The Foundation for a Strategic Advantage:

Missions for Infrastructure Policy in Times of Change

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Responding to Change is Not Easy

- "The danger in times of turbulence is not the turbulence. It is to act with yesterday's logic"
  - Peter F. Drucker

Today's logic: How would the United States have a strategic advantage in the 21st Century Economy?

Table Stakes: Having an advantage in access to the key inputs for economic growth

Broadband

- Cheap, Abundant Bandwidth
- Both Fixed and Mobile

Energy

- Cheap, Abundant Energy
- Moving from Carbon to Renewable

Is this is our current path in the United States in wire line?

We are Mid-tier and dropping

Category/Date	January 2012	April 2012
Download Speed	31	35
Upload Speed	37	45
Quality	38	38
Cost Per Megabit	29	17

And most of the world's fastest cities are in Asia or Europe.

Source: Ookla

Market forces are not providing critical mass of world leading networks in U.S.

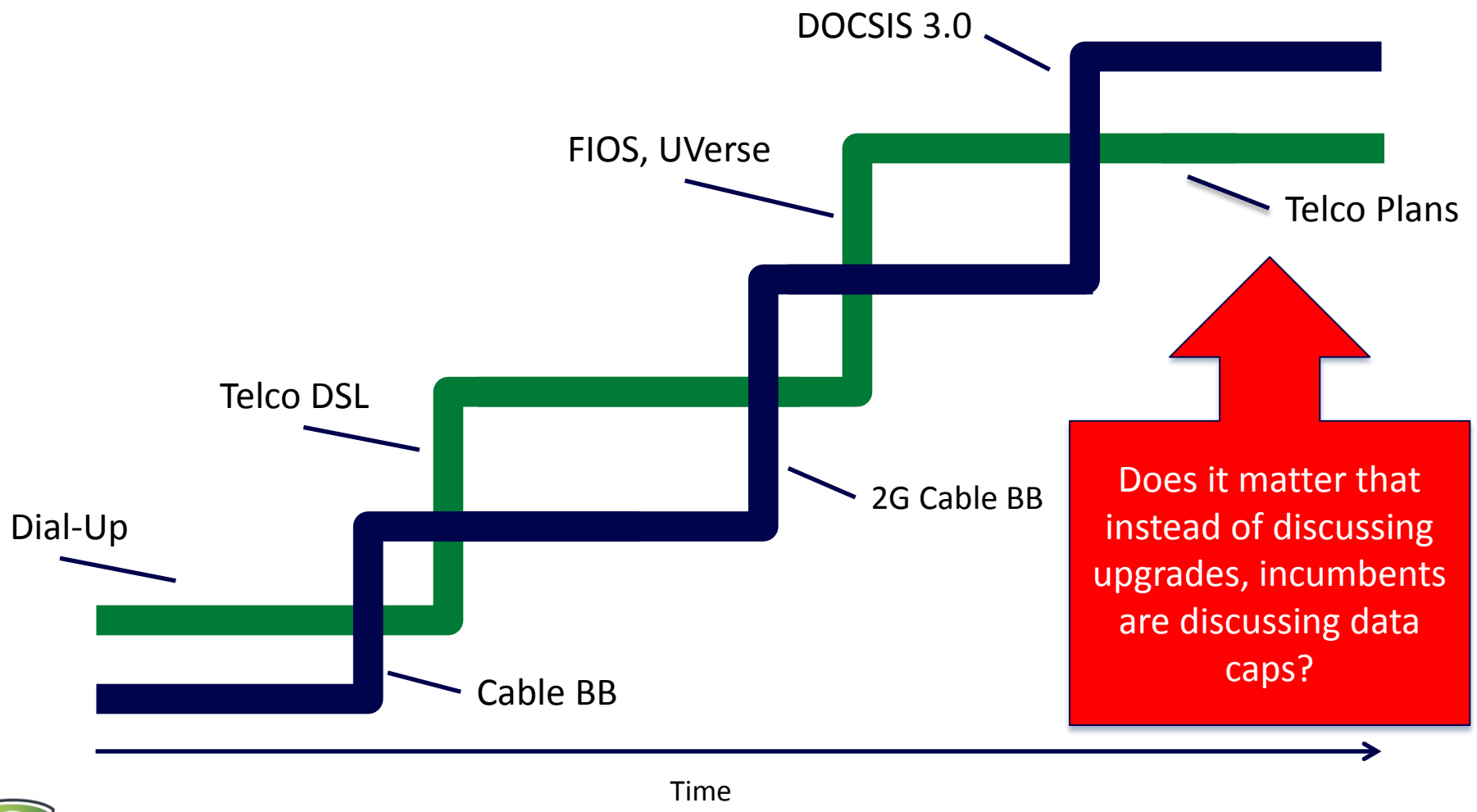
Verizon has stopped the FiOS Build

…we will accelerate our efforts to improve our overall growth profile. We will do that by looking at opportunities to either divest or restructure low performing and nonstrategic assets.

AT&T Chairman and CEO Randall Stephenson, January 26, 2012

And AT&T is looking to sell wire line assets

For the first time since the beginning of the commercial internet, there are no plans for a national wired provider to build a faster network than the leading network



And what does that mean for where will we be in April, 2015?

Category/Date	January 2012	April 2012	April 2015
Download Speed	31	35	?
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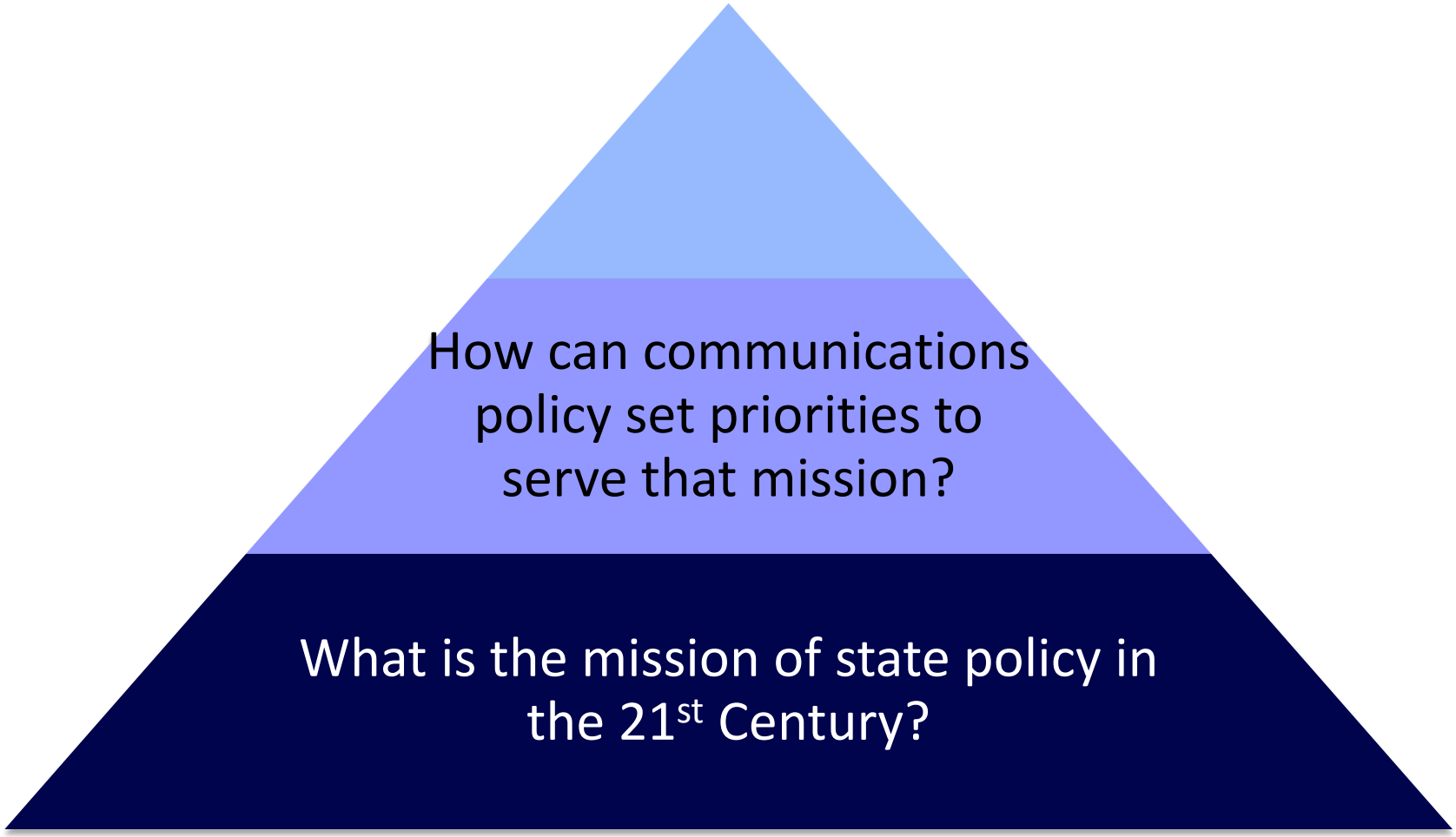
Cost per Megabit	29	17	?

Agenda

- The Role of High Performance Knowledge Exchange
- The Traditional Three Missions of Policy
- The Two New Critical Missions of Policy
- Common Lessons for Driving Change in Bandwidth and Energy

THE ROLE OF HIGH PERFORMANCE KNOWLEDGE EXCHANGE

Underlying Everything



Underlying the State Mission

The Management Challenge: Productivity of Knowledge Work

- The most important, and indeed the truly unique, contribution of management in the 20th century was the fifty-fold increase in the productivity of the manual worker in manufacturing**. The most important contribution management needs to make in the 21st century is similarly to increase the productivity of knowledge work and knowledge workers**. The most valuable assets of a 20th-century company was its production equipment**. The most valuable asset of a 21st- century institution (whether business or non-business) will be its knowledge workers and their productivity. ..It is on (the productivity of knowledge work), above all, the the future prosperity-and indeed the future survival of developed economies will increasingly depend."**
  - Peter F. Drucker "Knowledge-worker productivity: the biggest challenge"

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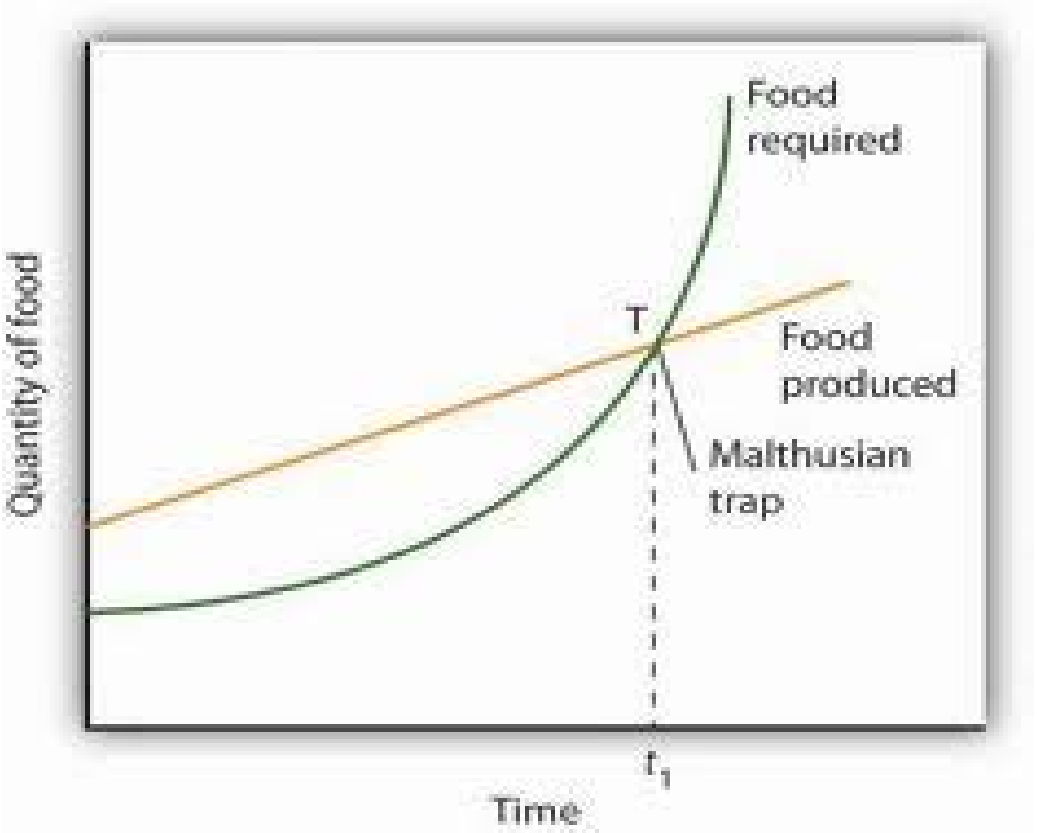
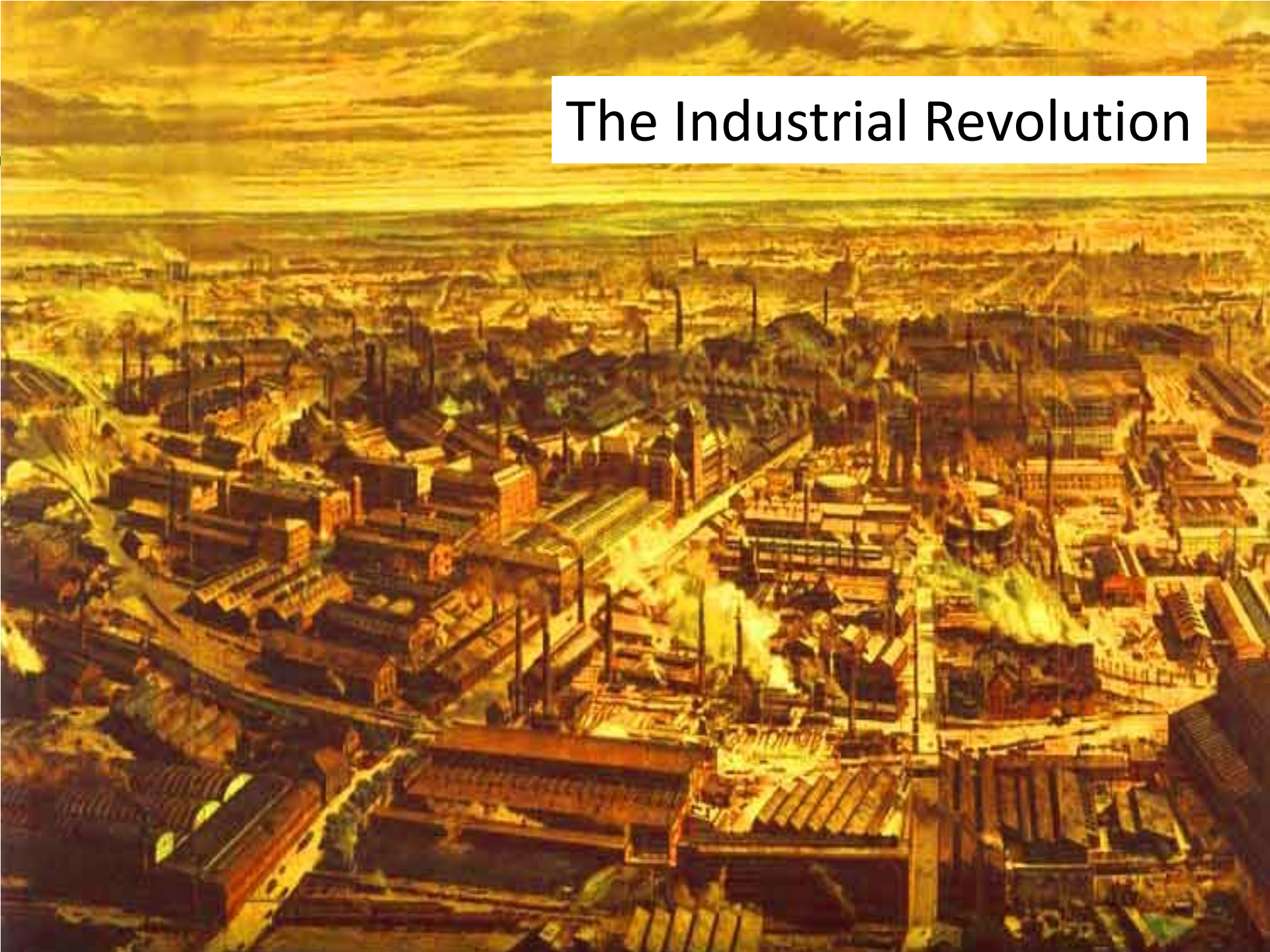
A Quick Look Back At Technology and Progress

- From First Century to 1500, population and GDP increase at constant rate around world (Malthusian Trap)



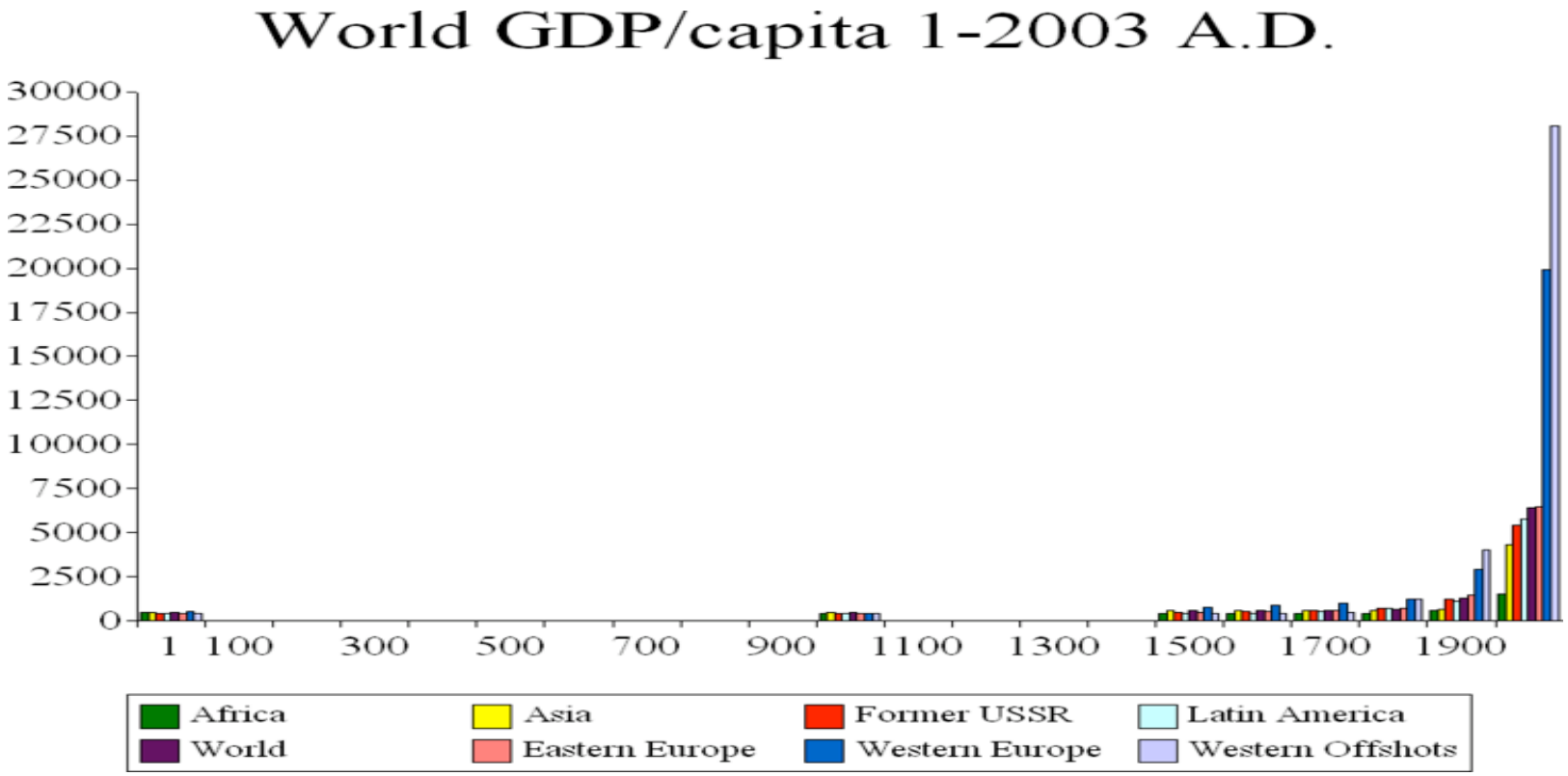
But something got us out of that trap...

The Industrial Revolution



Continuing Innovation and Growth

- Unlike earlier technology developments in China, Islamic Golden Age, innovation was not isolated period of ongoing; rather growth has continued due to "***combinatorial innovation***"---the process of knowledge building upon knowledge



New inputs drive economic growth

1800's

- Access to new forms of power (steam engines)
- Access to new forms of transportation (canals, then trains)

1900's

- Access to new forms of power (electricity)
- Access to new forms of transportation (cars, trucks and planes)

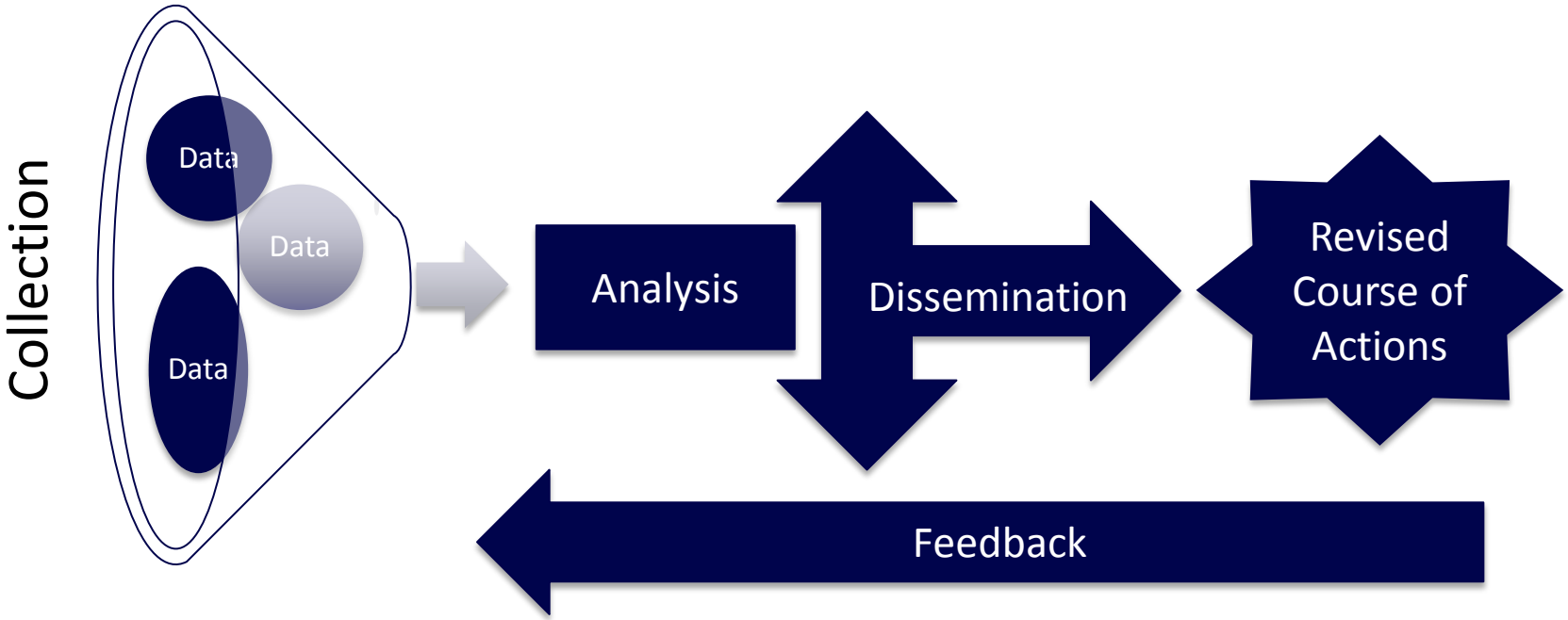
2000's

- Access to computing power
- Access to data storage
- Access to digital communications

New energy yet to come

Fastest growing parts of the economy are those that best use new inputs

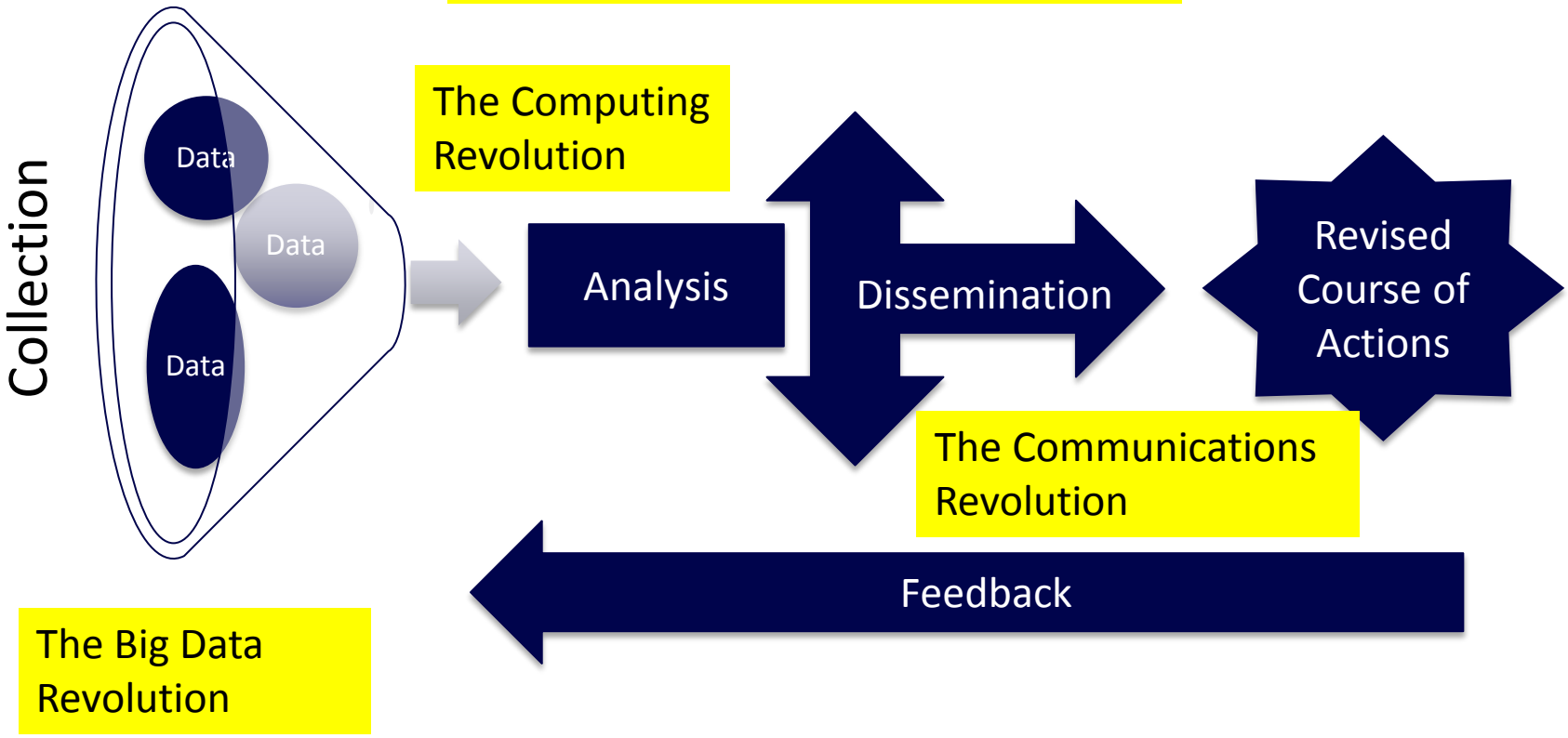
These Two Concepts Come Together in the Fundamental Task of Knowledge Exchange



The Foundation for Combinatorial Innovation

The Fundamental Task of Knowledge Exchange

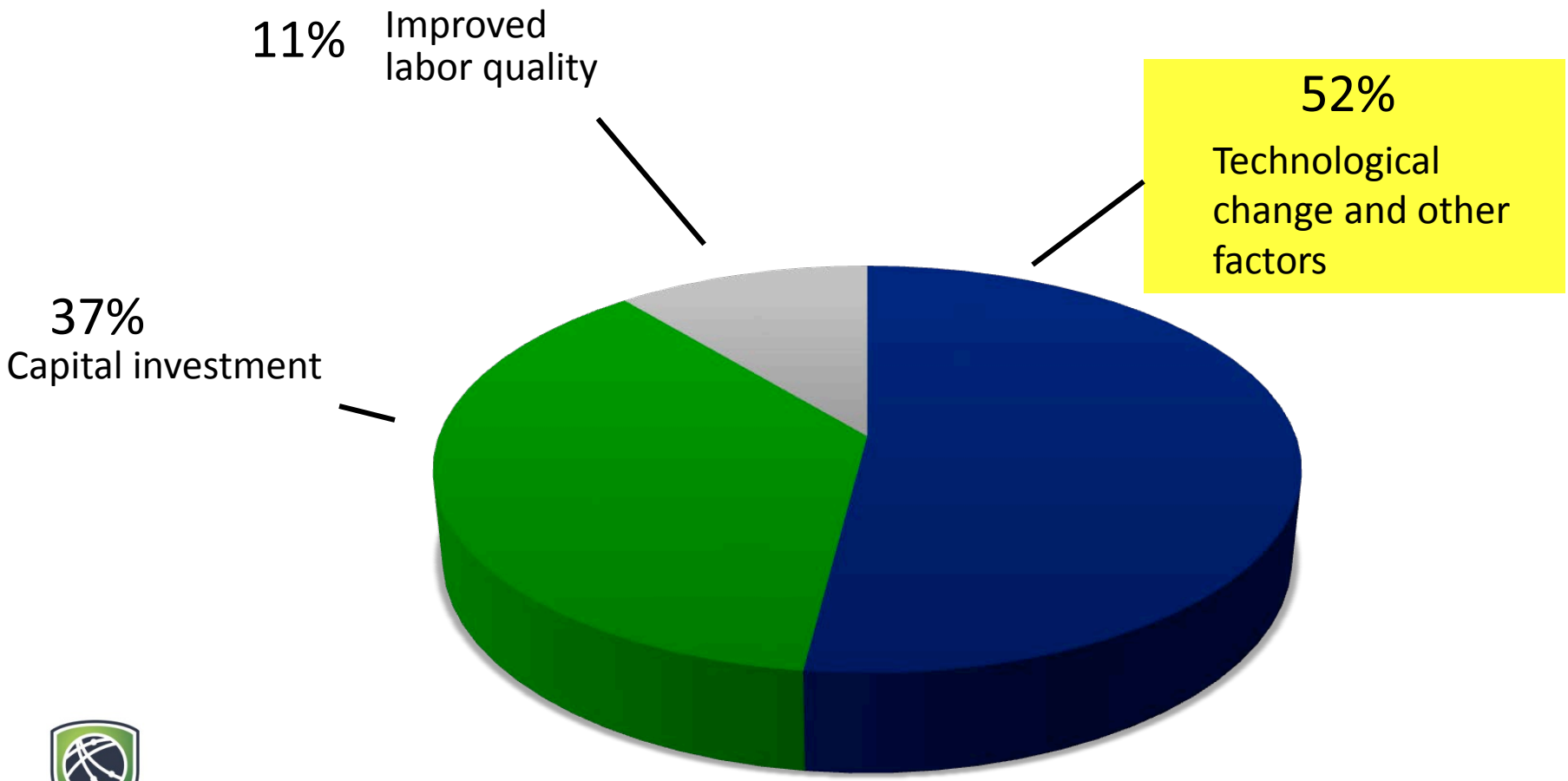
Transformed by New Inputs



Changes in Inputs Now Enable High-Performance Knowledge Exchange

Such changes are key to productivity growth

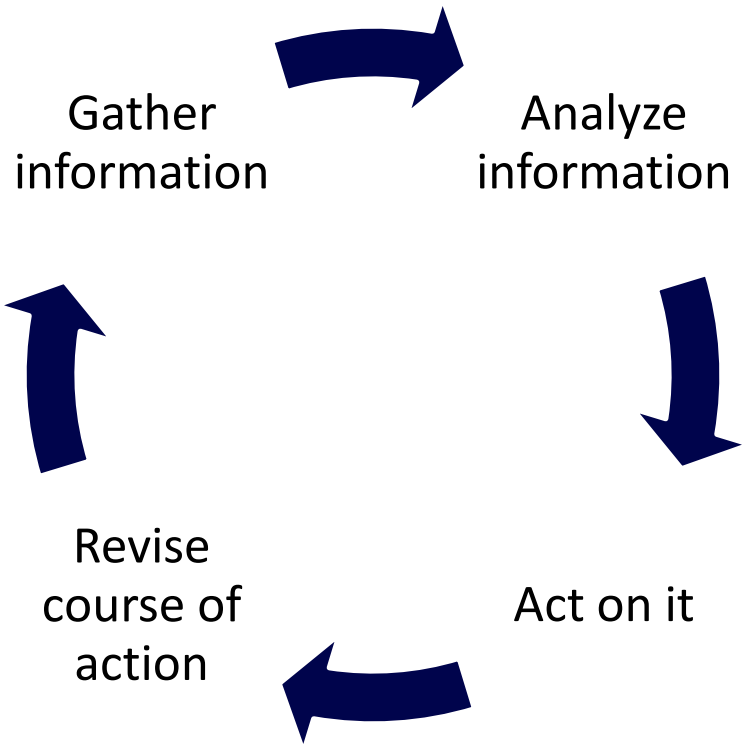
Contribution to long-term productivity growth



Data: US Bureau of Labor Statistics

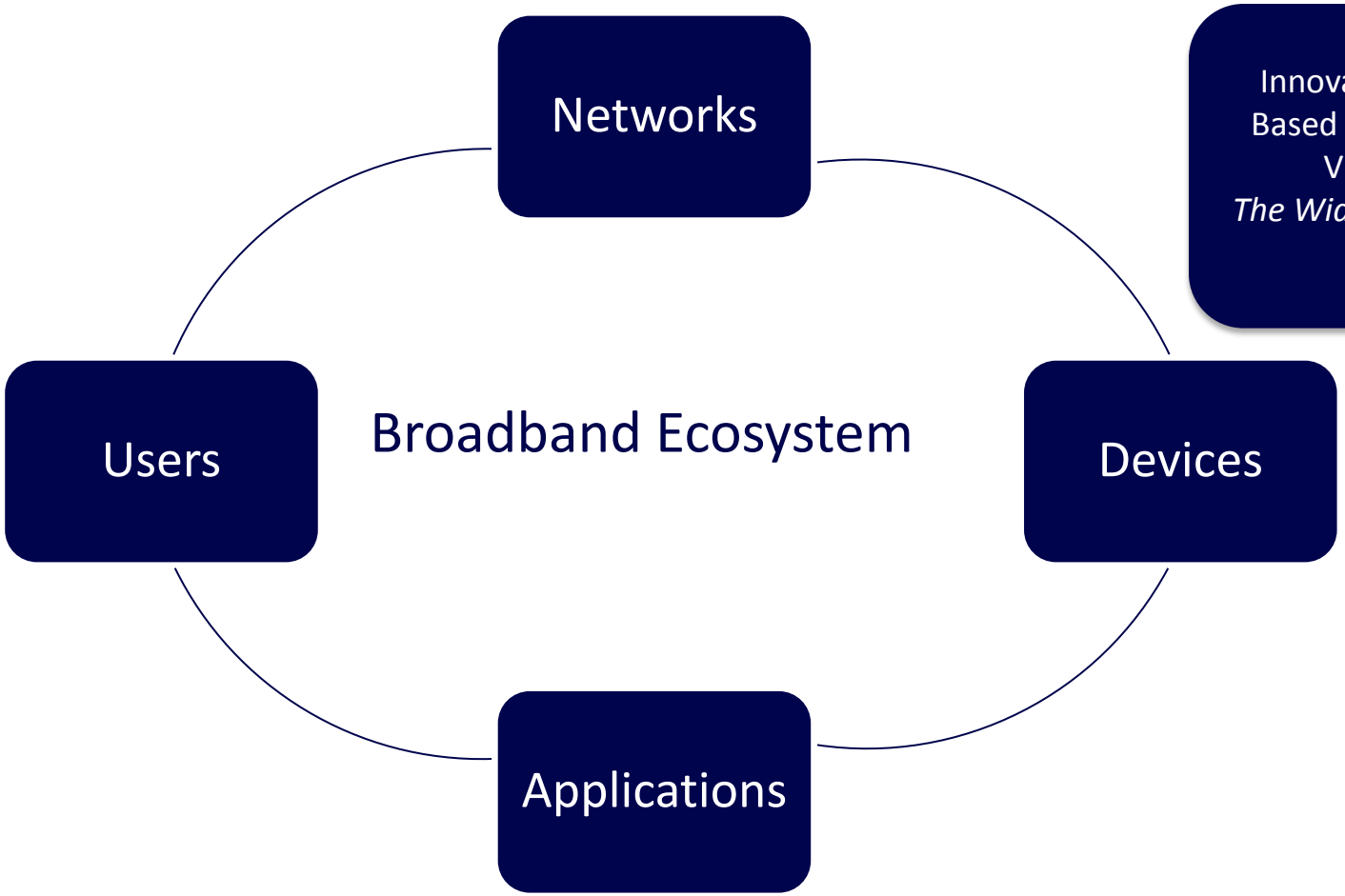
The biggest leaps in growth are driven by meta-ideas

Improving the exchange of information improves the conditions for innovation.



"Parallel experimentation by millions of entrepreneurs is the best and fastest way (to drive innovation)"
Brynjolfosson and McAfee

Broadband is the common platform for knowledge exchange



Innovations Succeed or Fail Based on Whether there is a Vibrant Ecosystem
The Wide Lens: A New Strategy for Innovation

Improvements in each element of the ecosystem drive improvements in others in a virtuous cycle.

Knowledge Exchange Not Just a Service, High-Tech Sector Issue: Now Core to All Parts of the Economy

Manufacturing	• Enables just-in-time assembly • Critical for supply side management
Agriculture	• Affecting real time decisions as to weather, prices • Enables new business models (Community Supported Agriculture)
Construction	• Mobile broadband now essential on construction sites for scheduling, supplies, coordination • Broadband networks used for site security
Retail	• RFID revolutionizing inventory control • Broadband networks used throughout shipping and transport process for retail

Also, it is critical to core tasks of society, such as education, public safety, health care and civic engagement, which are at their core primarily about knowledge exchange

THE TRADITIONAL THREE MISSIONS OF POLICY

The Traditional 3 Missions

Getting Networks Everywhere

Getting Everyone On

Having A Competitive Market Dynamic That Drives Innovation and Consumer Benefits

Access--Traditional

How Do We Get Networks Everywhere?

- Providing baseline level of service to most rural of residents
- Accomplished by a subsidy collected from telephone revenues; urban to rural, business to residential, and long-distance to local
- In power, accomplished as well by direct government subsidy to high-cost areas

Adoption---Traditional

How Do We Get Everyone On?

- Generally done by taxing all users to subsidize service and equipment for low-income persons, both in communications and energy
- Also involves subsidizing institutions that serve under-adopting communities

Competition---Traditional

How Do We Have A Competitive Market Dynamic that Drives Innovation and Consumer Benefits?

- Merger reviews
- Spectrum screens; availability
- Unbundling requirements
- Access requirements

Access---New Issues

How Do We Get Networks Everywhere?

- Need both fixed and mobile, with shifting levels of services
  - Mixture of fiber and spectrum
- Need to avoid subsidizing past business models in ways that embed their advantage
- Need to find new financing base for support of high-cost networks
- Need way to address carrier of last resort obligations and stranded investment
- How do we get the right networks to the right places

Access---New Priorities

How Do We Get Networks Everywhere?

- How do we efficiently use spectrum/Digital Dividend
- How do we use unlicensed to open up options
- How do we use fiber as deep as economically efficient
- How do we connect networks with new energy sources to traditional access networks
- How do incent incumbents to emerge from their silos to better use existing assets?

Adoption—New Issues

How Do We Get Everyone On?

- How do we create relevance?
- What kinds of devices/services require subsidy?
- How do we provide training for multiple layers of literacy?

Competition--New

How Do We Have A Competitive Market Dynamic that Drives Innovation and Consumer Benefits?

- How do we enable both long-term investment and new models to emerge?
- How do we allow collaboration that does not enable anti-competitive behavior?
- How do we address value chain competition?
  - How do enable high performance knowledge exchange to drive improved energy use (data apps on smart grids)

THE TWO NEW CRITICAL MISSIONS OF COMMUNICATIONS POLICY

The New Two Missions

Using The Networks Better to Achieve Economic and Policy Goals

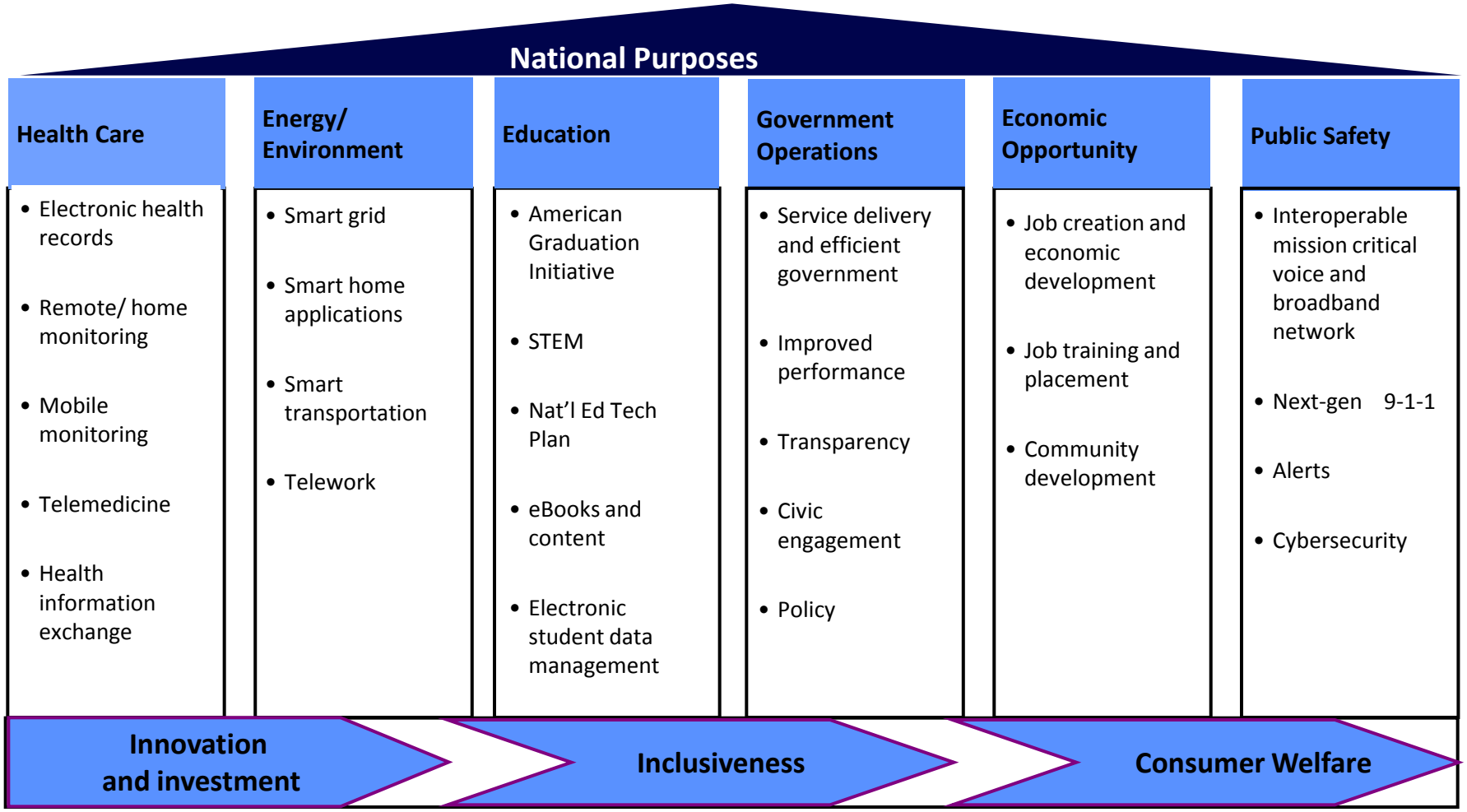
Creating a Strategic Advantage

Use

How Do We Use The Networks Better?

- How can we use to better deliver health care, education, public safety?
- How can governments use networks to drive economic growth?
- How can networks improve the democratic process?

National Purposes:
Broadband is part of the solution to many of the country's problems



Use—New Questions

How Do We Use The Networks Better?

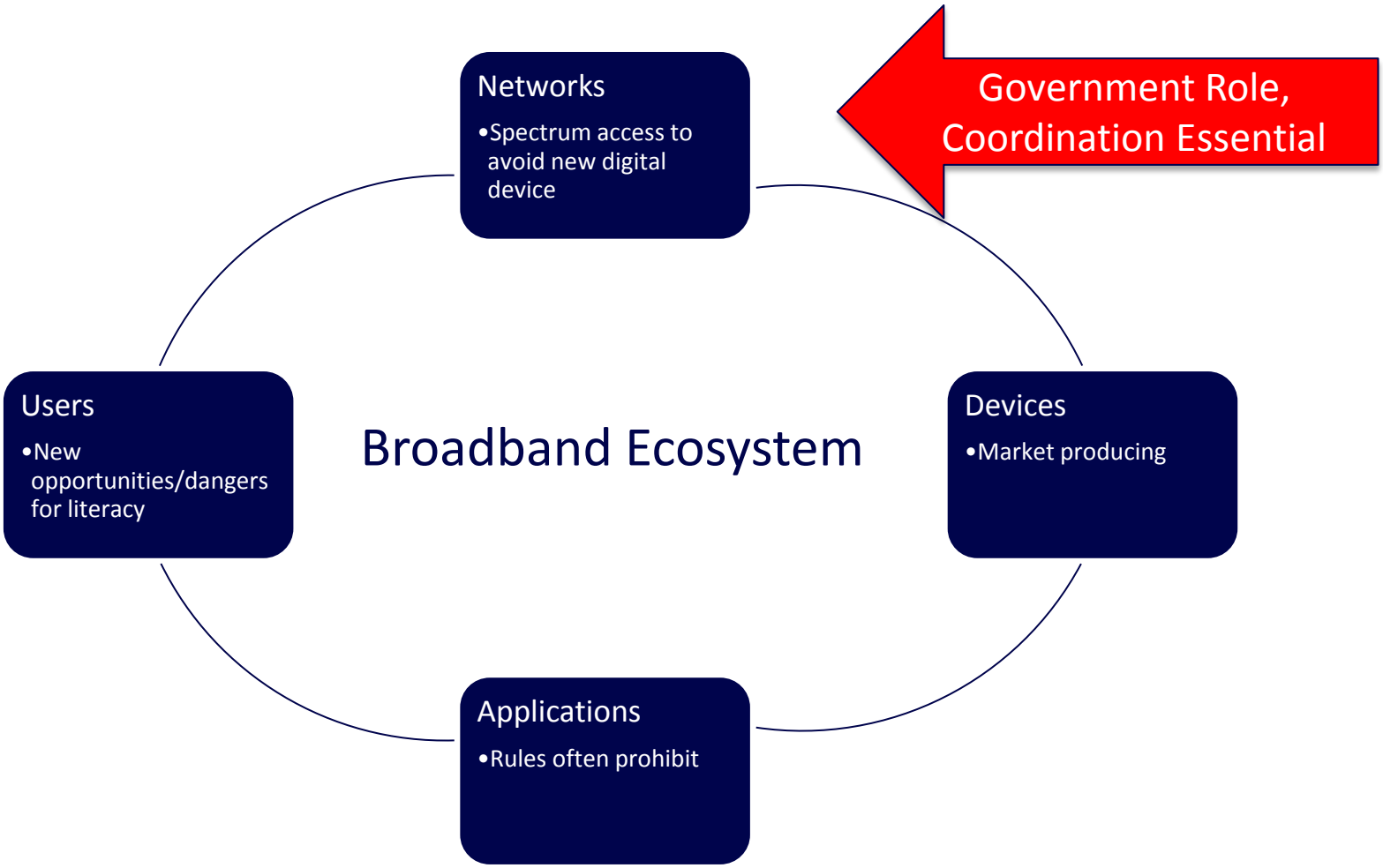
- How can government be data driven?
- What government agencies should be eliminated?
- When can we get rid of paper?

What Platform is Best for Our Kids: Gutenberg's or Digital?

- Options for student who does not understand: None
- Updated: Twice a decade at big cost
- Effectiveness hard to test
- Restricted to text and pictures
- Expensive to distribute
- Provides no data to teachers, board or parents

- Options for student who does not understand: multiple
- Updated: Whenever at little cost
- Easy to test effectiveness
- Can use multimedia and communications
- Inexpensive to distribute
- Can provide constant, actionable data to teachers, board and parents

But need complete ecosystem to work



Strategic Bandwidth--Trends

Having Abundant Bandwidth to Take Advantage of High-Bandwidth Opportunities

- Big Data Revolution
- Two Way Video Collaboration
- Enabling High-Bandwidth Devices

Strategic Bandwidth—New Questions

Having Abundant Bandwidth to Take Advantage of High-Bandwidth Opportunities

- How do markets create bandwidth for innovation when the markets have been designed for mass consumption?
- How do we recognize need for different kinds of networks without losing the benefits of all being served by similar networks?
- How do we provide an incentive for networks that drive a psychology of abundance, rather than a psychology of scarcity

Bandwidth, unlike dial-tone, has multiple variables

What does a Farmer and a Doctor need?

25 years ago	Dial tone	Dial Tone
Today	Mobile Data	Enough Bandwidth for real time collaboration with an MRI

Research facilities are moving to 100 Gbps connections

"National LambdaRail provides 100 Gigabit Connection for NOAA at Supercomputing 2011. Next Generation Research Capabilities Will Be Demonstrated Using Cisco Technology and NLR Transport Network"

By Bizjounrals.com, November 7, 2011

"Research institute deploys 100 Gigabit Ethernet from core to closet"

By Shamus McGillicuddy, November 28, 2011

New Devices Require Much Higher Bandwidth

"DNA Sequencing Caught in Deluge of Data"

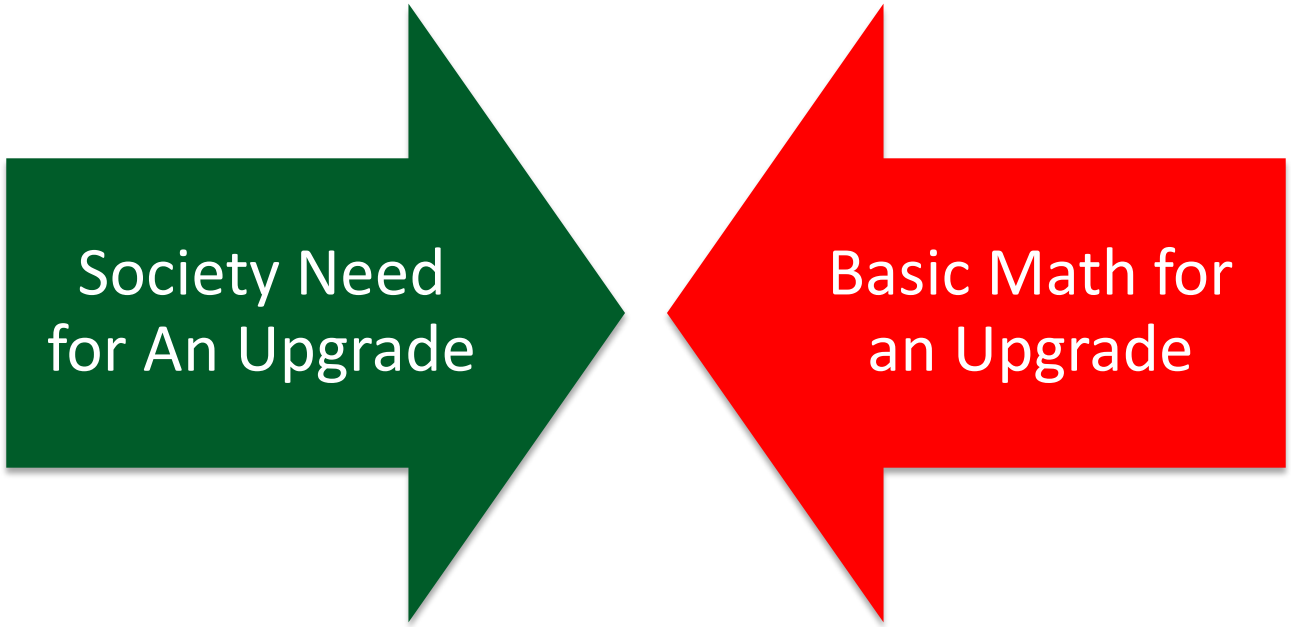
By Andrew Pollack, New York Times, November 30, 2011

BGI, based in China, is the world's largest genomics research institute, with 167 DNA sequencers producing the equivalent of 2,000 human genomes a day.

BGI churns out so much data that it often cannot transmit its results to clients or collaborators over the Internet or other communications lines because that would take weeks. Instead, it sends computer disks containing the data, *via FedEx.*

Other Such Devices Include 4K Cameras and Robots

Barrier



The returns do not justify the investment

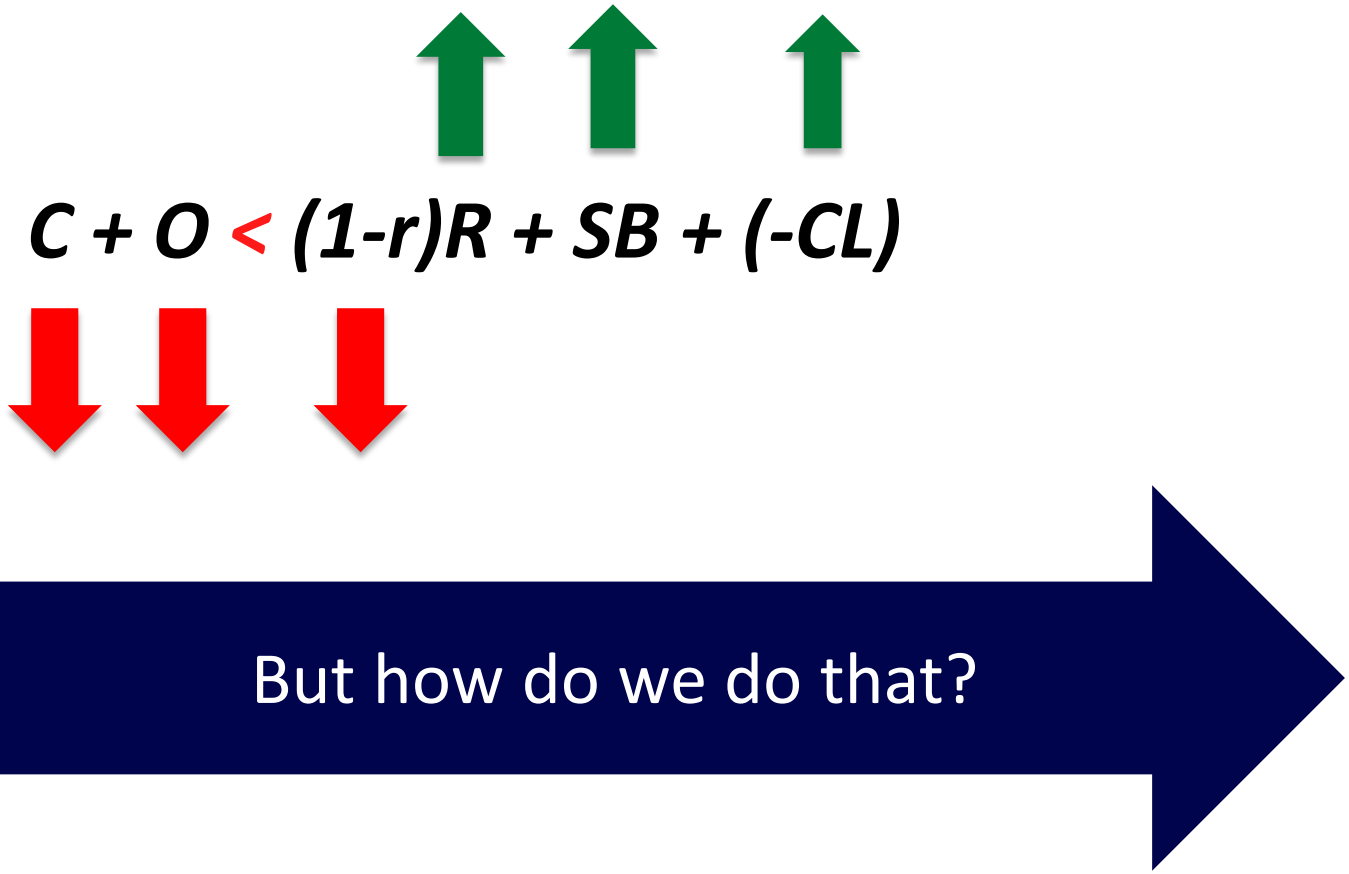
For the incumbent, the equation usually looks like this:

Costs | Benefits

$$C + O > (1-r)R + SB + (-CL)$$

C – Capital Expenditures
O– Operating Expenditures
r – Risk
R- Revenues
SB- System Benefits
(Benefits that drive increased revenues outside the communities where the new or incremental investments are made.)
CL- Losses due to competition

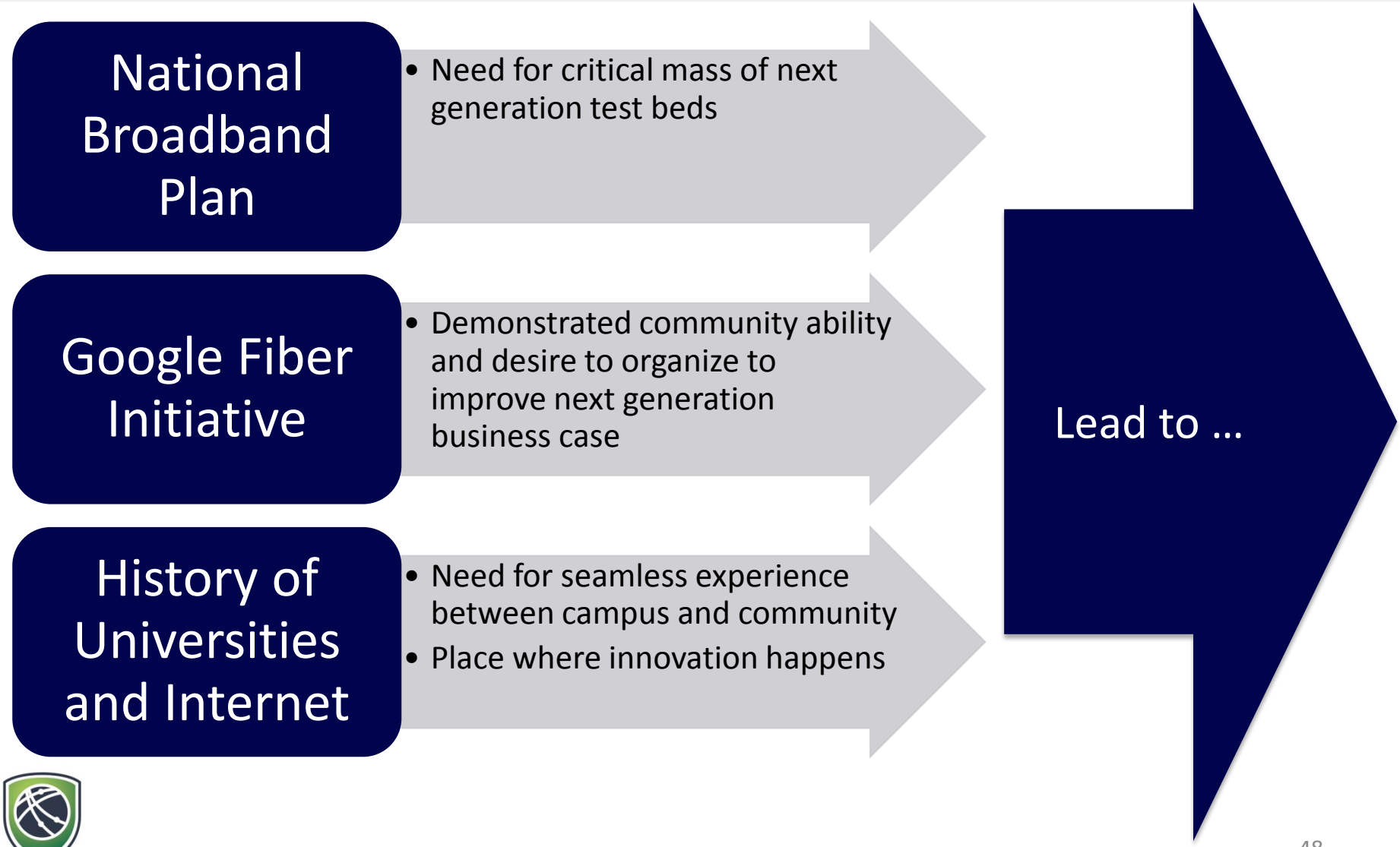
The path forward: change the math



Historically, investments are made when policy alters equation

Sector /opportunity	Ecosystem change	CapEx	OpEx	Risk	Revenue	Competitive Losses
Telco	Grant of monopoly			Lower	Raise	
Cable	Grant of monopoly, pole attachment law, compulsory broadcast license			Lower	Raise	
Rural areas	USF	Lower	Lower	Lower	Raise	
Wireless	Limited # of licenses			Lower	Raise	
DBS	Limited # of licenses, program access			Lower	Raise	
Broadband upgrade	Deregulation, two wire policy				Raise	Raise
Wireless upgrade	More licenses, lowered TAC, oversight of siting authority		Lower		Raise	Raise
Broadcast television to digital	Provide 2nd channel for transition period	Lower		Lower	Raise	

Approach for Addressing Strategic Bandwidth



Focus where math is easiest and impact greatest

Private investment gap smallest in University-communities

Demand for Bandwidth = **Greatest**

Cost of Deployment = **Least**

Positive Impact of Network Access Due to Innovation Culture and First Major Use Case (Health Care) = **Greatest**

What we have learned

Any community that wants its residents to have access to a Gig can do so

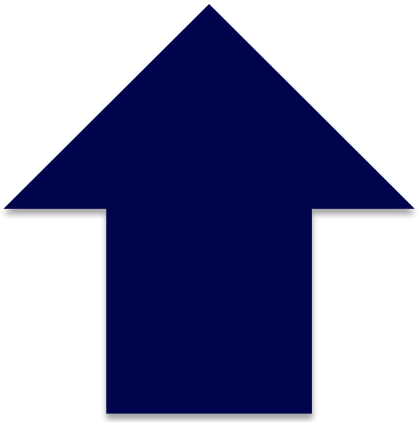
- The barrier is not technology or economics
- The barrier is organization; specifically, organizing demand and the better use of underutilized assets

University communities have the greatest motive and easiest organizing task

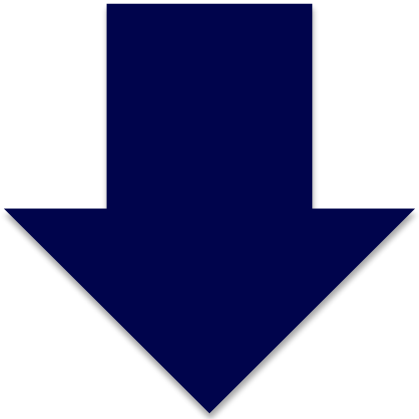
- Big data communities have the greatest existing demand and as high bandwidth-based enterprises are born, they will want to locate there
- University communities have the assets and organization tools best suited to the task

COMMON LESSONS OF BROADBAND AND ENERGY

First Principle

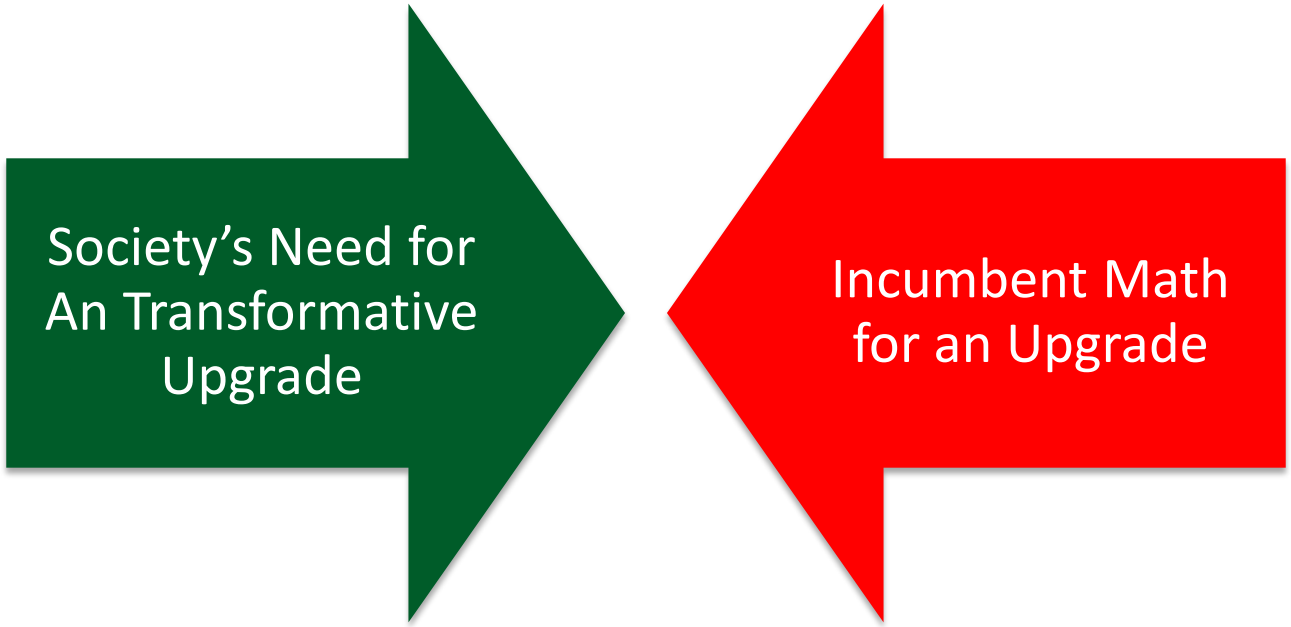


Plan
Beats

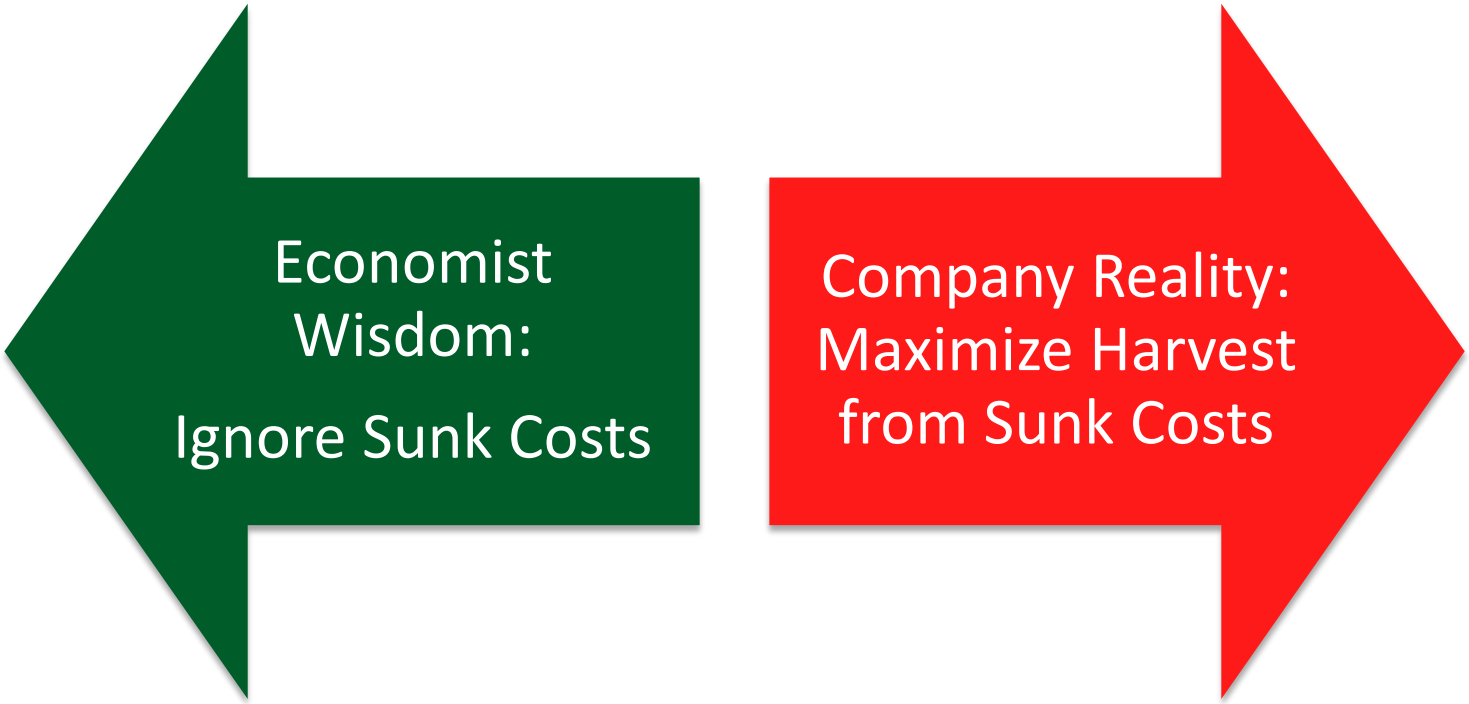


No Plan

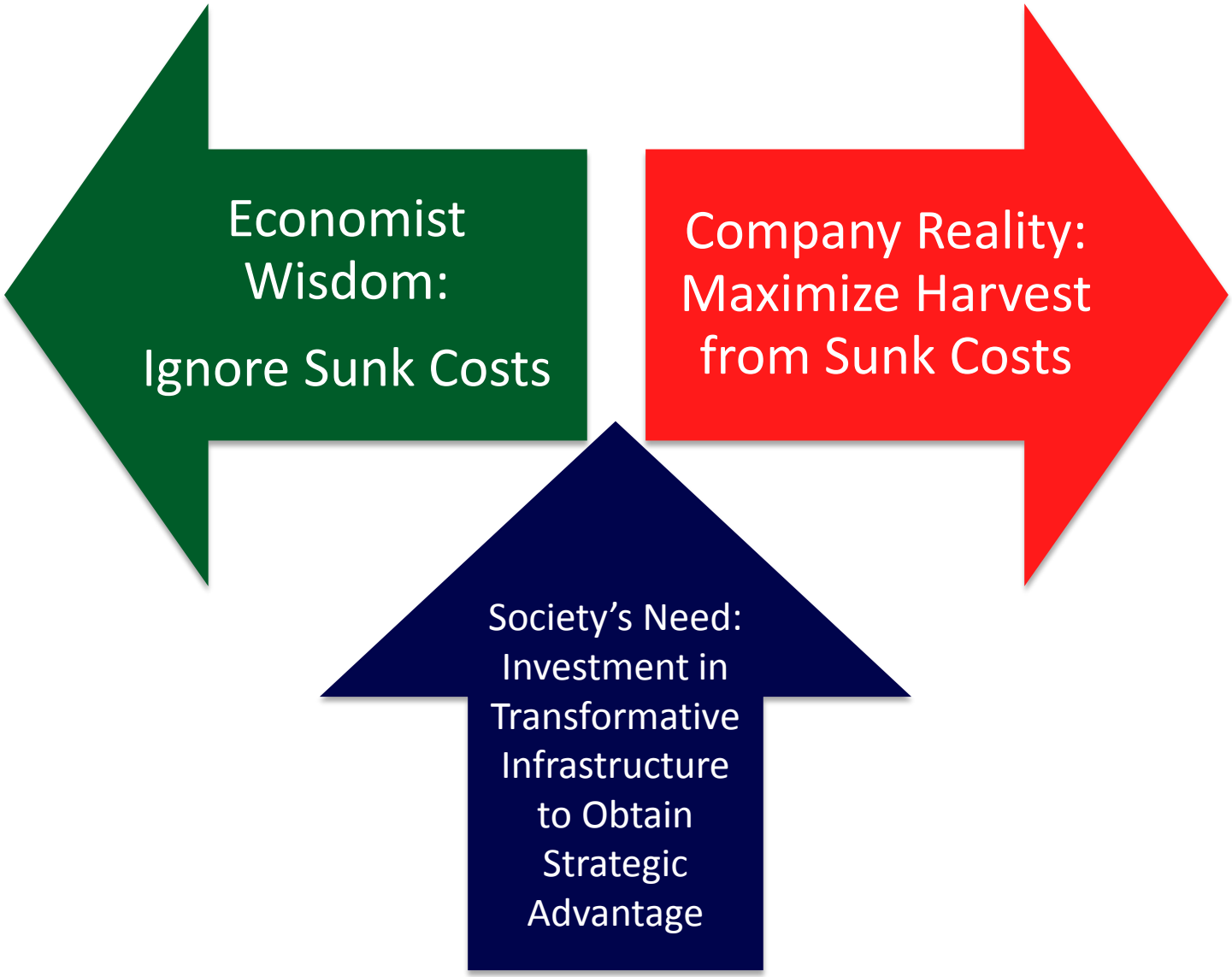
Barrier


Society's Need for An Transformative Upgrade
Incumbent Math for an Upgrade

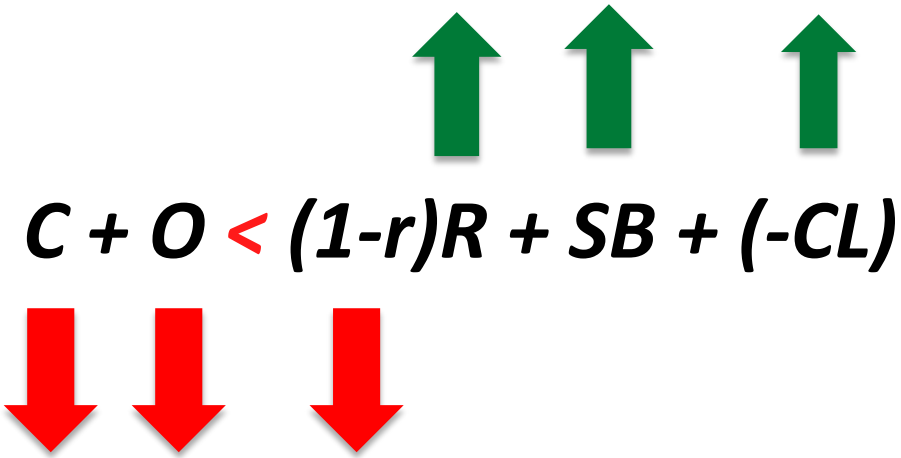
Infrastructure Math



Infrastructure Math



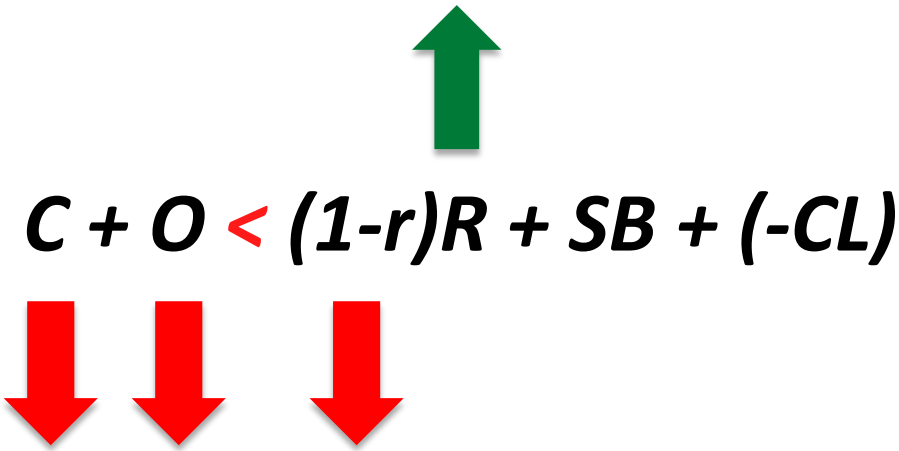
The Path Forward: Change the Math



Common to Bandwidth and Energy:

1. Need investment Strategy for Inventing the Future Rather Than Harvesting the Past
2. Need to Find Ways to Leverage Existing Assets to Move to World as if We Ignored Sunk Costs

Wall Street Math



Common to Bandwidth and Energy:

1. Transmission Companies Judged by ROIC, not EBITA
2. To Incent Investment, Have to Drive Up ROIC
3. Two ways: Increase Price or Lower Costs and Risk
4. First Eliminates Strategic Advantage for Society
5. Therefore, Policy Should Focus on Second

Tactical Focus

$$C + O < (1-r)R + SB + (-CL)$$

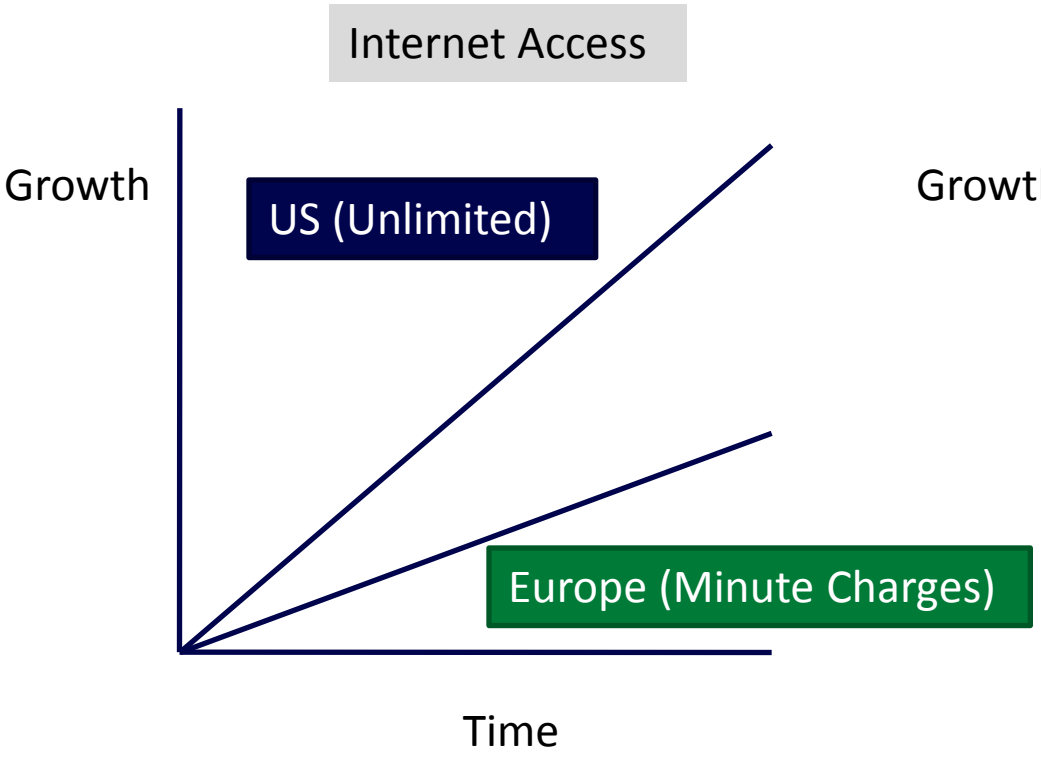
To Lower Costs and Risk

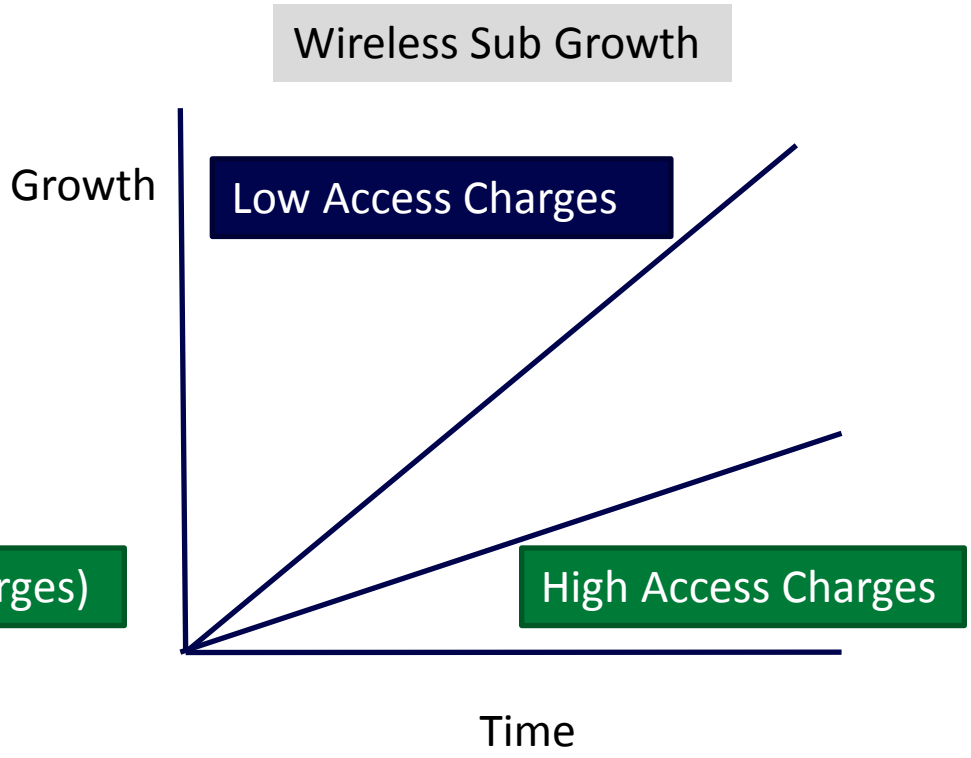
1. Lower Costs of Finance (Green and Infrastructure Banks)
2. Incent Better Use of Existing Assets
3. Aggregate Demand for Strategic Product Sets
4. Favorable Tax Treatment

State/local efforts can change the math

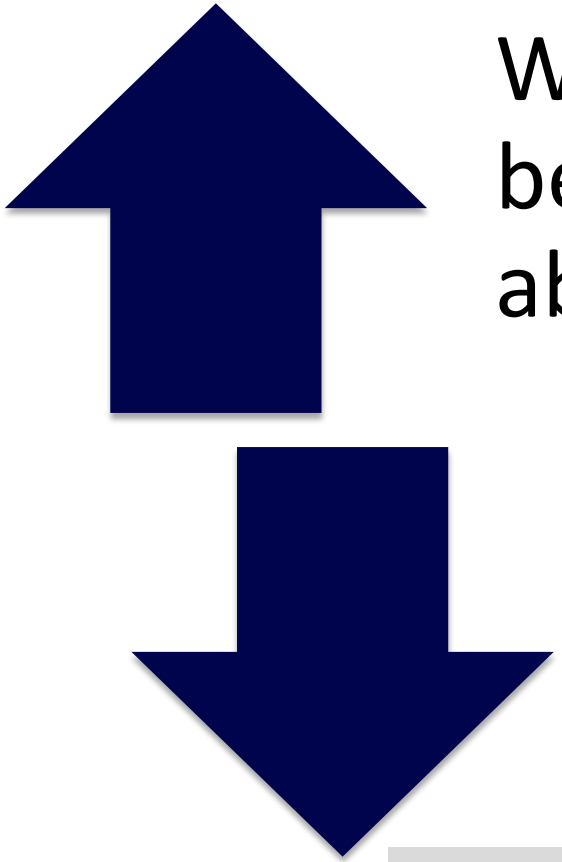
Reduce Cap Ex	• Build to Demand Model • Access to ROWs, Facilities • Reduce Regulatory Time • Dig Once for BB and Natural Gas
Reduce Op Ex	• Access Payments • Reduce Ongoing Regulatory Costs • Utilize Existing Billing Platforms
Reduce Risk	• Build to Demand • Standardize Functions Across Areas, Vendors
Increase Revenues	• Demand Acceleration/Aggregation • Marketing Platform • New Services
Increase Ecosystem Benefits	• Distributed Innovation • Seeding Long-Term Growth

Regulation Can Serve Growth by Understanding Change: The Psychology of Abundance vs. the Psychology of Scarcity





Fundamental question for policymakers:



Will our future be one of abundance….

….or constraints?

If the plan is not one of abundance, we will find ourselves on the wrong side of history

What are the inputs that will enable us to lead?

所美国大学筹备各自建立**1Gbps网络社区“GigU”**

Headline from Chinese Newspaper day after Gig.U launch