable all promising technologies to quickly and efficiently realize their interdependent market “tipping points”?

BACK-UPS

Range of Consumer Needs



Advanced Propulsion Technology Strategy



10 Leadership Imperatives

1. Focus on framing questions
2. See the challenge as a “whole”
3. Be an integrative thinker
4. Enable a portfolio of options
5. Target market “tipping points”
6. Innovate positive consumer experiences
7. Understand investor & supplier motivations
8. Learn efficiently & fast
9. While politics matter, avoid being political
10. Never, never, never, never give-up

RISK MANAGEMENT

IS NOT:

- Better Business Cases
- Improved Forecasts
- Planning
- Constraint Focused
- Enterprise Risk Management
- Knowing the “right answer”
- Sensing and Responding
- “or” Trade-offs
- Good Managers
- Committees
- Trained People
- Rigorous Analysis

IS:

- Customer/Brand Focus
- Scenarios and Contingencies
- Executing
- Market Focused
- Innovation
- Rapid Learning
- Anticipating and Leading
- “and” Synergies
- Great Leaders
- Empowered Teams
- Trained and Adaptable People
- Synthesis (“Connecting the Dots”)

RISK MANAGEMENT

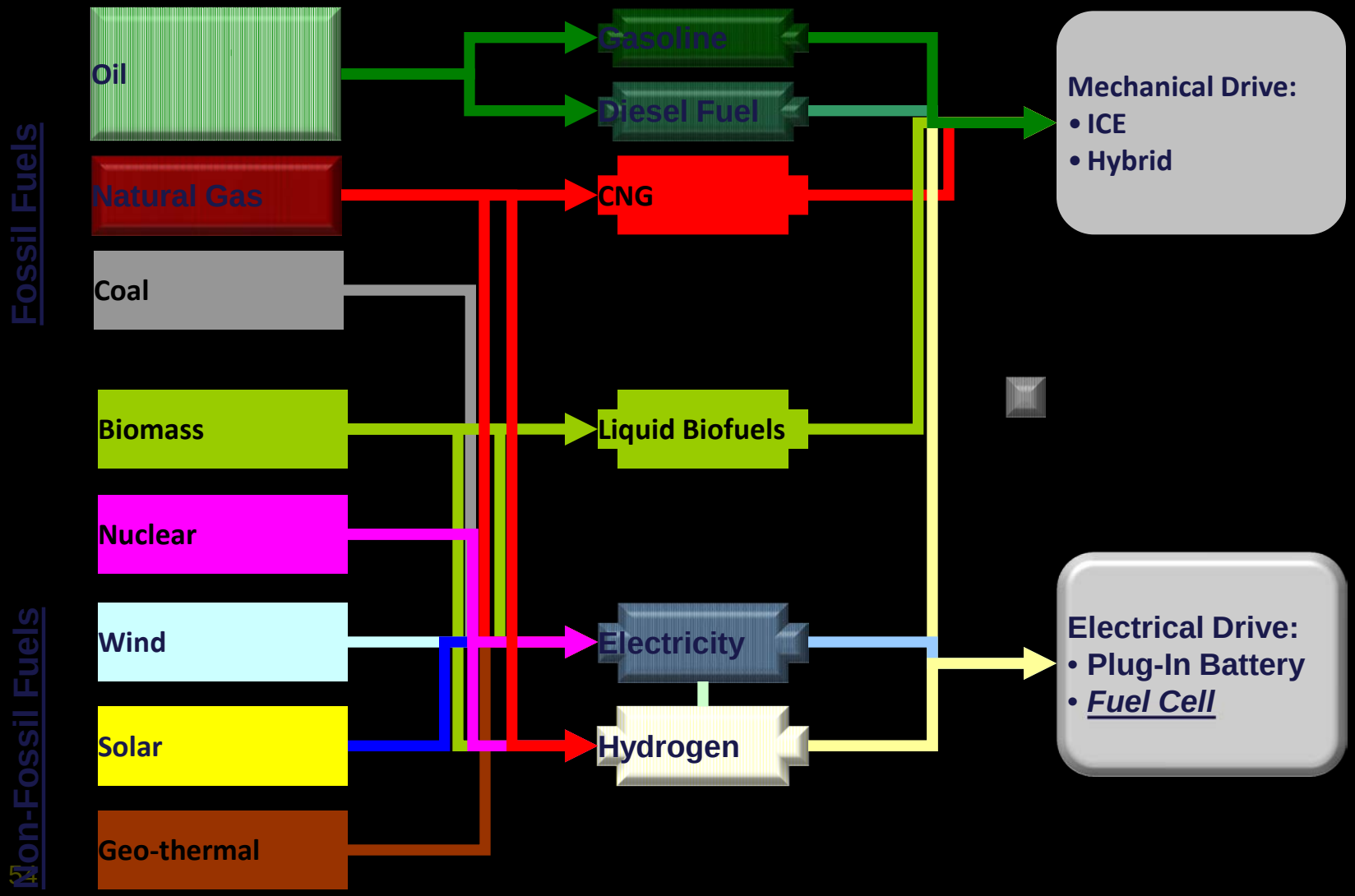
IS NOT:

- Performance Targets
- Operational Effectiveness
- Asking “What Will Happen?”
- Working Forward Towards Targeted Goals
- Business Plans
- Good Assumptions
- Change Management
- Benchmarking “Best Practices”
- Perfect Decisions
- Resisting Change
- Reacting to the “Urgent”
- Fighting Politics
- Newsletters and Websites

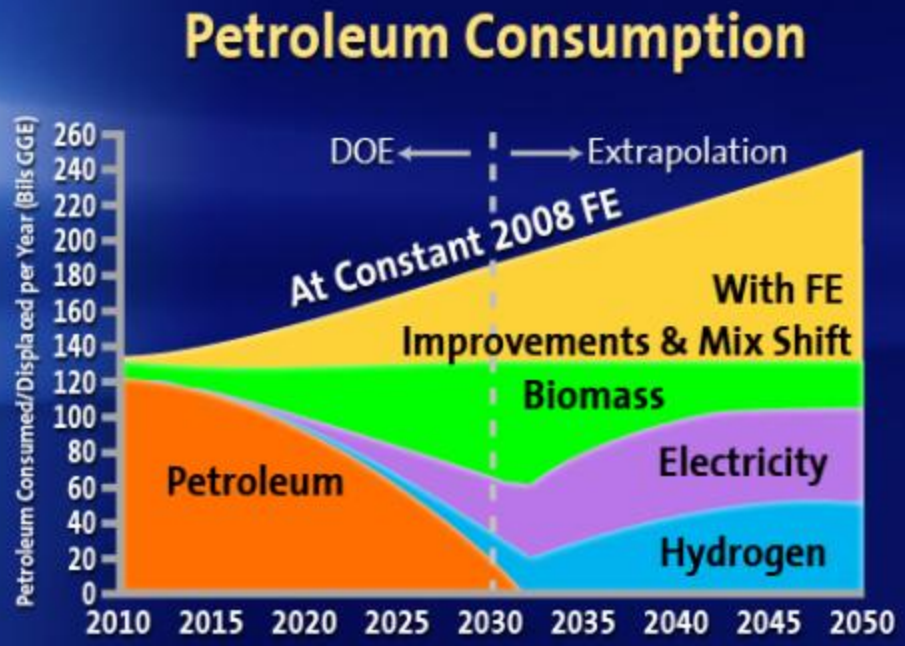
IS:

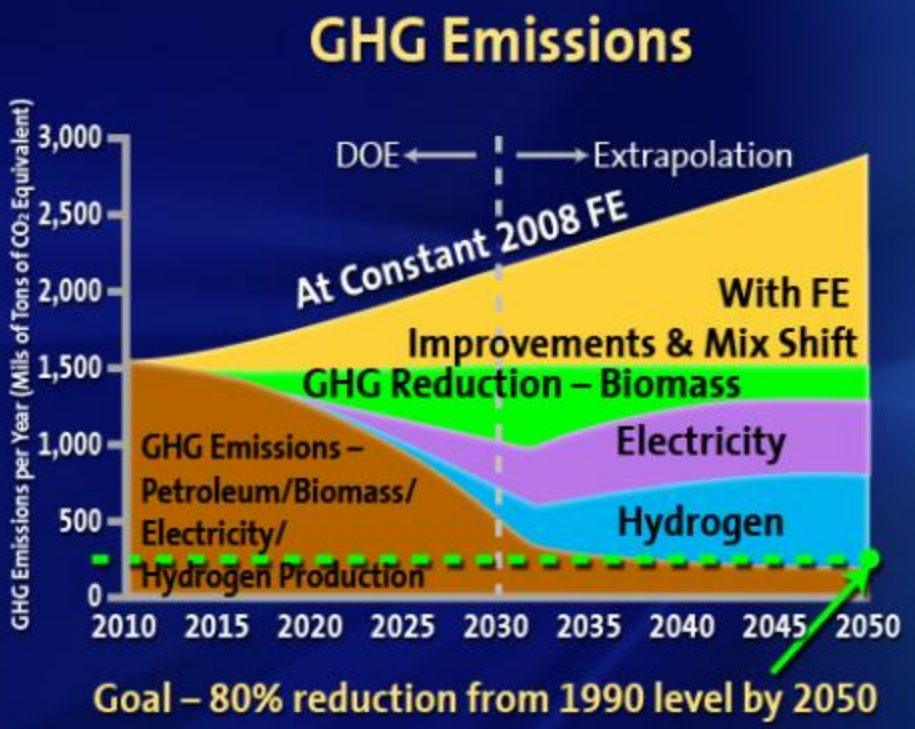
- Compelling Vision
- Unique Sustainable Advantage
- Asking “What Must be True?”
- Working Backward From Desired Ends
- Portfolio of Executable Options
- Eliminating Variation You Control
- Creating the Future
- Systems Integration
- Fast Good Decisions
- Getting in Front of the Inevitable
- Focusing on the “Important”
- Accepting Politics
- Clear and Frequent Communications

Road Transportation Energy Supply



The Power of "AND" – Scale





Start soon with early options; finish job with strongest long-term portfolio

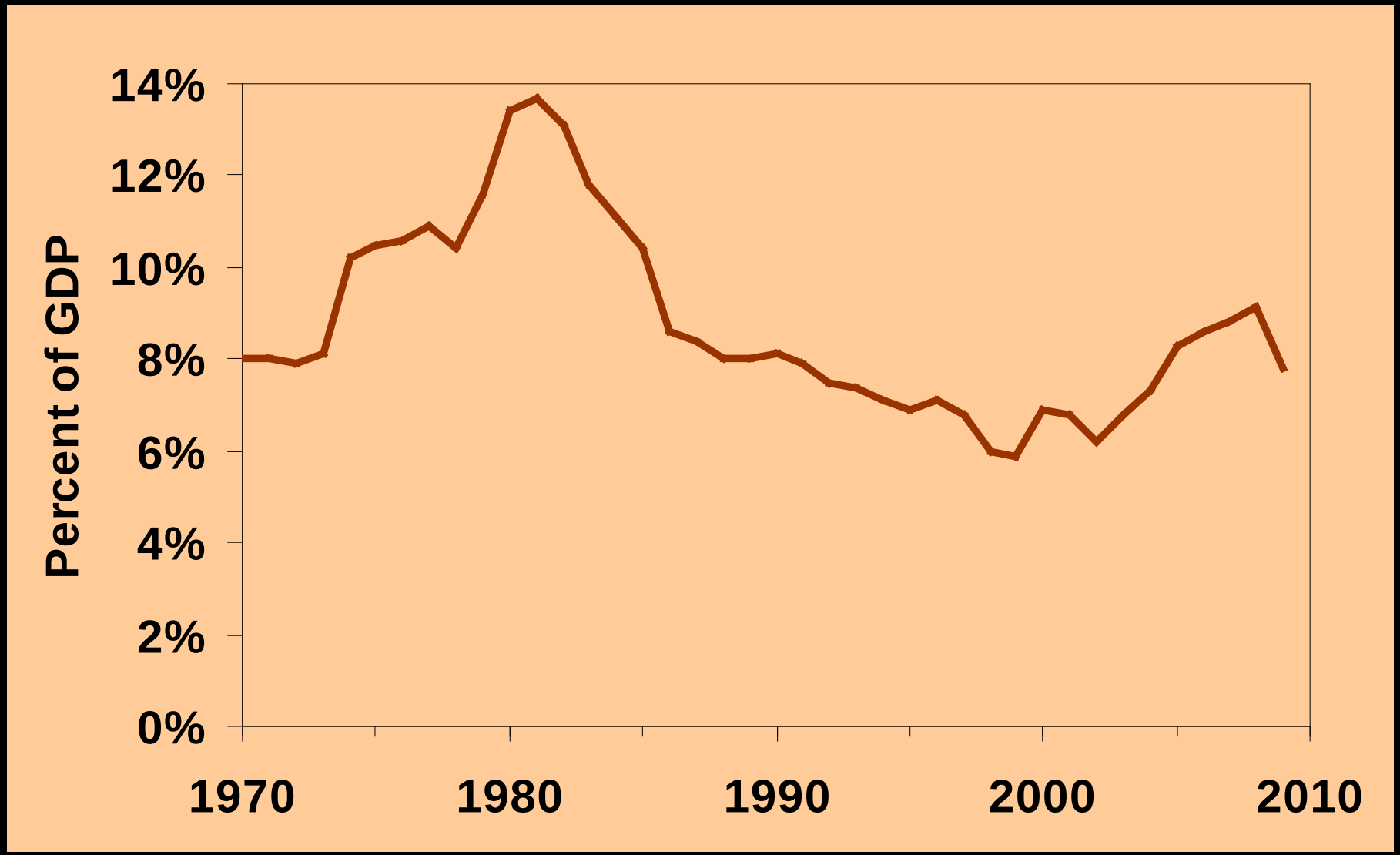
Full Portfolio of Solutions

- Gasoline/diesel
- Corn ethanol
- Current U.S. electric grid for electric vehicle charging
- Compressed natural gas
- Cleaner electric grid for electric vehicle charging
- Natural gas to hydrogen for fuel cell vehicle
- Cellulosic biomass to liquid fuel/vehicle charging/hydrogen
- Nuclear electricity for vehicle charging/hydrogen
- Renewable electricity for vehicle charging/hydrogen

Risks of Disruption

- Examples of Industries that have been disrupted
  - Photography
  - Media
  - Entertainment
  - Computer
  - Telecom
  - Television
  - Pharmaceutical
- Incumbents Rarely Do Well When Industries Disrupt
- Transportation and Energy Sectors are Ripe for Disruption
  - Enormous Inertia of Installed Base Reduces Risks

U.S. Energy Expenditures As Share Of GDP



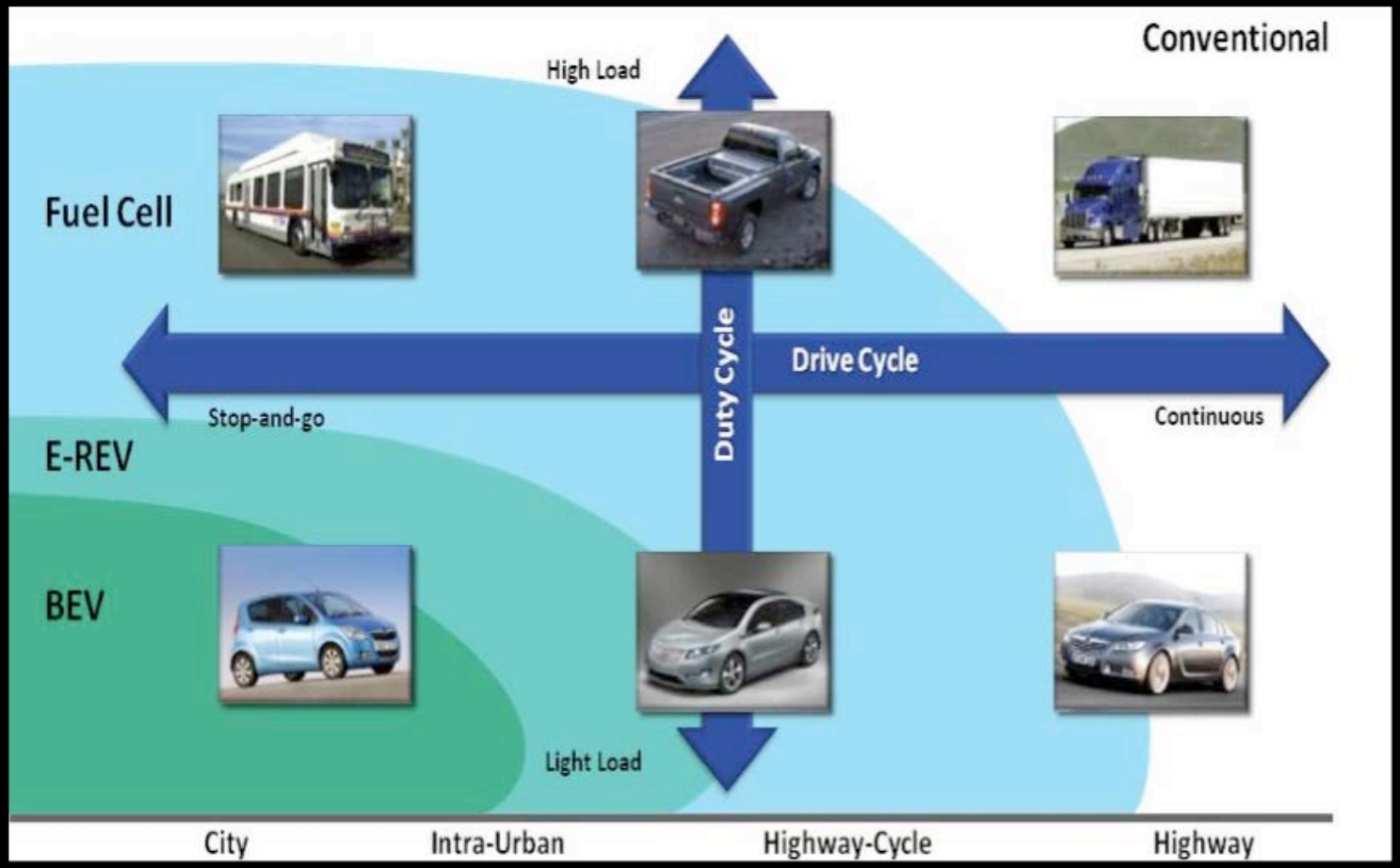
My Home

- Natural Gas
  - Furnace
  - Hot Water Heater
  - Back-Up Generator
  - Fireplace
- Electricity
  - Lights
  - Washer/Dryer
  - Refrigerator/Stove/Microwave
  - Entertainment/Computers
  - Water Pump
  - Garage Door Openers
  - Air Conditioner
  - ……
- Propane
  - BBQ Grille

Example Energy System Interactions and Interdependencies

- Transportation
  - Vehicles and energy stations
  - Gasoline and natural gas
  - Electric drive and energy diversity
- Home
  - Electricity and natural gas
  - Solar and grid
  - 120V/240V and appliances
- Stores
  - Location and transportation
  - Size and distribution
  - Lighting and air conditioning
- Industry
  - Ventilation and air conditioning
  - Power and heat
  - Steel and hydrogen

A ***Portfolio*** of Vehicle Types are Needed to Meet Consumer Needs



“and” vs. “or”

Individual Applications

Natural Gas **or** Biomass **or** Wind **or** Solar for Transportation **or** Stationary Energy

vs.

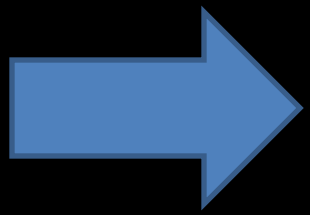
Integrated System

Natural Gas **and** Biomass **and** Wind **and** Solar for Transportation **and** Stationary Energy

Primary-to-Secondary Energy

Primary Energy

- Sun
- Wind
- Geothermal
- Biomass
- Oil
- Coal
- Natural Gas
- Uranium



Secondary Energy

- Gasoline
- Diesel Fuel
- Ethanol
- Fuel Oil
- Electricity
- Hydrogen
- Syn Gas

Integrated and Optimized Community Energy Systems

- Communities can be cities, towns, counties, or townships
- Energy systems simultaneously and synergistically comprehend all sources and uses of community energy
- Sources include renewables, fossil fuels and nuclear
- Uses include transportation, buildings and industrial/agricultural processes
- Systems entail generating, distributing and storing energy and using this energy to enable economic and social activity
- Objective: optimally deploy and operate integrated community energy systems that make the best overall use of resources
- Community energy demand and supply are balanced through energy pricing and energy trading with other communities (pricing should reflect externalities)
- Community energy systems will evolve based on technology improvements (lower cost, higher efficiency, less environmental impact) and policy levers (regulations, subsidies, taxes)
- The local market will determine the best mix of energy supply technology and capacity and the best deployment of energy efficiency technology
- Consumers and suppliers are the key drivers of markets. Their behaviors must be deeply understood to motivate transformational change through technology and policy

Regionally/Nationally Integrated Energy Systems

- Regional and national energy systems can result from optimally integrating community energy systems
- Some communities will be able to competitively supply surplus energy while others will have energy demand that exceeds competitively priced supply. The intent is to optimally distribute energy from communities with surpluses to those with shortfalls. A nations energy distribution system can be defined to enable this dynamic optimization
- Regional and national energy systems comprised of integrated and optimized community energy systems are inherently more robust with respect to security threats and supply disruptions than large-scale centralized energy systems

Key Enablers of Integrated Community Energy Systems

- **Energy storage**
  - **Demand variation**
  - **Intermittent wind and sun**
- **Real-time information and system control**