CARBON DIOXIDE: SOCIAL COST OR SOCIAL BENEFIT?

Presented at the
U.S. Energy Association
Washington, D.C.

Roger H. Bezdek, Ph.D.
Management Information Services, Inc.
www.misi-net.com

December 15, 2014

CO_2 BLAMED FOR EVERYTHING

- Warm weather, and/or cold weather
- Excessive snowfall, and/or lack of snow
- Excessive rain and flooding, and/or drought
- Hurricanes
- Tornadoes
- Sea ice melting/sea level rise
- Increasing ocean acidity
- Wildfires
- Coral reefs disappearing
- Problems with polar bears, walruses, bees, etc.
- Biblical plagues of locusts, frogs, boils,……?
- Numerous other “negative externalities”

“Global warming is a religion.” John Howard, former Australian Prime Minister.

IWG, SCC, AND BENEFIT-COST ANALYSIS

- **Federal govt. must assess benefits & costs of regulations**
- Federal Interagency Working Group (IWG) developed estimates of the social cost of carbon (SCC):
  - -- February 2010 ~ $22/ton
  - -- May 2013, revised upward to ~ $36/ton

- SCC: "Estimate of monetized damages associated with an incremental increase in carbon emissions in a given year"
- Meant to be comprehensive estimate of climate change damages
- Used by federal agencies in benefit-cost (B-C) analyses of regulatory actions
- However, in B-C analyses **both the benefits and the costs of CO_2 must be considered**
- We analyze and compare the benefits and the costs of CO_2

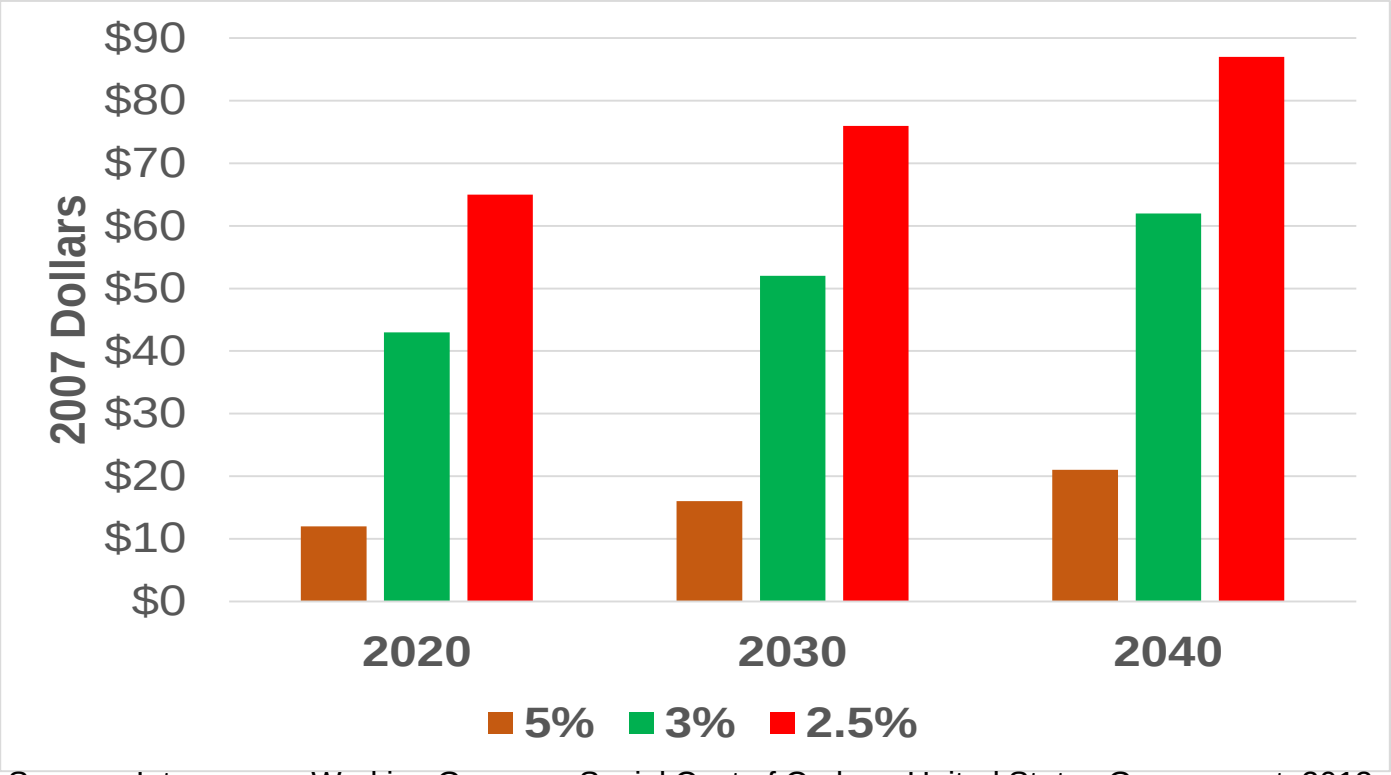
EO 12688, requiring B-C analysis of govt. regulations, was issued in 1993 by President Clinton

II. FEDERAL INTERAGENCY WORKING GROUP

- Federal IWG comprised of 12 agencies
- **Integrated assessment models (IAMs): Basis of IWG SCC estimates**
- Purpose: Allow agencies to incorporate benefits of reducing CO_2 emissions in regulatory actions
- First IWG report was published in February 2010
- May 2013, IWG published an updated report
- **2013 SCC estimates are > 50% 2010 SCC estimates**
- 2013 SCC estimates first used in June 2013 rule on efficiency standards for microwave ovens

SOCIAL COST OF CARBON (SCC)

Federal Interagency Working Group 2013 SCC Estimates
(discount rates of 5%, 3%, and 2.5%)



Source: Interagency Working Group on Social Cost of Carbon, United States Government, 2013.

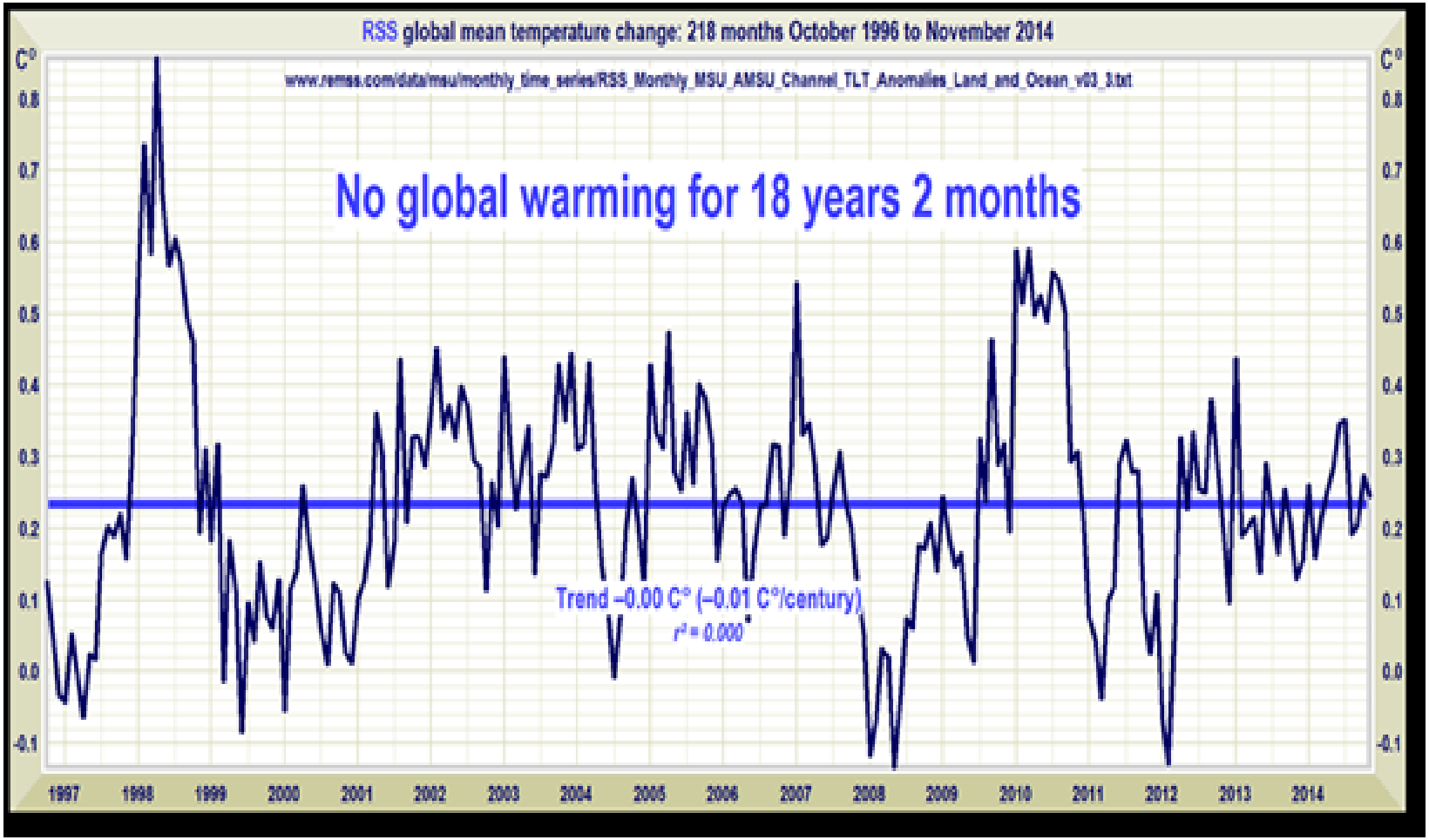
SCC is "an estimate of the monetized damages associated with an incremental increase in carbon (or CO_2) emissions in a given year."

SCC BASED ON FLAWED SCIENCE

- Basic problem: No empirical scientific evidence for significant climate effects of rising CO_2 levels
- **No convincing evidence that Anthropogenic Global Warming (AGW) will produce catastrophic climate changes**
- No global warming over the past 18+ years when CO_2 increased
- Only "evidence" comes from unvalidated climate models that disagree even with each other
- SCC relies on climate models that are increasingly inaccurate
- IWG used unwarranted exaggeration of actual climate sensitivity
- IWG relies on unsubstantiated claims of AGW in successive UN-IPCC reports.

"The equilibrium climate sensitivity used by the IWG is not scientifically defensible." Patrick Michaels and Paul Knappenberger, 2014

WHAT GLOBAL WARMING?

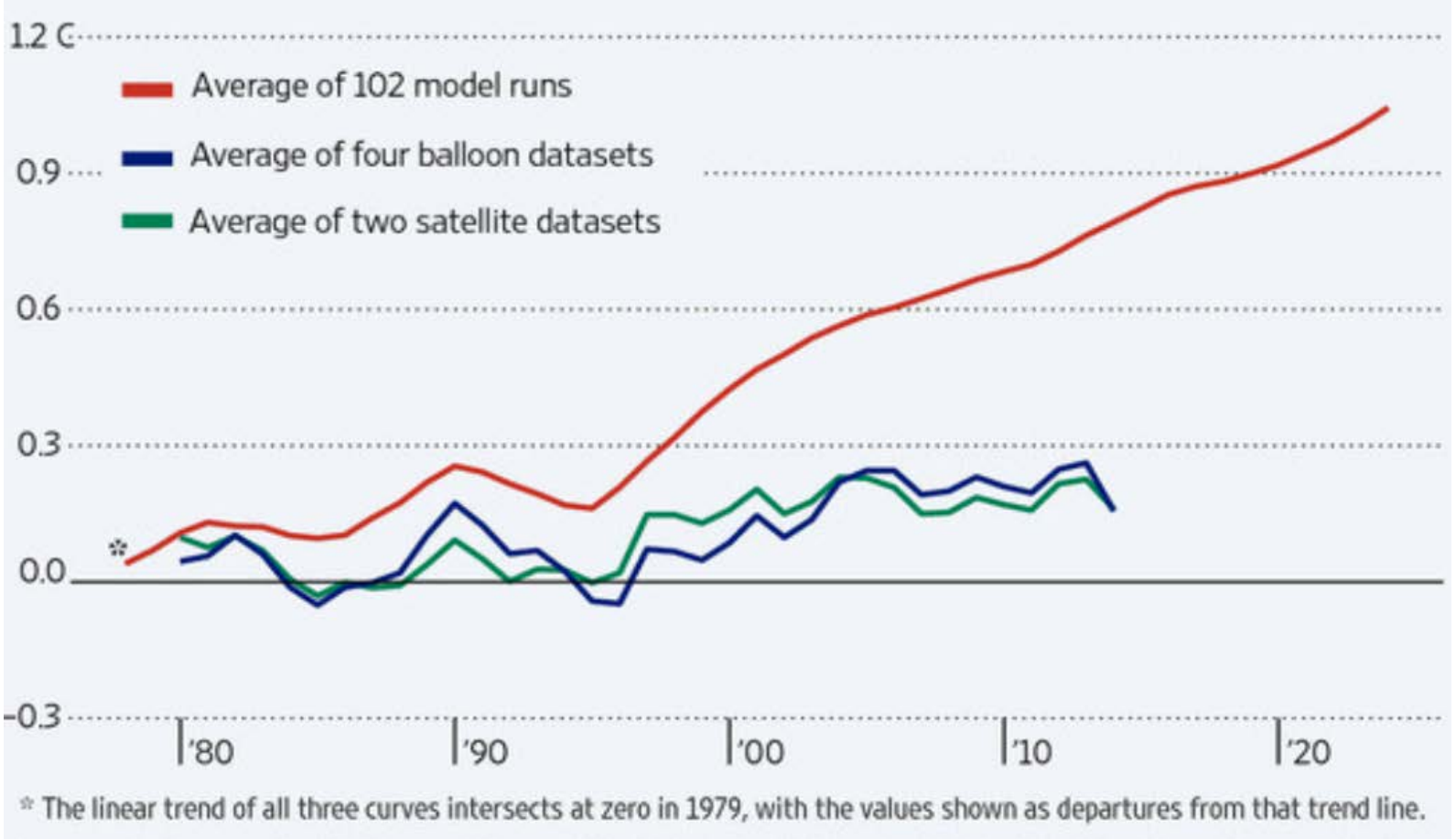


Source: Remote Sensing System

"The warming hiatus raises <u>serious questions as to whether the climate-model projections of 21st-century temperatures are fit for making public-policy decisions</u>." Dr. Judith Curry, 2014

CLIMATE MODELS VS. REALITY

Global Mid-Tropospheric Temperature, 5-year Means in Degrees C



Source: Roy Spencer and American Meteorological Society.

"The IWG Climate models have now, by normal standards of scientific inquiry, been falsified by the actual temperatures observed." Walton Francis, former head of DHHS Policy and Regulatory Analysis, 2014.

IWG DAMAGE ESTIMATES SUSPECT

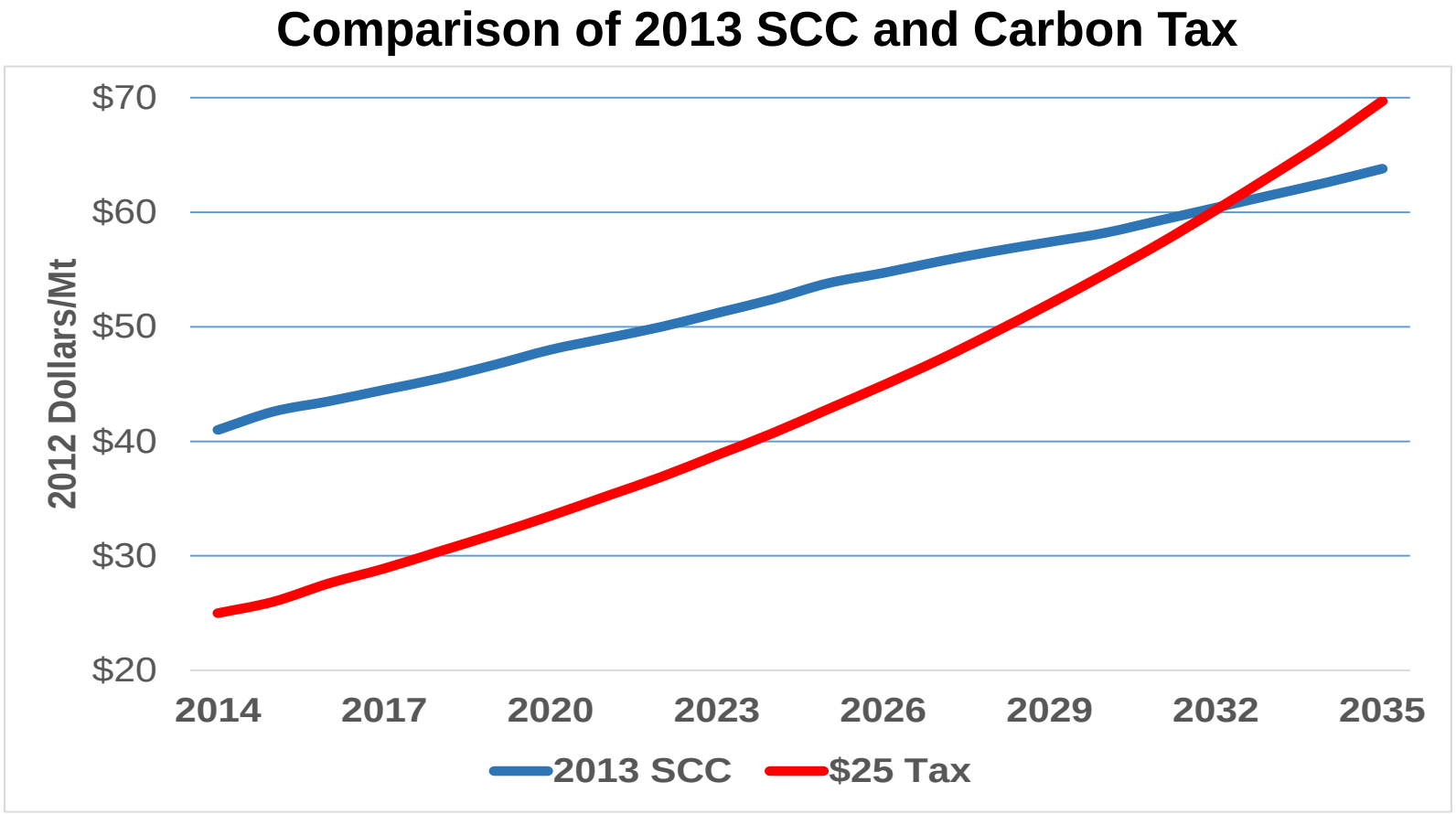
- SCC estimates based on arithmetic average of 3 IAMs -- DICE, FUND, and PAGE
- Each IAM has its own damage function, based on estimated damages for each sector (agriculture, sea level rise, etc.)
- **“Damage functions" used in these models are simply a guess** about the relationship between changes in temperature & GDP
- Average SCC estimates from the models differ by a factor of 3 to 8, depending on discount rate
- $ figures for “damage per sector” disagree among the models, reflecting wide choice of assumptions by model builders
- **Integrated damage figures differ even in sign (!)** for modest increases in global temperature < 3^{o} C
- IWG does not reconcile this inconsistency

ARE SCC ESTIMATES VIABLE?

- No: Are **artificial constructs** designed by Obama Administration to penalize fossil fuels
- **Allows Administration to achieve via regulation what it cannot via Congress** – carbon tax, Waxman-Markey, UN commitment, etc.
- SCC is malleable concept dependent on modeling assumptions
- Lacks transparency
- Lacks consideration of CO_2 benefits
- IAMs imply level of knowledge & precision that is illusory
- **Allows modeler to obtain any desired result**
- Arbitrary assumptions have huge effects on SCC estimates – even their sign

"America is addicted to fossil fuels and we must accelerate the transition away from these fuels." Remarks by President Obama to the Nation on the BP Oil Spill, June 15, 2010

WITH SCC, WHO NEEDS CONGRESS?



Source: Interagency Working Group on Social Cost of Carbon, U.S. Energy Information Administration, and Management Information Services, Inc.

SCC is a de facto carbon tax – which Obama could never get Congress to pass

SCC ESTIMATES ARE INVALID

Independent assessments: SCC estimates suffer from uncertainty, speculation, & lack of info on variables; for example:

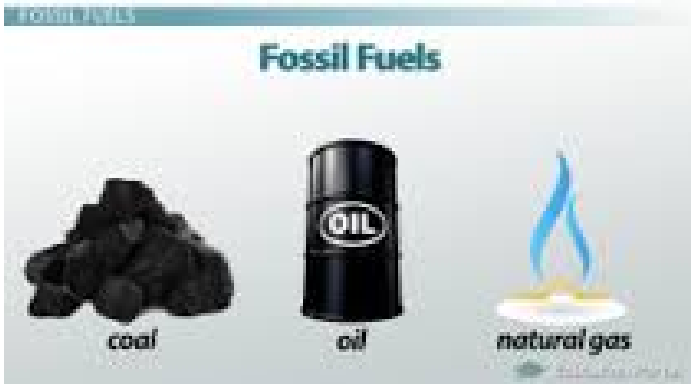
- "SCC assessments **raise serious questions** of science, economics, and ethics." National Academies of Science
- IAMs are "**close to useless** as tools for policy analysis." Professor Robert Pindyck, MIT
- IAMs have **very serious weaknesses** and must not be taken too literally." Sir Nicholas Stern
- "IAMs **do not embody the state of the art** in the economic theory of uncertainty." Professor Frank Ackerman, Tufts U.
- "The idea that climate change poses an existential threat to humankind is **laughable**." Professor Richard Tol

"What do the IAMs tell us? Very little." Professor Robert Pindyck, MIT

HOW ROBUST ARE SCC ESTIMATES?

- Differences in 2010 & 2013 SCC estimates so large as to question their validity
- Prior to 2010, “official” Federal govt. SCC estimate was zero
- Between 2010 & 2013, SCC estimate increased > 50%
- **If any valid govt. economic estimate, such as GDP, was revised > 50% within 3 yrs. it would be a scandal & farce**
- Will SCC increase by similar amount in 2015 or 2016? With current Administration, we can guess the answer
- “Official” government SCC estimates vary widely. For ex., Minn. PUC established range of $0.38 to $3.97/ton (2007$)
- **NEVERTHELESS, HERE WE USED THE IWG SCC ESTIMATES INTACT**

II. FOSSIL FUELS = MODERN CIVILIZATION

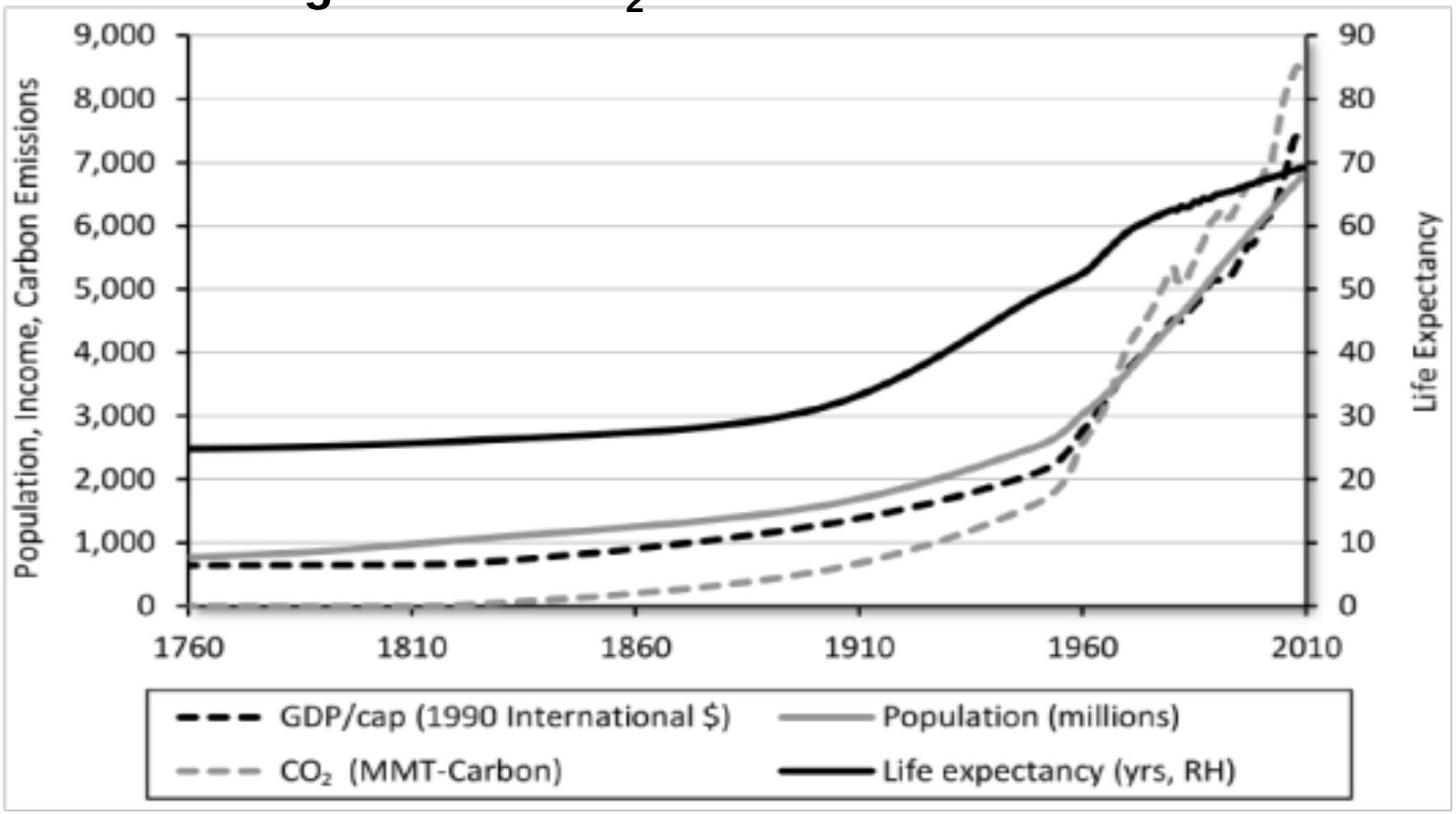


- Fossil fuels:
  - -- Facilitated successive industrial revolutions (including 21st century)
  - -- Created modern world
  - -- Permit current high quality of life
- Over past 250 years:
  - -- Global life expectancy increased > 2X
  - -- Population increased 8X
  - -- Incomes increased 11X
- CO_2 concentrations increased from ~ 320 ppm CO_2 to ~ 400 ppm (from 0.032% of the atmosphere to 0.040%)

"Ours is a high energy civilization based largely on fossil fuels." Dr. Vaclav Smil

FOSSIL FUELS = GROWTH & PROSPERITY

Global Progress and CO_2 Emissions From Fossil Fuels

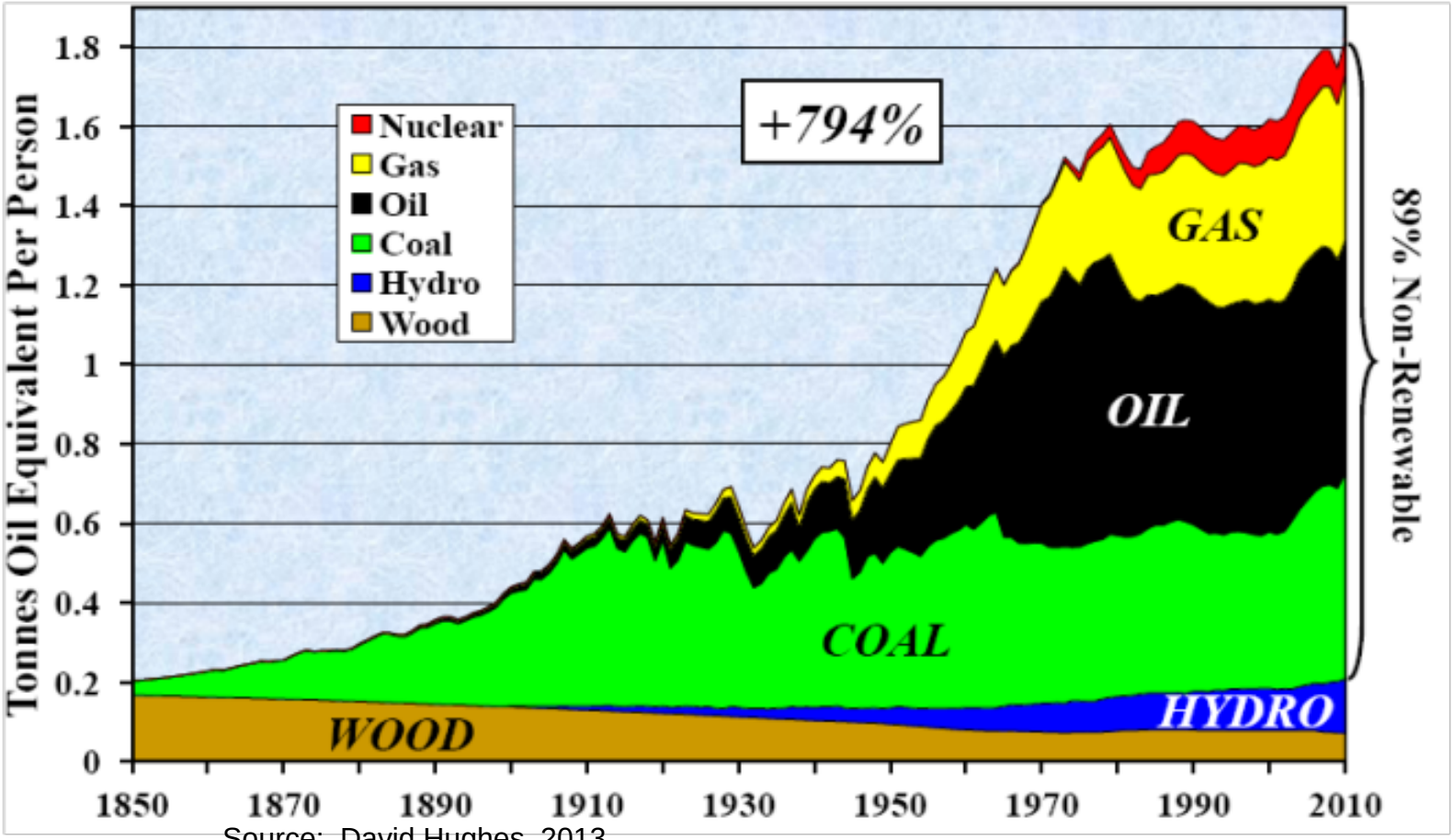


Source: Indur Goklany, 2012.

"The economic system is essentially a system for extracting, processing, and transforming energy." Professor Robert Ayres

FOSSIL FUELS POWER THE WORLD

World Per Capita Annual Primary Energy Consumption by Fuel

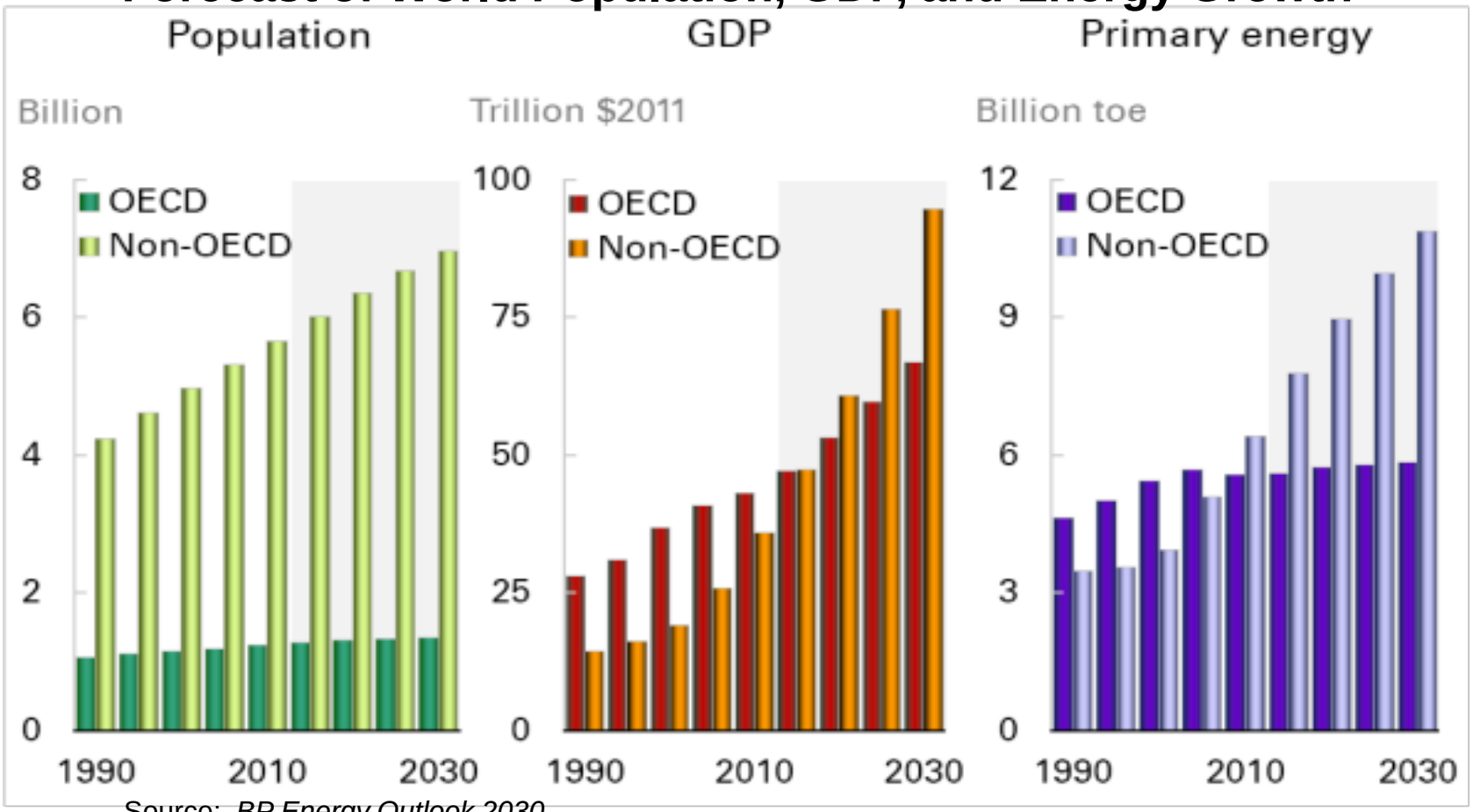


Source: David Hughes, 2013.

"Electricity really is life." Barbara Thompson, Deputy Minister of Energy, Republic of South Africa

ENERGY REQUIRED FOR ECONOMIC GROWTH

Forecast of World Population, GDP, and Energy Growth

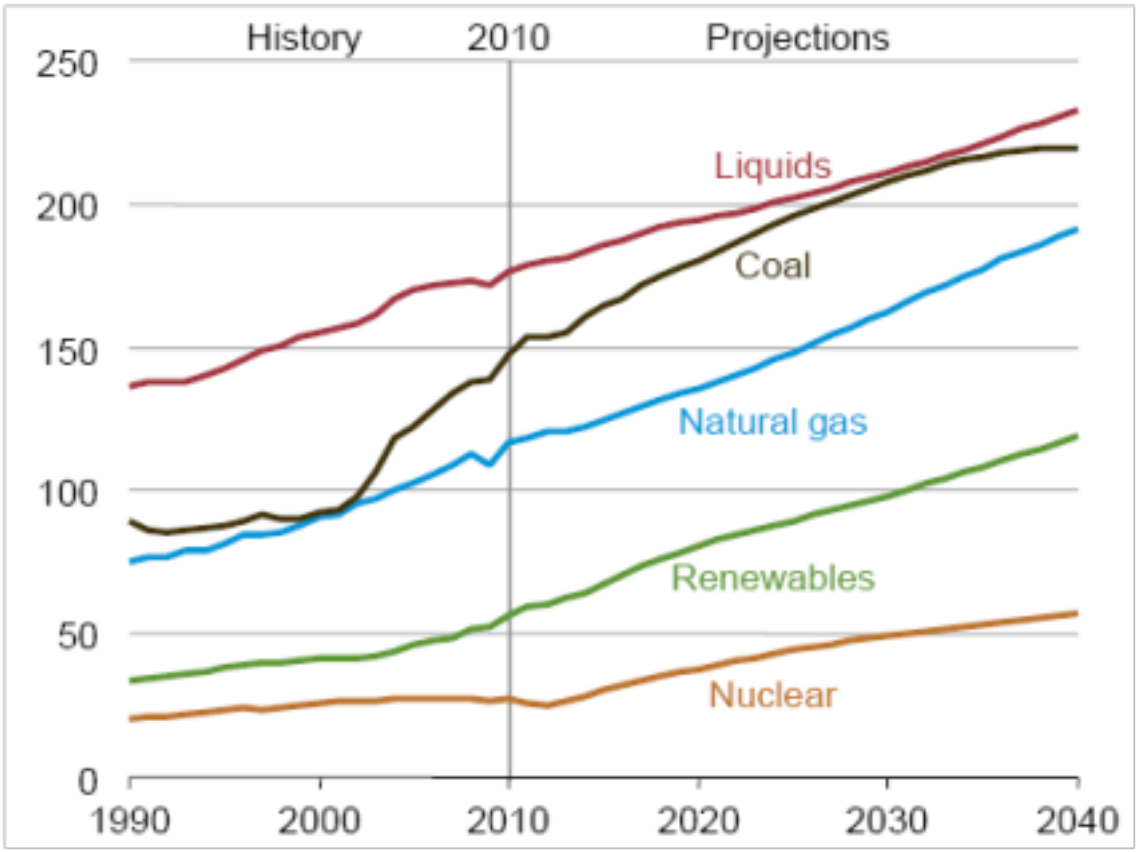


Source: *BP Energy Outlook 2030.*

"Energy use is essential for conquering poverty, and there is a need for increased power in poorer countries."
Dr. Amartya Sen (Nobel Laureate in Economics), August 2014.

FOSSIL FUELS WILL REMAIN SUPREME

World Energy Consumption by Fuel Type (Quads)

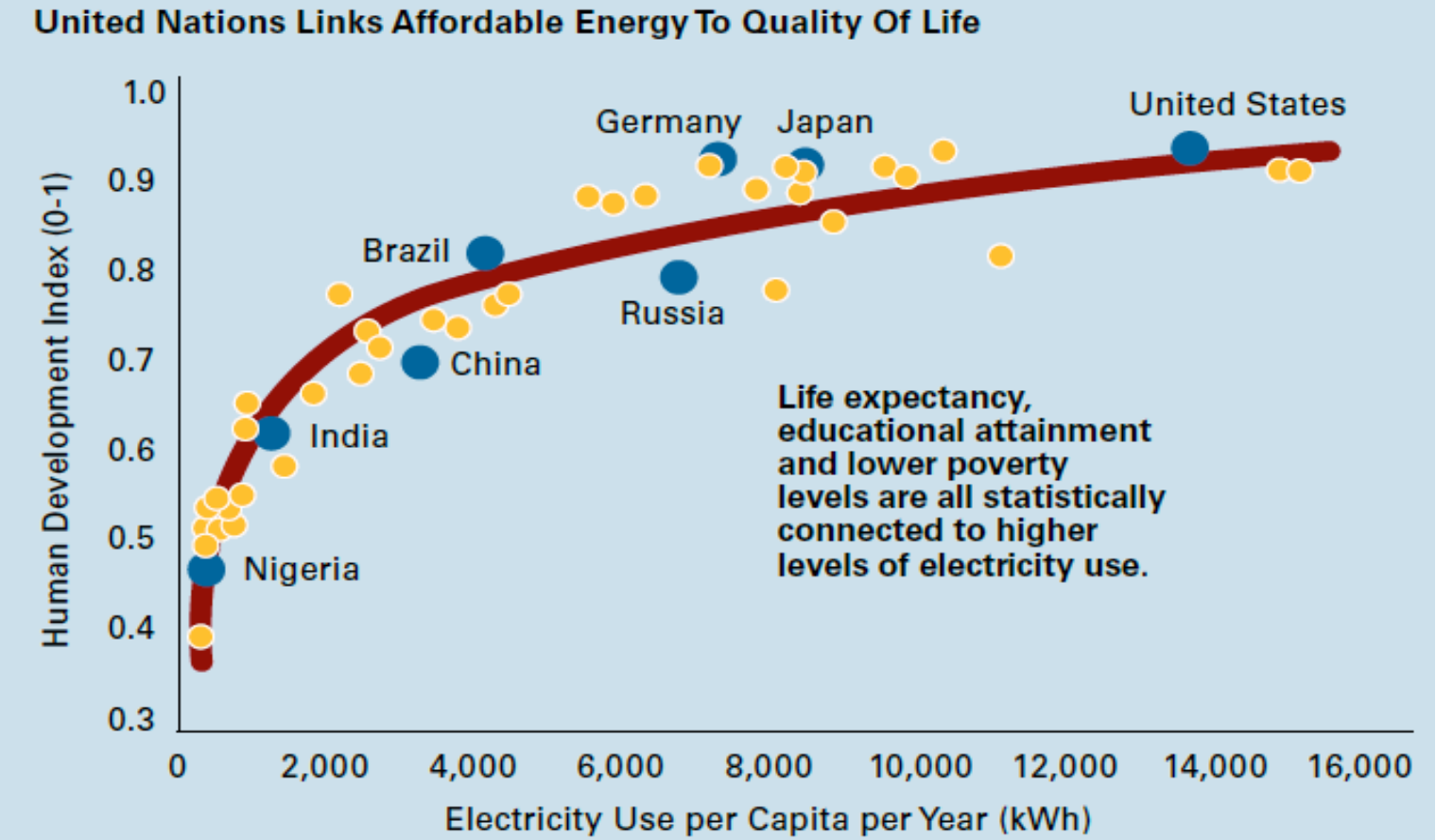


Source: U.S. Energy Information Administration, *International Energy Outlook 2013*

EIA forecasts that fossil fuels will continue to provide 75% – 80% world energy

ELECTRICITY ESSENTIAL FOR LIFE

UN Human Development Index and Per Capita Electricity Use

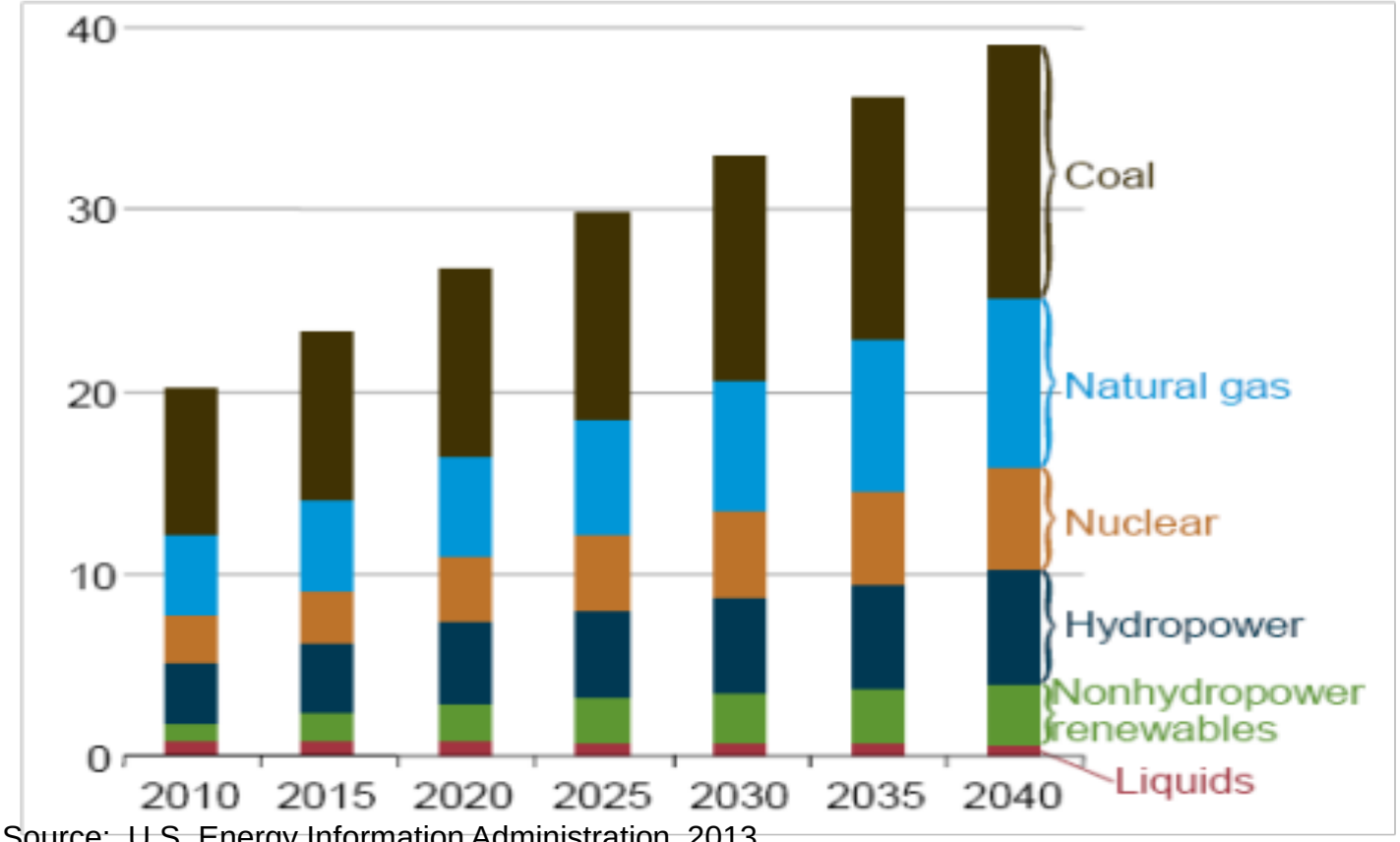


Source: United Nations Development Program, 2012.

Electrification: "World's most significant engineering achievement of past century, & ranked as 2nd most significant innovation of past 6,000 years, after the printing press."

FOSSIL FUELS ESSENTIAL FOR ELECTRICITY

Growth in World Total Electricity Generation and Total Delivered Energy Consumption (Index: 1990 = 1)



Source: U.S. Energy Information Administration, 2013.

Electricity use doubles: <u>Coal is currently world's predominant fuel for electricity generation & will remain so</u>

III. WHAT ABOUT CO_2 BENEFITS? CO_2 IS PLANT FOOD

Here is What Happens With More CO_2

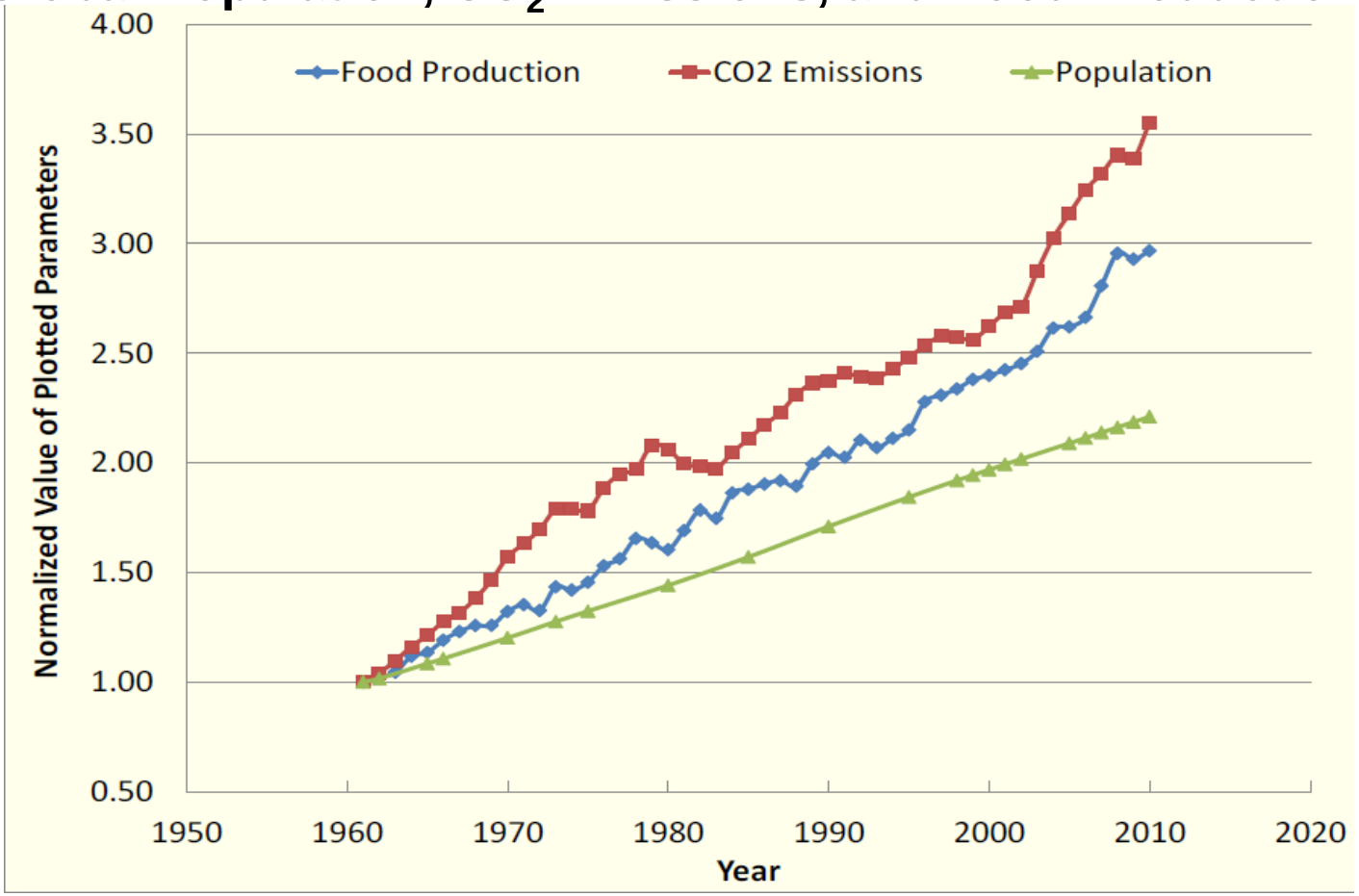
385 ppm **535 ppm** **685 ppm** **835 ppm**

Source: William Happer, 2014.

There is a reason greenhouses pump in CO_2.

AGRICULTURAL PRODUCTION

Global Population, CO_2 Emissions, and Food Production

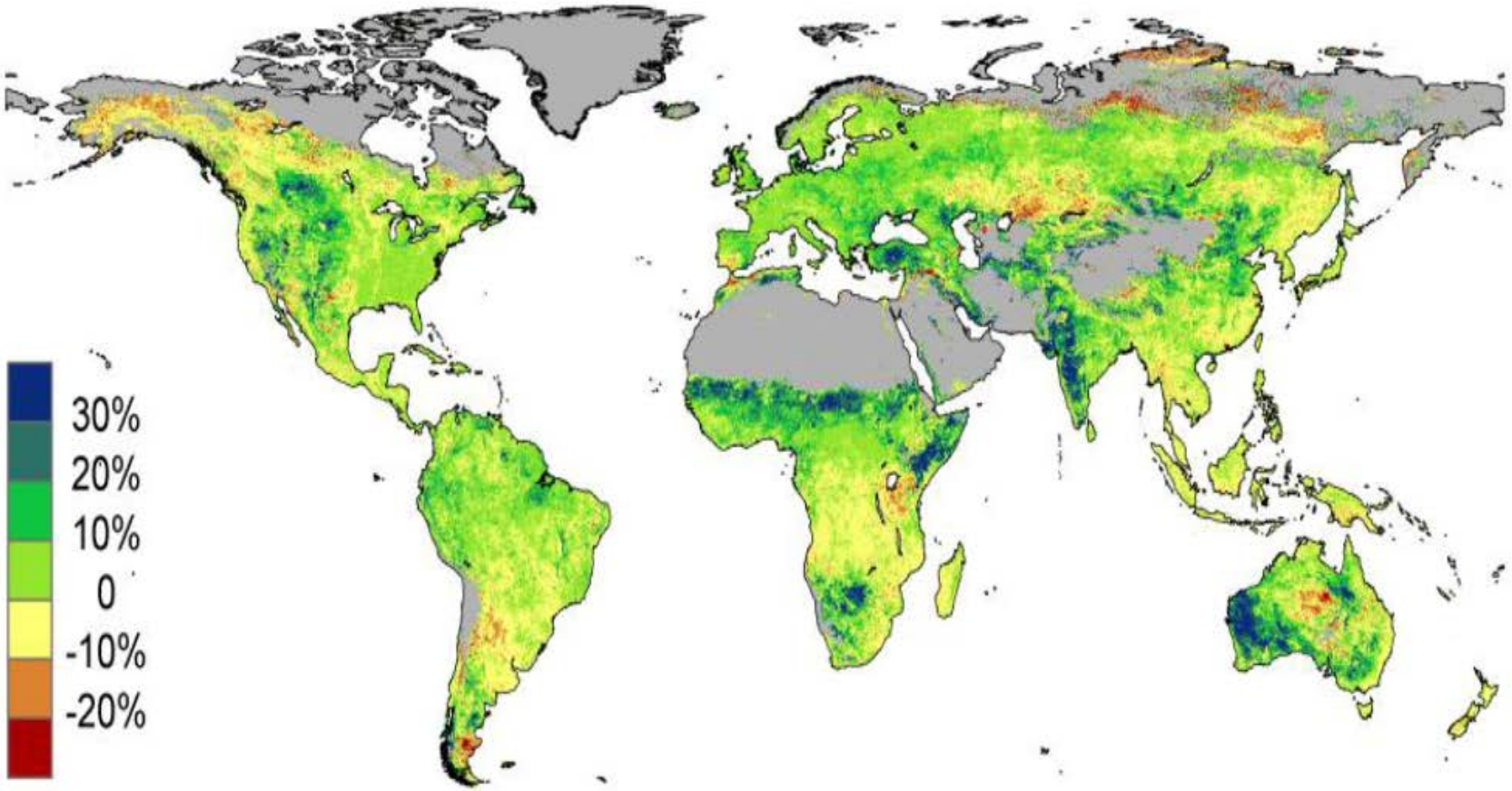


Source: Craig Idso, "The Positive Externalities of Carbon Dioxide," 2013.

"Rising global population leads to rising CO_2 emissions, which have benefited food production." Dr. Craig Idso

MORE CO_2 = GLOBAL GREENING

Global Greening From CO_2 Fertilization: 1982-2010

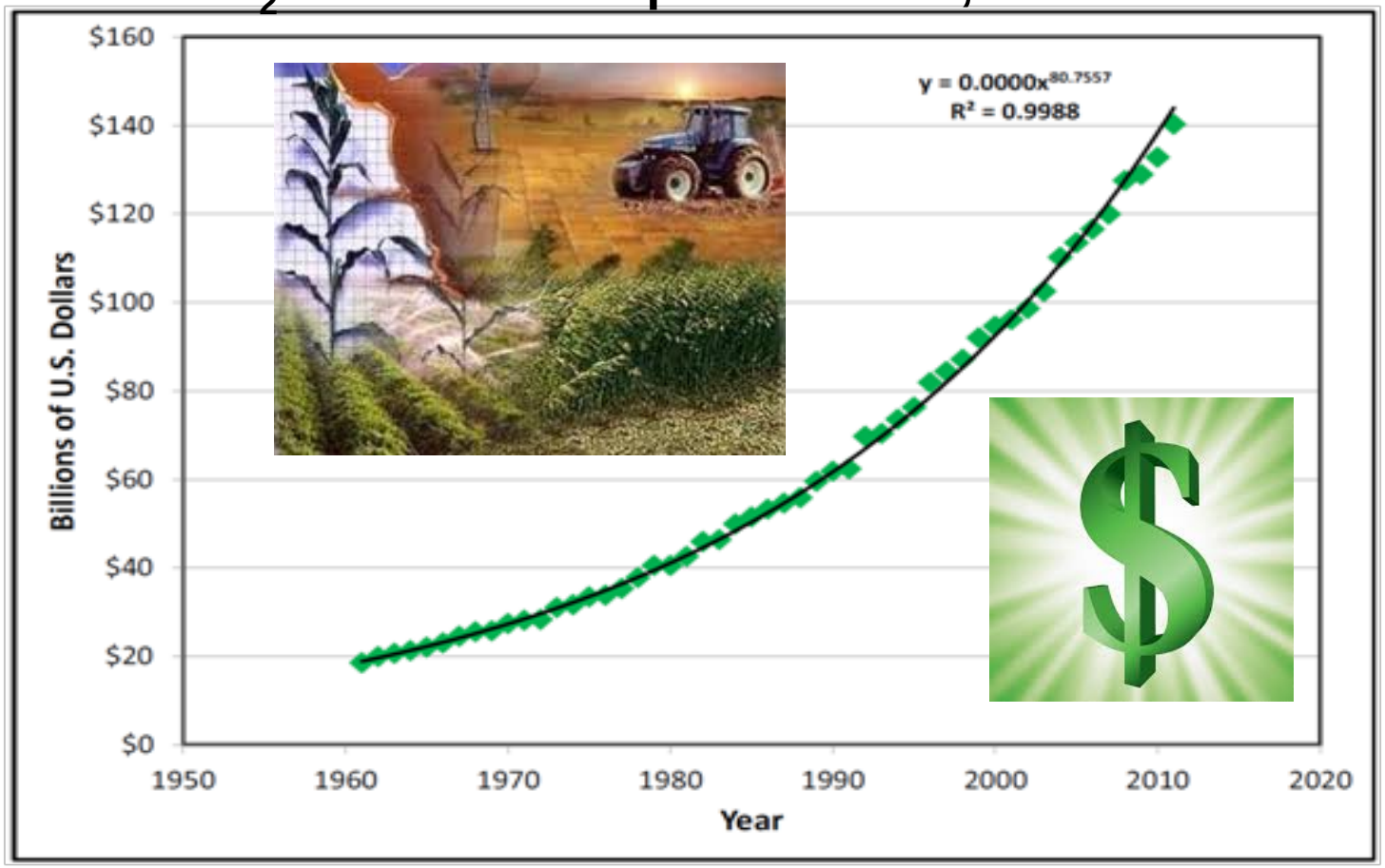


Source: William Happer, 2014.

"Greening of the planet is already being observed."
Professor William Happer, Princeton University.

QUANTIFYING CO_2 BENEFITS

Total Annual Monetary Value of the Direct CO_2 Benefit for Crop Production, 1961-2011



Source: Craig Idso, "The Positive Externalities of Carbon Dioxide," 2013.

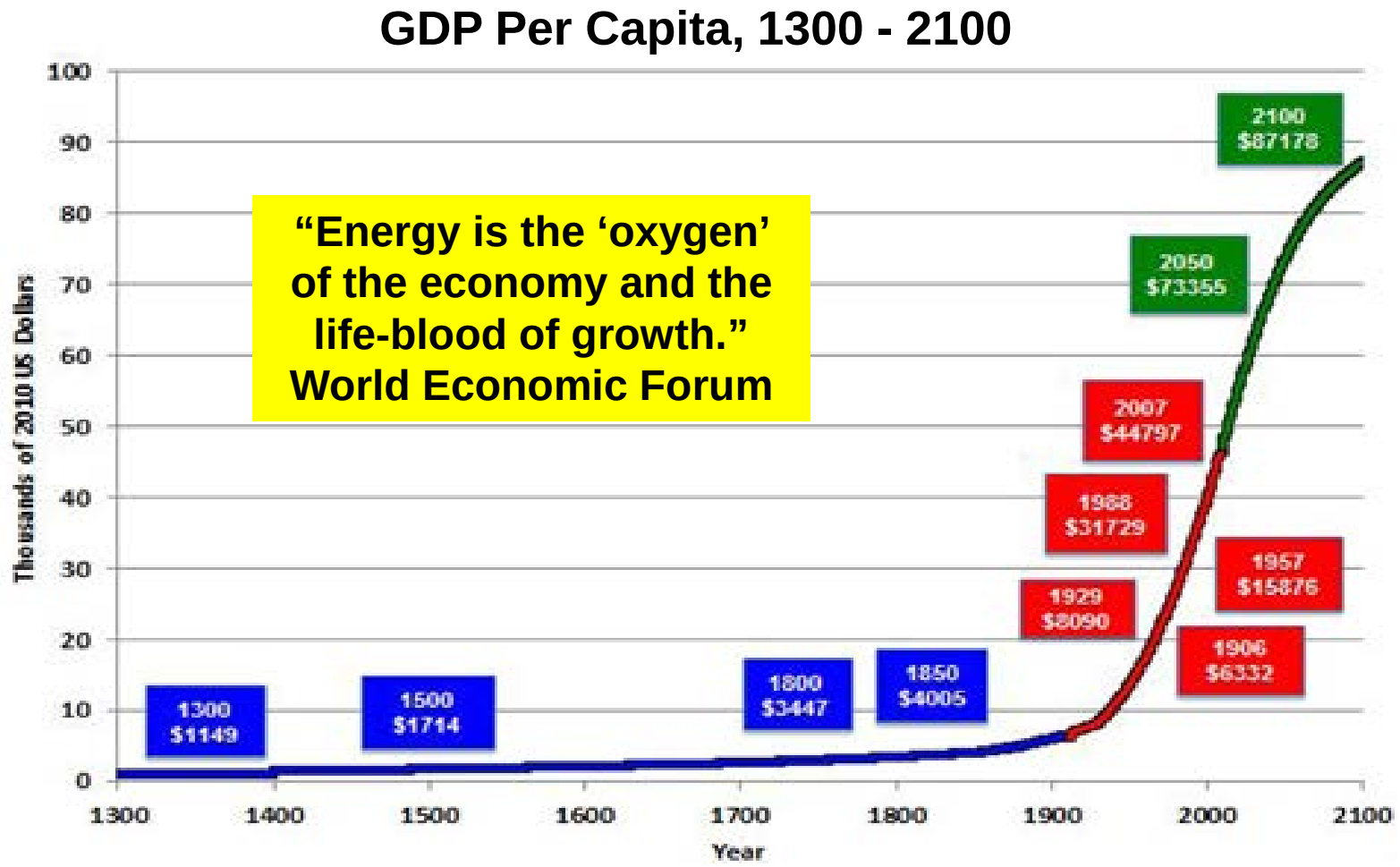
"Positive externalities:" CO_2-induced benefit for global food production since 1961 = $3.2 trillion. Forecast 2012-2050: $10 trillion

IV. FOSSIL FUELS & GDP: MYRIAD SEMINAL STUDIES LINK ENERGY & GROWTH

- "**Ours is a high energy civilization based largely on fossil fuels**." Professor Vaclav Smil
- "The standard assumption that economic growth is independent of energy availability must be discarded absolutely. It is not tenable." Dr. Robert Ayres
- "The bottom line is that an **enormous increase in energy supply will be required** to meet the demands of projected population growth and lift the developing world out of poverty." Dr. James Brown
- "**Energy use and output are tightly coupled**, with energy availability playing a key role in enabling growth. Professor David Stern
- "Economic growth has been driven primarily not by "technological progress" but by the availability of ever cheaper coal, oil, & gas." Dr. Robert Ayres and Dr. Benjamin Warr
- "There is a **close connection between energy growth, population growth, and economic growth**." Gail Tverberg

"Energy is central to sustainable development and poverty reduction." UN Development Program

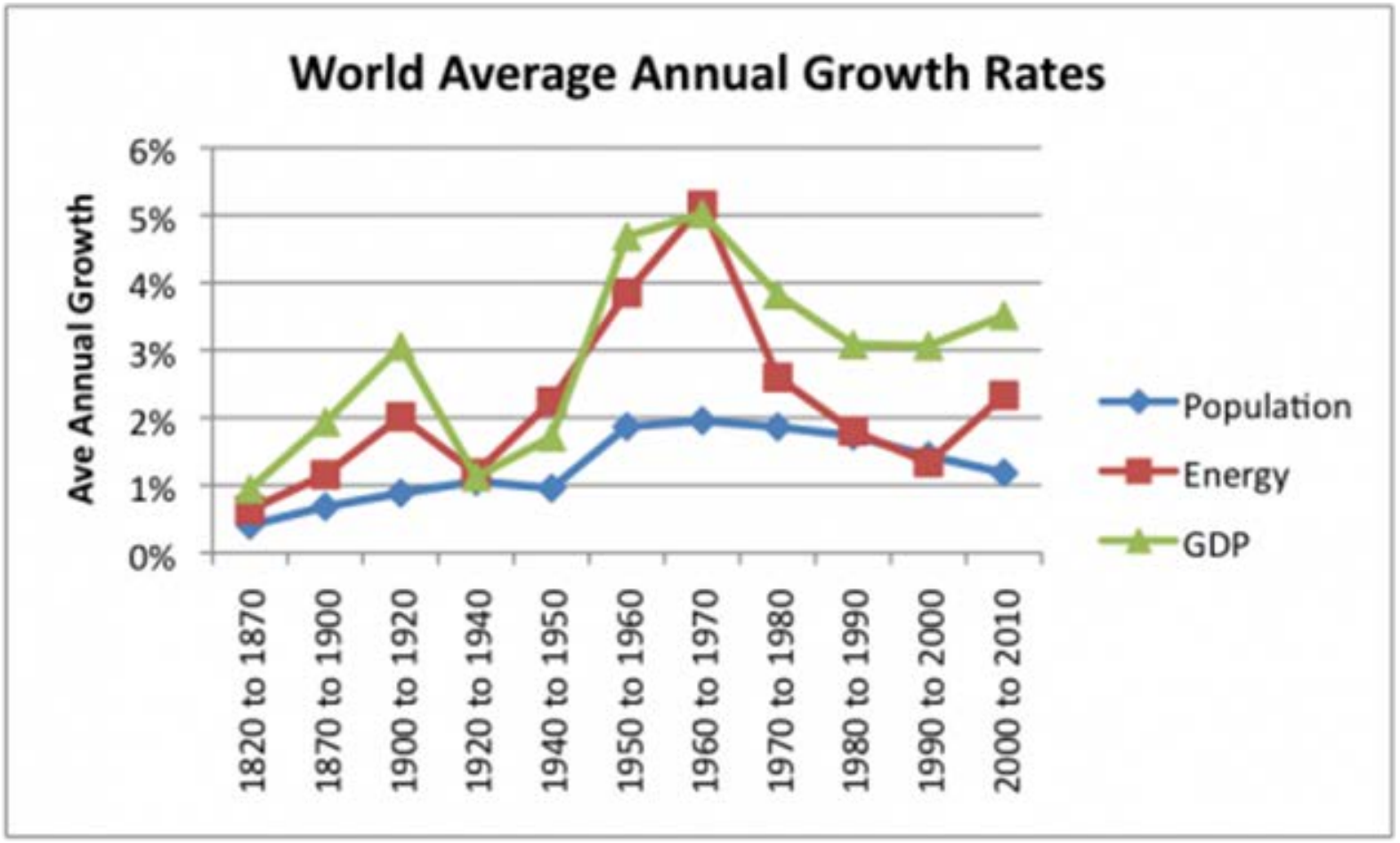
FOSSIL FUELS POWERED THE INDUSTRIAL REVOLUTIONS



Source: Robert J. Gordon, National Bureau of Economic Research, 2012.

Note: Blue is UK, red is USA, green is forecast.

CLOSE LINK BETWEEN ENERGY & GDP

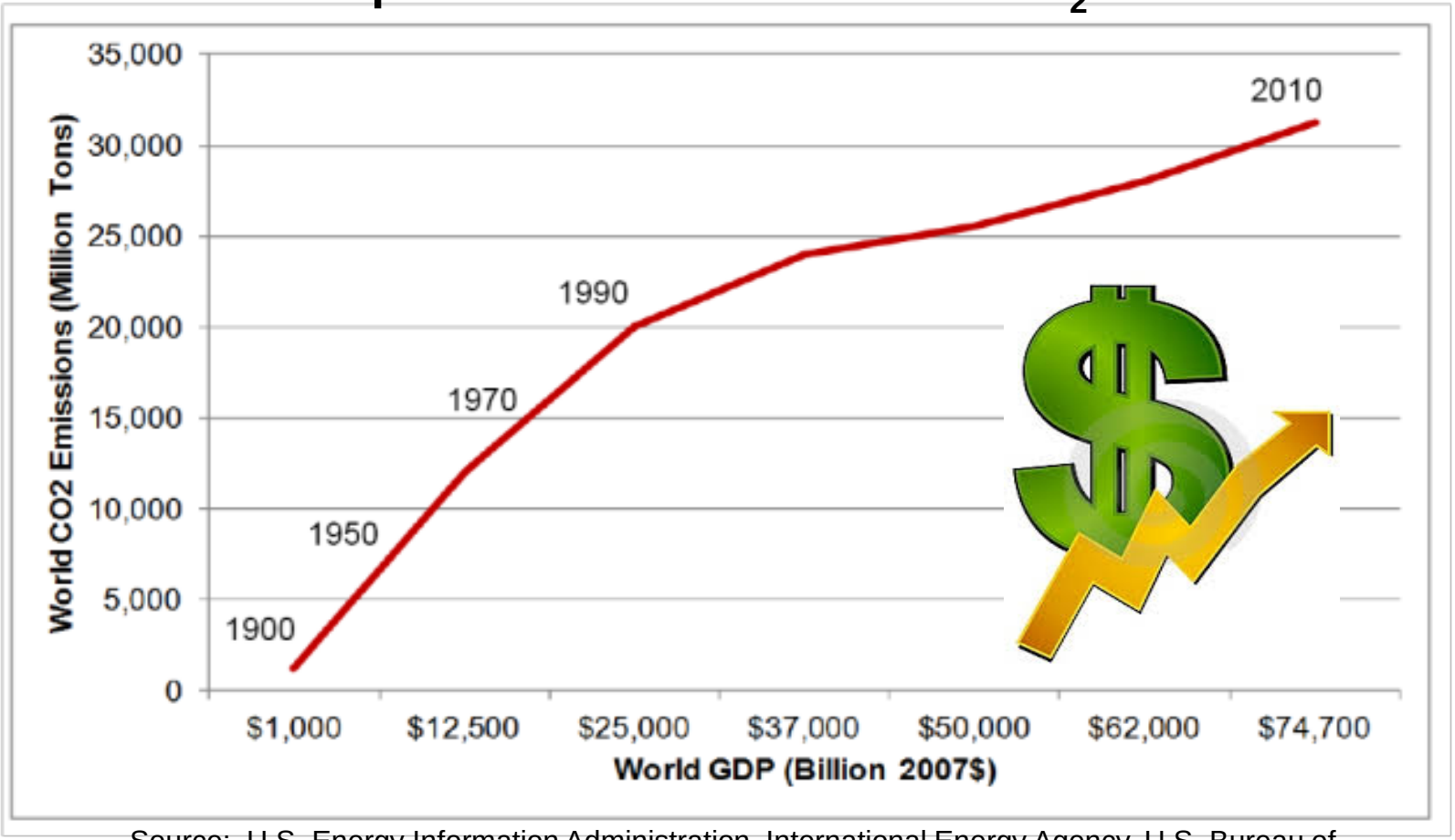


Source: Gail Tverberg, 2012.

"Fossil fuels created an economic miracle that has lifted billions of people out of hopeless poverty." Robert Zubrin

CLOSE LINK BETWEEN CO_2 & GDP

Relationship Between World GDP and CO_2 Emissions

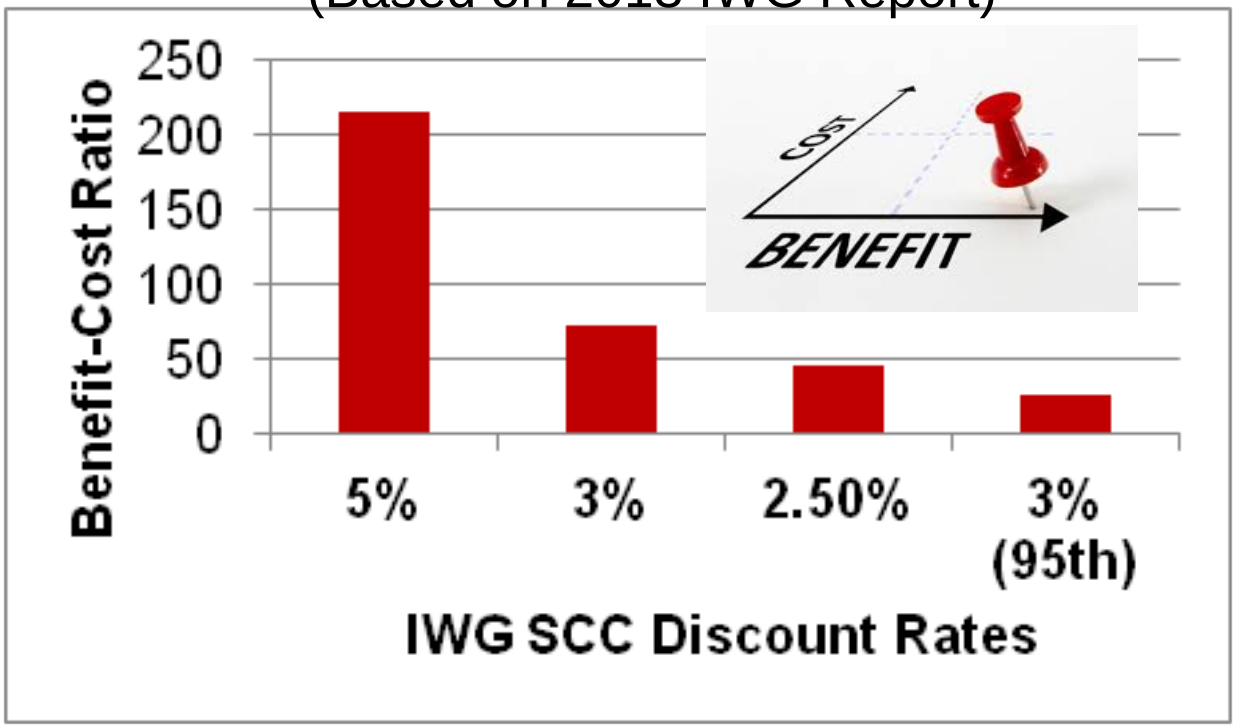


Source: U.S. Energy Information Administration, International Energy Agency, U.S. Bureau of Economic Analysis, and Management Information Services, Inc.

"Access to energy is <u>absolutely fundamental in the struggle against poverty</u>." Rachel Kyte, vice president, World Bank

CO_2 BENEFITS GREATLY EXCEED SCC

2010 CO_2 Benefit-Cost Ratios
(Based on 2013 IWG Report)



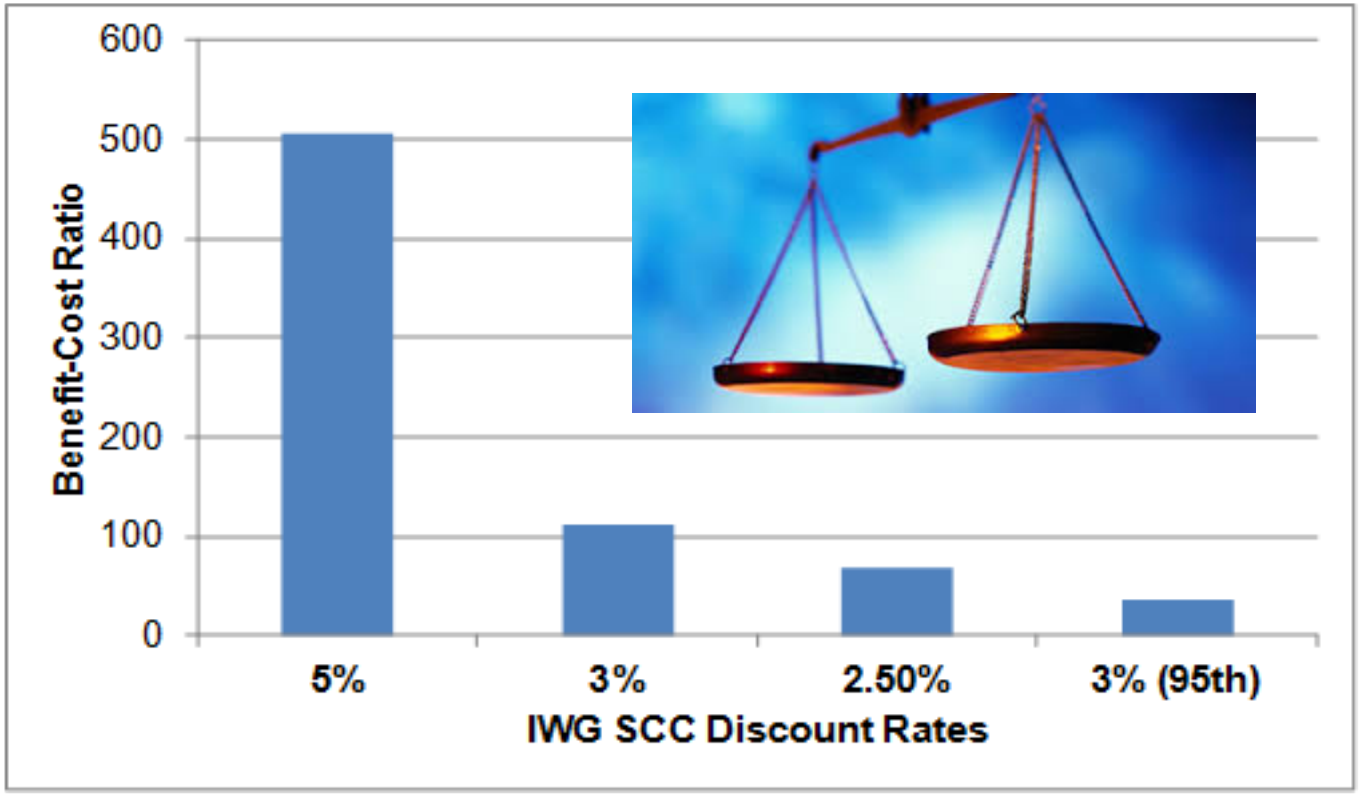
Source: U.S. Energy Information Administration, U.S. Bureau of Economic Analysis, U.S. Interagency Working Group, and Management Information Services, Inc.

Using 2013 IWG report, CO_2 benefits > SCC by 60-to-1 to 200+-to-1.

Perspective: B-C ratios of 2-to-1 or 3-to1 considered very favorable.

CO_2 BENEFITS GREATLY EXCEED SCC

2010 CO_2 Benefit-Cost Ratios
(Based on 2010 IWG Report)



Source: U.S. Energy Information Administration, U.S. Bureau of Economic Analysis, U.S. Interagency Working Group, and Management Information Services, Inc.

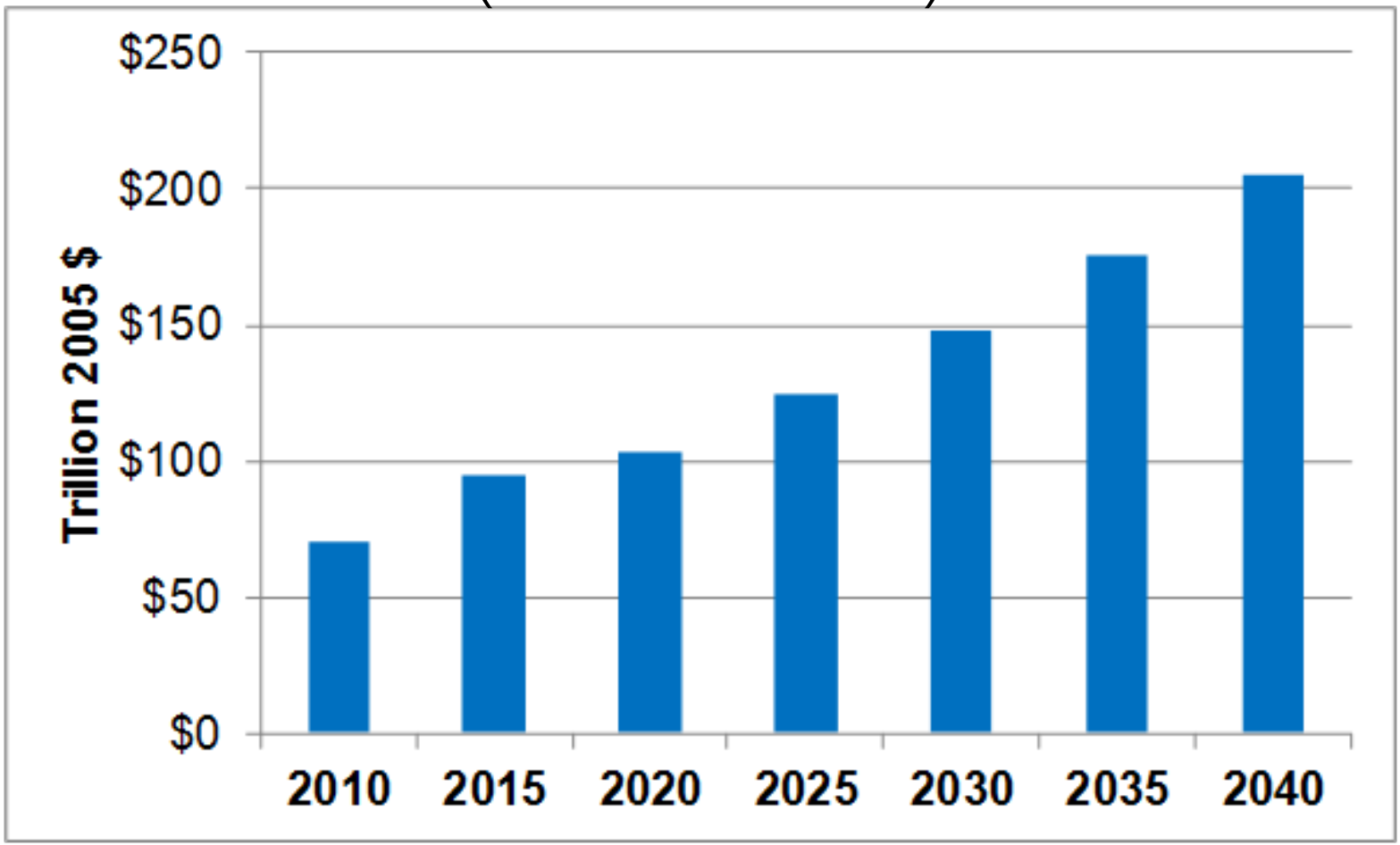
Using 2010 IWG report, CO_2 benefits > SCC by 100-to-1 to 500+-to-1.

FORECAST COSTS AND BENEFITS

- Much of the SCC debate concerns:
  - -- Future emissions
  - -- Potential costs & impacts
  - -- Prospective policies
- Therefore, we <u>analyzed forecast CO_2 benefits compared to SCC forecasts</u>
- We thus examined forecasts of:
  - -- World economic growth
  - -- Fossil fuel utilization
  - -- CO_2 emissions.
- We then estimated future B-C ratios through 2040

WORLD GDP FORECAST TO INCREASE 3X

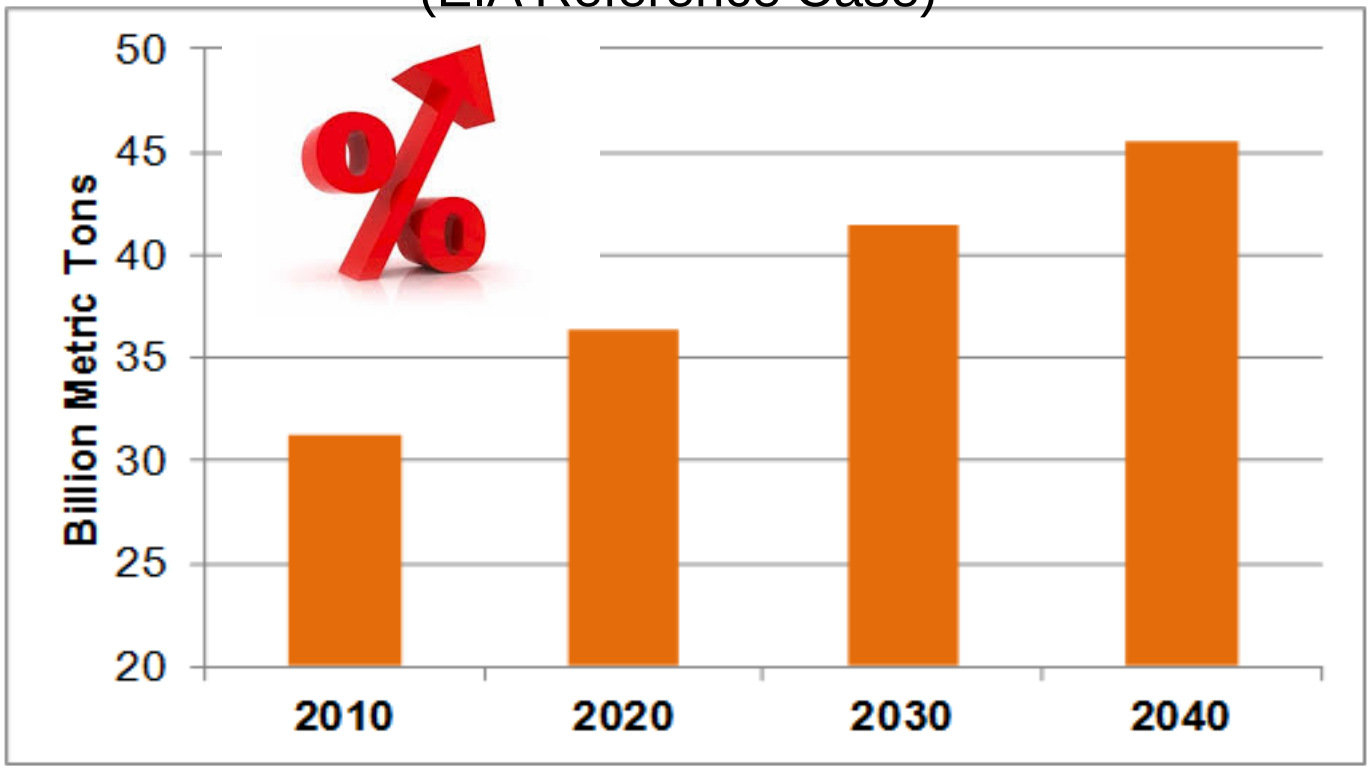
World GDP Forecast
(EIA Reference Case)



Source: U.S. Energy Information Administration.

WORLD CO_2 EMISSIONS FORECAST TO INCREASE 50%

Forecast World Energy-related CO_2 Emissions
(EIA Reference Case)

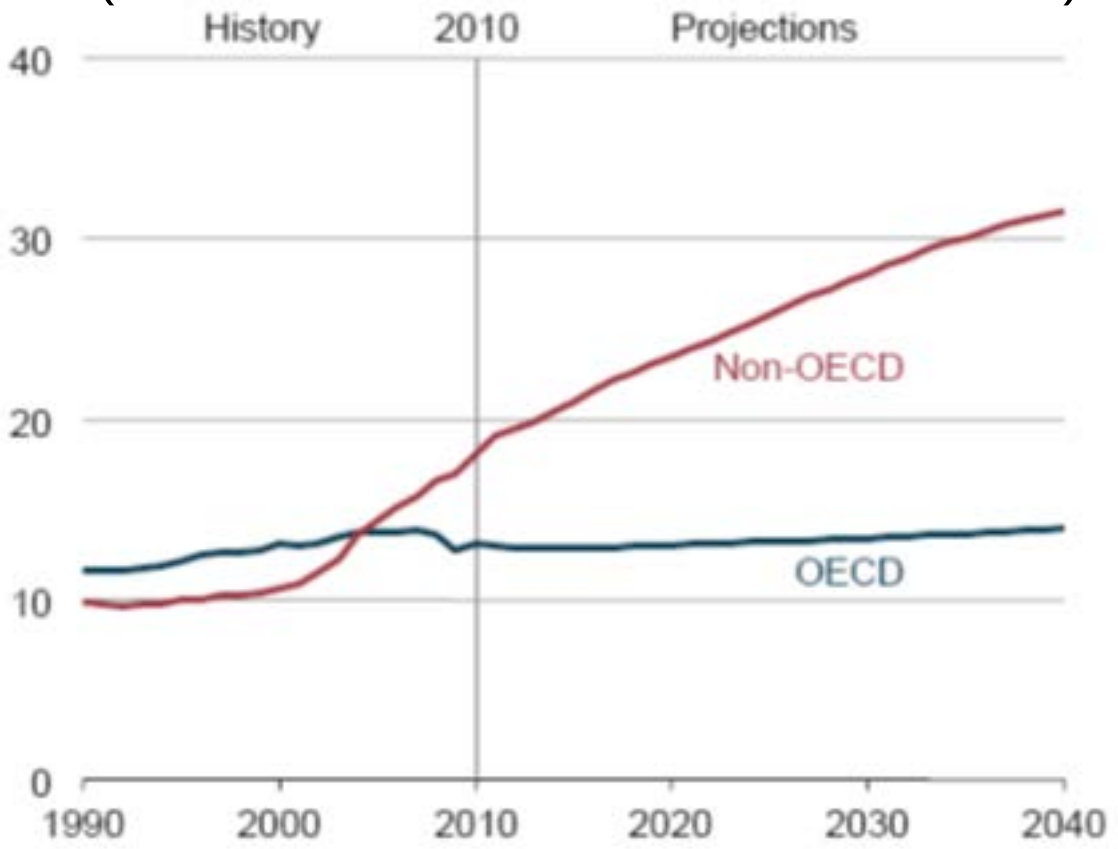


Source: U.S. Energy Information Administration.

Note: There is already a huge amount of "decarbonization" incorporated into the EIA forecasts.

FUTURE CO_2 EMISSIONS

World Energy-related CO_2 Emissions, 1990-2040
(Billion metric tons – EIA Reference case)

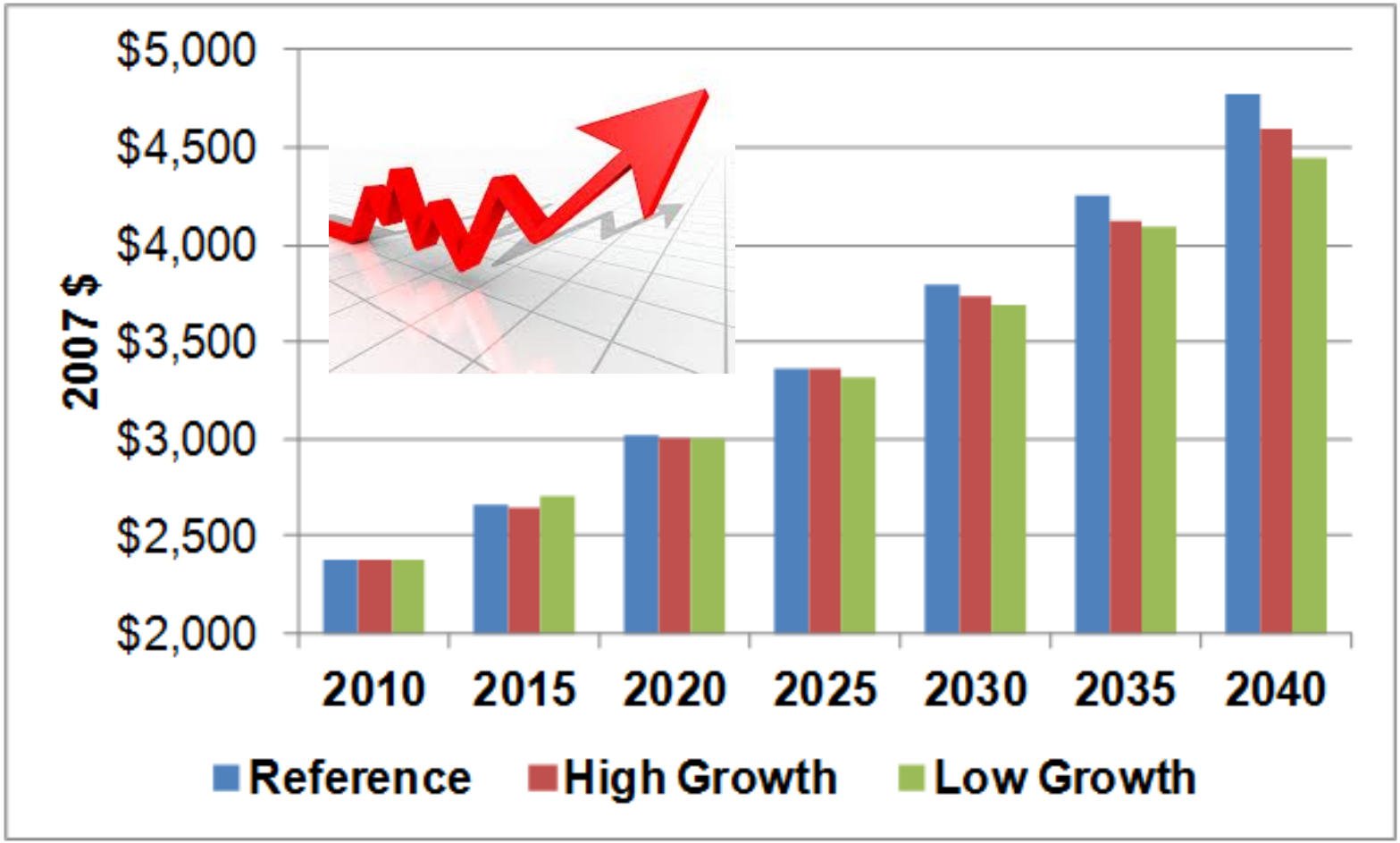


Source: U.S. Energy Information Administration.

"All CO_2 growth occurs in developing countries." IEA, 2014.

GDP, ENERGY, & CO_2 REMAIN CLOSELY LINKED

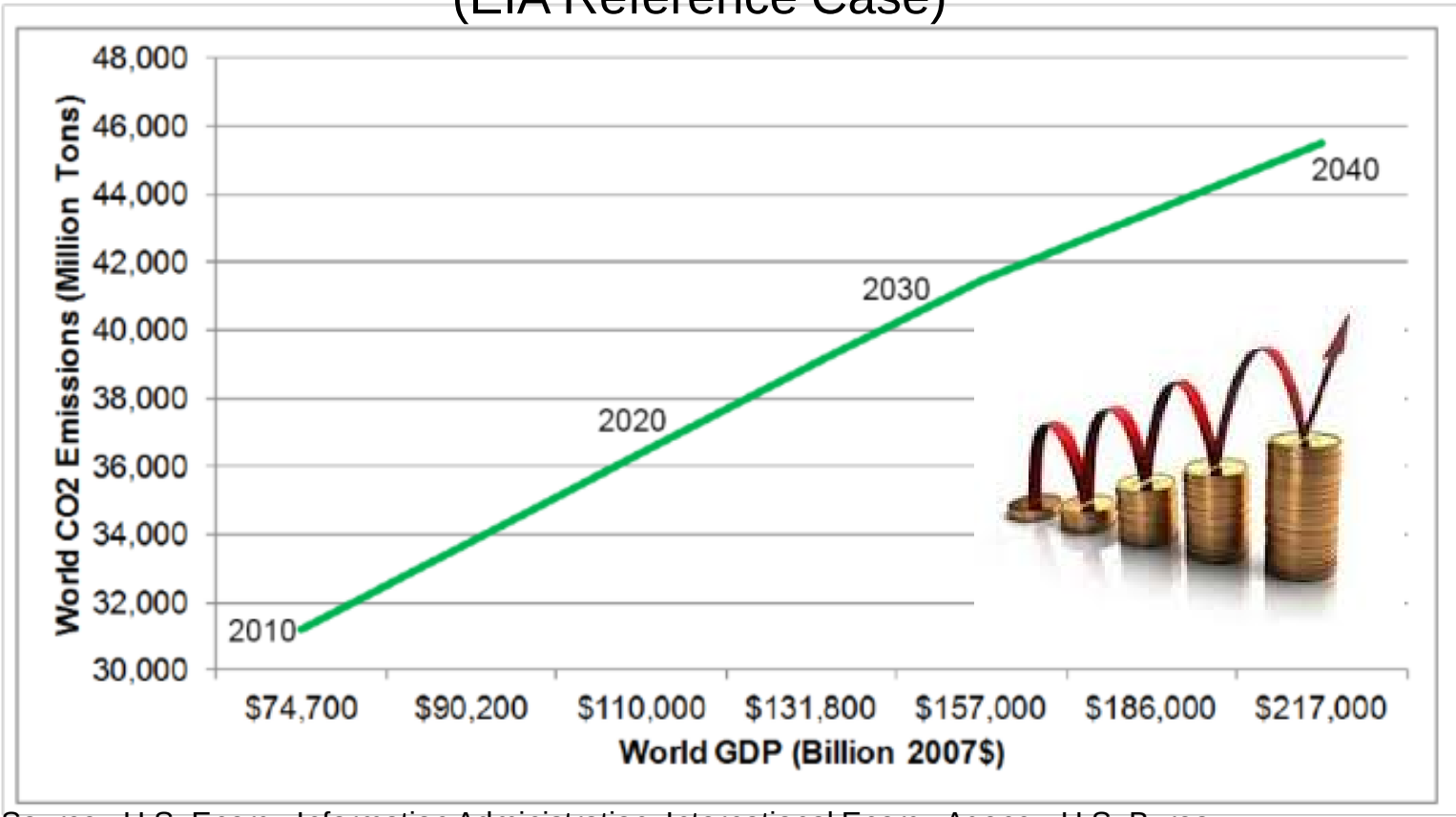
Alternate Forecasts of World GDP Per Ton of Energy-Related CO_2



Source: U.S. Energy Information Administration, U.S. Bureau of Economic Analysis, U.S. Interagency Working Group, and Management Information Services, Inc.

CONTINUED LINK BETWEEN GDP & CO_2

Forecast Relationship Between World GDP and CO_2 Emissions
(EIA Reference Case)

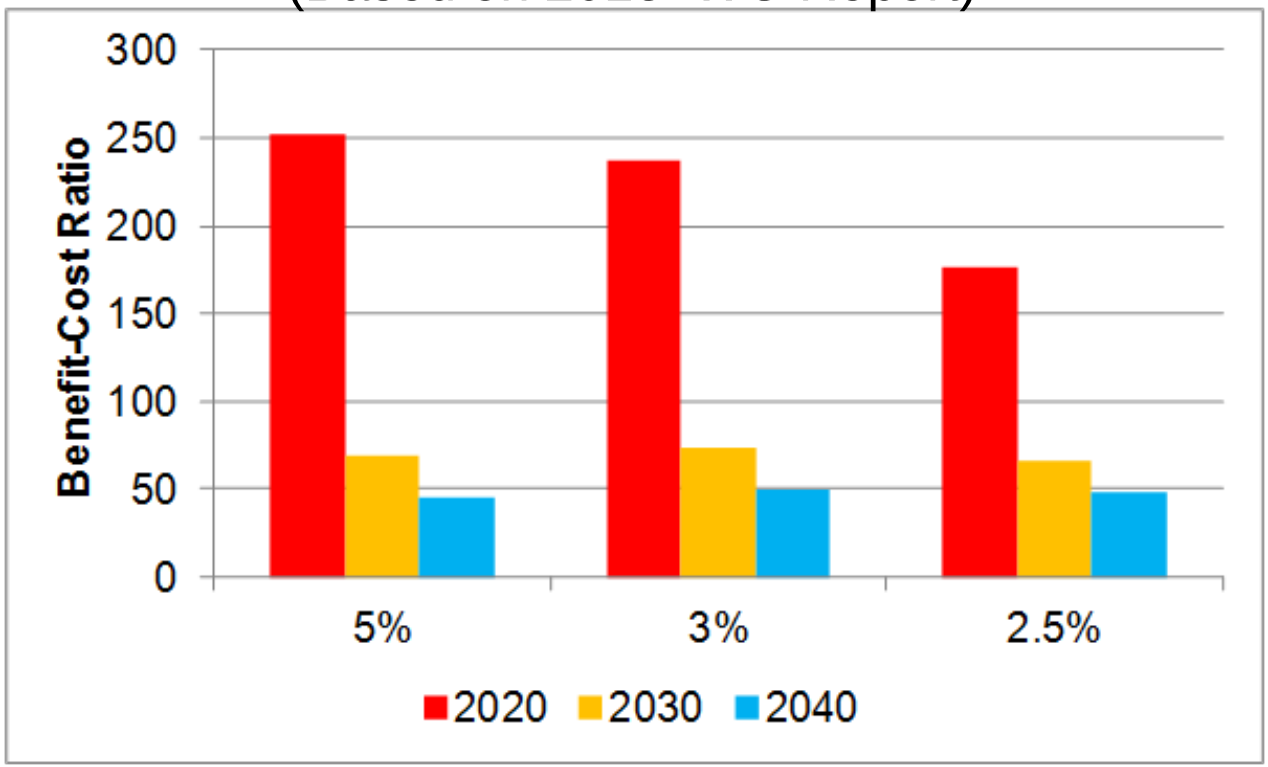


Source: U.S. Energy Information Administration, International Energy Agency, U.S. Bureau of Economic Analysis, and Management Information Services, Inc.

"If you could pick just one thing to reduce poverty, by far you would pick energy. " Bill Gates, *New York Times*, 9-24-13."

CO_2 BENEFITS FORECAST TO CONTINUE TO GREATLY EXCEED SCC

Forecast Reference Case CO_2 Benefit-Cost Ratios
(Based on 2013 IWG Report)

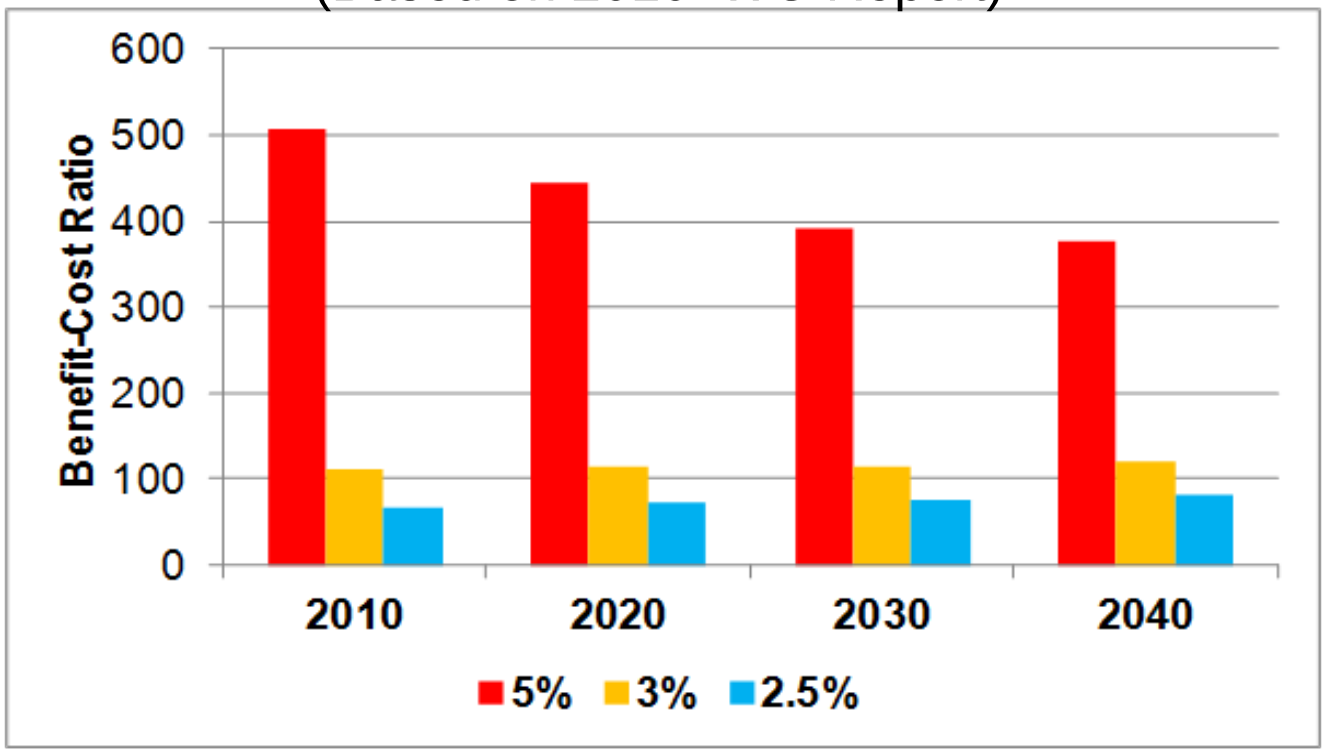


Source: U.S. Energy Information Administration, U.S. Bureau of Economic Analysis, U.S. Interagency Working Group, and Management Information Services, Inc.

Using 2013 IWG report, forecast CO_2 benefits > forecast SCC by 70-to-1 to 250-to-1.

CO_2 BENEFITS FORECAST TO CONTINUE TO GREATLY EXCEED SCC

2010 and Forecast Reference Case CO_2 Benefit-Cost Ratios
(Based on 2010 IWG Report)



Source: U.S. Energy Information Administration, U.S. Bureau of Economic Analysis, U.S. Interagency Working Group, and Management Information Services, Inc.

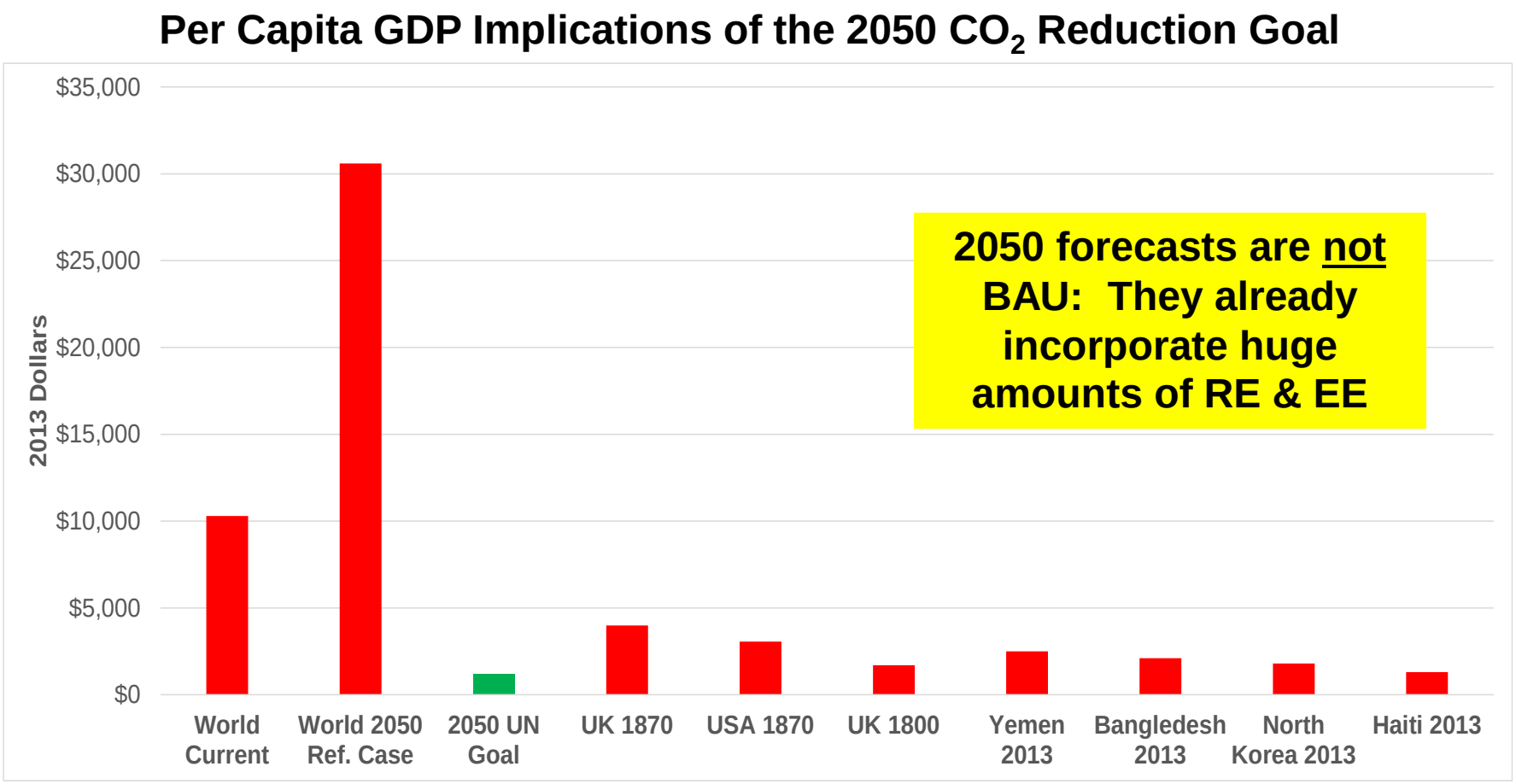
Using 2010 IWG report, forecast CO_2 benefits > forecast SCC by 100-to-1 to 500-to-1.

VI. CONCLUSIONS: HOW VIABLE ARE CO_2 BENEFIT ESTIMATES?

- **CO_2 benefit estimates are transparent, reproducible, believable, & robust**
- CO_2 benefit estimates developed here are simple, straightforward, logical, understandable
- Based on 2 centuries of historical fact
- Substantial CO_2 benefits are direct: Plant growth & agricultural productivity, backed by 1000s of studies
- Indirect CO_2 benefits created by fossil fuels CO_2
- **Extensive literature verifies critical role of fossil fuels** in creating current technology, wealth, & high standards of living

"Fossil fuels reduce poverty." Professor Deepak Lal, UCLA

ECONOMIC IMPLICATIONS OF 2050 CO_2 GOALS



Sources: U.S. Energy Information Administration and Management Information Services, Inc.

Reducing CO_2 emissions to 80% < 1990 levels by 2050 implies reducing 2050 CO_2 emissions (& GDP) to ~ 95% < 2050 forecast levels.

ANOTHER "INCONVENIENT TRUTH"

Coal is major world energy source of past, present, & future:

- **Coal was dominant energy source in 19th century**
- **Coal was world's major energy source in 20th century**. More energy obtained from coal than from oil &, 20th century was really the "coal century," not the "oil century."
- **Coal is world's most rapidly growing energy source in 21st century** & grew 2X > any other energy source over past decade.
- Coal's dominance will continue: **By 2020 coal will become world's largest energy source**, exceeding oil for 1st time since 1960.
- Coal essential to meet the world's rising energy demand, for it comprises 75% of world's recoverable fossil fuel resources.

"Coal is raising living standards and lifting hundreds of millions of people out of poverty." Dr. Fatih Birol, chief economist, IEA

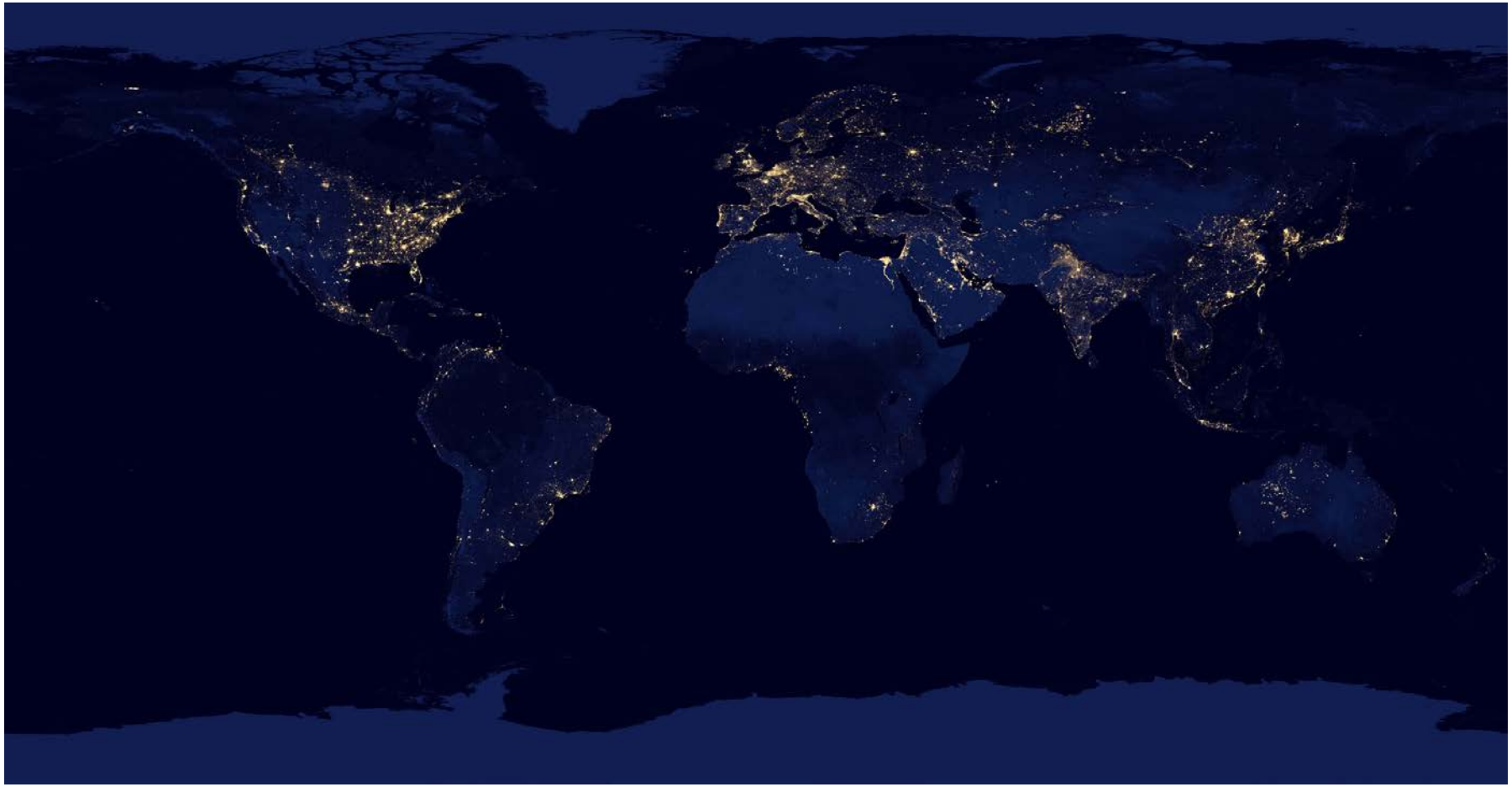
CONCLUSIONS

- CO_2 is demonized & blamed for everything
- IGW's SSC imputes $ costs to CO_2
- However, CO_2 derives from fossil fuels, which are essential to modern life & will remain so in future
- **CO_2 benefits are extremely large compared even to the dubious IWG SCC estimates**
- Thus the B-C ratios are very high and will remain **orders of magnitude larger than any reasonable SCC estimates**
- Federal agencies are required to assess both the costs & benefits of regulations, & B-C estimates are critical
- **Policies designed to artificially reduce fossil fuel use will do much more harm than good & should be avoided**
- This is a truism; an empirical fact – even though to some it may be an inconvenient truth

CARBON BENEFITS > CARBON COSTS BY ORDERS OF MAGNITUDE.

COAL (& OTHER FOSSIL FUELS) REQUIRED TO KEEP THE LIGHTS ON

World at Night



APPENDIX: IWG 2010 SCC ESTIMATES

Original (2010) Social Cost of CO2, 2010 – 2050

(In 2007 dollars per metric ton of CO_2)

Discount Rate	5%	3%	2.5%	3%
Year	Avg	Avg	Avg	95th
2010	4.7	21.4	35.1	64.9
2015	5.7	23.8	38.4	72.8
2020	6.8	26.3	41.7	80.7
2025	8.2	29.6	45.9	90.4
2030	9.7	32.8	50.0	100.0
2035	11.2	36.0	54.2	109.7
2040	12.7	39.2	58.4	119.3
2045	14.2	42.1	61.7	127.8
2050	15.7	44.9	65.0	136.2

Source: Interagency Working Group on Social Cost of Carbon, United States Government, 2010.

APPENDIX: IWG 2013 SCC ESTIMATES

Revised (2013) Social Cost of CO2, 2010 – 2050
(In 2007 dollars per metric ton of CO_2)

Discount Rate Year	5.0% Avg	3.0% Avg	2.5% Avg	3.0% 95th
2010	11	33	52	90
2015	12	38	58	109
2020	12	43	65	129
2025	14	48	70	144
2030	16	52	76	159
2035	19	57	81	176
2040	21	62	87	192
2045	24	66	92	206
2050	27	71	98	221

Source: Interagency Working Group on Social Cost of Carbon, United States Government, 2013.

2013 SCC estimates ~ 30% – 50% > 2010 SCC estimates

FULL REPORT AVAILABLE

THE SOCIAL COSTS OF CARBON? NO, THE SOCIAL BENEFITS OF CARBON

Prepared for the American Coalition for Clean Coal Electricity

By

Management Information Services, Inc.

January 2014

www.misi-net.com/publications/CarbonBenefits-0114.pdf

MANAGEMENT INFORMATION SERVICES, INC.

Management Information Services, Inc. is an economic and energy research firm with expertise on a wide range of complex issues, including energy, electricity, and the environment. The MISI staff offers specializations in economics, information technology, engineering, and finance, and includes former senior officials from private industry, the federal government, and academia. Over the past three decades MISI has conducted extensive proprietary research, and since 1985 has assisted hundreds of clients, including Fortune 500 companies, nonprofit organizations and foundations, the UN, academic and research institutions, and state and federal government agencies including the White House, the U.S. Department of Energy, the U.S. Environmental Protection Agency, the U.S. Energy Information Administration, the U.S. Department of Defense, the U.S. Marine Corps, the U.S. Air Force, NASA, the National Energy Technology Laboratory, the U.S. General Services Administration, and the National Academies of Science.

For more information, please visit the MISI web site at www.misi-net.com.