



Infrastructure Economics

Ross Valley Rotary Club
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Who Are We?

- **Honorary Board: 54 members**

- 2 Fed Chairs: Janet Yellen, Ben Bernanke
- 6 Chairs Council of Economic Advisers
 - o Furman (D), Rosen (R), Bernanke (R), Yellen (D), Tyson (D), Goolsbee (D)
- 3 Nobel Prize Winners
 - o Akerlof, Smith, Maskin

- **Delegates: 600+ members**

- At all levels of academia and some in government service
- All have a Ph.D. in economics
- Crowdsource slide decks
- Give presentations

- **Global Partners: 45 Ph.D. Economists**

- Aid in slide deck development



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Credits and Disclaimer

- **This slide deck was authored by:**

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- **Disclaimer**

- NEED presentations are designed to be nonpartisan.
- It is, however, inevitable that the presenter will be asked for and will provide their own views.
- Such views are those of the presenter and not necessarily those of the National Economic Education Delegation (NEED).



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Outline

- **What do we mean by infrastructure?**
- **Current state of infrastructure in the US**
- **Why should we invest in infrastructure?**
- **Infrastructure investment in the US**



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What is a Useful Definition of Infrastructure?

- *Infra-* means "below;"
 - So the infrastructure is the "underlying structure" of a country and its economy.
- **Miriam-Webster definition of Infrastructure:**
 - the system of public works of a country, state, or region
 - *also* : the resources (such as personnel, buildings, or equipment) required for an activity
 - the underlying foundation or basic framework (as of a system or organization)
 - the permanent installations required for military purposes



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Infrastructure – Is it:

- **Traditional:**
 - Roads, bridges, tunnels, airports, seaports, dams, water, electrical, and telephone systems?
- **Additional:**
 - Broadband
- **What about:**
 - R&D? Human capital? Institutions?
- **What definition of “infrastructure” is the most useful today?**




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Current State of Infrastructure in the US

2021 Infrastructure Grades

AVIATION	D+	PORTS	B-
BRIDGES	C	RAIL	B
DAMS	D	ROADS	D
DRINKING WATER	C-	SCHOOLS	D+
ENERGY	C-	SOLID WASTE	C+
HAZARDOUS WASTE	D+	STORM WATER	D
INLAND WATERWAYS	D+	TRANSIT	D-
LEVEES	D	WASTEWATER	D+
PARKS AND RECREATION	D+		

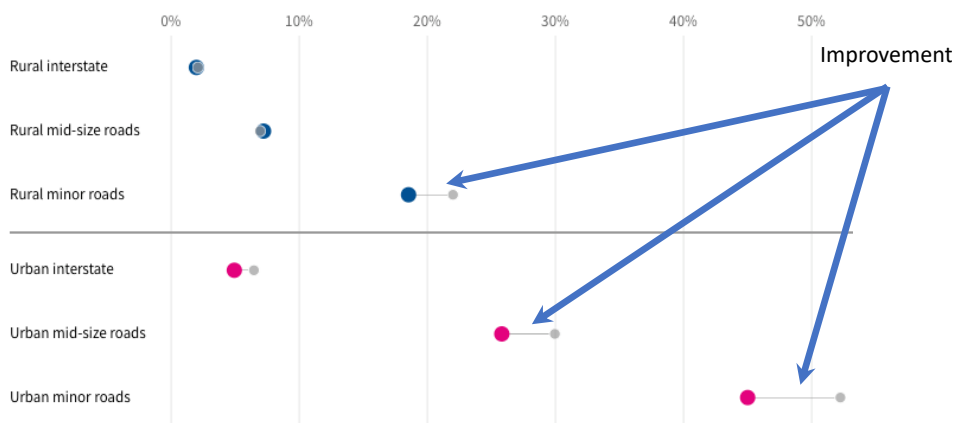
America's Cumulative Infrastructure Grade



A	EXCEPTIONAL
B	GOOD
C	MEDIOCRE
D	POOR
F	FAILING

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But Some Infrastructure is Getting Better



PERCENT OF ROADS IN UNSATISFACTORY CONDITION 2000 VS 2019

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Current Infrastructure Package



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What is in it?

• Transportation

Roads, bridges, major projects	\$110 Billion
Passenger and freight rail	\$66 Billion
Public transit	\$39 Billion
Airports	\$25 Billion
Port infrastructure	\$17 Billion
Transportation safety programs	\$11 Billion
Electric vehicles	\$7.5 Billion
Zero and low-emission buses and ferries	\$7.5 Billion
Revitalization of communities	\$1 Billion

• Other

Broadband	\$65 Billion
Power infrastructure	\$73 Billion
Clean drinking water	\$55 Billion
Resilience and waste water storage	\$50 Billion
Removal of pollution from water and soil	\$21 Billion



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What is missing?

- **Strategic thinking:**
 - Long term thinking, planning, prioritizing.
- **Meaningful climate resilience planning.**
- **Education & R&D.**
- **Expanding/insuring water supplies.**
- **Hazardous waste.**
- **A meaningful magnitude of spending?**



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Infrastructure Benefits



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Why Should we Invest in Infrastructure?

- **Vital ingredient to economic growth**

- Facilitates economies of scale, raises productivity
A 10% rise in infrastructure assets directly increases Real GDP per capita by 0.7 – 1%.
 - o Assuming increases in spending translate 1-1 to the stock of assets:
 - ~\$50 billion will raise GDP per capita in the US by ~\$300 - \$450.
 - \$100 to \$150 billion in increased GDP.
- Productivity growth raises standards of living



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Why Should we Invest in Infrastructure?

- **Vital ingredient to economic growth**

- Facilitates economies of scale, raises productivity
- Reduces trade costs by improving access to markets
 - o Port capacity improvement
 - o Reducing traffic congestion
- Reduces effective distances, facilitates trade and agglomeration
- Advances public health by providing clean water and effective sewage systems



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Case for Spending More on Infrastructure Maintenance

- **Rundown infrastructure increases costs**

- Longer travel time → higher costs for businesses
- Wear on cars → more spending on car repairs → faster car depreciation
- Vehicle deterioration → Additional fuel consumption

“The average motorist in the U.S. is losing \$523 annually -- \$112 billion nationally -- in additional vehicle operating costs as a result of driving on roads in need of repair.”

-- November 2016 Urban roads TRIP report

- **Deferred maintenance is a debt burden on the future generations.**



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Empirical Evidence on Effect of Gov't Spending

- **In studies from 80s, early 90s:**

- A 1% increase in the stock of public capital raised GDP by 0.39%.

- **In more recent studies:**

- by only 0.08% in the short run, 0.12% long run.

- **In terms of multiplier, most short-term estimates are less than 1.**

- Due to negative effects of tax/interest rate increases on private C and I

- **Longer term multiplier:**

- US interstate highway system – 1.8



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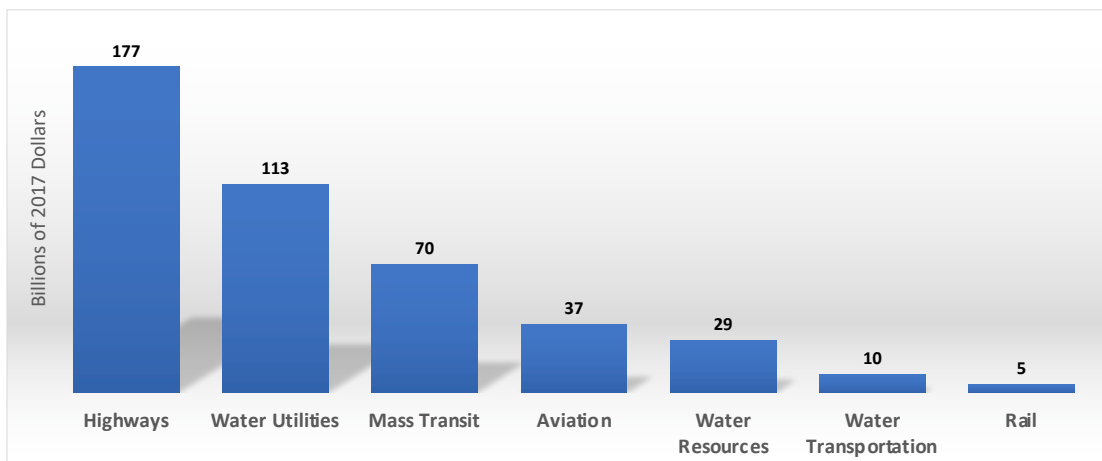
Infrastructure Investment in the US

- **Transportation, drinking water, and wastewater infrastructure**
 - mainly funded by the public sector
- **Publicly owned transportation infrastructure**
 - Highways
 - Mass transit
 - Aviation
 - Water transportation
 - Rail
- **Publicly owned water infrastructure**
 - Water utilities
 - Water resources
- **In 2017, Federal, State and Local governments spent**
 - \$441 billion on infrastructure
 - 2.3% of gross domestic product



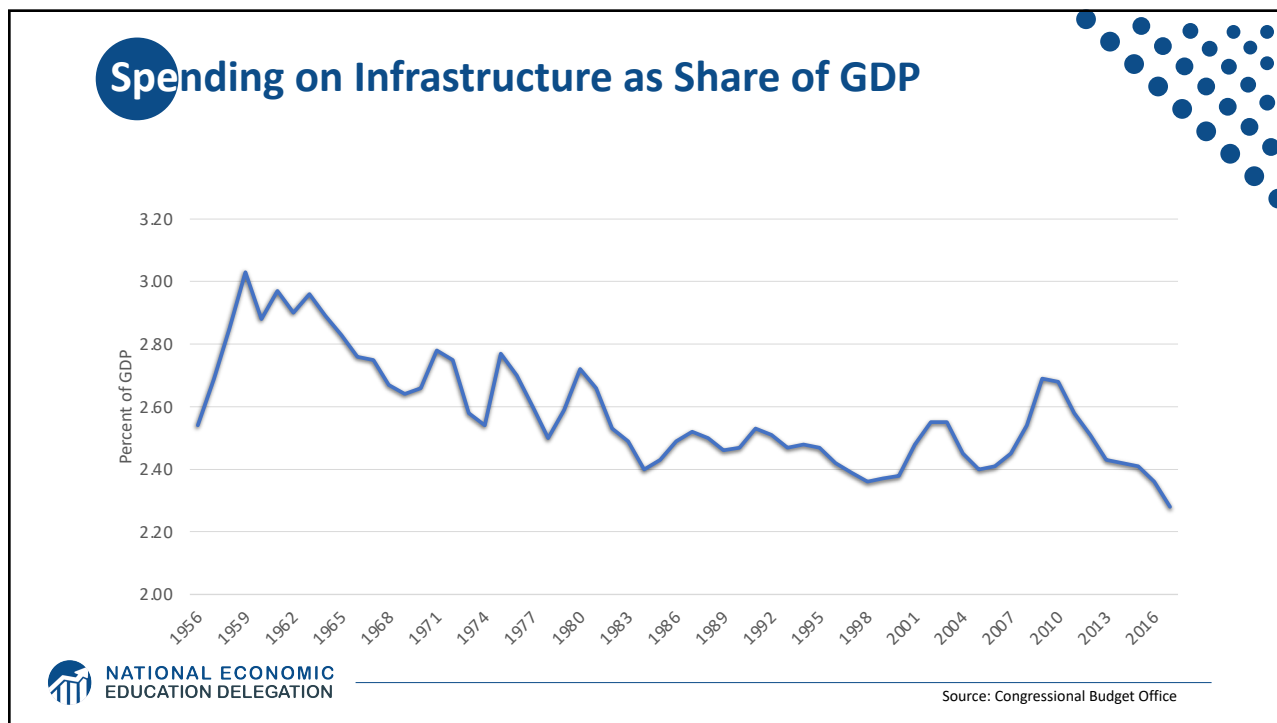
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Government Spending on Infrastructure, 2017

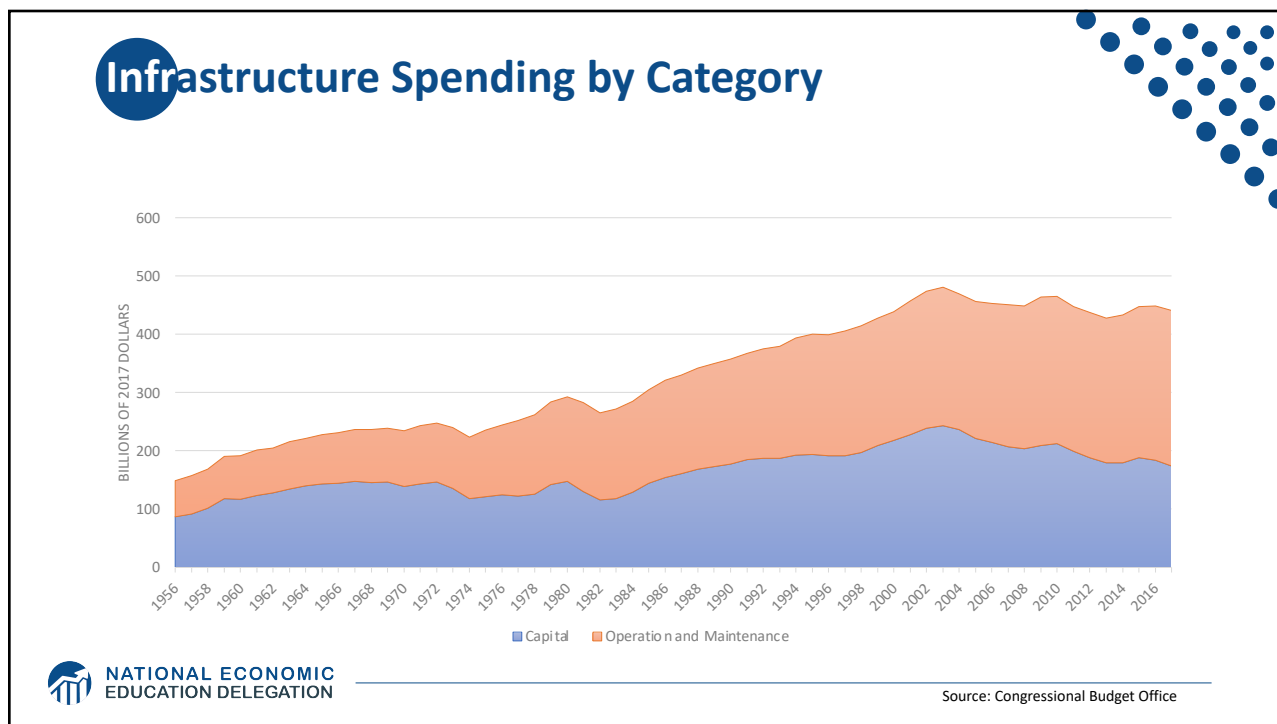


Source: Congressional Budget Office

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Another Aspect of Infrastructure – Broadband

- Talk of a digital divide ubiquitous
 - especially in light of the current pandemic
- 21 million+ Americans lack meaningful access to the internet
 - Meaningful access: 25 Mbps download and 3 Mbps upload
 - 14.5 million have no access at all
- Lack of access more common among the less educated, low income, living in rural or suburban areas
- 9 million+ school children lacked internet access for online schoolwork



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Enormous Economic Benefits to Access

- **Individual benefits:**
 - Better health and life outcomes.
 - Access to health and education online.
 - Job search and development of digital skills.
 - Higher property values.
 - Increased population and job growth.
 - Higher rates of business formation.
- **Broader economic benefits:**
 - World Bank
 - 10% increase in access yields a 1.2% jump in real incomes.
 - Indiana
 - ROI = 300-400%.



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Summary

- **Infrastructure investment is important.**
- **Current state of US infrastructure – leaves a lot to be desired for.**
- **Public infrastructure investment can play a vital role in long run growth.**
 - Improve mobility
 - Raise private capital productivity
 - Improve health
- **May not be ideal as short-term stimulus.**
- **Arguments for and against going big.**
 - ROI arguments likely carry the day in today's interest rate environment.
 - Risk is always the impact on the debt.



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Thank you!

Any Questions?

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Different Kinds of Infrastructure (& Examples)

- **Provide basic services.**
 - Electricity, water, broadband (?).
- **Improve the performance of the economy.**
 - Roads, bridges, airports, seaports.....
 - General R&D?
 - Education
- **Make people's lives better.**
 - Roads, bridges, airports...
 - Protection from natural disaster
 - Child care, education.



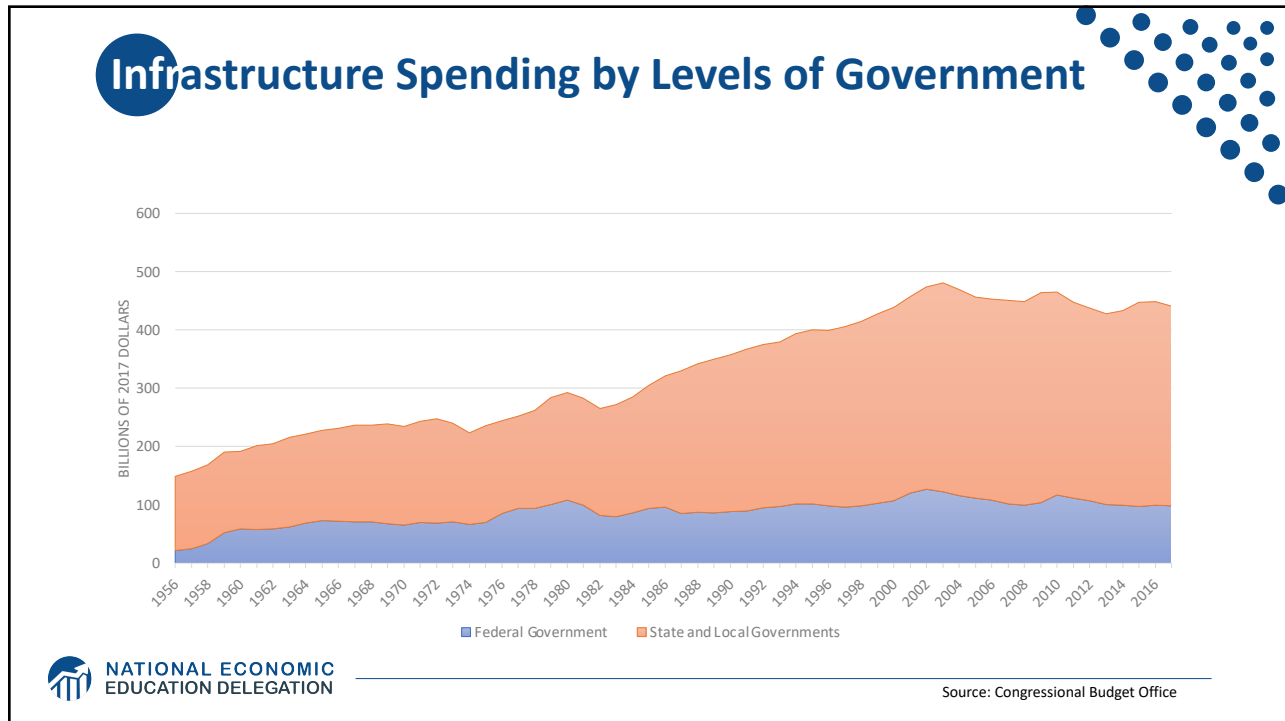
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Categories of Infrastructure

- **Transportation**
 - Highways, roads, bridges
 - Mass transit
 - Airports, seaports
- **Water**
 - Supply
 - Distribution
- **Waste management**
 - Trash, recycling, and wastewater
- **Energy**
 - Generation
 - Transmission
- **Communications**
 - Telephone
 - Internet



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Funding – According to the White House

- **Unspent emergency relief funds**
- **Targeted corporate user fees.**
- **Strengthening tax enforcement – crypto currencies.**
- **Revenue generated from higher economic growth.**

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Current State of Transportation Infrastructure

• Roads

- Over 4 million miles of roads.
- In 2018: 3.3 trillion VMT (Vehicle Miles Traveled).
- 40%+ of America's urban interstates are congested.
- In 2017, 8.8 billion hours of traffic delay.
 - o Costing the country \$166 billion in wasted time and fuel.

"The average auto commuter spends 54 hours in congestion and wastes 21 gallons of fuel due to congestion at a cost of \$1,080 in wasted time and fuel."

-- 2019 Urban Mobility Report, Texas A&M Transportation Institute

- 42,060 motor vehicle fatalities in 2020 (8% increase over 2019).



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Current State of Transportation Infrastructure

• Mass Transit

- ~2,500 separate transit agencies.
- Transit ridership: peaked at 10.7 billion in 2014.
- 50% of passenger trips by bus.
 - o 10% of fleets NOT in "state of good repair".
- 33+% by heavy rail (subway/metro)
 - o 3% of fleets NOT in "state of good repair".
- Transit's physical infrastructure fairs considerably worse (% NOT in "state of good repair"):
 - o 15% of facilities (e.g., maintenance facilities),
 - o 17% of systems (e.g., power, signal, communications, fare collecting)
 - o 35% of guideway elements (e.g., tracks), and
 - o 37% of stations.



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Current State of Transportation Infrastructure

• Aviation

- In 2018, 10 million+ commercial flights
 - o Flying ~3 million passengers daily
- National Plan of Integrated Airport Systems (NPIAS)
 - o identifies over 3,300 airports in the U.S. aviation network
- Contributed 5.1% to US GDP
 - o Generated 10.6 million jobs
- In 2017, 80% of flights were on-time. Delays were caused by
 - o late-arriving aircrafts (6.8%),
 - o air carriers (5%),
 - o weather (3.1%), and
 - o diverted flights (0.2%).



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Current State of Transportation Infrastructure

• Ports

- 99% of US overseas trade pass through ports
- Los Angeles and Long Beach – busiest ports in the US
 - o Top 10 U.S. ports account for 3/4th of U.S. trade
- Congestion decreased port productivity by over 25% over the past decade
- Port infrastructure upgrades needed to accommodate new, larger ships with deeper navigation channels

• Waterways

- More than 600 million tons of cargo
 - o 14% of annual domestic freight
- Beyond their 50-year design life
- 50% vessels experience delays due to maintenance shut downs



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Current State of Water Infrastructure

• Drinking Water

- 150,000+ public drinking water systems
- 1 billion+ glasses of drinking water consumed daily
 - o 80% from surface waters such as rivers, lakes, oceans, reservoirs
 - o 20% from groundwater aquifers
- Delivered via 1 million miles of pipes
 - o Majority laid in mid-20th century and are aging
 - o estimated 240,000 water main breaks occur each year
 - o 6 billion gallons of treated drinking water lost daily due to leaking pipes
 - could support 15 million households



Current State of Water Infrastructure

• Wastewater

- 14,748 wastewater treatment plants
 - o 1.3 million miles of public and private lateral sewers
- Used by 76% of Americans
 - o Likely to serve 56 million more people by 2032
- Structural failure, blockages, and overflows cause at least 23,000 to 75,000 sanitary sewer overflow events each year



Current State of Water Infrastructure

• Dams

- There are over 90,000 dams in the US providing:
 - drinking water,
 - irrigation,
 - hydropower,
 - flood control, and
 - recreation
- Average age – 56 years
- By 2025, 7 out of every 10 dams will be over 50 years old
- In 2015, there were 15,500 high-hazard potential dams
 - up 52% since 2005



Current State of Water Infrastructure

• Levees

- A network of 30,000 miles of levees
- Levees in the U.S. Army Corps of Engineers Levee Safety Program protect
 - over 300 colleges and universities,
 - 30 professional sports venues,
 - 100 breweries, and
 - an estimated \$1.3 trillion in property
- Built in the mid-20th century with an average age of 50 years, aging fast
- Levees are crucial with majority of the U.S. population living within 50 miles of a coast



Public or Private Infrastructure Investment?

- **Nonrival consumption**
- **Non-excludable use**

- Social benefits might exceed expected financial return.
- Private sector likely to underprovide key types of infrastructure.
- Economic case for public provision of infrastructure assets.



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Public or Private Infrastructure Investment?

- **A few arguments for public provision:**

- Provision of public infrastructure increases productivity of private infrastructure
 - o Incentivizes private capital investment,
 - o Increases labor productivity,
 - o Indirectly increases employment and wages.



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Public or Private Infrastructure Investment?

- **A few more arguments for public provision:**

- Provides short-term stimulus to the economy by creating jobs
- Promotes trade and commerce
- Promotes equity
 - o Pays prevailing wages
 - o More demographically inclusive
 - o Encompasses all congressional districts
- Promotes public health and well-being
- Improves public safety
- Affects not just the present but the future generations also

- **Some of these are more debatable than others**



Broadband Access

- Modern-day equivalent of the interstate highway system
- Lack of access not just a rural problem
 - In 2016, 57% of households in Detroit, MI;
 - 49% in Memphis, TN and
 - 48% in Cleveland, OH without fixed broadband
- Digital redlining within cities
- Where available, service is often limited to a single service provider – natural monopolies
 - Due to high up-front fixed costs of laying fiber optic lines



Solutions to the Access Problem

- FCC Launched a \$20 billion Rural Digital Opportunity Fund in February 2020
 - \$6 million budget
 - Target census blocks that without 25/3 Mbps broadband
- Taking matters into their own hands, cities and communities:
 - Building municipal infrastructure and cooperatives providing broadband
 - Despite legal barriers or bans on publicly owned networks in 19 states
 - 850+ communities served by a municipal network or cooperative
- Community-owned networks are less expensive and have more transparent pricing than private ISPs – Harvard Study



Technological Advancements of the Future to the Rescue?

- Low Earth Orbit (LEO) satellite internet
 - On June 13, 2020 Elon Musk's SpaceX launched 58 satellites into low earth orbit as part of the Starlink program.
 - Aims to provide low-latency (less lag) satellite internet.
 - Better internet coverage than traditional communications satellites.
 - Could potentially provide high quality internet to homes and businesses without access to cable, fiber, or reliable cellular internet.



Pace of Investment



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Too Much, Too Soon? Too Little, Too Late?

- **Is the current infrastructure package appropriate?**
- **The United States has enormous needs.**
 - Basic infrastructure – bridges, roads, etc.
 - Other:
 - General R&D: 2% of GDP in the 1950s, currently 0.75%.
- **Is now the time to borrow extensively?**
 - Have just borrowed > \$4 Trillion.
 - Interest rates are very low.
- **Given the state of our infrastructure, the ROI can be very high.**



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Debt Outlook is Troublesome

Federal Debt Held by the Public, 1900 to 2050

Percentage of Gross Domestic Product



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Available NEED Topics Include:

- US Economy
- Climate Change
- Economic Inequality
- Economic Mobility
- US Social Policy
- Trade and Globalization
- Trade Wars
- Immigration Economics
- Housing Policy
- Federal Budgets
- Federal Debt
- 2017 Tax Law
- Autonomous Vehicles



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