

“...and I will move the world.”

Transportation 2010 to 2060

NCHRP 20-83 A

Long-Range Strategic Issues

Facing the Transportation Industry

Alex Lightman

CTO and Director, Fortune Nest Corp.

Opinions expressed are my own



“...and I will move the world.”

Transportation 2010 to 2060



**“Give me a lever, a fulcrum,
and a place to stand, and I
will move the world.”**

**Archimedes of Syracuse, pitching
King Hiero on funding for
infrastructure, via Dept. of Energy,
Transportation, Defense and Space**

You are all more important than you seem to realize. I would have called this:

NCHRP 20-83 A
Long-Range Challenges
and Potential Catastrophes
Facing the Entire World, and Potential
Solutions from the Infrastructure
Community of US Federal government
and State governments

Starting/Startling Points

1. I love the initiative and enterprise.
2. It's very useful and important.
3. Forecasting/predicting the future is not a function of “possibility”, it is a function of “competence”. You are at the stage of “conscious incompetence” with respect to 50 year foresight.
4. For THIS, science fiction must be part of your input, processing, and output. Seriously!
5. Now, while it's still not too late, I recommend you change the “who”: DoIT, DoS

This is very useful and important.

1. 50 years is a good time frame to amortize the investment in infrastructure.
2. By 2060, US (population 333 million in 2011) will become North America (population 555 million in 2011, and 1 billion by 2060), per capita 50% wealthier than today in 2010 \$.
3. Our creditors also have 50 year plans, and will think of the DoTs as the grown-ups, in world where cred = \$50 trillion.
4. Future@mit.edu and mr4g@4G.org = seizing virtual highground; thought-leadership

The Quiet National Learning Process

- Unconscious Incompetence – don't know what to do and don't know that you don't know.
- Conscious Incompetence – You don't know what to do, but now you know that you don't know – usually ask for help.
- Conscious Competence – You've learned: you know what to do, and are proud that you know it. You think about it as you do it with pride.
- Unconscious Competence – You know what to do and how to do it, but you do it automatically or as a routine.
- *Hundreds of millions of people have gone through a long equivalent of apprenticeship and are at the stage of unconscious competence with respect to SF.*

Nomen est Omen

- Department of War was a name that limited ability to get funding. 50% of people would always be against it. Defense? Who could reasonably be against defense, besides sworn pacifists?
- Department of Transportation isn't sexy, futuristic, or even what the bulk of funding is for. You enable the creation of infrastructure that people use to transport themselves.

You Enable Superconnectors

- I suggest that the Departments of Transportation/Infrastructure rename themselves Department of Superconnection, putting it above mere virtual connection.
- Give attention to how people can be able to find, meet, transact, exchange, and depart, not just move across.
- Blur the lines with telcos, FCC, DoE, and think of how to get people, places and things to and from each other.

Get Ready for More Responsibility

- Rina Cutler worked for PennDOT, head of administration. Now is the Deputy Mayor of Philadelphia for Infrastructure.
- Rina is responsible for airport, streets, water. Electricity and gas is private, but she is also the liaison to the regulators, and SEPTA (Southeastern Pennsylvania Transportation Authority).
- Rina is your future, if we get smarter.

Fake it ‘til you make it

- Rather, Simulate and emulate until you create.
- I think these studies should be done “as if” in a parallel Earth in which you are called the Department of Infrastructure or Dept. of Infrastructure and Technology from 2011 to 2025, and then the Dept. of Superconnectors from 2026 to 2060. (25 years each).
- I actually do think that the Depts. of Transportation should be called Depts. of Infrastructure (and Technology).

What is Infrastructure?

- During infrastructure, takes 10 units of effort to get 1 unit of results. After infrastructure, takes 1 unit of effort to get 10 units of results.
- Infrastructure is the “secret” reason for US federal government’s success. US funded infrastructure, which created new industries, which created commercial explosion of technologies and companies, which created jobs, which funded US gov’t, and next infrastructure.

The Greatest ROI in History

- US federal gov't spent 100% of the first \$50 million on the IPv4 Internet (ARPAnet under Dr. Larry Roberts; Len Kleinrock at UCLA; Vint Cerf and Bob Kahn IPv4)
- Dept. of Defense “went on walkabout” in 1984, 19 years AWOL until IPv6 Summit, 2003.
- Federal revenues went from \$1.1 Trillion 1990 to \$2.1 trillion in 2000. Roughly half of GDP growth related to the Internet.

\$500 billion a YEAR = 1,000,000% a YEAR ROI

ROI = Vital. If you can't measure it

- ... you can't manage it, and you can't brag about it to get tens of trillions in funding.
- Need to add: estimated ROI/IRR calculations for all PAST infrastructure, US and foreign, and all PRESENT and FUTURE infrastructure.
- DoT needs to step up, be bold, and be the “elder” agency, arguing for greater ratio of INVESTMENT to CONSUMPTION by US and states. Vital for financial viability of US.

Transportation AND Communication

- Ministry of Transportation and Communication in Finland. Former is responsible for icebreaking ships. Later for doubling GDP after USSR collapse, via GSM.
- Other smart governments with MoTC
- 1. People's Republic of China (largest creditor)
- 2. Singapore (large sovereign wealth fund)
- 3. Sweden (also a leading telecom exporter)
- S. Korea is considering, plus electrification

Go Bold: US and State Dept. of Infrastructure

1. Dept. of Transportation absorbs, manages:
2. Federal Communications Commission
3. Smart grid, which needs federal, state, and local regulation beyond public utility commissions.
4. Space ports – over \$1 Trillion invested in launch facilities in the US. FAA already licenses space ports, but does not regulate, but should

Greece is closest to what I mean: Ministry of Infrastructure, Transport, and Networks

The mission of the Ministry of Infrastructure, Transport and Network are:

- Contribution to national policy and establish appropriate institutional framework and policy implementation in the field of Public Works.
- The supervision in construction activity throughout the country.
- The long-term training programs and annual project execution, ensuring funding and tracking their performance.
- The logical framework for the development and monitoring of technical, organizational and financial capacity of the contracting companies that undertake the construction works.

The administrative structure of the General Secretariat of Public Works is shown in [organization chart](#) of.

- The design and implementation of national policy and the creation of appropriate institutional framework and contribute to policy development and creating an institutional framework at European and international level to develop traffic and transport, telecommunication and postal services of high quality, fair competition.
- The promotion of transport safety and transport, and telecommunications.
- Promoting the Information Society.
- The contribution to the country's economic growth and improve the quality of life in terms of areas of competence of the Ministry.

Why DoT regulation of Smart Grid?

- 1. DoTs appear to receive 90% of their funding from fuel taxes. US has only 2% of proven reserves of oil. In public interest to move to electric vehicles. DoT has “perverse incentives” not to support, since it would be eliminating revenue.
- 2. Need to transition from 90% revenue from liquid fuel to 50% to 75% from electricity. Need to solarize, smart gridize highways.

“But that’s not our job, dummy!”

- Most progress was made by the wrong person in the wrong place at the wrong time for the wrong reason. Network theory says: normal!
- If not you, with your 50 year enterprise, who?
- Wasn’t MY job to architect 4G, but I did.
- Wasn’t MY job to lead global IPv6 transition, but I did. Got over 40 federal agencies to speak at IPv6 Summits in Reston, and over 40 countries (NATO, China, Japan, S. Korea) to agree with IPv6 transition cooperation.

How do you make change to Dept. of Infrastructure

- 1. Come up with ROI survey as part of this study, past, present and future.
- 2. Recognize that US federal, state, local finances are approaching “peak credit”, and general collapse of creditworthiness.
- 3. Funding will flow to government agencies that have income and balance sheet aspects, from GCC and China, which are Big Planners.
- 4. Have Congressional hearing on Infrastructure Leadership.

Infrastructure Leadership

- Need to create a new Sputnik. Children of Sputnik (Oct. 4, 1957): GPS, DARPA, NASA...and half of the Information Technology revolution.
- I helped Congressman Tom Davis (R-VA) organize Government Reform Committee hearing on Internet Leadership: To Lead or Follow. Raised specter of China taking US place. US has had about 50% of Internet traffic, 25% routed via ISPs/telcos 1 hour.
- China: 2015 will have over 50% world HS rail.

A Critique: Money is Missing!

- 1. Finance and creditworthiness of US federal government and states. Going down? Default?
- 2. In reduced credit world, move towards USER FEES, and disintermediation of deficit-ridden entities that will spend on debt service.
- 3. Need a Transportation DARPA – Tom Kalil, Director of Policy for Office of Science and Technology /policy, and an IN-Q-TEL (venture fund for the CIA)

What Use is Science Fiction?

Starting points

- "Imagination is more important than knowledge." - Albert Einstein
- "Science fiction, which started out on the edges of literature and pulp fiction, has become more than mainstream; it is now an essential way of interpreting the world." –*The New York Times*
- "We control matter because we control the mind. Reality is inside the skull."
–George Orwell / *Nineteen Eighty Four* (1948)

MIT uses SF to get grants

- "Imagine the psychological impact upon a foe when encountering squads of seemingly invincible warriors protected by armor and endowed with superhuman capabilities, such as the ability to leap over 20-foot walls" said Professor Ned Thomas, ISN director announcing the award.
- <http://web.mit.edu/newsoffice/nr/2002/isn.html>, accessed April 1, 2002, Army selects MIT for \$50 million institute to use nanomaterials to clothe, equip soldiers

Science Fiction as Natural Resource

Jules Verne

- more than a century ago envisioned a submarine run on electric batteries and a rocket to the moon launched from Cape Canaveral, directly inspiring what led to the first nuclear submarine, the *Nautilus*, and to the Apollo space program.

H. G. Wells

- directly inspired
 - the battle tank,
 - air forces,
 - the atomic bomb, and
 - future studies.
 - “*To you literature is an end, to me, literature, like architecture, is a means, it has a use.*” – H.G. Wells (*conversing with Henry James*)

The Medium that Transmutes the Future

- *SF is the medium in which our miserable certainty that tomorrow will be different from today in ways we can't predict, can be transmuted to a sense of excitement and anticipation, occasionally evolving into awe. Poised between intransigent skepticism and uncritical credulity, it is par excellence the literature of the open mind -- John Brunner*

SF as Inspiration for 21st Century Economy

Arthur C. Clarke

- Geosynchronous satellites
- Satellite television
- Porn channels
- Impact of watching porn from satellite television on reduced productivity
- Water bed.



Star Trek

Inspired Martin Cooper at Motorola to make, in 1973, the first private hand held mobile phone, called “the Star Trek”, then the Star Track, then the StarTac, DynaTac (Dynamic Adaptive Total Area Coverage) in 1983. (\$8,000 in current \$)

PADD from Star Trek also inspired Palm Pilot and Newton, leading to the iPhone today.

Science Fiction is Misunderstood

- An awkward way of saying that something isn't actual, real, authentic or true.
- “It's science, not science fiction”.
- Misnomer, from Hugo Gernsback.
- Science fiction authors used to be world-famous, and consult with heads of state.
- H.G. Wells screwed this up by picking fights with both Henry James and J.P. Morgan, picking fights with literature and business.

SF: Formerly all *a priori*

- Scientists talk about *a priori* knowledge – knowledge that comes before experiment and experience (for example, Jules Verne on what the moon's surface is like)-
- and *a posteriori* knowledge – knowledge that comes after repeated experiments or experience (astronaut Neil Armstrong on what the moon's surface is like).
- Science fiction used to be nearly 100 percent *a priori*, making wild guesses about hundreds of things, many of them laughably wrong but some of them still, amazingly, on target.

SF: Supercharged with *a posteriori*

- In 2010, we have the benefit of tens of millions of man-years and trillions of dollars worth of scientific and industrial research to draw upon.
- So many serious scientists have taken to writing SF themselves, or to collaborating or consulting on manuscripts to maintain accuracy in scientific details, that today's science fiction is thoroughly penetrated by a hard-won *a posteriori* knowledge.

My Definition of Science Fiction

- *Visions of technology that people will pay for.*

'I respond to three questions,' stated the augur. 'For the twenty terces I phrase the answer in clear and actionable language; for 10 I use the language of cant, which occasionally admits of ambiguity; for five, I speak a parable which you must interpret as you will; and for one terce, I babble in an unknown tongue.'

Prophet in The Dying Earth, by Jack Vance, who makes the point that we get what we pay for.

My Definition of Science Fiction

- *Visions of technology that people will pay for.*
- Every novum (new cool thing) creates a goal for a new tribe (transparent aluminum in Star Trek IV)
- SF has a big advantage in that its many fans, increasingly rich as the baby boomers all move into and beyond their 40s, try – consciously or unconsciously - to make the SF ideas of youth come into being.
- SF is a form of self-fulfilling prophecy, or what I call *blueprint prophecy* because it not only says what may happen, but also promises: “If you build it, they will come. And pay you. And think you are cool for making dreams come true.”

Science Fiction is About Stories

- Raised \$12 million for two ventures. “That’s a great story”. Sand Hill Road = SF stories!
- SF stories are “ideas worth spreading” fanatically. Real life video karaoke (/ - Slant).
- Billionaire friend of mine, advisor to kings: “Powerful people are always being told things they don’t want to hear, in ways they don’t want to hear it. I tell them things in a way that they like to hear it, whether they like the things or not.”

The Nature of Technology by Brian Arthur

Technologies are:

1. based on interactions with natural phenomena
2. composed into modular systems of components
3. that grow into domains with their own conceptual languages.
4. Because the systems are modular, they can leverage the combinatorial explosion
5. once a certain technology reaches a critical mass of components and interfaces it can evolve rapidly
6. entering new domains and exposing new natural phenomena to interact with

(from a reader comment on Amazon.com)

The Nature of Technology by Brian Arthur

"Technology": the entire collection of devices and engineering practices available to a culture.

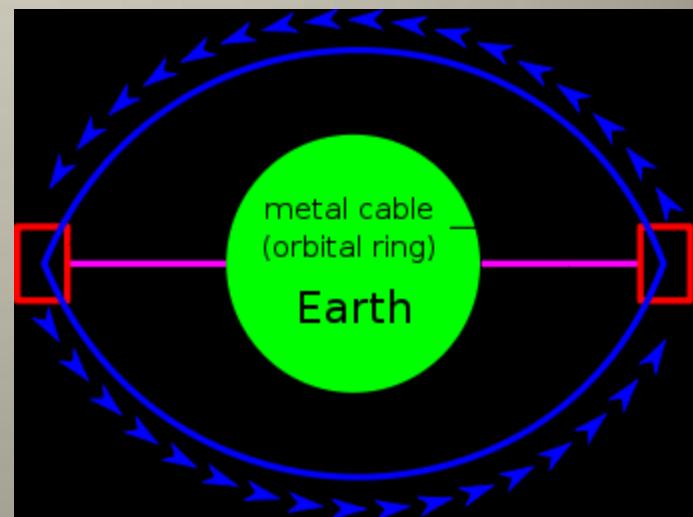
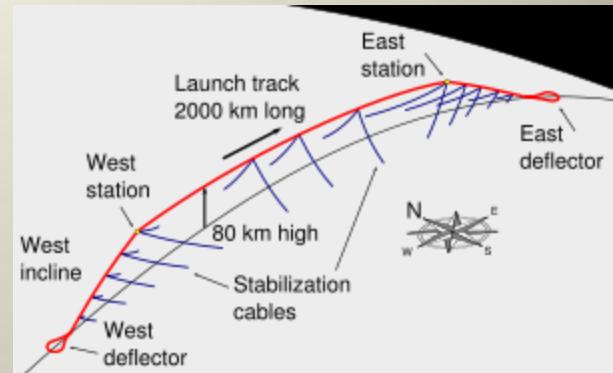
The essence of technology, Arthur suggests, is a phenomenon or set of phenomena captured and put to use, a programming of one or more of "truisms of nature" to our purposes. The history of technology, he proposes, is one of capturing finer and finer phenomena, enabled by earlier technology.

As he sees it, technology provides a "*vocabulary of elements that can be put together in endlessly new ways for novel purposes.*

Technology is "autopoietic," or self-creating, Arthur believes. It creates new opportunity niches and new problems, which call forth still more new technology. The economy is in a state of perpetual novelty, unsatisfied, roiling constantly. (from Jay C. Smith, Amazon.com review)

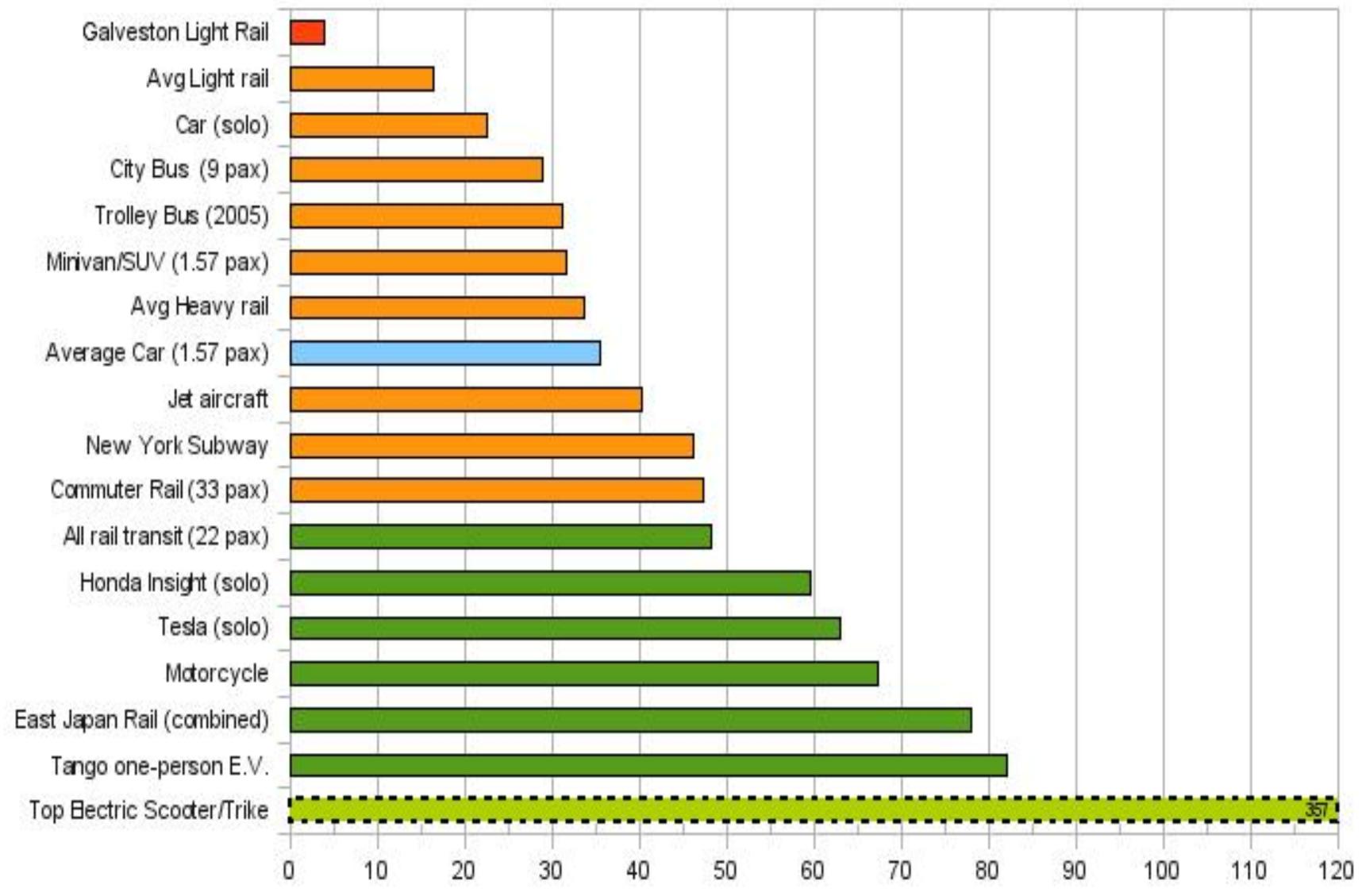
Science Fiction Transport

- Air-propelled train (a reimagining of the Atmospheric railway that went into Ireland and England mid-19th century)
- Flying car
- Launch loop (see illustration)
- Personal rapid transit
- Slidewalk (H. G. Wells, Heinlein, Jetsons)
- Spacecraft propulsion or Space transport
- Space elevator
- Orbital ring



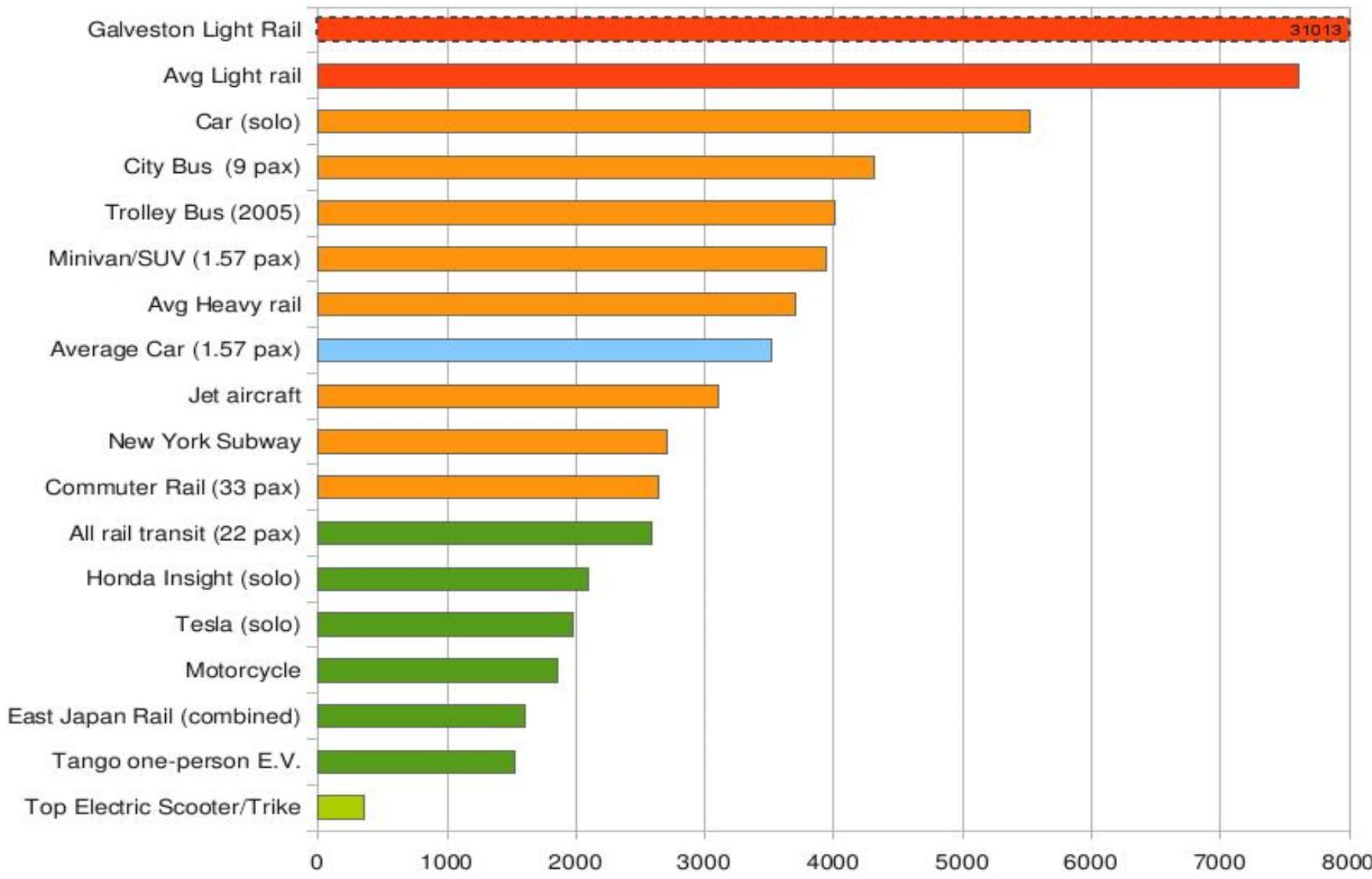
USA Transportation Fuel Usage

Passenger-Miles per Gallon-Equivalent



USA Transportation Energy Use

BTUs per passenger-mile



China's Impact on US Projects

- China has \$2.8 trillion in its sovereign wealth fund, and growing.
- China is spending all out on highways, streets, 300 mph passenger railways, Maglev, massive airports, harbors, cars, trucks, powerplants.
- China is growing 9% a year, vs. 1.6% in the US.
- Sooner or later, we will see the connection: transportation spending = GROWTH
- China will become the archetype.
- China will want to buy highways not bonds.

Predictions about China 1

- 2012: Prohibition on exports of rare earth metals to US harms our emerging electric car, wind power industry. Delays adoption.
- 2013-15: Violent riots force gov't to offer health care, social security. Entitlements up.
- 2016: China's labor force peaks, GDP stalls
- 2017: China stops buying US Treasury bonds. Too risky. Depreciating asset. Soft default.
- 2018: China will fund only transportation infrastructure, but wants to own or co-own.

Predictions about China 2

- 2022: China GDP = US GDP in PPP.
- 2020s: Privatization replaces Treasury bonds, U\$.
GCC owns all US highways, rail, ports, airports.
- 2030s: China pushes the US out of the Arabian Gulf,
builds pipelines but these are under constant attack.
- 2040s: Return of US to Arabian Gulf, infrastructure
boom as everything rebuilt 200%
- 2050s: End of oil and natural gas exports from GCC.
This gives the time line for transition to electric
vehicles, smart grid powered by solar, wind, nuclear
fission and fusion, physical travel a luxury.

Predictions about GCC 1

- 2012: After \$500B invested, GCC countries admit they have 500 billion barrels of oil; 2.2k TcF of natural gas (50% and 25% of world for 40 million people. GCC oil 50% is KSA; gas is Q.
- 2015: GCC sovereign funds have \$15 trillion, but, with oil at \$160, oil value is \$80 trillion.
- 2016: GCC starts buying up US transportation infrastructure. Funding abundant for private highways, airports, railways
- 2019: GCC completes \$150 billion in railways.

Predictions about GCC 2

- 2022: Qatar FIFA World Cup, shocking wealth, \$200k/yr.; over \$100k year in GCC (vs. \$50k US). Archetype: new transport.
- 2020s: New Cold War: China counters US everywhere. No loans from China, US debt shock. Fuel taxes skyrocket.
- 2030s: War and chaos as China makes its move, takes over Gulf, builds many pipelines, railways, highways across Asia (New Greater East Asia Co-Prosperity Sphere). Endless guerilla war, oil \$300-400/barrel.
- 2040s: China defeated in World War, collapse, massive emigration, especially to US.
- 2050s: China split into pieces, run by warlords.
- 2060: No. America population 1 billion, rising. China 900 million and falling.

A Final Thought

- Create an open source-ish model, like Club of Rome's Limits to Growth Model done with MIT's Systems Dynamics Group, and have a standard model, but allow others to change variables
- Make two books, each with documentaries that can be posted on YouTube, summarizing the studies. One book is speculative nonfiction, a la The Club of Rome's Limits to Growth, and the other works of science fiction.