There is no Plan B

Global Sustainability

Presented by Dr. David Gould

Contents

- ISO Standards
- Global Sustainability
- Urban Sustainability
- Governance
- Close

ISO Standards

Some Business Principles

- Better
- Faster
- Cheaper

Forever → $$$

The most successful organism is not the smartest, but the most adaptable to its environment.
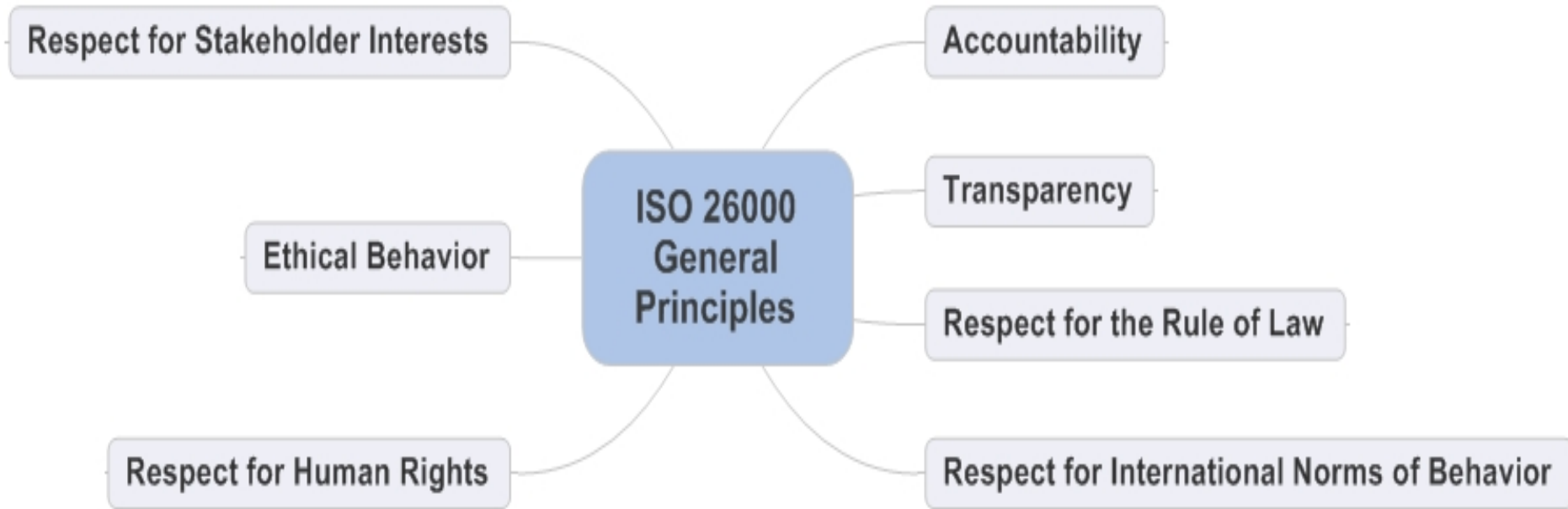
- Charles Darwin

Social Responsibility (ISO 26000)

- Social responsibility is the responsibility of an organization for the impacts of its decisions and activities on society and the environment, through transparent and ethical behavior that:
  - Contributes to sustainable development, including the health and welfare of society
  - Takes into account the expectations of stakeholders
  - Is in compliance with applicable law and consistent with international norms of behavior
  - Is integrated throughout the organization and practiced in its relationships

ISO 26000 (cont)

- ISO 26000 is a draft international standard for social responsibility

- Developed by several thousand contributors and reviewers from more than 90 countries

- Provides guidance for all types of organizations

- Linkage with PDCA
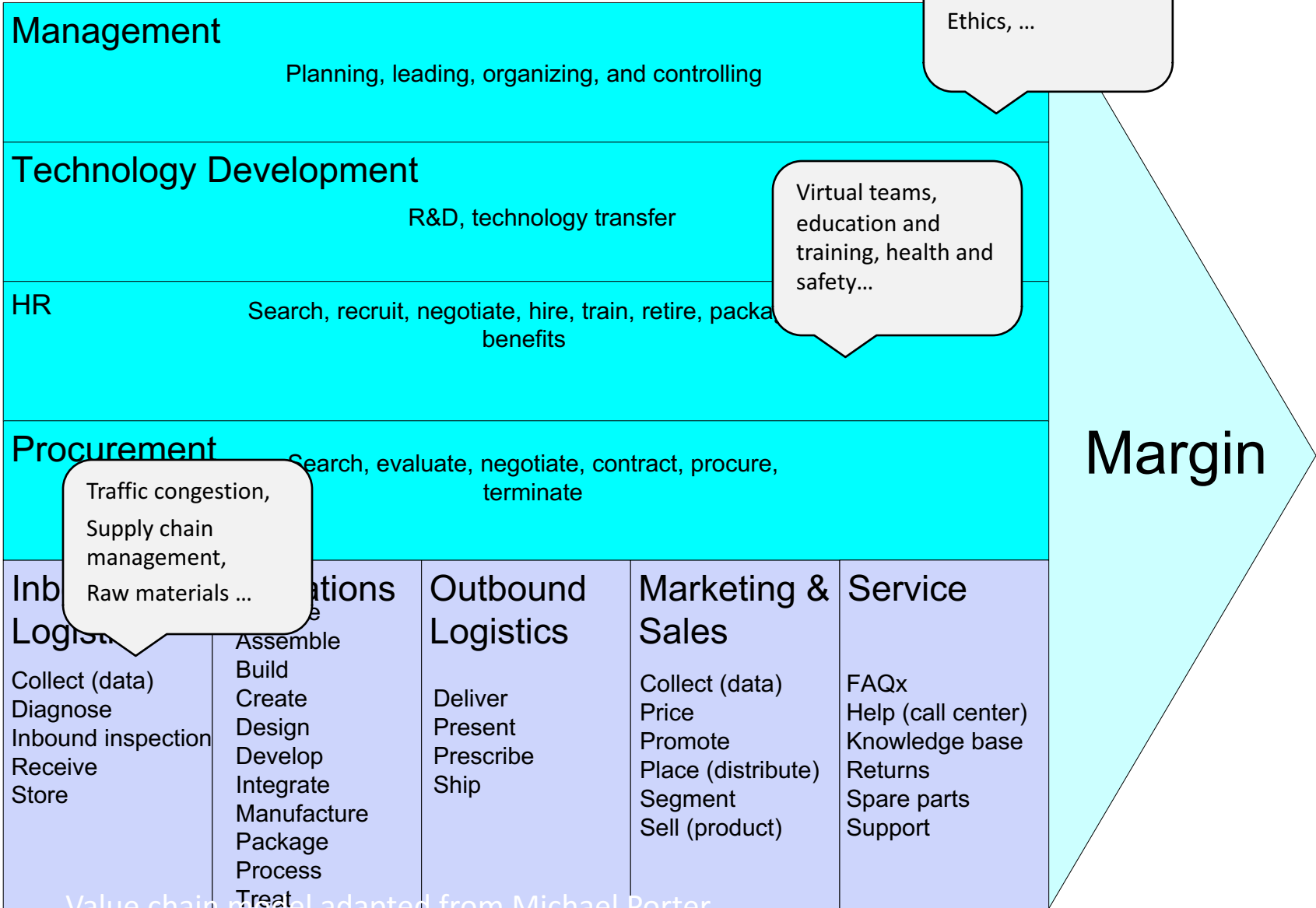
ISO 26000: General Principles

Respect for Stakeholder Interests

Ethical Behavior

Respect for Human Rights

ISO 26000 General Principles

Accountability

Transparency

Respect for the Rule of Law

Respect for International Norms of Behavior

ISO 26000: Seven Core Subjects

ISO 26000 Implementation / PDCA Linkage

Step	Activity	PDCA Step
1	Conduct a self assessment	Plan
2	Identify and build a team	Plan
3	Begin engaging internal and external stakeholders	Plan
4	Determine what is significant to your organization	Plan
5	Set measurable targets and draft the social responsibility plan	Plan
6	Implement the plan and begin monitoring progress	Do
7	Communicate and report	Check
8	Repeat the process of self-assessment, improvements, and ongoing communications	Act

ISO 26000 and a Value Chain

Management				
Planning, leading, organizing, and controlling				

Accountability, Transparency, Ethics, …

Technology Development

R&D, technology transfer

Virtual teams, education and training, health and safety…

HR

Search, recruit, negotiate, hire, train, retire, packa... benefits

Procurement

Search, evaluate, negotiate, contract, procure, terminate

Traffic congestion, Supply chain management, Raw materials …

Margin

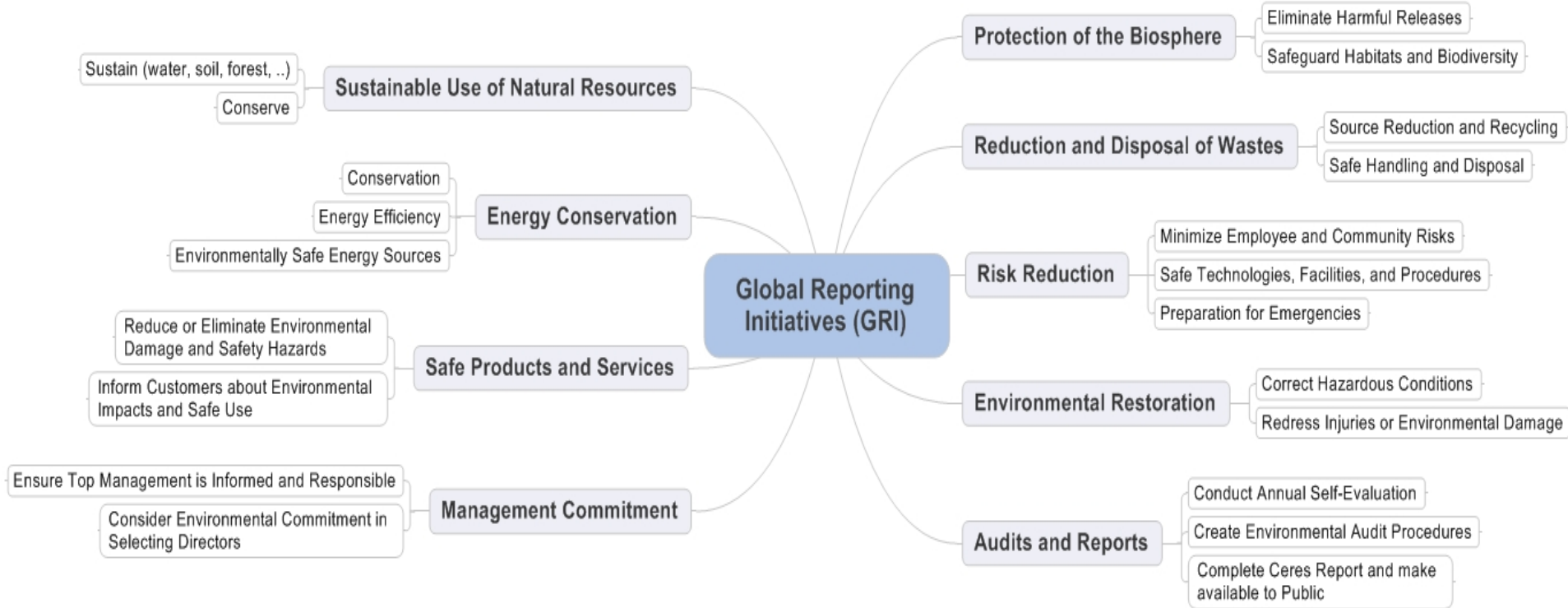| Inbound Logistics	Operations	Outbound Logistics	Marketing & Sales	Service
Collect (data) Diagnose Inbound inspection Receive Store	Assemble Build Create Design Develop Integrate Manufacture Package Process Treat	Deliver Present Prescribe Ship	Collect (data) Price Promote Place (distribute) Segment Sell (product)	FAQx Help (call center) Knowledge base Returns Spare parts Support

Value chain model adapted from Michael Porter

Finance (ISO 9000)

- Addresses financial aspects of business
- Most widely established quality methodology
- Used by 900,000 organizations and over 170 countries
- The standard for not only quality management, but management in general
- ISO 9000 – Fundamentals an Vocabulary
- ISO 9001 – Requirements
- ISO 9004 – Guidelines for Performance Management

Environment (ISO 14000)

- Is an environmental management system with specified requirements and guidance on environmental performance

- Linkage with PDCA

- Environmental management includes auditing, labeling, evaluating environmental performance, assessing life cycles, communicating environmental concerns, and reducing greenhouse gases

Global Reporting Initiative (GRI)

Sustain (water, soil, forest, ..)
Conserve
Sustainable Use of Natural Resources

Conservation
Energy Efficiency
Environmentally Safe Energy Sources
Energy Conservation

Reduce or Eliminate Environmental Damage and Safety Hazards
Inform Customers about Environmental Impacts and Safe Use
Safe Products and Services

Ensure Top Management is Informed and Responsible
Consider Environmental Commitment in Selecting Directors
Management Commitment

Global Reporting Initiatives (GRI)

Protection of the Biosphere
Eliminate Harmful Releases
Safeguard Habitats and Biodiversity

Reduction and Disposal of Wastes
Source Reduction and Recycling
Safe Handling and Disposal

Risk Reduction
Minimize Employee and Community Risks
Safe Technologies, Facilities, and Procedures
Preparation for Emergencies

Environmental Restoration
Correct Hazardous Conditions
Redress Injuries or Environmental Damage

Audits and Reports
Conduct Annual Self-Evaluation
Create Environmental Audit Procedures
Complete Ceres Report and make available to Public

GRI International Guidelines established in 1997. Source: Fiksel, J. (2009). *Design for Environment* (2nd ed.). New York, NY: McGraw-Hill

Plan Do Check Act (PDCA)

- Plan
  - Plan for change—based on objectives, data, observations, …..
- Do
  - Execute the change, perhaps starting with a pilot test
- Check
  - Study / analyze the effects of the change
- Act
  - Decide on the next steps. Recycle as necessary

PDCA – Simple Model
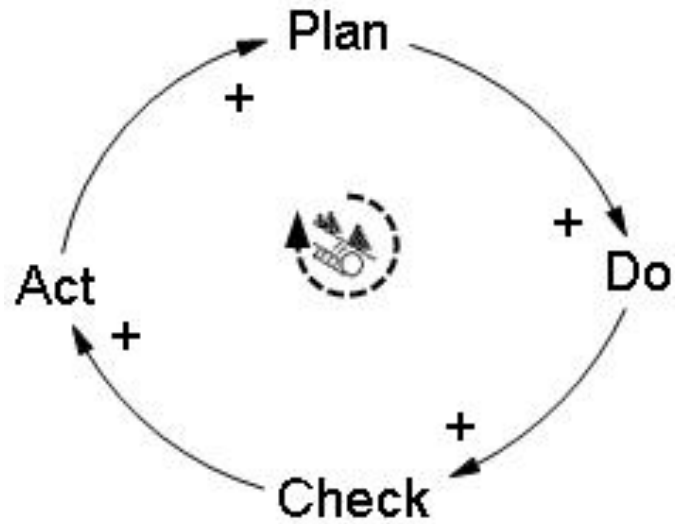
PCDA – Limits To Success Model
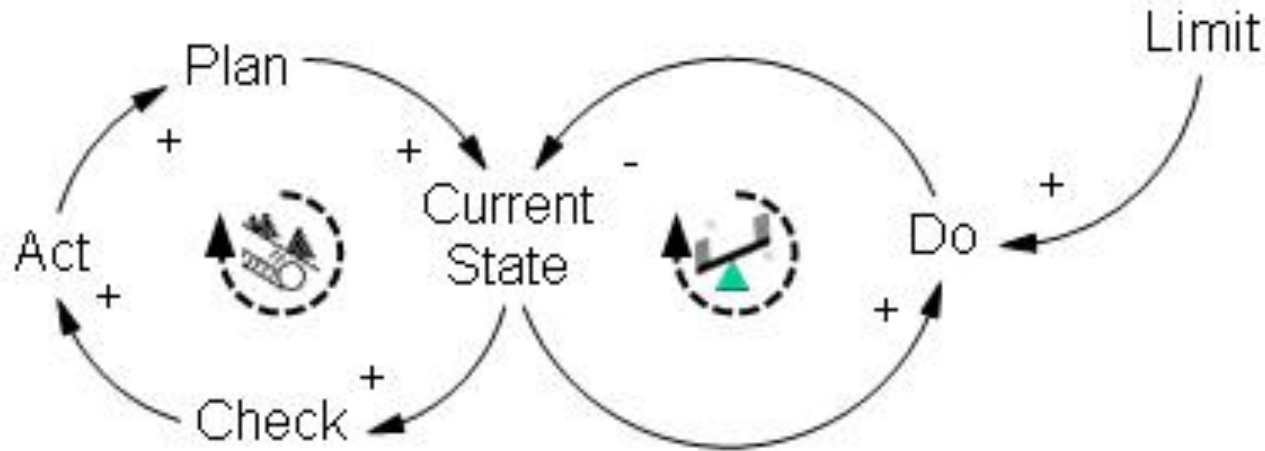
There are limits to improvement such as the laws of physics, investment capital, time, mental models, interest ….

PDCA Behavior Over Time
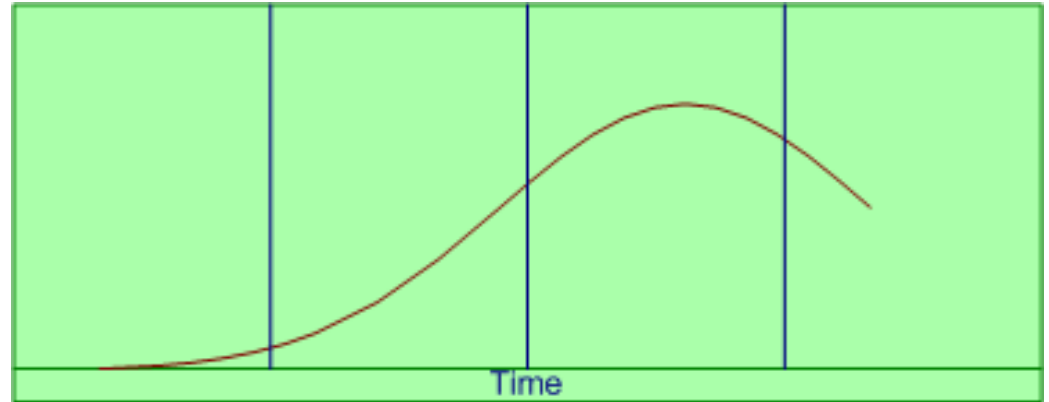
Improvements may start slow, speed up, slow to stop, oscillate about a line, or even decline as limits to improvements are reached

Any thoughts here?

Global Sustainability

Definitions

- **Sustainability** (Noun)
  - Capable of meeting the needs of the present generation without compromising the ability of future generations to meet their own needs
    - Our common future
  - We can also think of sustainability as a performance goal.
    - Source: *John M. Anderies, Carl Folke, Brian Walker, and Elinor Ostrom*

Definitions (cont)

- **Resilience** is a systems ability to recover from a disturbance or perturbation
  - In other words, how do systems evolve over time after a disturbance?
- **Resistance** is a systems ability to withstand a disturbance or perturbation with little deformation
- **Perturbations** are variations in inputs, which may be measureable
  - For example, a loss of a job or a promotion may change financial inputs for a family

Definitions

- **Robustness** means that the output from a system or algorithm varies little when some of the inputs vary (Csete and Doyle 2002). Because shocks are specific examples of variation in inputs, robustness can be interpreted as reduced sensitivity of outputs to shocks; if outputs are related to the continued functioning of the system, then robustness and resilience are related.

  - Source: *John M. Anderies, Carl Folke, Brian Walker, and Elinor Ostrom*

Definitions

- A **system** is a set of interrelated elements exhibiting behavior according to Meadows (2008). Thus, three things are present: elements, relationships between elements, and some sort of behavior(s).
  - Additionally, these elements and relationships are networks, a system may contain many diverse networks, and a system experiences history

The Three Spheres of Sustainability

Social-Environmental
Environmental Justice
Natural Resources Stewardship
Locally & Globally

Environmental
Natural Resource Use
Environmental Managemet
Pollution Prevention
(air. water, land, waste)

Environmental-Economic
Energy Efficiency
Subsidies / Incentives for
use of Natural Resources

Social
Standard of Living
Education
Community
Equal Opportunity

Sustainability

Economic
Profit
Cost Savings
Economic Growth
Research &
Development

Economic-Social
Business Ethics
Fair Trade
Worker's Rights

Adopted from the 2002
University of Michigan
Sustainability Assessment

UN Sustainable Development Goals

- No Poverty
- Zero Hunger
- Good Health and Well Being
- Quality Education
- Gender Equality
- Clean Water and Sanitation
- Affordable and Clean Energy
- Decent Work and Economic Growth

SDG (cont)

- Industry, Innovation, and Infrastructure
- Reduced Inequalities
- Sustainable Cities and Communities
- Responsible Production and Consumption
- Climate Action
- Life below Water
- Life on Land
- Peace and Justice`

We have about 15 years to solve these problems

Planetary Boundaries
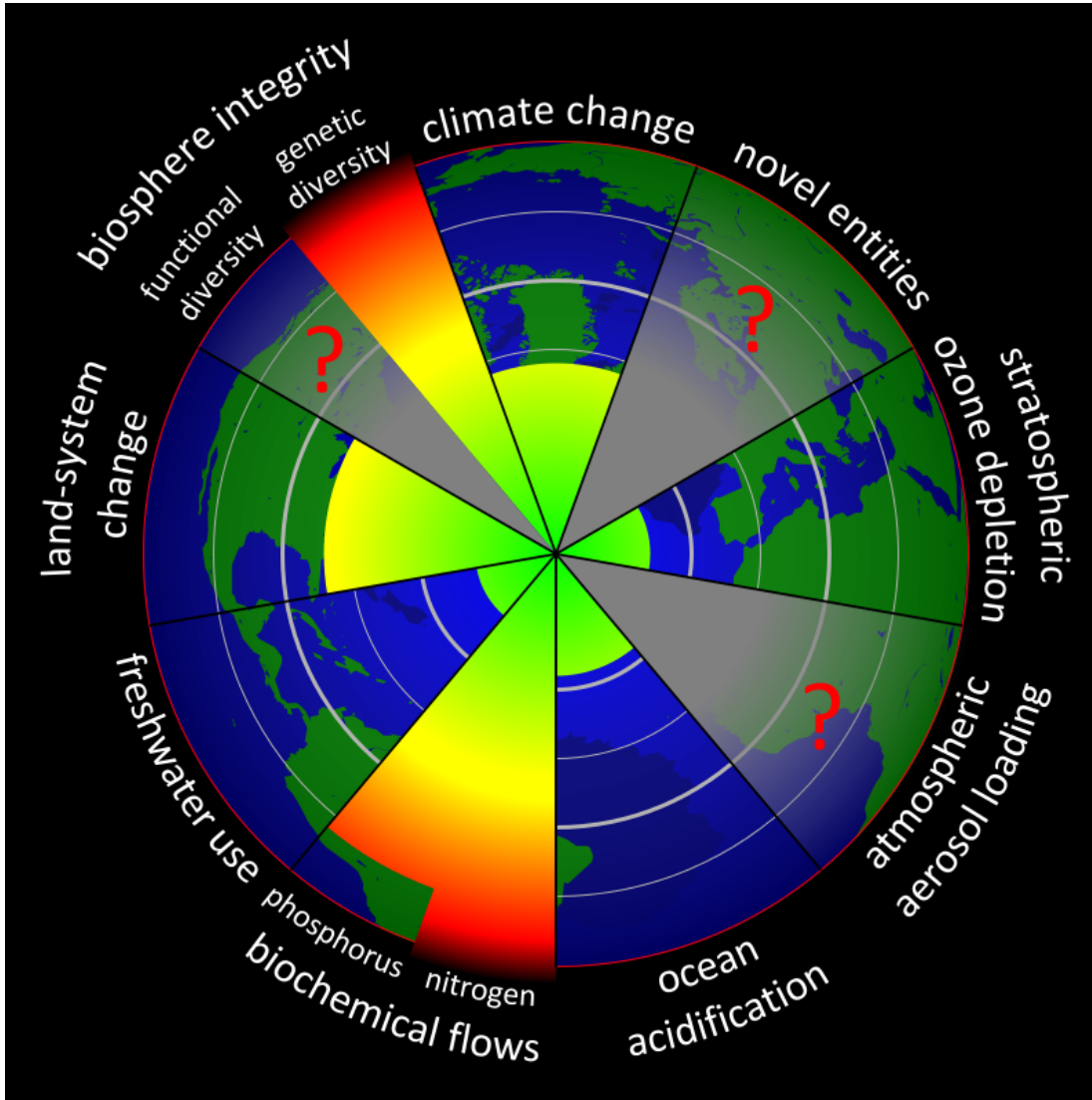
Stockholm Resilience Alliance

Atmosphere CO2 at Mouna Loa
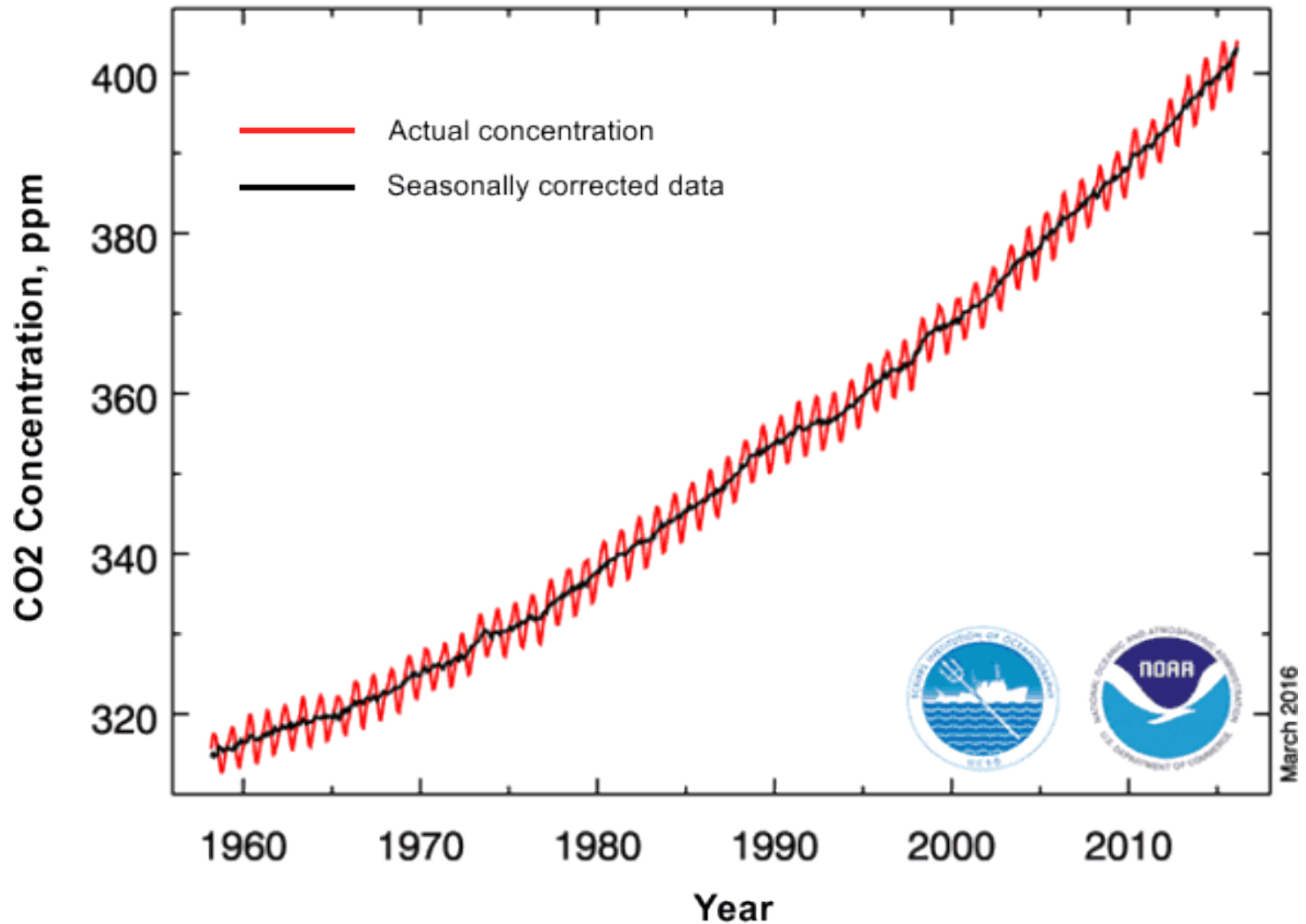
Climate Change

- The Paris Agreement: An agreement within the framework of the United Nations Framework Convention on Climate Change (UNFCCC) addressing GHG emissions, mitigation / adaptation, … begining in 2020.

- Signed by 195 countries in December 2015

- Agreed to limit emissions such that earth temperatures would not increase an additional 1.5C

- Yet, earth temperatures have already increased over 1 C in 2016

So, how is this working out and what are we going to do next?

NASA Climate Change Projections
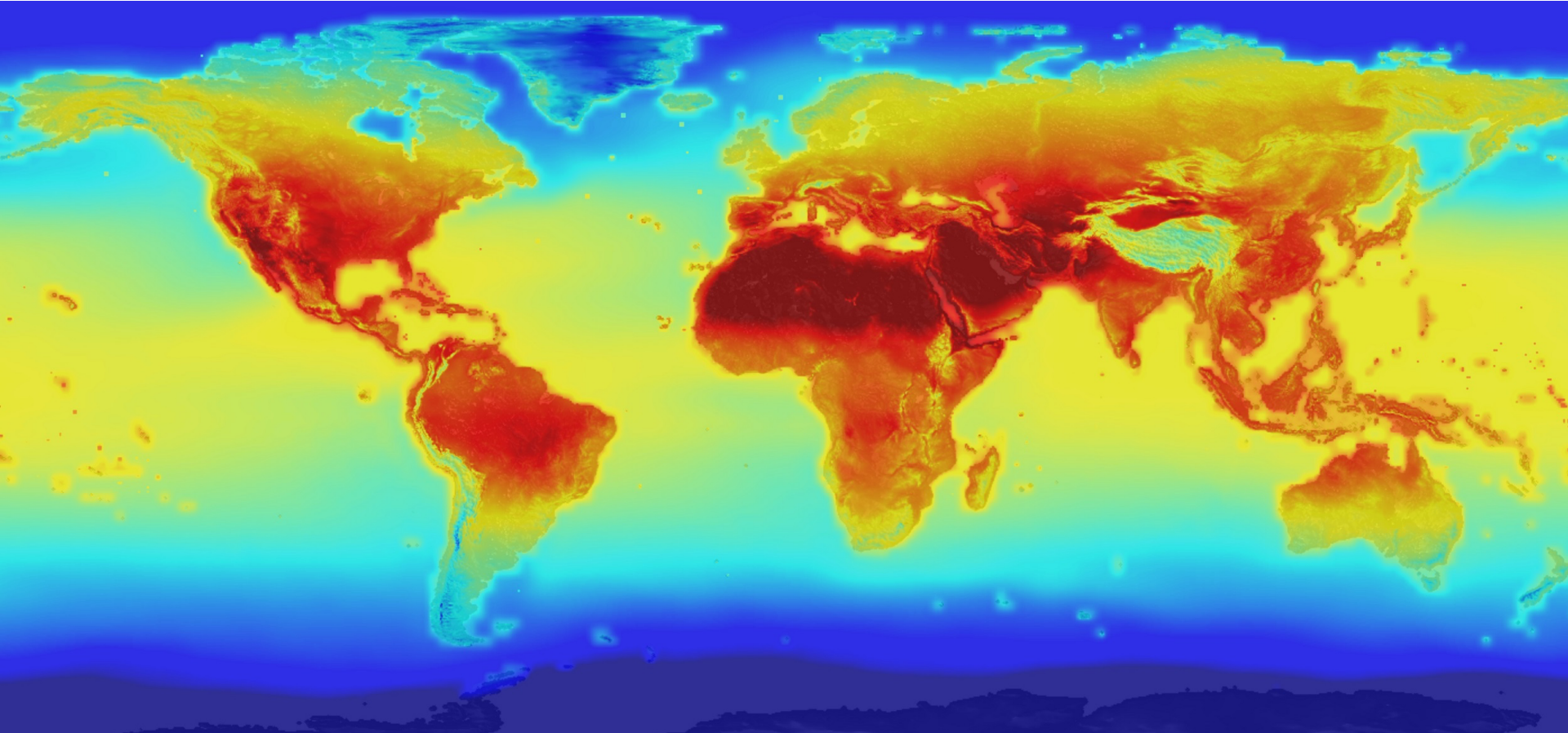
Arctic Sea Ice

- A 40% reduction in arctic sea ice over the last 38 years
- Glacier Bay National Park has seen some tide water glaciers retreat over six miles in a similar period of time
- What might happen if 80%, 90% or 100% of the sea ice disappears?
- What might happen to keystone predators (e.g., wolves, polar bears, …?
- What might happen to the food web if these predators disappear?
- What might happen to us?

Arctic Sea Ice

World Population

- 2016 ~ 7.2 billion

- 2030 ~ 8.3 billion

- 2050 ~ 9-10 billion

How might we feed, clothe, shelter, educate, transport, entertain, … another 2-3 billion people?

Adding another 1.1 billion people over the next 15 years is equivalent to adding a new China or India

One minor implication of adding another 1.1 billion people will be increasing food production by 50% or so as existing people will want to eat better too!

POPULATION OF THE EARTH

Number of people living worldwide since 1700 in billions
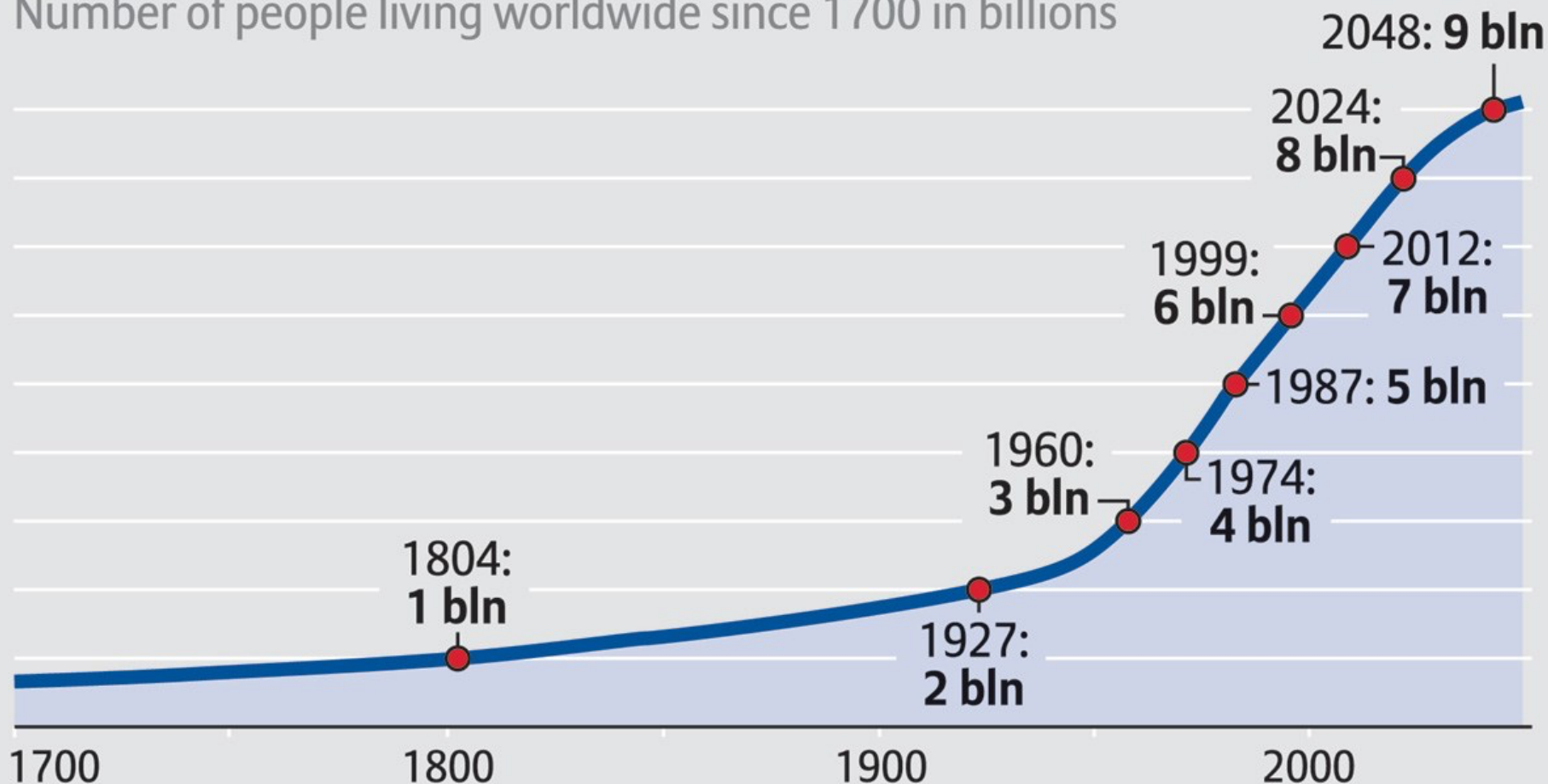
Allianz (II)

2048: **9 bln**

2024: **8 bln**

1999: **6 bln**

2012: **7 bln**

1987: **5 bln**

1960: **3 bln**

1974: **4 bln**

1804: **1 bln**

1927: **2 bln**

1700   1800   1900   2000

Plummeting Cost of Solar Modules
(Cost Per Watt in 2012 Dollars)

-- **Coal / Natural Gas Cost Band** --
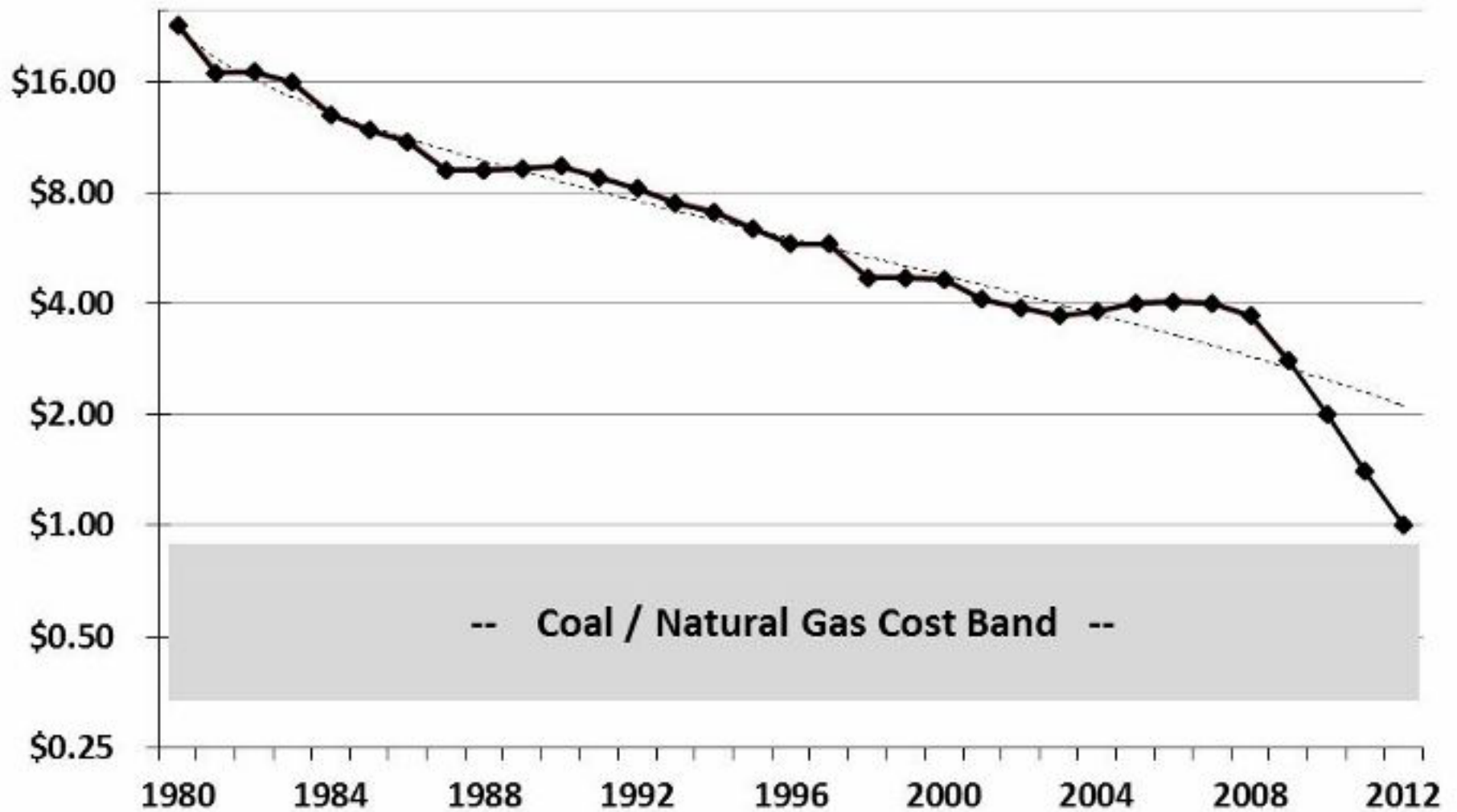
Sources: DOE NREL Solar Market Report, SolarBuzz Retail Price Environment
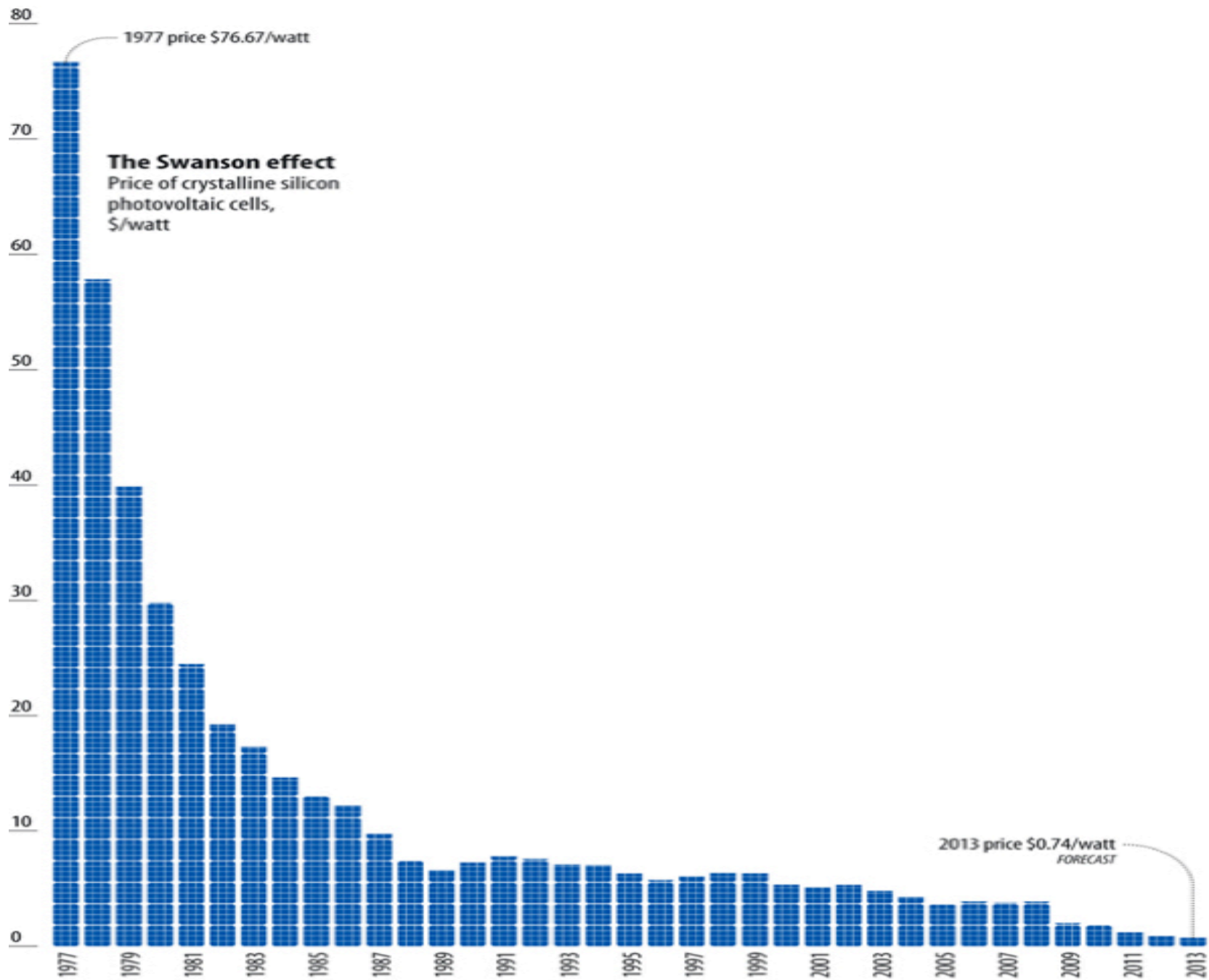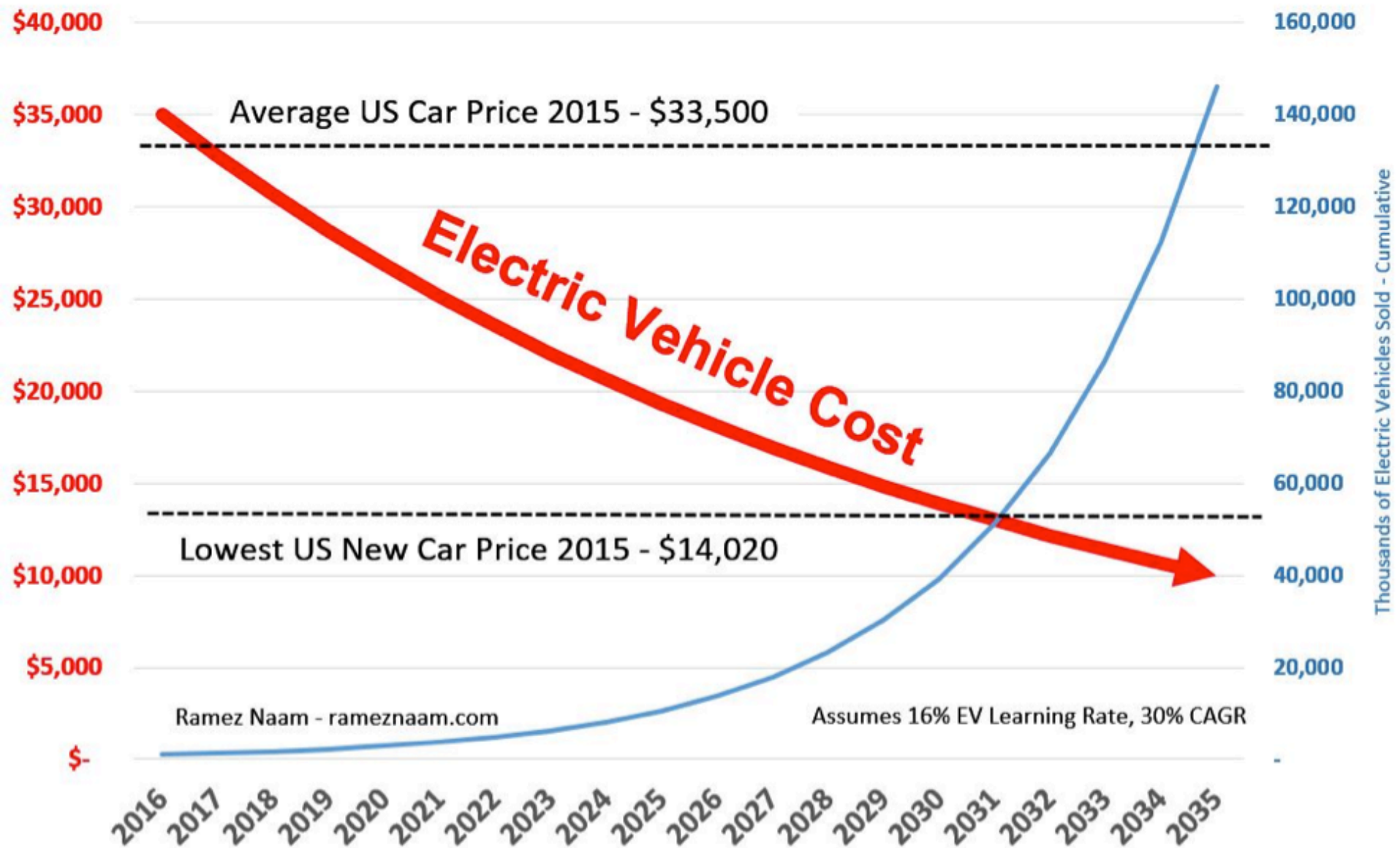
The Swanson effect
Price of crystalline silicon photovoltaic cells, $/watt

1977 price $76.67/watt

2013 price $0.74/watt
FORECAST

Source: Bloomberg, New Energy Finance

Cost of 200 mile range EV

Average US Car Price 2015 - $33,500

Electric Vehicle Cost

Lowest US New Car Price 2015 - $14,020

Ramez Naam - rameznaam.com

Assumes 16% EV Learning Rate, 30% CAGR

Thousands of Electric Vehicles Sold - Cumulative
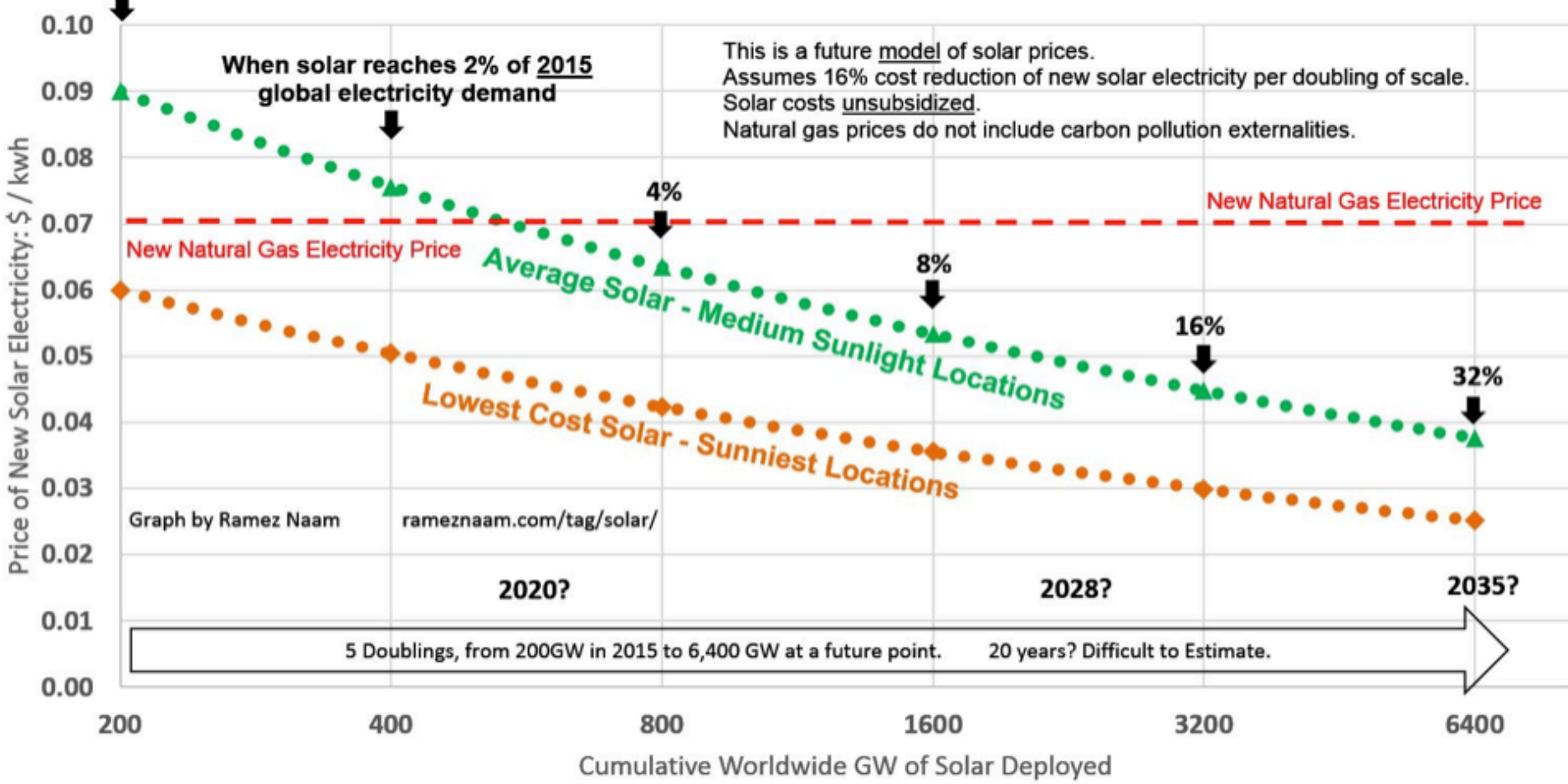
Urban Sustainability

A City Model

Source

Sink

Inputs

City

Outputs

Material,
Information,
Energy

Material,
Information,
Energy
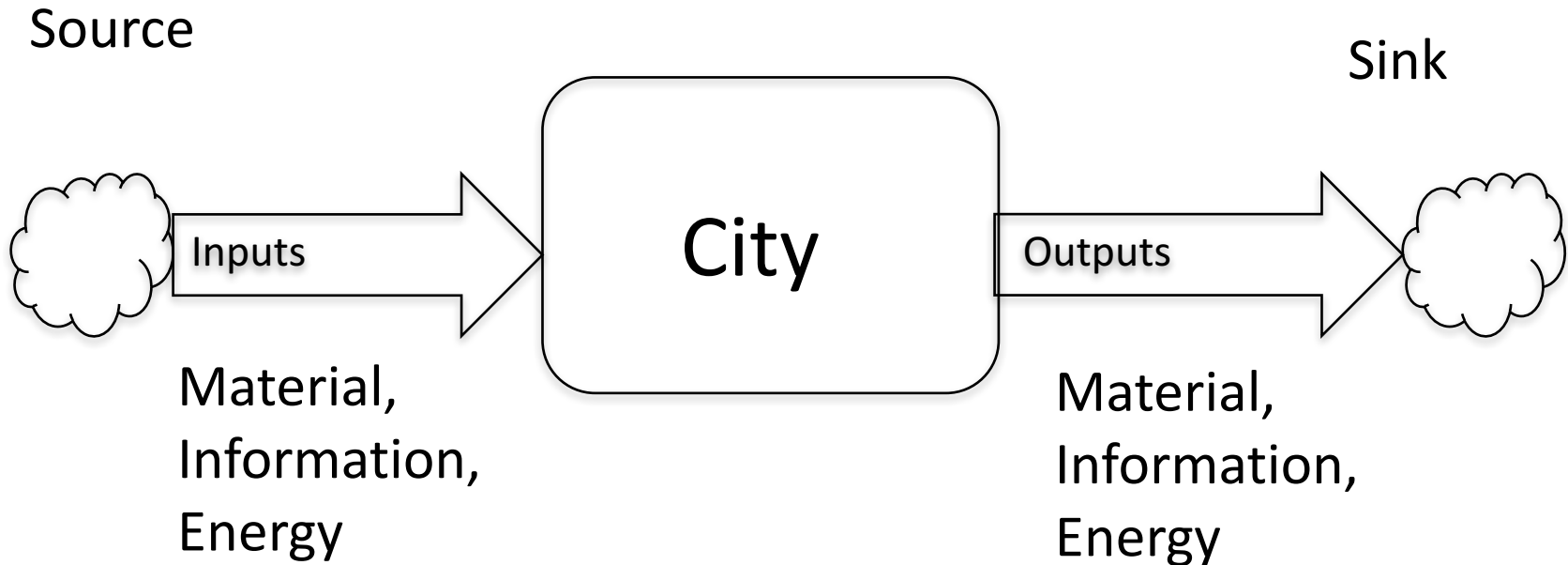
Perturbations: Variations in inputs or threats or opportunities

A City Model

- MIE (input) > MIE (consumed) > MIE (output)
  - M (input) > M (consumed) > M (output)
  - I (input), I (consumed), I (output) Few constraints as I may be generated in almost unlimited quantities
  - E (input) > E (consumed) > E (output)
- M, E (sources) >>>> M, E (input)

A City Model

- Larger cities are more M, E efficient
- M, E last longer when consumption / processing activities {Reduce, reuse, …}

Stress / Shocks

- Stress or shocks are variations in inputs
- May add up to a release or collapse
- Some stresses
  - Population stress
  - Energy stress
  - Environmental stress
  - Climate stress
  - Economic stress

How might we mitigate or adapt to them?
Can we mitigate or adapt?
If not, then what?

Urban Metabolism

The sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of
Waste.

(Kennedy et al., 2007)

Resources (MIE) Stored in Cities as a Measure of Resilience

Resiliency is associated with the time it takes for a system to return to operation after a shock.

When supply fails, internal buffer capacity becomes vital to meeting demand and hence
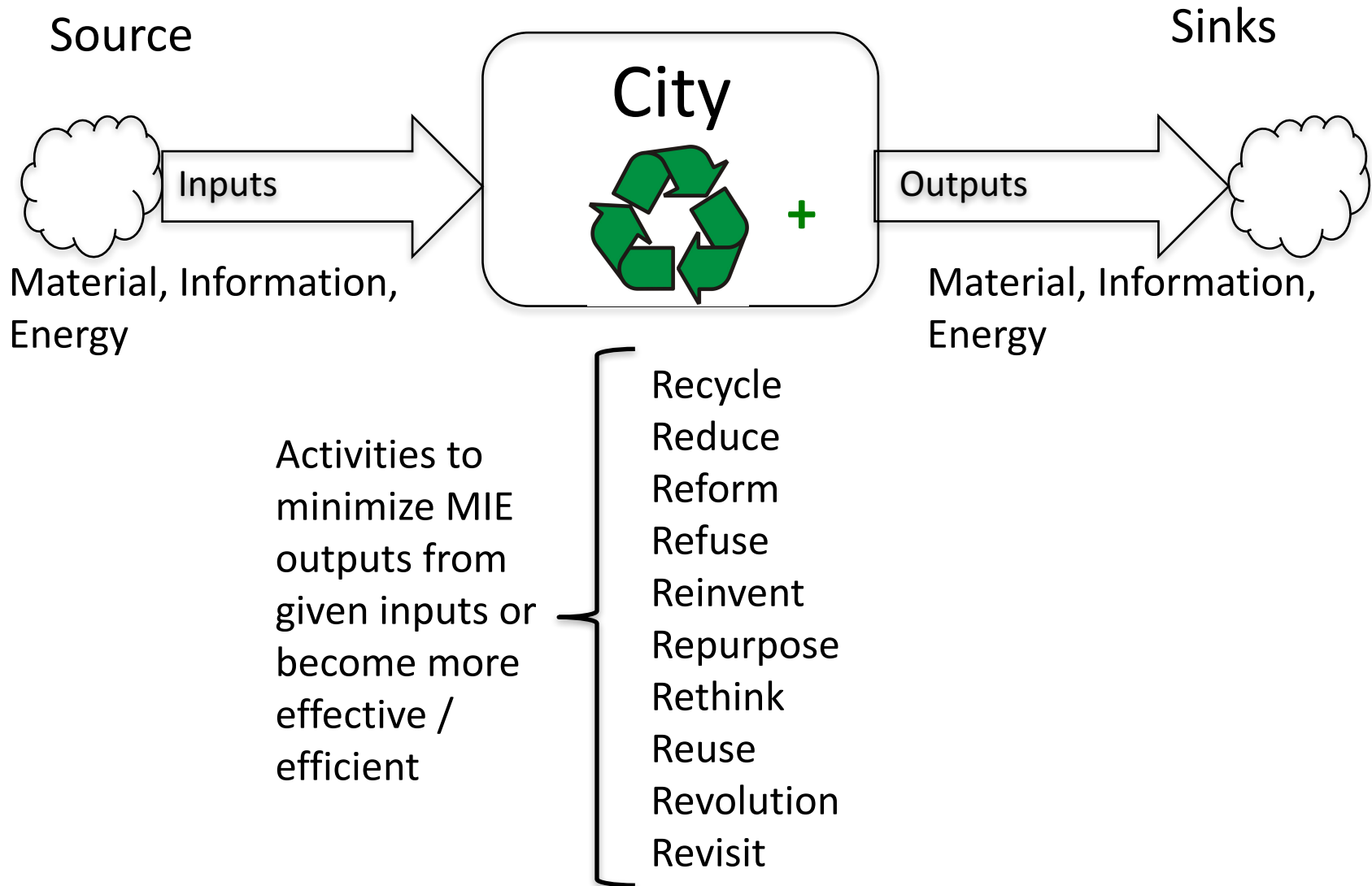
is an important factor in resilience.

How resilient, robust, or sustainable is your city?
How resilient, robust, or sustainable is your family?
What might you do about it?

Sustainable Cities

Key Principles

- Reduced, circulating, and clean flows of materials
- A prominent place for nature
- Compact and connected patterns of development
- Creative placemaking
- Centers of well-being
- People-centered development
- Participatory governance

Sustainable Urban Metabolism

Source

Sinks

City

Inputs

Outputs

Material, Information, Energy

Material, Information, Energy

Activities to minimize MIE outputs from given inputs or become more effective / efficient

Recycle
Reduce
Reform
Refuse
Reinvent
Repurpose
Rethink
Reuse
Revolution
Revisit

The key to urban sustainability is to transition to low carbon electrified cities.

- Christopher Kennedy
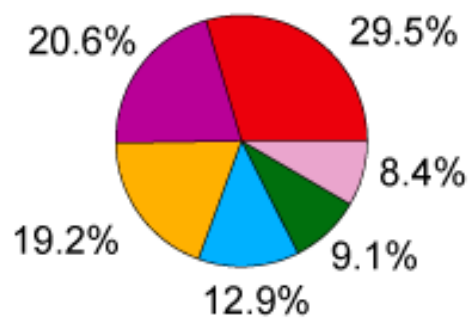
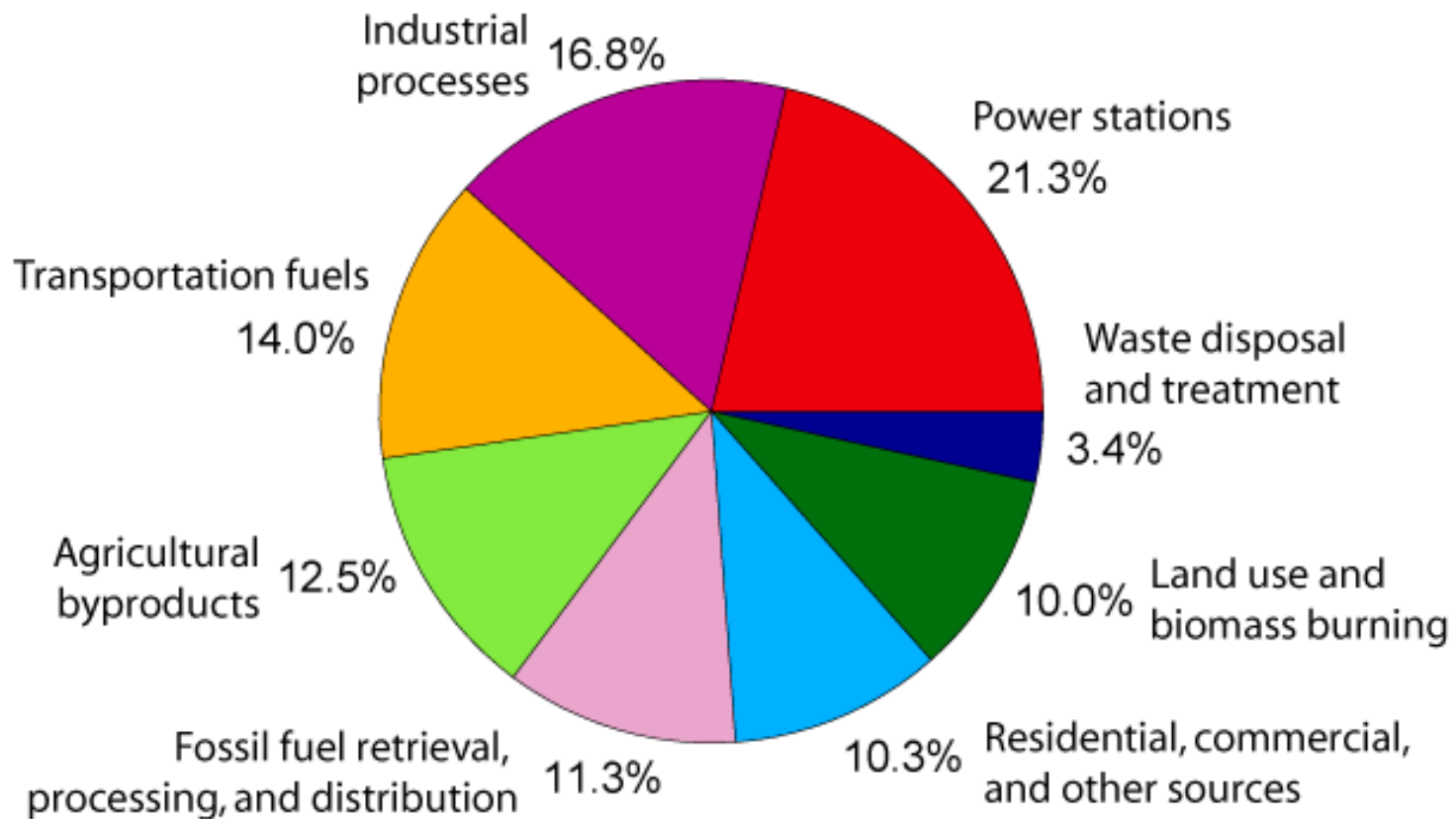How can we do this?

Urban Population

- 2016 ~ 50% or about 3.6 billion
- 2050 ~ 75% or about 7 billion

- 1/3 of U.S. counties are losing population as people migrate to cities
- Maine and West Virginia are two U.S. states losing population

How much will your home be worth in 10, 20, 30 … years?
What does this do the supply / demand curve?
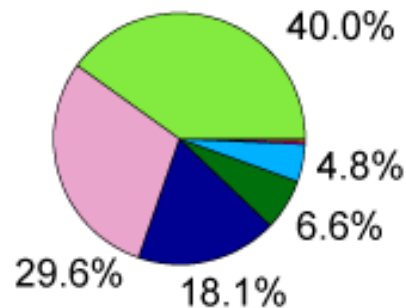Will you be able to move around your city?

Greenhouse Gases

- Today, cities are responsible for about 75% of all human produced GHG
  - UN Habitat
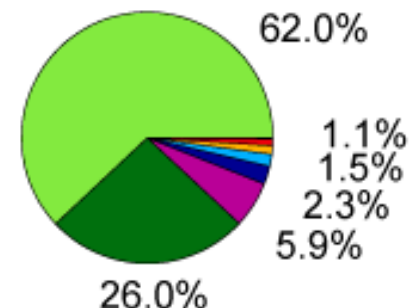- Climate change will be won or lost in our cities

Annual Greenhouse Gas Emissions by Sector

Industrial processes 16.8%

Power stations 21.3%

Transportation fuels 14.0%

Waste disposal and treatment 3.4%

Agricultural byproducts 12.5%

Land use and biomass burning 10.0%

Fossil fuel retrieval, processing, and distribution 11.3%

Residential, commercial, and other sources 10.3%

Carbon Dioxide
(72% of total)

29.5%
8.4%
9.1%
12.9%
19.2%
20.6%

Methane
(18% of total)

40.0%
4.8%
6.6%
18.1%
29.6%

Nitrous Oxide
(9% of total)

62.0%
1.1%
1.5%
2.3%
5.9%
26.0%

The design of a city's built environment, its land area and land use will affect its urban ecological footprint.
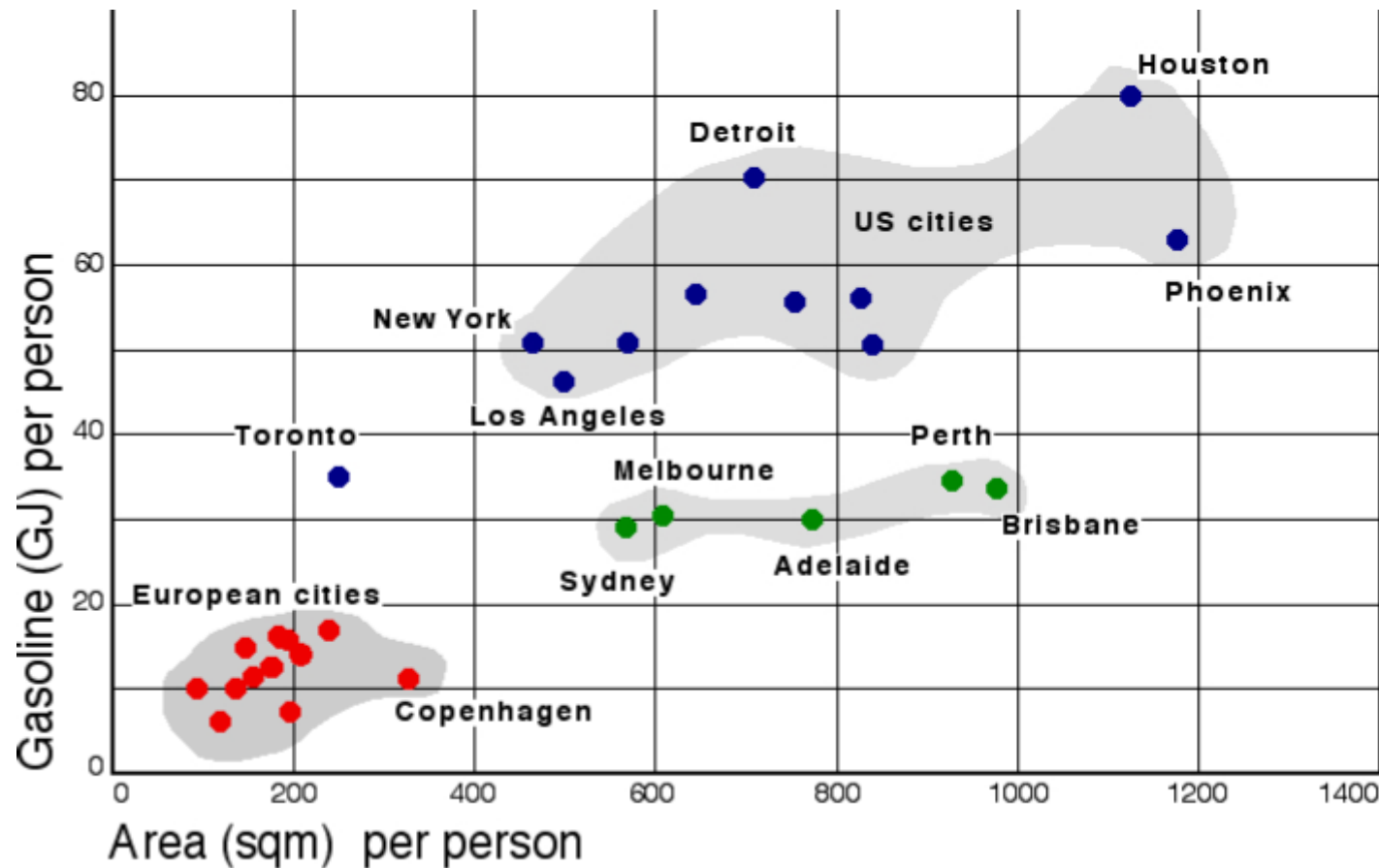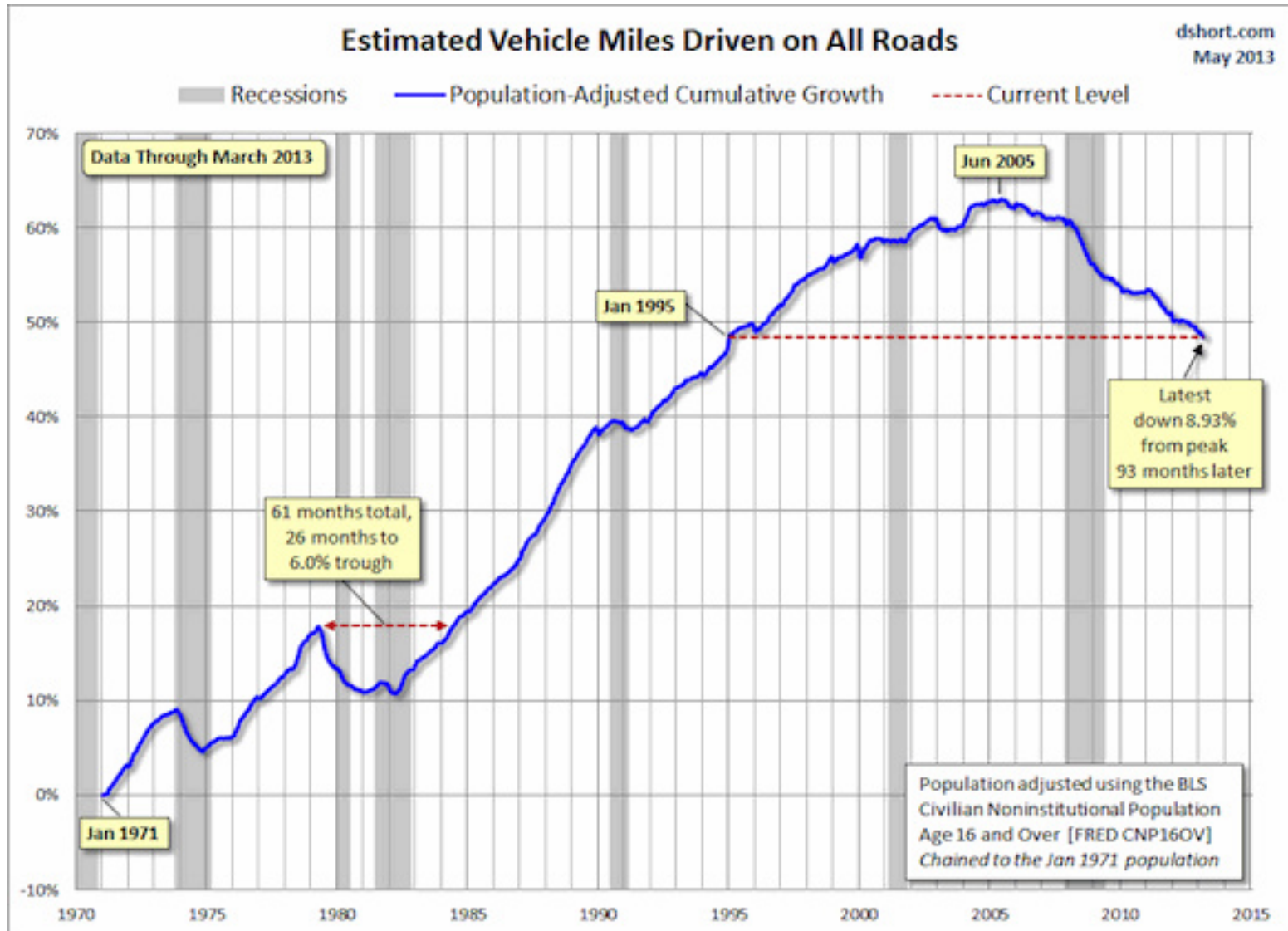
Peak Car Usage

- Car kilometers per capital have been decreasing in the U.S. and Australia since 2005.

- Reasons
  - Increasing density in cities such that people walk, bicycle …
  - Public transportation including light rail
  - Telecommuting
  - Carpooling
  - Fewer work days; longer shifts
  - Cafe culture begining to replace car culture

Source: Peter Newman

Peak Car Usage

Estimated Vehicle Miles Driven on All Roads

dshort.com
May 2013

Recessions — Population-Adjusted Cumulative Growth ---- Current Level

Data Through March 2013

Jun 2005

Jan 1995

Latest down 8.93% from peak 93 months later

61 months total, 26 months to 6.0% trough

Jan 1971

Population adjusted using the BLS Civilian Noninstitutional Population Age 16 and Over [FRED CNP16OV] Chained to the Jan 1971 population

Biophilic Urbanism

- Plant trees, shrubs, flowers, vines ….; lots of them!!!
  - Along streets
  - On walls
  - On buildings
  - Create more open space and parks

http://biophiliccities.org

How biophilic is your city? Why, why not?

Governance

Governance Hierarchy

- Federal Government
  - State Governments
    - City Governments
      - Organizations

Cities are not mentioned in the Constitution
What can cities do?
What can people do?
What can you do?

Closure

People will rarely acknowledge that an accustomed way of life is unsustainable except in the face of prolonged devastating failure.

- Joseph Tainter

So, how do we get out of this mess???

1. Lots of innovation and disruptive social and physical technologies!
2. Teach others to learn
3. Plus some very good luck

Every morning in Africa, a gazelle wakes up.

It knows it must run faster than the fastest lion or it will be killed.

Every morning a lion wakes up.

It knows it must outrun the slowest gazelle or it will starve to death.

It doesn't matter whether you are a lion or a gazelle.

When the sun comes up, you better start running.

-African Proverb

Thank You!

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  - http://www.asq.org
- Draft ISO Standards for Social Responsibility
  - http://www.trbav030.org/pdf2010/Stewart_ISO-26000_TRB100112.pdf
- Intergovernment Panel on Climate Change
  - http://www.ipcc.ch
- MIT Open Courseware
  - http://ocw.mit.edu
- NASA
  - http://climate.nasa.gov

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- Renewable energy
  - http://www.renewableenergyworld.com/index/tech.html
- Resilient Cities
  - http://resilient-cities.iclei.org
- Santa Fe Institute
  - http://www.santafe.edu
- Stockholm Resilience Centre
  - http://www.stockholmresilience.org

Websites (cont)

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  - https://sspp.proquest.com

- Sustainable Development Goals
  - http://www.undp.org/content/undp/en/home/sdgoverview/post-2015-development-agenda.html

- The Millennium Project (State of the Future)
  - http://www.stateofthefuture.org

- United Nations
  - http//www.un.org

- World Future Society
  - http://www.wfs.org

Note: A few references from a list of over 100 journal articles, websites, and books.

Journals

- California Management Review

- Foreign Affairs Quarterly

- Futurist

- Harvard Business Review

- IBM Systems Journal

- McKinsey Quarterly

- MIT Technology Review

- New Scientist

- Sloan Management Review

- Strategy+Business