José Cordeiro, PhD
(www.cordeiro.org)

The Millennium Project
Director, Venezuela Node

Singularity University
NASA Ames, California, USA

Institute of Developing
Economies, Tokyo, Japan

The Energularity: The Future of Energy and the Energy of the Future

La era industrial de la energía y el transporte está a punto de disrupción. Este libro demuestra que la tecnología solar, los vehículos eléctricos y autónomos y otras tecnologías exponenciales están abriendo paso a la nueva era de la energía limpia, basada en el conocimiento.

La Edad de Piedra no se acabó porque nos quedáramos sin piedras. Se terminó porque las rocas fueron desplazadas por una tecnología superior: el bronce. La era de las fuentes de energía centralizadas, de "control y mando", basadas en la extracción de recursos, no se terminará porque nos quedemos sin petróleo, gas natural, carbón o uranio.

Se terminará porque estas fuentes de energías, los modelos de negocio que utilizan, y los productos que las sostienen se volverán obsoletos gracias a tecnologías, arquitecturas de producto y modelos de negocios superiores. Tecnologías exponenciales como la energía solar, eólica, los vehículos eléctricos y autónomos traerán la disrupción y barrerán las industrias de la energía y el transporte tal como las conocemos.

Esta es una disrupción basada en la tecnología, reminiscente de cómo el teléfono móvil, internet o las computadoras personales barrieron industrias como la telefonía fija, la publicación y la fotografía con rollos de película. Así como estas disrupciones voltearon la arquitectura de la información, así la disrupción limpia volteará la arquitectura de la energía y traerá una energía limpia, abundante y participativa. Similarmente la disrupción limpia es inevitable y será rápida. La era industrial de la energía y el transporte se acabará para 2030. O quizá antes.

Disrupción Limpia es un libro visionario sobre la transición energética exponencial de energías fósiles a energías limpias. España ha sido pionera en algunas áreas de energía renovable y podría seguir siendo con una clara visión de futuro. Latinoamérica también podría convertirse en la Arabia Saudita de las energías renovables.
Ramón Tamames, miembro de número de la Real Academia de Ciencias Morales y Políticas, economista, político, y colaborador en prensa y radio.

Disrupción Limpia es un libro realmente revolucionario que visualiza la evolución exponencial de las industrias de la energía y el transporte durante las próximas dos décadas. ¿Serán acertadas las predicciones de Tony Seba una vez más? Sinceramente creo que así será, ¡para el beneficio de toda la humanidad!
José Luis Cordeiro, director del Millennium Project, profesor fundador de Singularity University, autor, y experto en energía y tecnología.

www.tonyseba.com

ISBN: 9780997047103

9 780997 047103

TONY SEBA

DISRUPCIÓN LIMPIA

DISRUPCIÓN LIMPIA

DE LA ENERGÍA Y EL TRANSPORTE

Tony Seba

Cómo Silicon Valley
Hará Obsoletos al Petróleo, Gas Natural, Carbón, Energía Nuclear, Empresas Eléctricas y Vehículos Convencionales para 2030.

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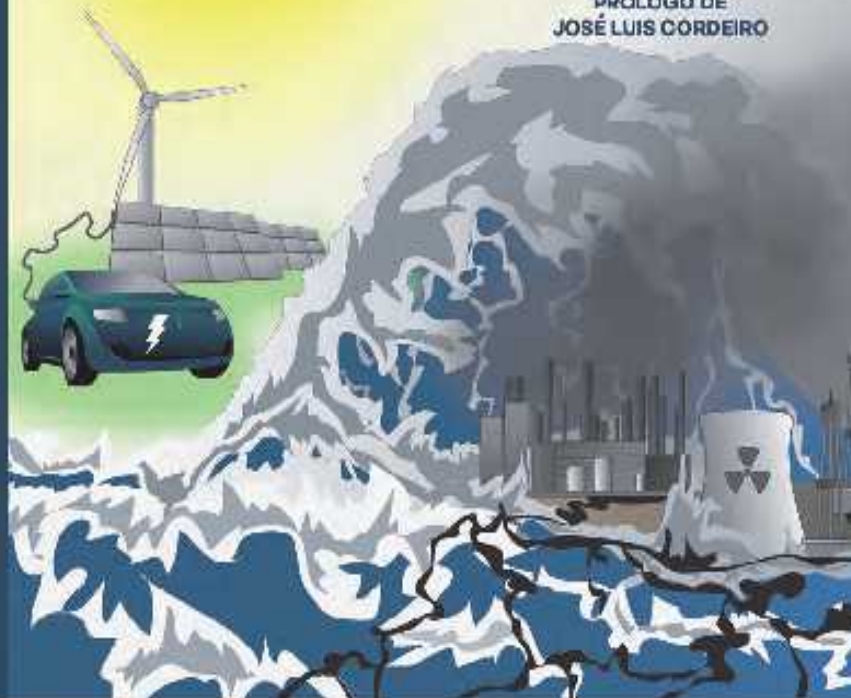
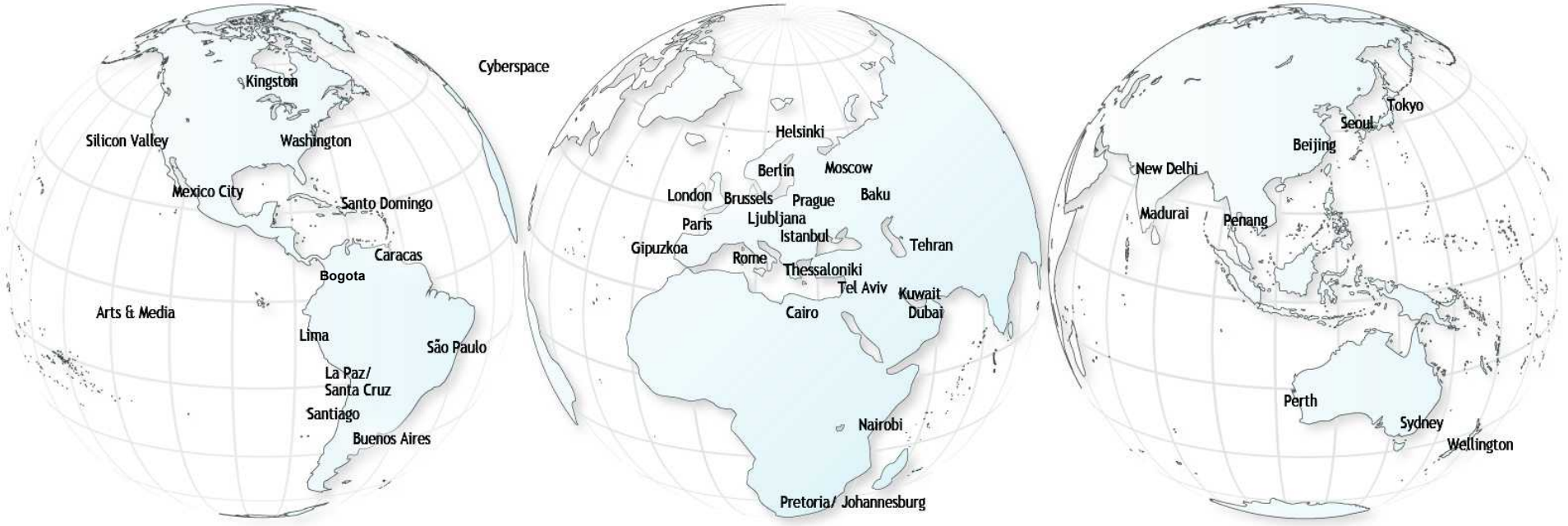
PRÓLOGO DE
JOSÉ LUIS CORDEIRO



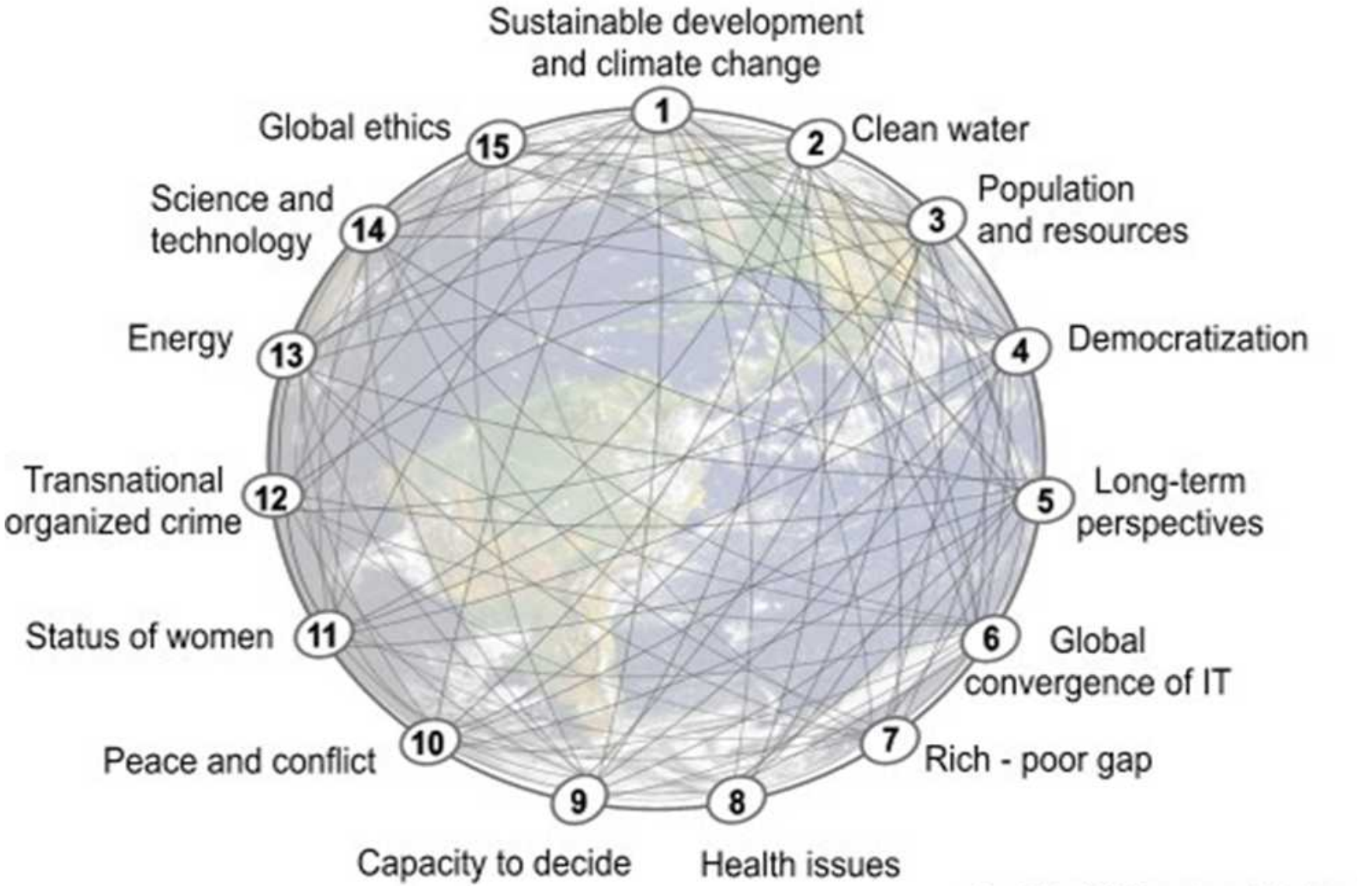
Venezuela: “Piccola Venezia”

The Millennium Project



Global futurist think-tank with over 50 nodes around the world

15 Global Challenges



2015-16 State of the Future

by Jerome C. Glenn, Elizabeth Florescu, and The Millennium Project Team

Pages: 289; includes some 40 graphs

ISBN: 978-0-9882639-2-5

Library of Congress Control Number: 98-646672

The ***2015-16 State of the Future*** is a comp
potentials for the future, and actions and poli
unparalleled breadth and depth. "It is time fo
high to tolerate business as usual", warns the

A lucid, thought-provoking, strategically orien
Mihaly Simai, former Chairman, Unite

*The **State of the Future** can make a differe*
Wendell Bell, Professor Emeritus, Yale

Global intelligence on the future of the world
KurzweilAI News

So important for many people around the wo
Eleonora Masini, former Secretary an

Absolutely worth the reader's time... takes th
Defense & Foreign Affairs Policy Journ

Strategic Planning for the Planet... remarkabl
Willian Halal, *Foresight Journal*

The Millennium Project

2030 LATINO AMERICA

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The Millennium Project

Una lectura fascinante para cualquiera que se pregunte como será el mundo en el año 2030, y más allá.
Andrés Oppenheimer, Columnista del *Miami Herald* y coganador del Pulitzer Prize (Argentina)

Latinoamérica 2030 ofrece escenarios útiles al pensamiento y a la acción volcados a superar los grandes desafíos de la región, en su relación con el mundo global.
Fernando Henrique Cardoso, Expresidente (Brasil)

Esta publicación del Millennium Project es un aporte muy relevante que debería ser consultada por académicos, políticos, empresarios y todos aquellos interesados en contribuir a mejorar las condiciones de vida en nuestros países.
Eduardo Frei Ruiz-Tagle, Expresidente (Chile)

Información invaluable para el futuro de las Naciones Unidas, sus estados miembros y la sociedad civil.
Ban Ki-moon, Secretario General de las Naciones Unidas (Corea del Sur)

La idiotez latinoamericana es como la materia: no se destruye, sino se transforma. Esperemos que las próximas dos décadas no sirvan para repetir los errores de las décadas pasadas.
Carlos Alberto Montaner, Escritor y periodista galardonado (Cuba)

Una visión a largo plazo, de una Latinoamérica en continuidad desde Canadá pasando por Illinois, Nueva York, Florida y todo el suroeste de EUA, para llegar a la Tierra del Fuego.
Ramón Tamames, Político y economista galardonado (España)

Una lectura obligatoria para cualquier tomador de decisión con visión de futuro.
Enrique Peña Nieto, Presidente (México)

Durante años Latinoamérica ha vivido fascinada con el pasado. Para quienes creemos que es hora de fascinarnos con el futuro y hacerlo nuestro de una buena vez, este libro es una herramienta imprescindible.
Álvaro Vargas Llosa, Politólogo y escritor galardonado (Perú)

Latinoamérica 2030 constituye una importante y rica herramienta de trabajo, que nos permite visualizar los escenarios posibles y plausibles que el futuro depara a nuestra región.
Leonel Fernández, Expresidente (República Dominicana)

Un libro fascinante para pensar y repensar el futuro de la región.
Diego Arria, Ex Secretario General Adjunto de las Naciones Unidas (Venezuela)

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2030 LATINO AMERICA

ATINOAMÉRICA, SEGÚN TRUMP

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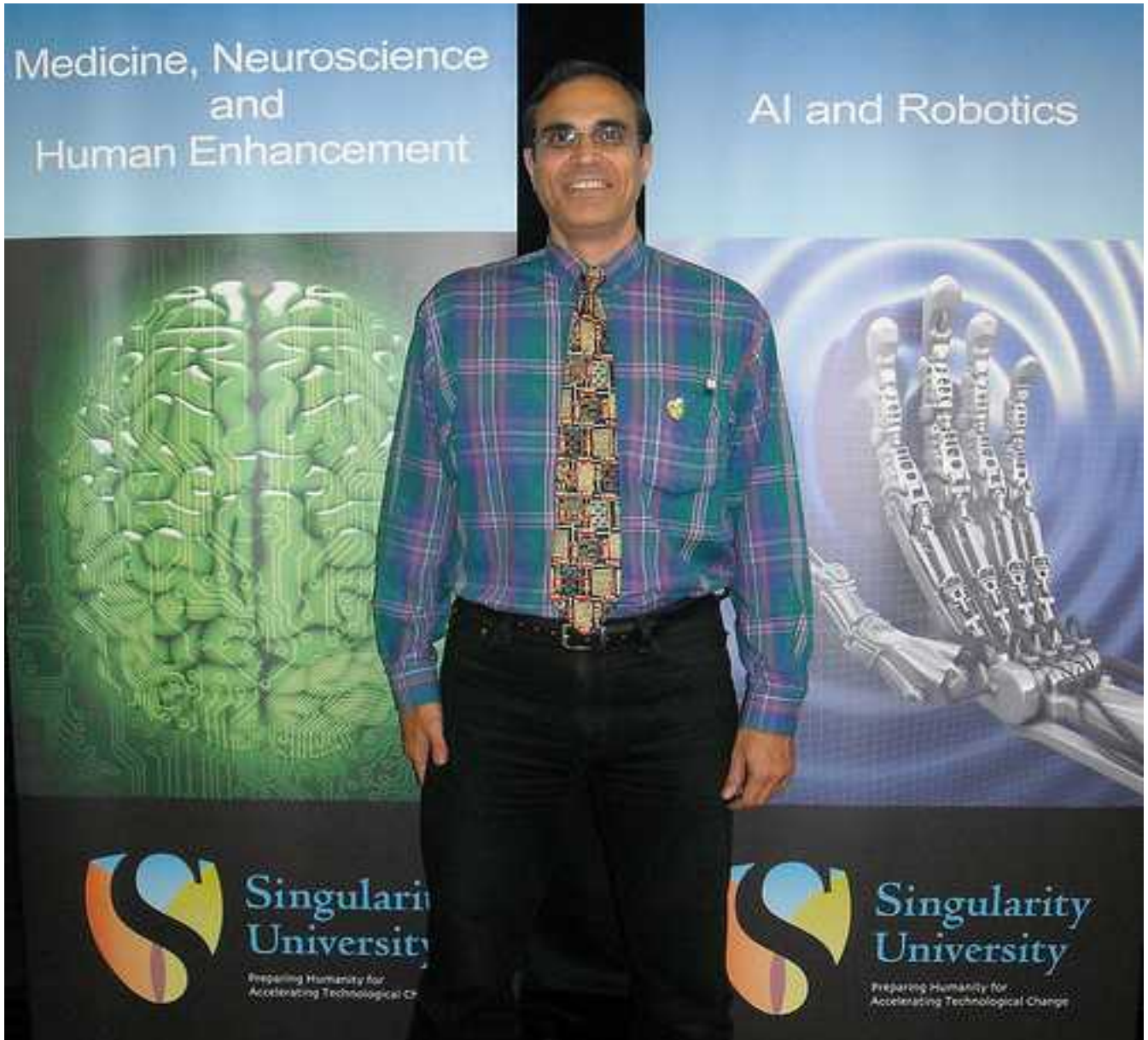


FEBRUARY 21, 2011

Revolution in Egypt

Joe Klein: What the U.S. should do
On the Street: Hope meets anxiety
Muslim Brotherhood: What it wants

Oscars: Portraits of star power

TIME

2045

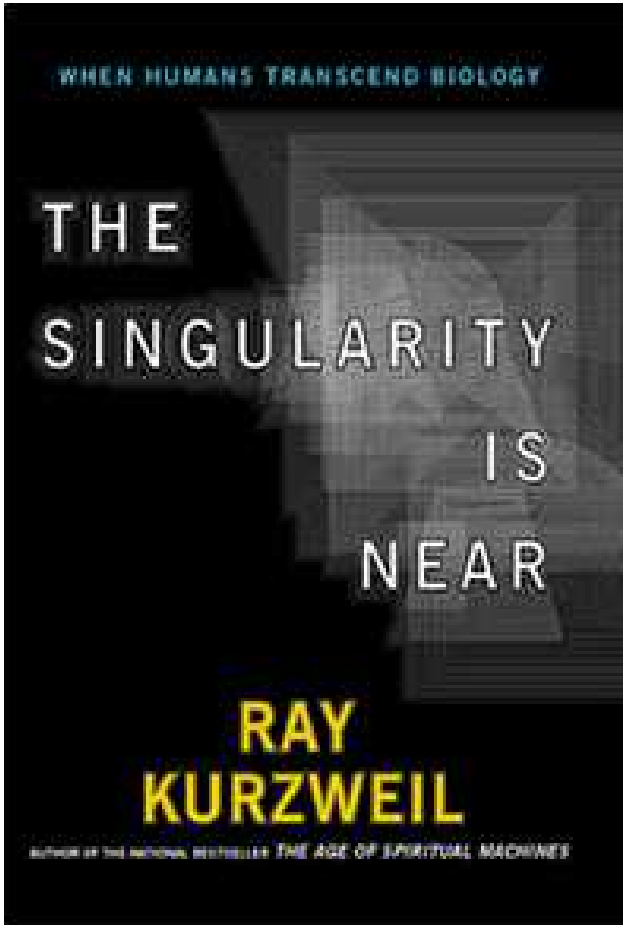
The Year Man Becomes Immortal*

BY LEV GROSSMAN

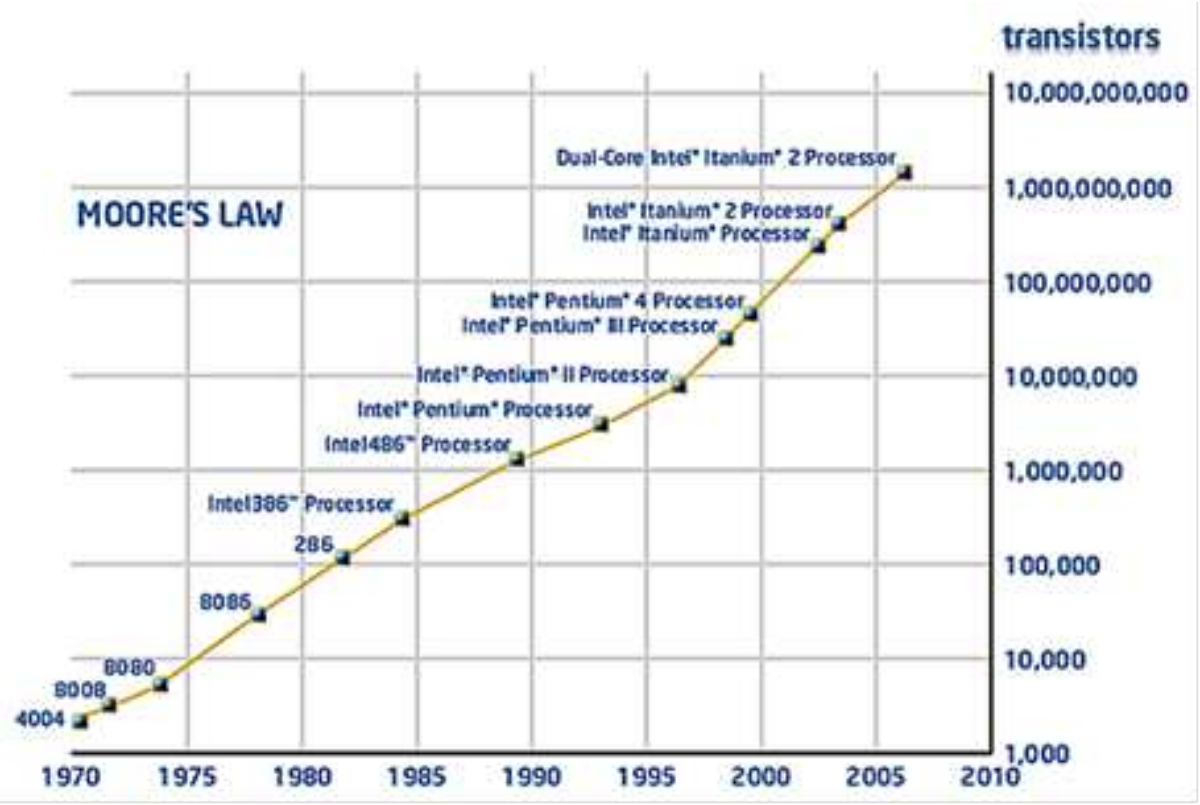
*If you believe humans and machines will become one. Welcome to the Singularity movement

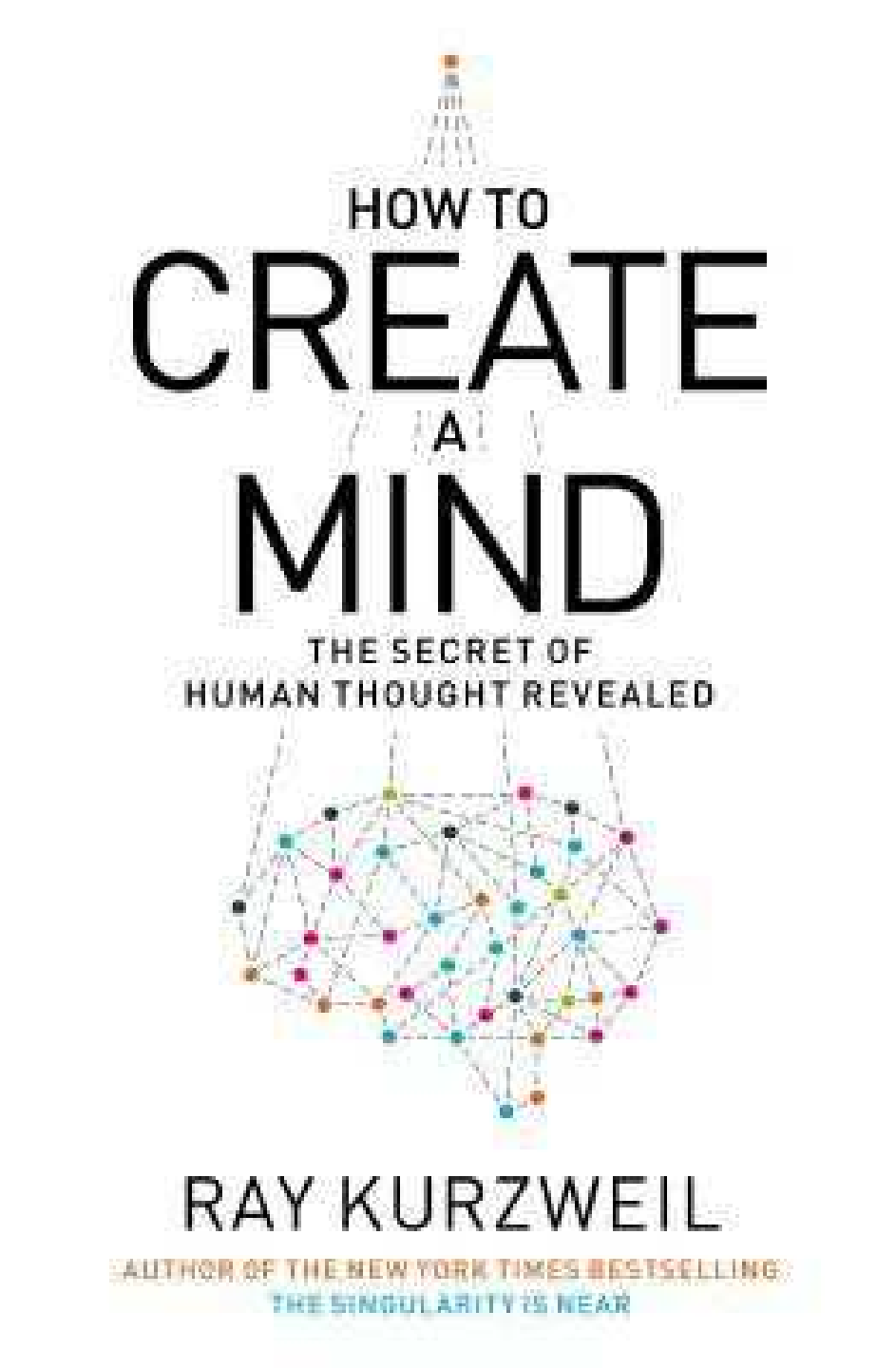
www.time.com

Ray Kurzweil (MIT):
The Singularity is Near



- **www.singularity.com**
- **Bill Gates**





Ray Kurzweil

Cómo crear una mente

El secreto del pensamiento humano

lola books

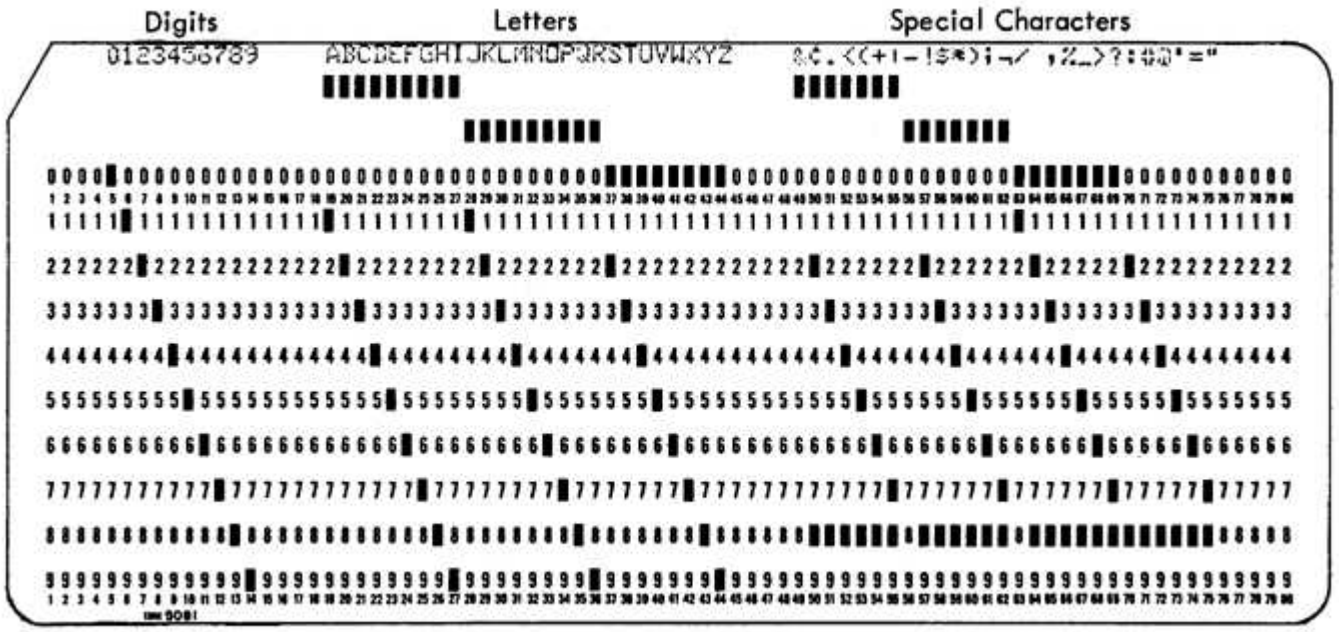
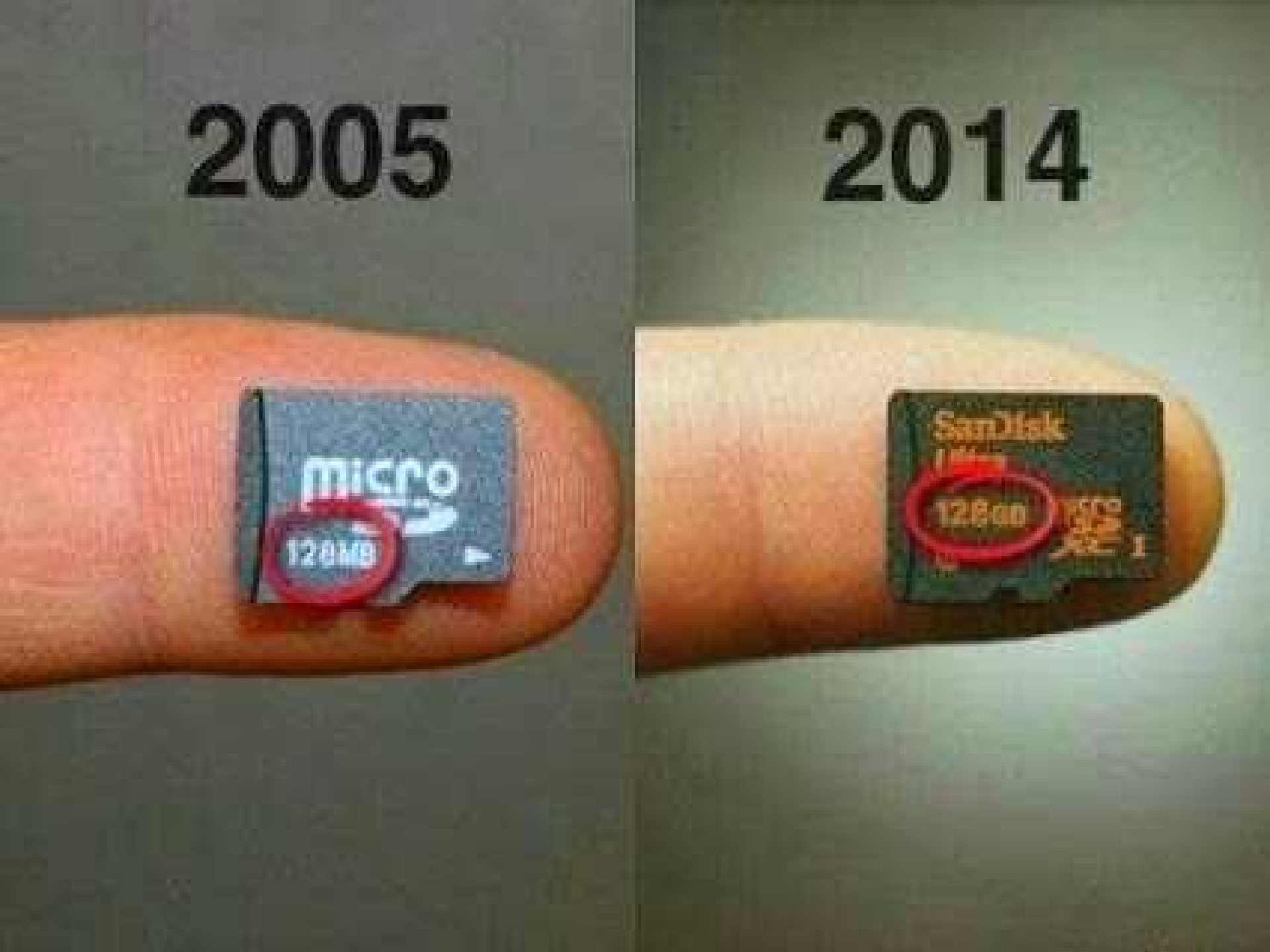


Figure 4. Card Codes and Graphics for 64-Character Set

2013 WAKE UP!


2005
micro
128MB
2014
SanDisk
128GB

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health and traits

Clinical Reports

Research Reports

ancestry

Maternal Line

Paternal Line

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genome sharing

Manage Sharing

Compare Genes

Family Inheritance

23andWe

My Surveys (24)

Our Research Mission

Featured Research

community

23andMe Community

Parkinson's Disease

Pregnancy

account

health and traits

These tables list those clinical reports we consider most notable based on your genetic information.
Move your mouse over the colored bars or icons for a glance at your data. Click the name of any disease or trait for your full report.

Clinical Reports

Research Reports (86)

Show data for: Jose Cordeiro

Disease Risks

Age-related Macular Degeneration	
Celiac Disease	
Psoriasis	
Type 2 Diabetes	
Prostate Cancer ♂	
1 locked report	

See all 10 risk reports...

Carrier Status

Alpha-1 Antitrypsin Deficiency	Variant Absent
Bloom's Syndrome	Variant Absent
Cystic Fibrosis (Delta F508 mutation)	Variant Absent
G6PD Deficiency	Variant Absent
Glycogen Storage Disease Type 1a	Variant Absent
1 locked report	

See all 8 carrier status...

Traits

Alcohol Flush Reaction	Does Not Flush
Bitter Taste Perception	Can Taste
Earwax Type	Wet
Eye Color	Likely Brown
Lactose Intolerance	Likely Tolerant

Drug Response

Warfarin (Coumadin®) Sensitivity	Increased
Clopidogrel (Plavix®) Efficacy	Typical

my home

health and traits
Clinical Reports
Research Reports

ancestry
Maternal Line
Paternal Line
Ancestry Painting
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genome sharing
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account
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paternal line

Your Y chromosome DNA determines your paternal haplogroup. What is a haplogroup?

Map | History | Haplogroup Tree

Your paternal haplogroup may have changed. This is due to a recent update to our paternal haplogroup tree. Find out more about this feature improvement at the Spittoon.

Paternal Haplogroup: R1b1b2a1a2

R1b1b2a1a2 is a subgroup of R1b1b2, which is described below.

Locations of haplogroup R1b1b2 circa 500 years ago, before the era of intercontinental travel.

R1b1b2 is the most common haplogroup in western Europe, where its branches are clustered in various national populations. R1b1b2a1a2b is characteristic of the Basque, while R1b1b2a1a2f2 reaches its peak in Ireland and R1b1b2a1a1 is most commonly found on the fringes of the North Sea.

Human Prehistory Video

Haplogroup: R1b1b2, a subgroup of R1b1b

Age: 17,000 years

Region: Europe

Populations: Irish, Basques, British, French

Highlight: R1b1b2 is the most common haplogroup in western Europe, with distinct branches in specific regions.

Your Family and Friends

D2a1	Japanese Person
E1b1a8a..	Nigerian Person
N	Chinese Person
R1b1b2a..	Jose Cordeiro

Famous People

C3	Genghis Khan

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health and traits
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Parkinson's Disease
Pregnancy

maternal line

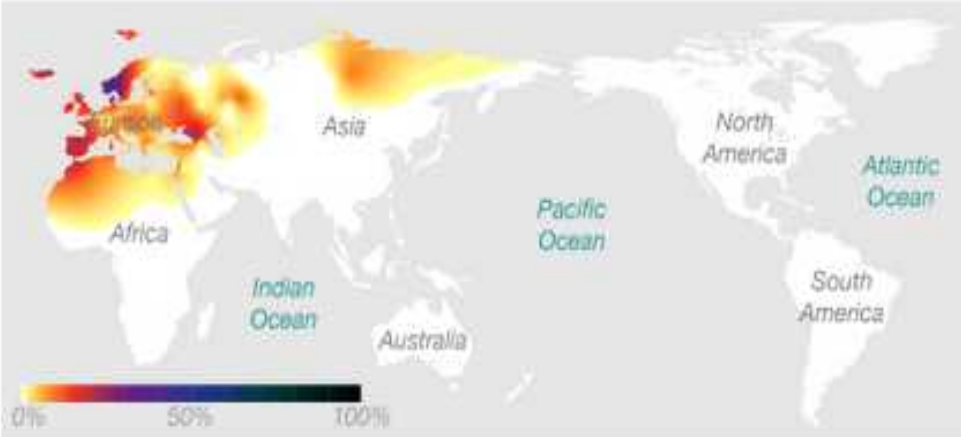
Your mitochondrial DNA determines your maternal haplogroup. What is a haplogroup?

Map | History | Haplogroup Tree

Maternal Haplogroup: H1*

H1* is a subgroup of H1, which is described below.

Locations of haplogroup H1 circa 500 years ago, before the era of intercontinental travel.



Haplogroup H1 is widespread in Europe, especially the western part of the continent. It originated about 13,000 years ago, not long after the Ice Age ended.

Haplogroup: H1, a subgroup of H

Age: 13,000 years

Region: Europe, Near East, Central Asia, Northwestern Africa

Populations: Spanish,Berbers,Lebanese

Highlight: H1 appears to have been common in Doggerland, an ancient land now flooded by the North Sea.

Your Family and Friends

D4e2	Japanese Person
D5a2	Chinese Person
H1*	Jose Cordeiro
L3e	Nigerian Person

Famous People

H	Marie Antoinette

Human Prehistory Video

Human Prehistory: Prologue

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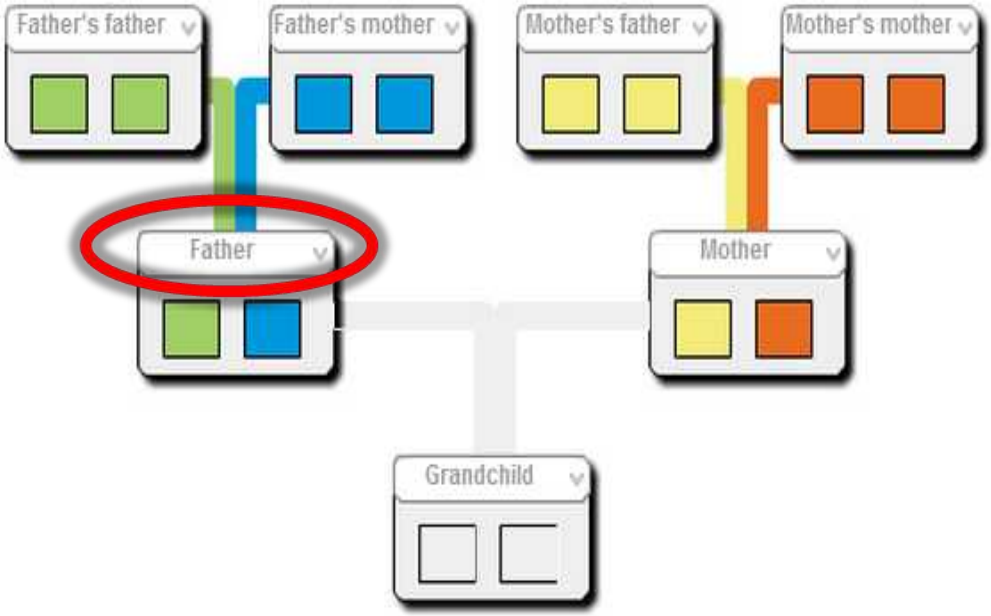
Featured Research

family inheritance

Genome View | GrandTree | Inheritance Calculator

Tell me how to use this feature...

Please select a grandchild for comparison.
Click on the down-arrow labeled "Grandchild" in the bottom box of the family tree.



Click on a trait for comparison:

Genome-Wide Comparison
Comparison across all of the genome data

Bitter Tasting
Genes related to bitter tasting

Circadian Rhythm
Genes related to regulating your internal clock

Endurance
Genes related to physical endurance

Female Fertility
Genes related to fertility in women

Immune System Compatibili

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Senior Games

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Inbox (1)
My Profile
Settings
Browse Raw Data

family inheritance

Genome View | GrandTree | **Inheritance Calculator**

Find out what traits (phenotypes) and genotypes a child might have based on the selected pair of parents.

 Jose Cordeiro +  Bj Price = Offspring's Possible Traits
How are these calculated?

Alcohol Flush Reaction

View Your Alcohol Flush Reaction Report

GG + GG

100% Little or no flush (GG)
0% Moderate flush
0% Extreme flush

Bitter Taste Perception

View Your Bitter Taste Perception Report

GG + CG

100% Bitter taster (GG, CG)
0% Non-bitter taster

Earwax

View Your Earwax Report

CC + CC

100% Wet earwax (CC)
0% Dry earwax

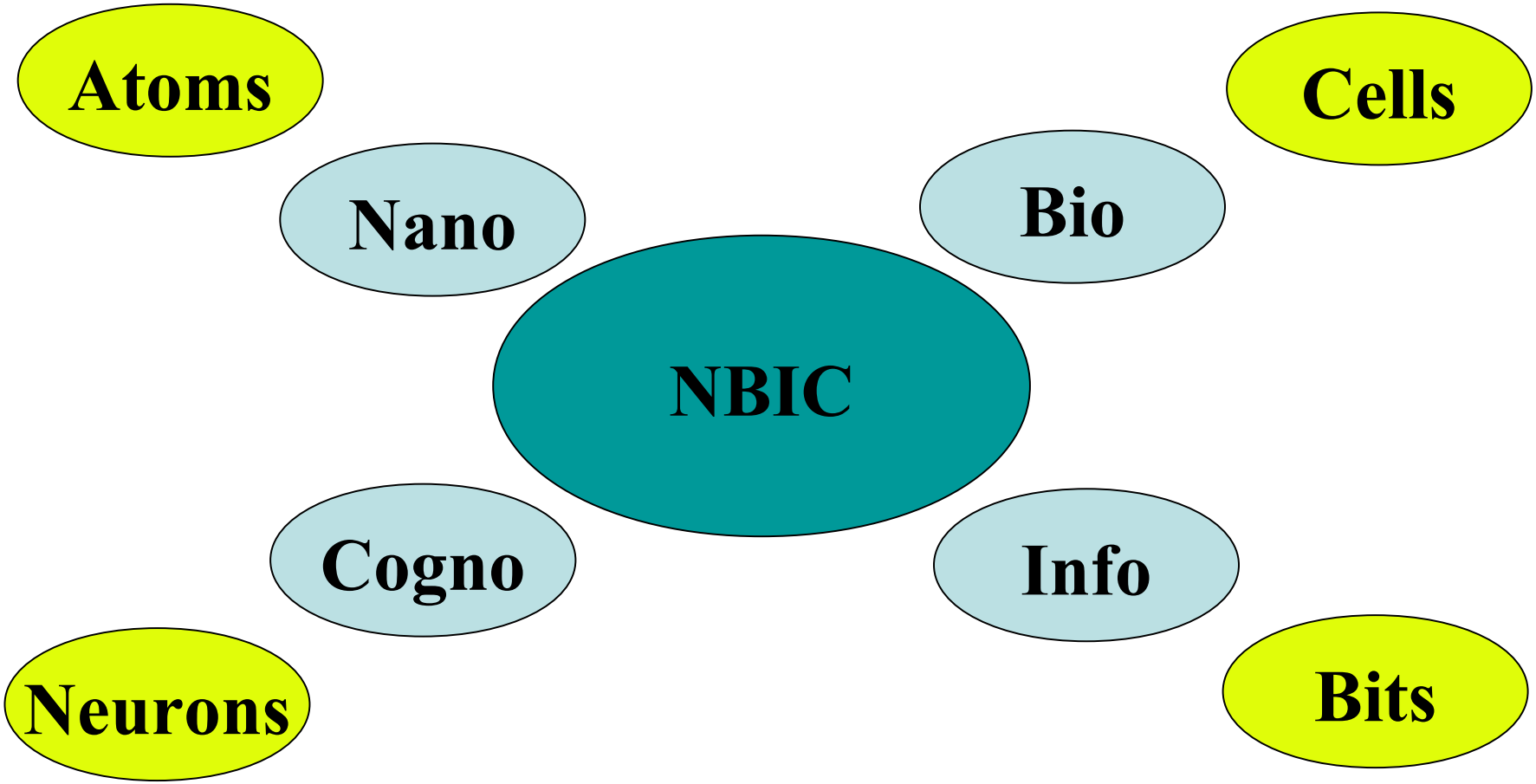
Eye Color

View Your Eye Color Report

AA + AG

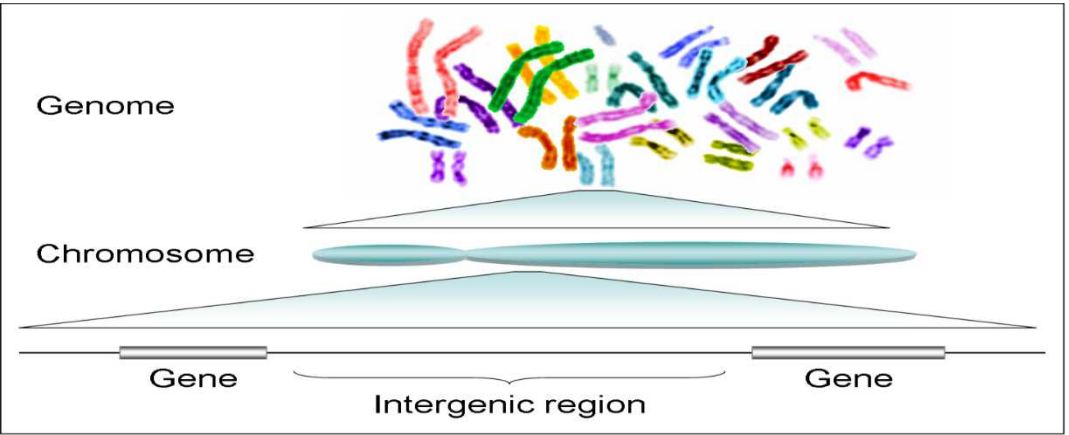
71% Brown/Black eyes (AA, AG)
26% Green/Hazel eyes (AA, AG)
4% Blue/Gray eyes (AA, AG)

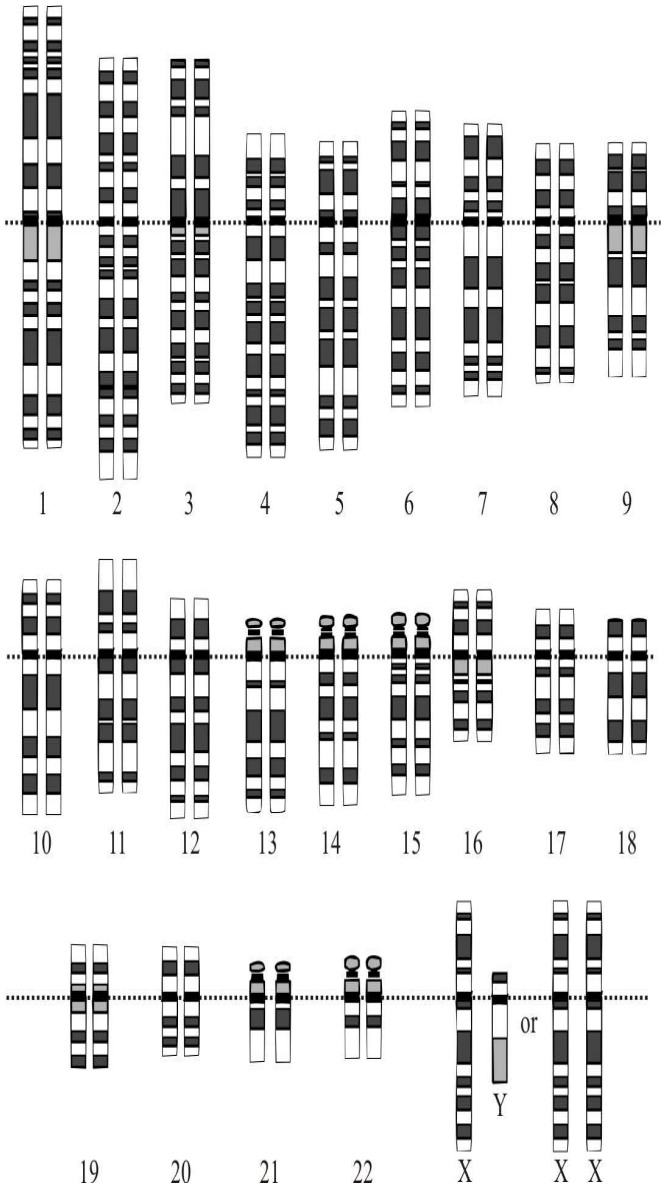
Technological Convergence NBIC



Synthetic biology is born

- Variola virus (smallpox)
  - Genes: 197
  - Base pairs: 185,000
- Mycoplasma genitalium (bacteria)
  - Genes: 485
  - Base pairs: 580,000
- Homo sapiens sapiens
  - Genes: ~25,000
  - Base pairs: **~3,000,000,000**



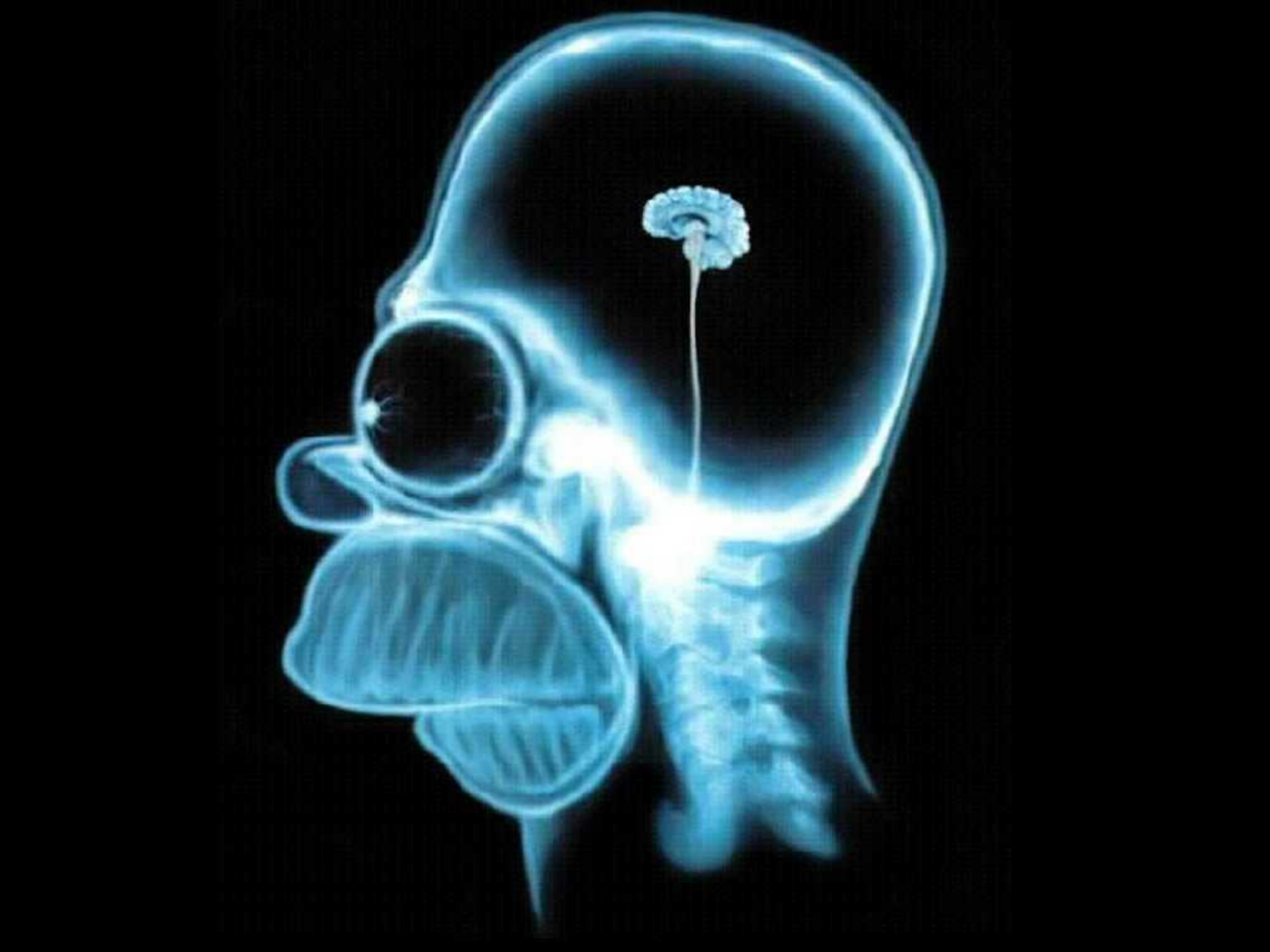


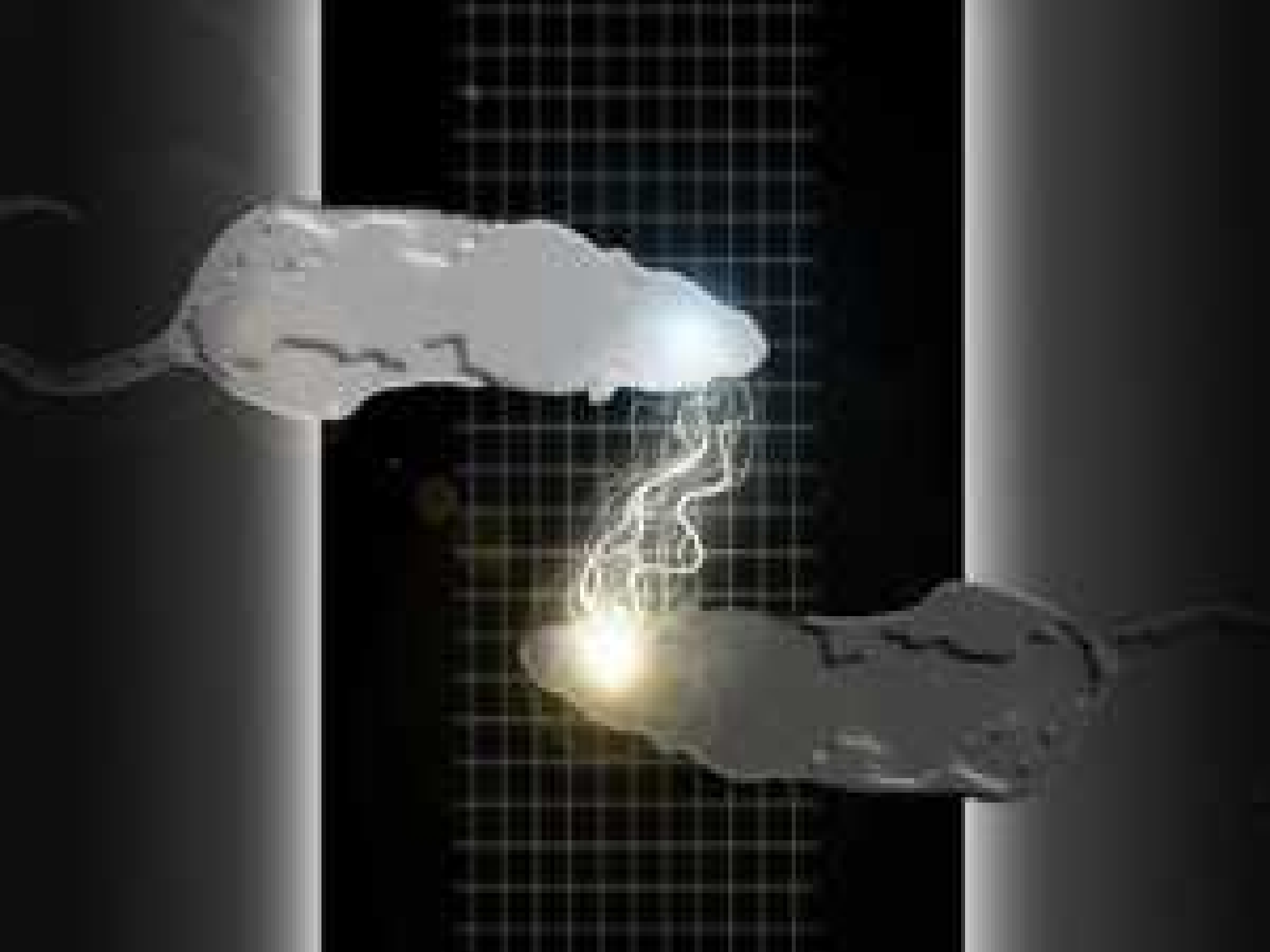
Sequencing the genome: cost and time

Year	Cost (US$)	Time
2003	1,000,000.000	13 years
2007	100,000,000	4 years
2008	1,000,000	2 months
2010	10,000	4 weeks
2015	1,000	5 days
2020	100	1 hour
2025	10	1 min

What is a brain?

- 1 brain
- 10^{11} neurones
- 10^{14} synapsis
- 10^{17} computations (per second)
- And the mind?
- And the spirit?
- And the soul?





External brain implants


mindwave
Decades of Laboratory EEG
Technology Research
for under $100
NeuroSky

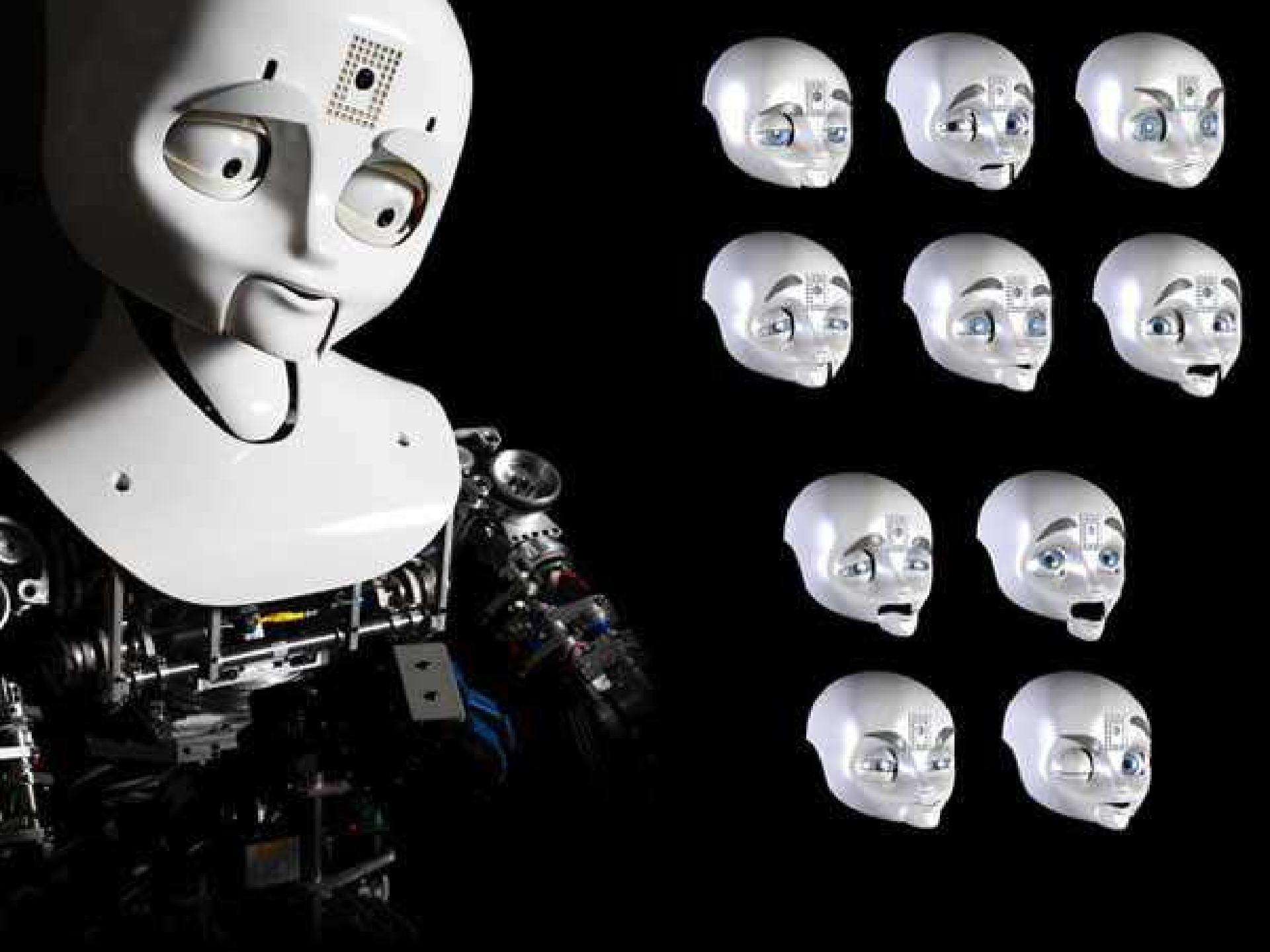
emotiv

you think, therefore, you can

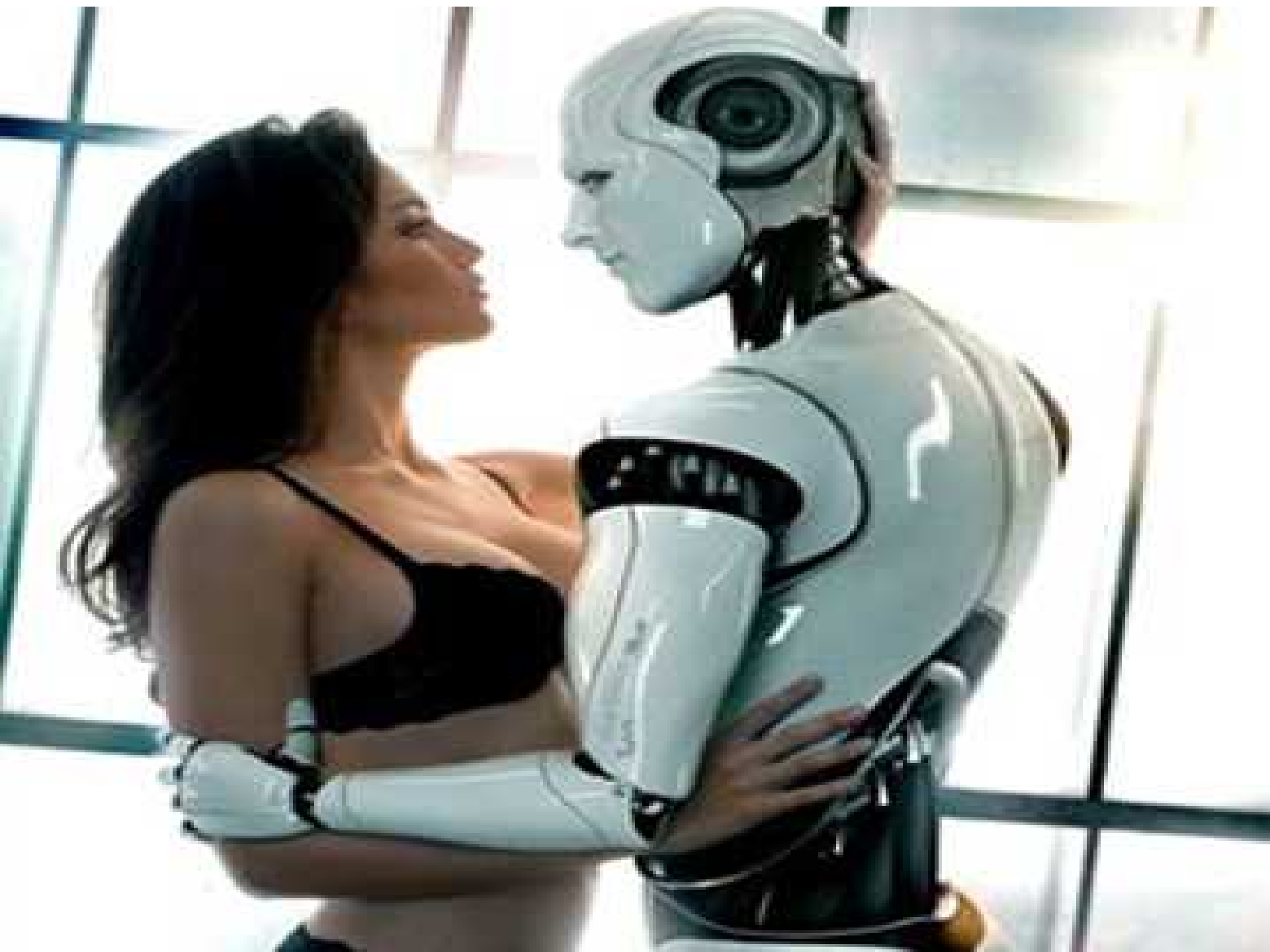
Robots in Japan and Korea

Asimo (Honda) evolution


ASIMO




Valiant

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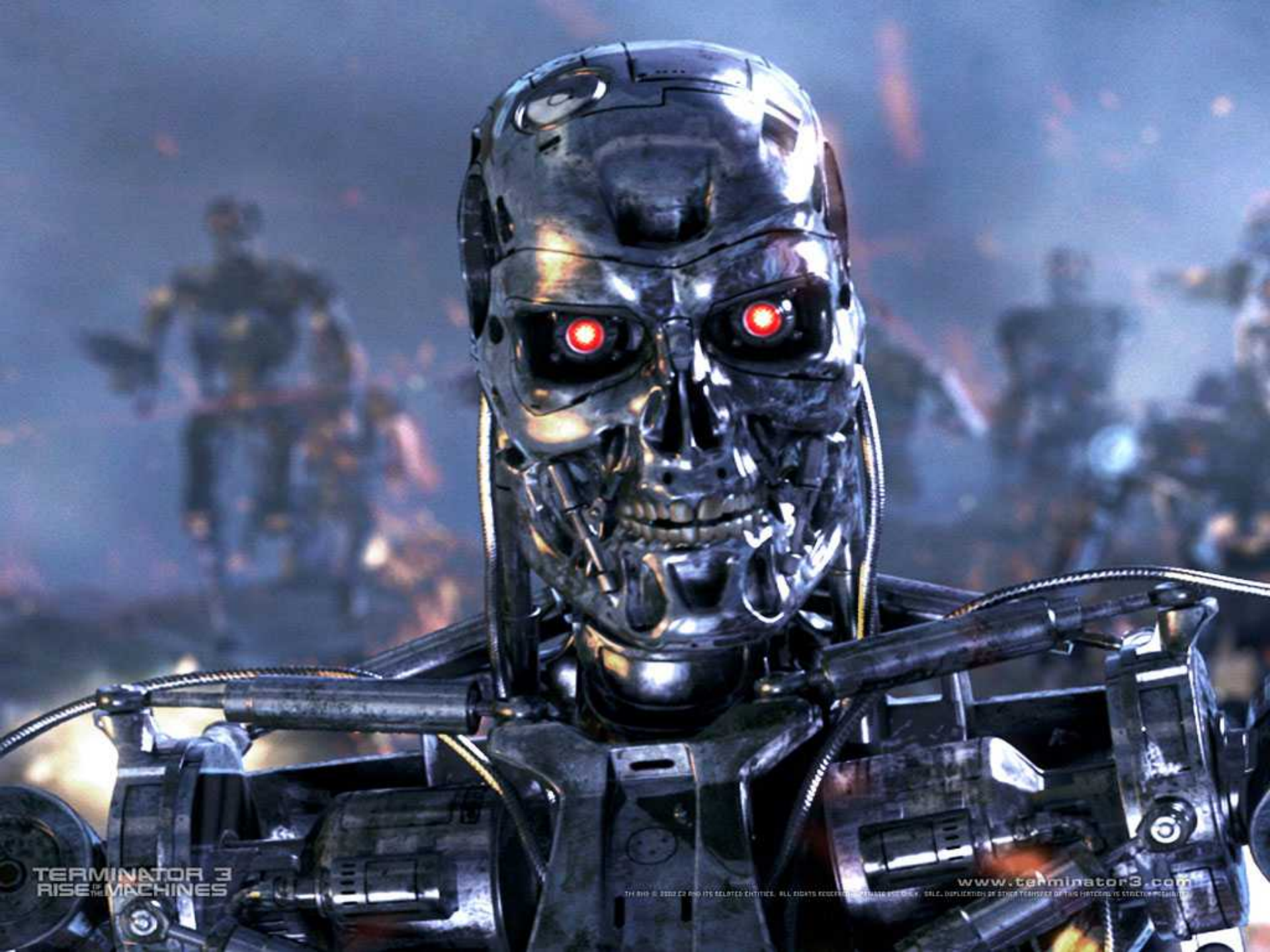
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RISE OF THE MACHINES
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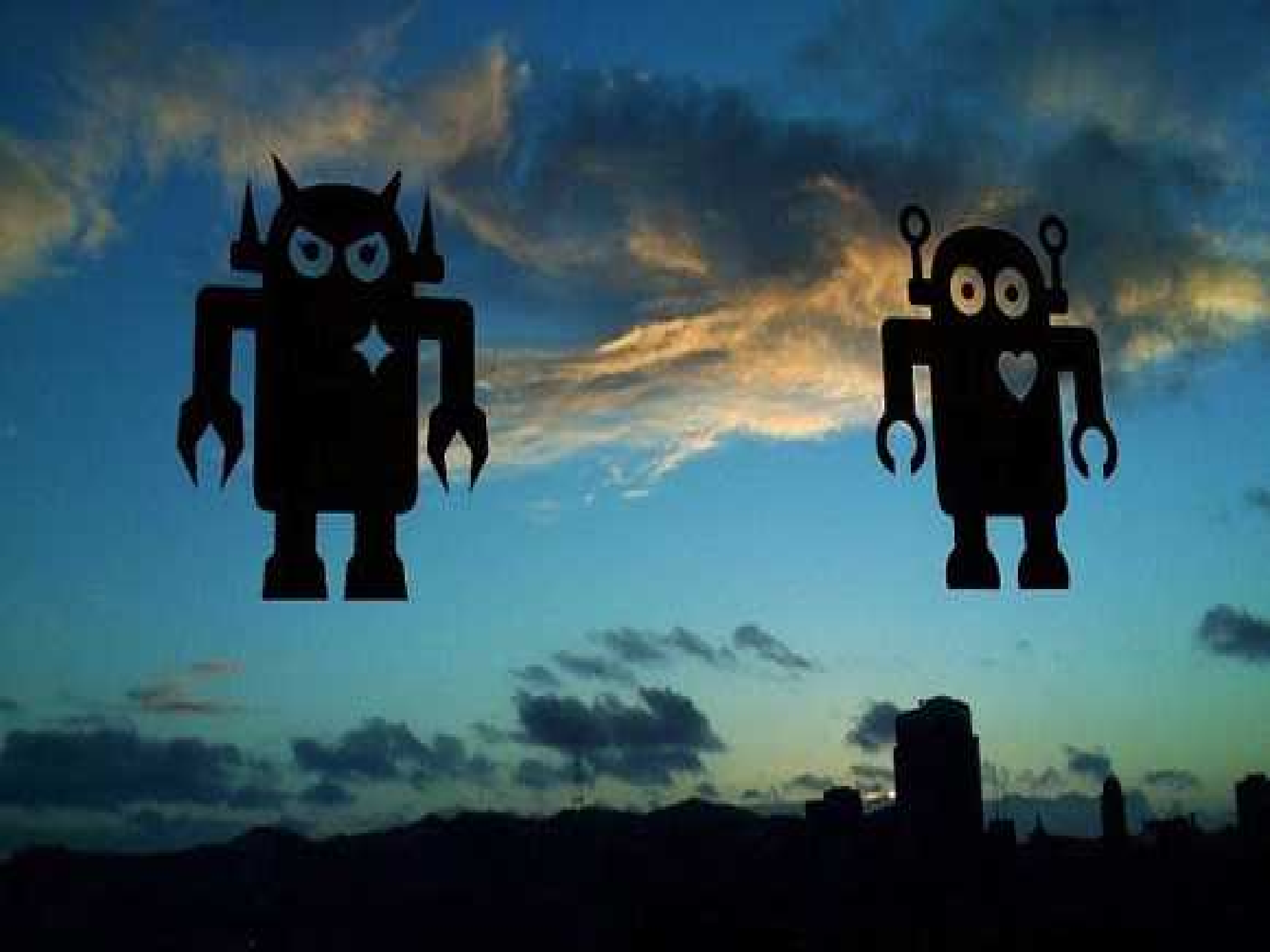
TERMINATOR 3
RISE OF THE MACHINES
THE WAR BEGINS JULY 2



Robots are good in Japan

Exponentially

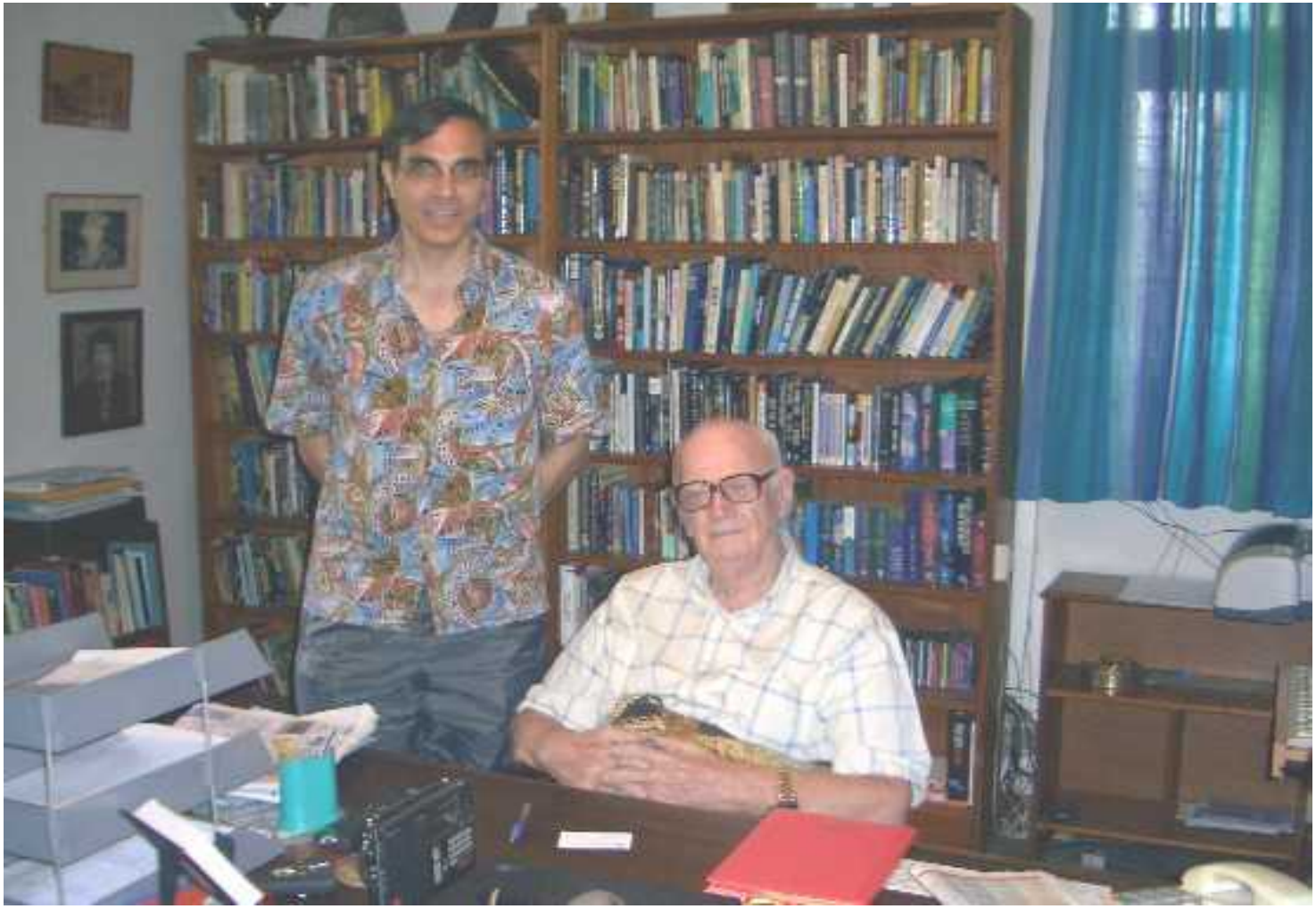
Faster

Smaller

Cheaper

Better

Sir Arthur C. Clarke with Jose Cordeiro



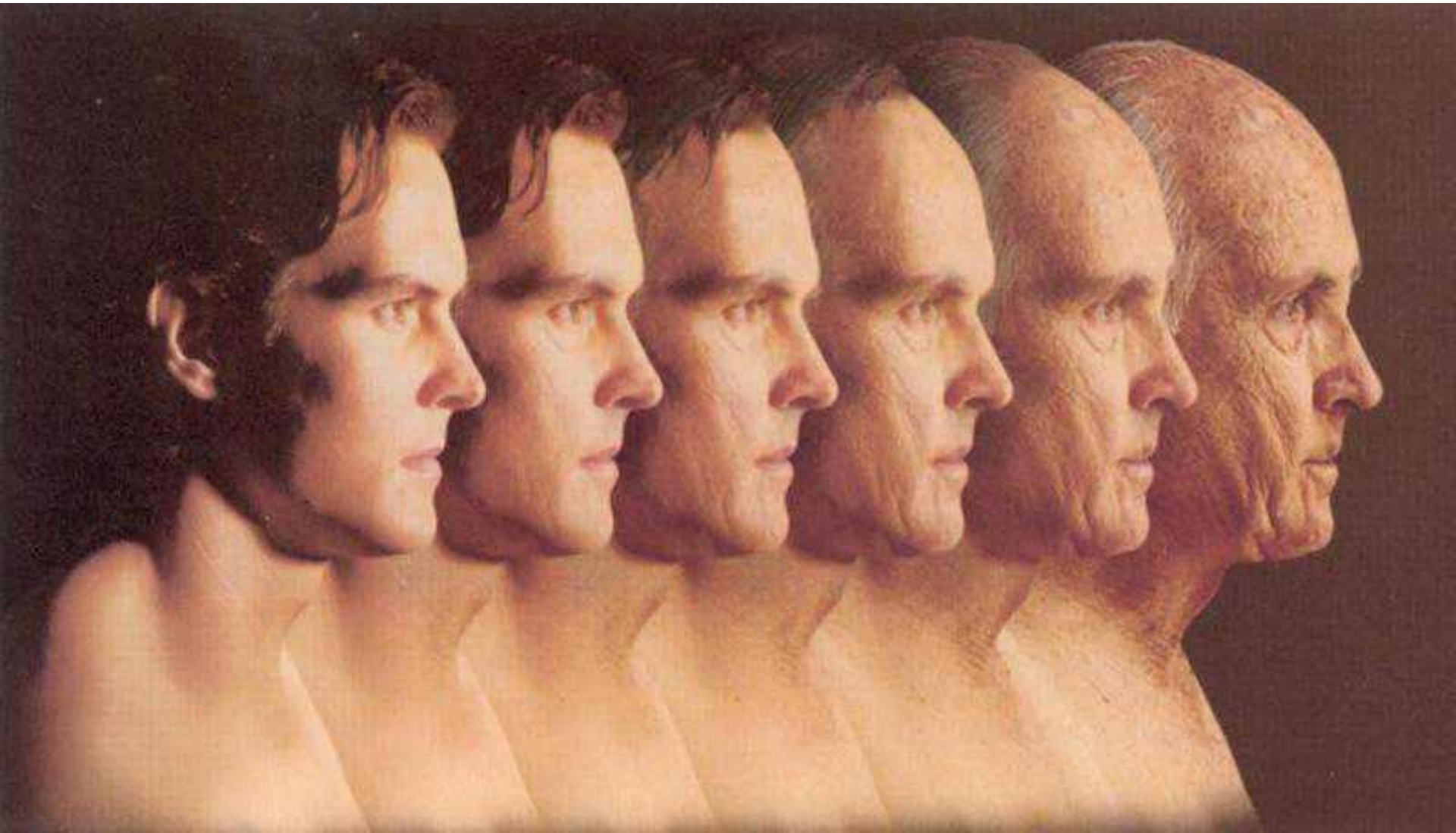
The Three Laws of Sir Arthur C. Clarke

- First Law: When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is very probably wrong.
- Second Law: The only way of discovering the limits of the possible is to venture a little way past them into the impossible.
- Third Law: Any sufficiently advanced technology is indistinguishable from magic.

Technologies of the "past"

- 30 years ago
  Personal computers
- 20 years ago
  Cell phones
- 10 years ago
  Google
- What will happen in 10 years? In 20 years? In 30 years?
  Immortal (ageless) cells!

Aging as a disease? And curable?



My Bridge 4 Life™
NewOrgan Prize
Mprize
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– History of Science Prizes
– Current Competitions
– Meet the Competitors
– Latest Mprize Winners
– How to Compete
– Scientific Advisory Board
Investing in the Future

Mprize
METHUSELAH FOUNDATION

The Mprize, introduced in 2003, is designed to directly accelerate the development of revolutionary new life extension therapies. The prize pot continues to grow through donations; awards are made whenever a research team extends the life of mice. There are two categories of cash prizes:

- **Longevity** - to the research team that breaks the world record for the oldest-ever mouse
- **Rejuvenation** - to the team that develops the most successful late-onset rejuvenation that extends the life of the mice

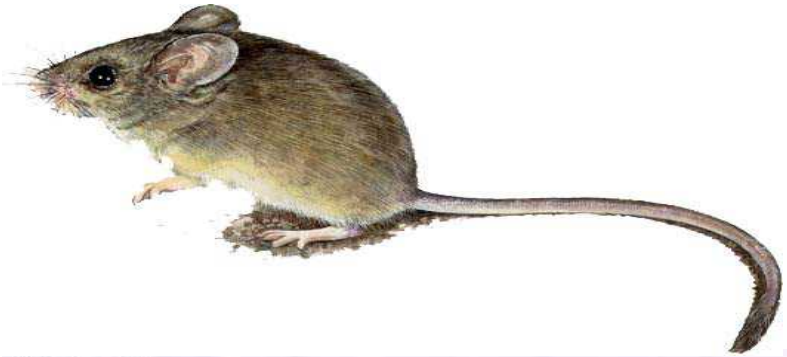
The prize makes it possible to attract scientists from major universities Andrzej Bartke, Southern Illinois Un who headed the team that holds the longevity and Dr. Stephen Spindler, Ur of California, the prize holder for rejuv In 2009 the first Special Mprize Achievement Award went to Dr. Z. Da for the successful healthy life exte already aged mice using a pharma rapamycin.

Meet the Competitors

Competition Rules and Application

Scientific Advisory Board: Meet the pr scientists who share our vision and enh ability to change the future of aging.

Life extension results: today, now!



x 3 times

x 4 times

x 6 times

Physical Immortality: Death of Death

1. Germinal cells (good)

2. Cancer cells (bad)

TIME

CAN Google SOLVE DEATH?

The search giant is launching a venture to extend the human life span.

That would be crazy—if it weren't Google

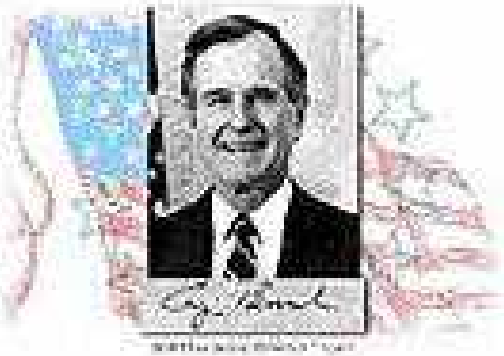
By Harry McCracken and Lev Grossman

Silicon Valley Investor Backs $1 Million Prize to End Death

September 14, 2014

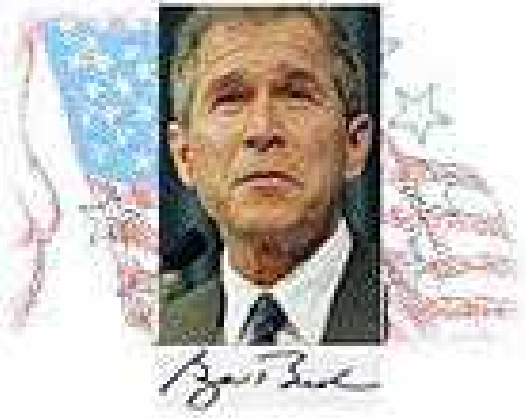
ENERGY

US$ 8 TRILLIONS



"We Shell not

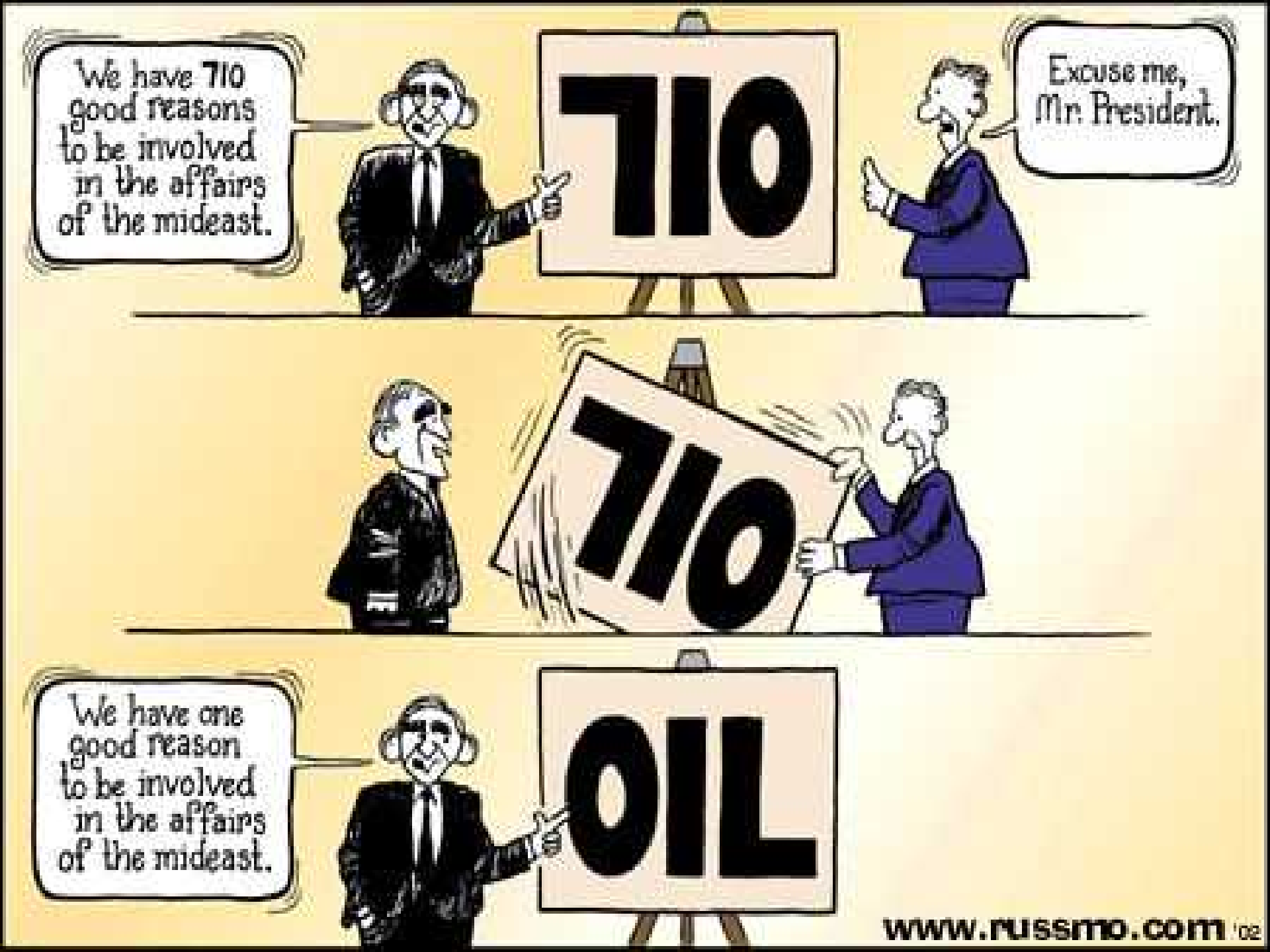
EXXONerate Saddam



Hussein for his actions. We will

Mobilize to meet this threat to vital interests in the Persian Gulf until an AMOCO ble solution is reached. Our best strategy is to BP repared.

Failing that, we ARCO ming to kick your ass."


We have 710 good reasons to be involved in the affairs of the mideast.
710
Excuse me, Mr. President.
710
We have one good reason to be involved in the affairs of the mideast.
OIL
www.russmo.com '02

NATIONAL ACADEMY OF ENGINEERING
OF THE NATIONAL ACADEMIES

CHALLENGES
GIVE US YOUR THOUGHTS

IDEAS
WORLD NEEDS

NEXT STEPS
TECHNOLOGIES, IDEAS AND RESEARCH

COMMITTEE
ROLE AND BIOGRAPHIES

GRAND CHALLENGES FOR ENGINEERING

Engineering's Grand Challenges

WHAT DO YOU THINK?

Click on the engineering challenge you think is the most important:


Make solar energy economical


Provide energy from fusion


Develop carbon sequestration methods


Manage the nitrogen cycle


Provide access to clean water


Restore and improve urban infrastructure


Advance health informatics


Engineer better medicines


Reverse-engineer the brain

COMMITTEE MEMBER SPOTLIGHT

LARRY PAGE

CO-FOUNDER AND PRESIDENT, PRODUCTS

Larry Page, a founder and first chief executive officer of Google Inc., continues to share responsibility for Google's day-to-day operations. Mr. Page graduated with honors from the University of Michigan, where ...

"The world needs to invest a lot more in energy R&D to provide the breakthroughs that can get down to near-zero carbon emissions in the next 75 years."

Bill Gates

WATCH VIDEO »

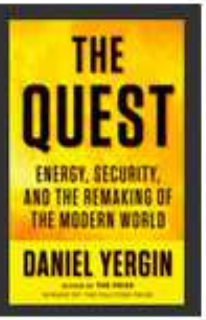
THE WALL STREET JOURNAL.
ECO:nomics
CREATING ENVIRONMENTAL CAPITAL

Energy innovation is key

The risk of climate change and its impact on the world's poorest people really makes finding new, cleaner energy sources incredibly urgent and necessary.

"...a valuable guide to the complex factors shaping the world's energy needs..."

READ BOOK REVIEW »



An expert looks at a complex issue

TED: We need an energy miracle

A conversation with Vinod Khosla

EcoMotors: A new combustion engine

Innovation at the L.A. Auto Show

The MITEI mission

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> Energy faculty
> Major energy studies and reports
> Energy classes
> Student groups
> Opportunities in Energy
> Spotlight archive
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> MITEI Members
> Members log in

Efficiency Forward: Ambitious collaboration between MIT and NSTAR aims to cut campus electricity use by 15 percent over 3 years.

In what could serve as a model for achieving large-scale energy-efficiency improvements, MIT and Boston-based utility NSTAR on Wednesday announced an ambitious collaboration that aims to slash the Institute's electricity use by 15 percent over the next three years.

Full spotlight >

Towards a post-petroleum world

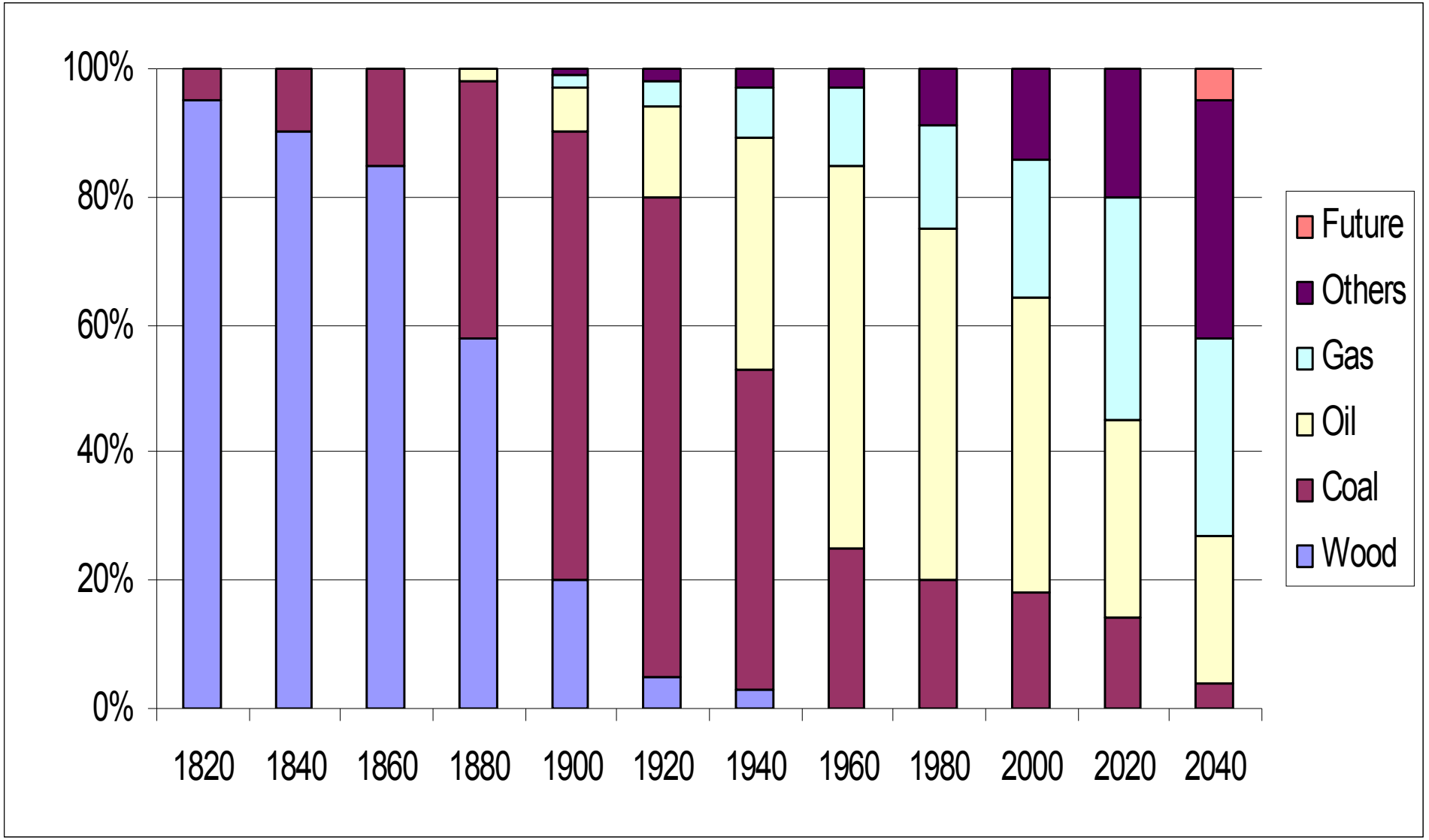
British Petroleum

Beyond Petroleum

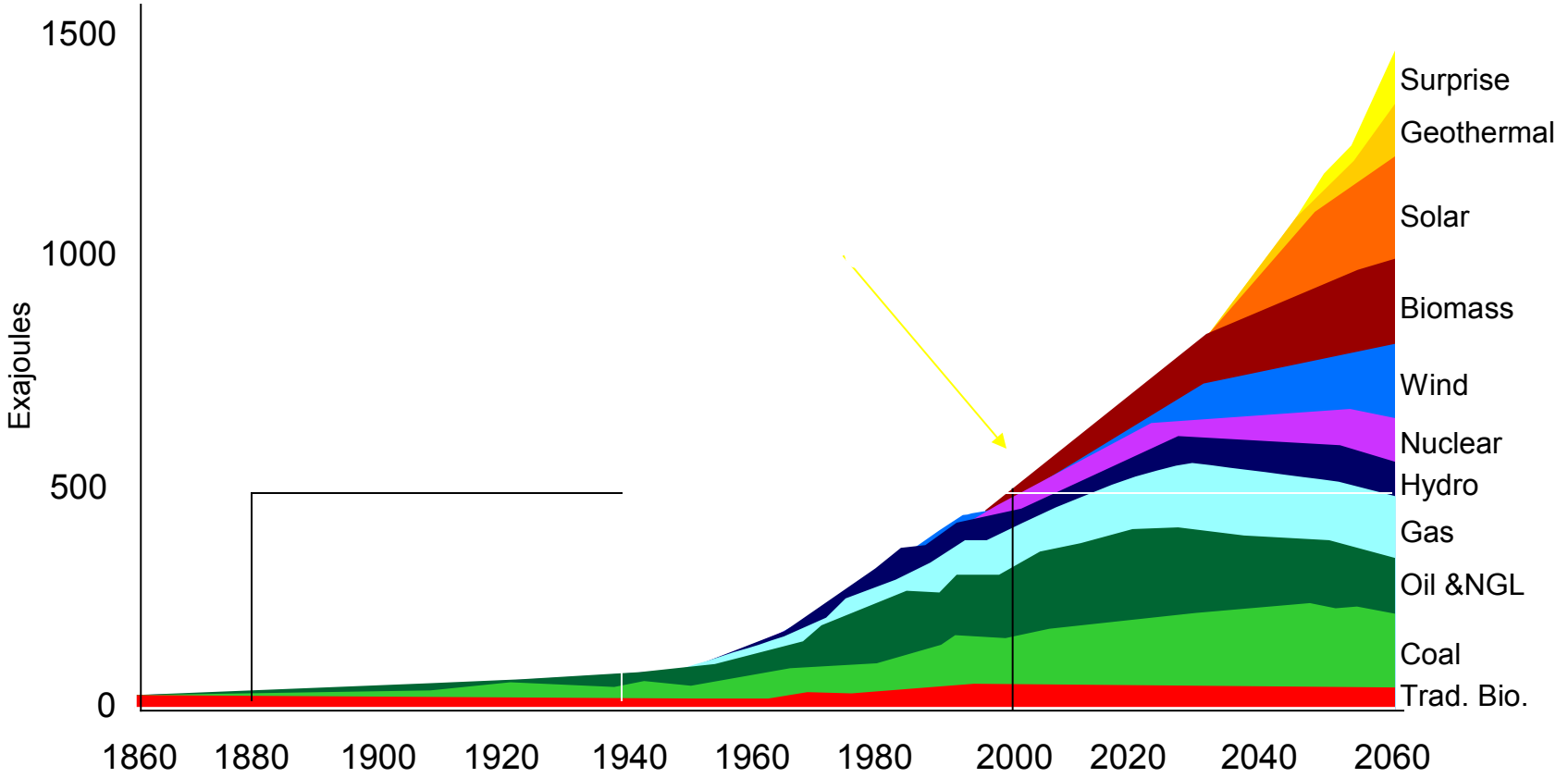
Sociedad Mundial del Futuro
VENEZUELA

De la manufactura a la mentefactura

Energy waves: “decarbonization”

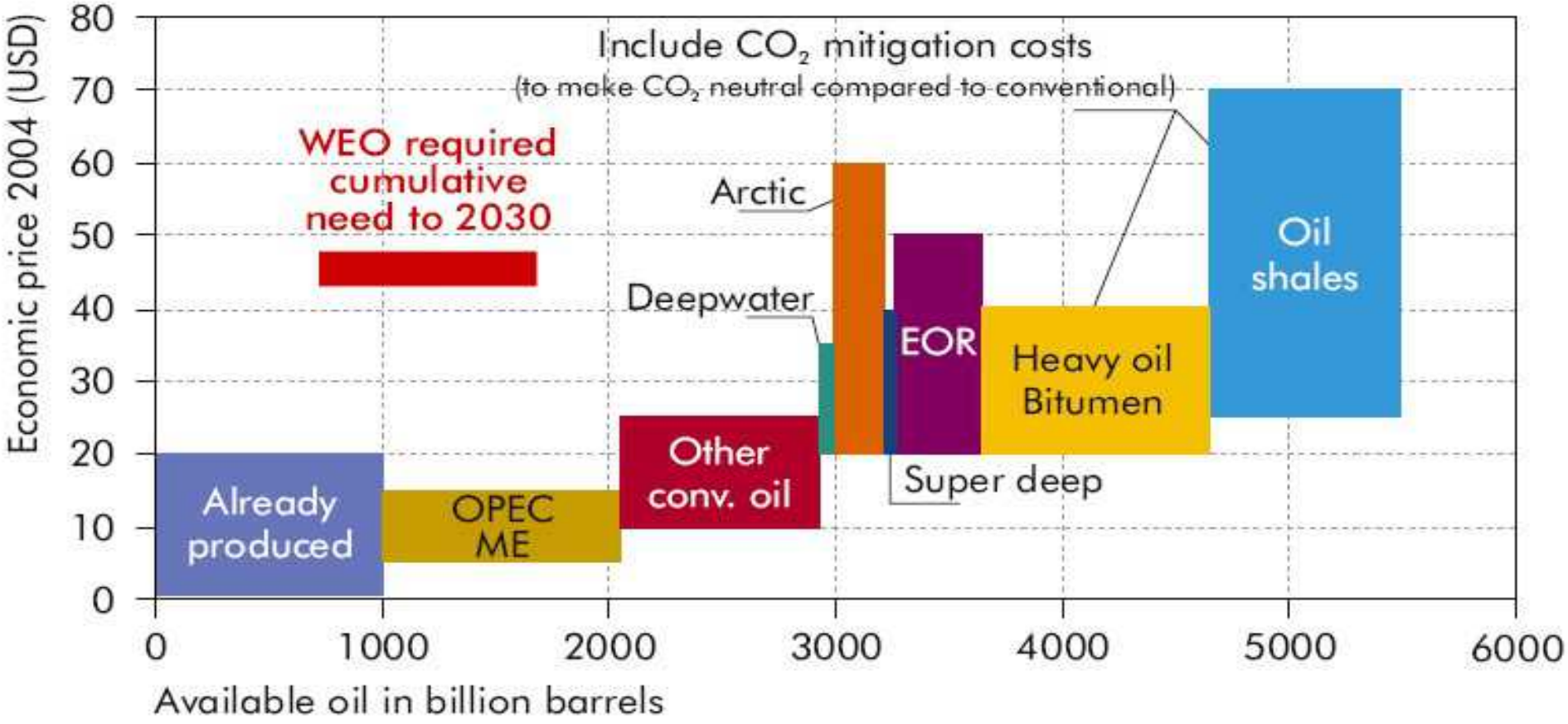


Shell: “Sustainable” Growth Scenario



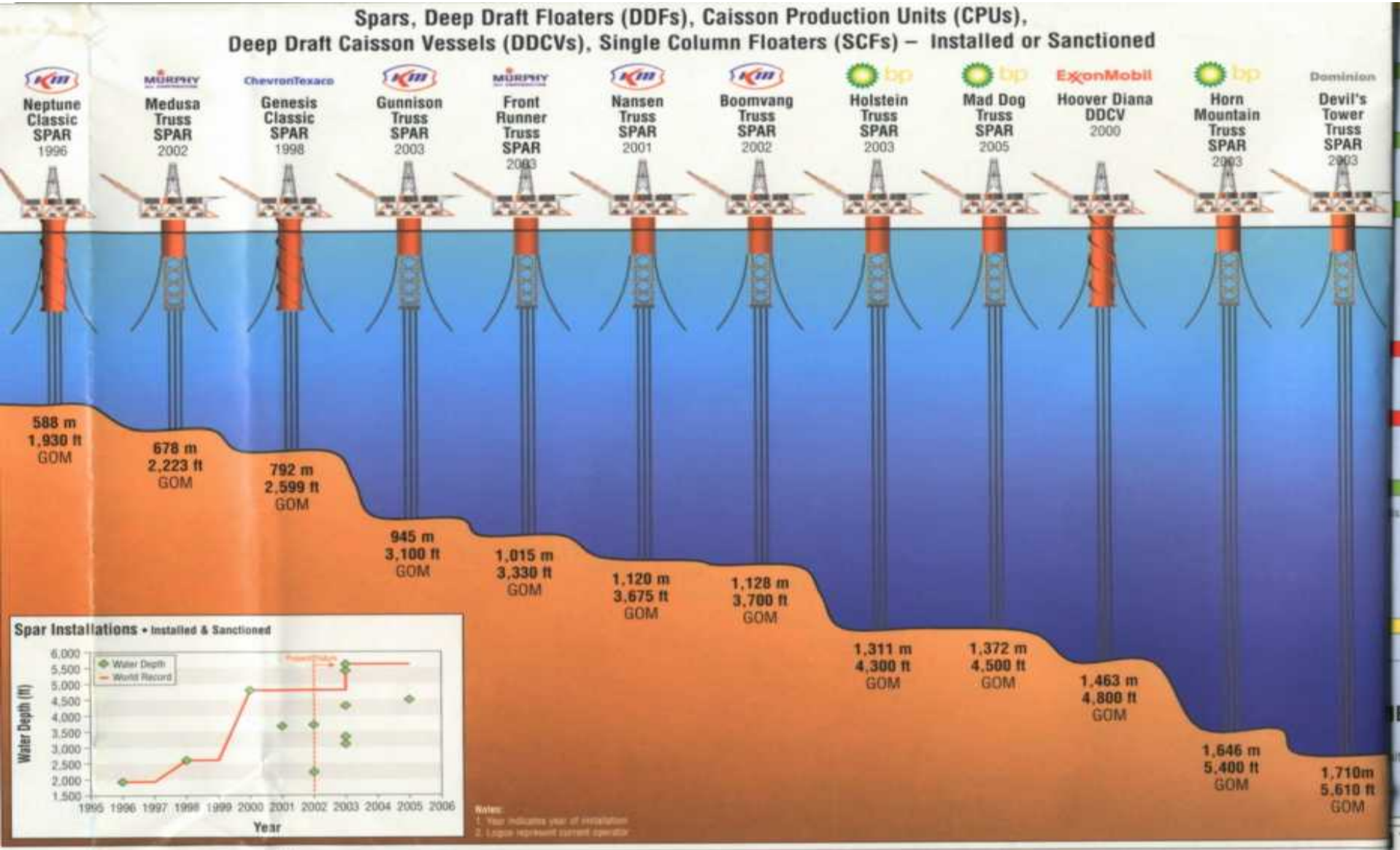
Oil costs and reserves

Figure 7.1 • *Oil cost curve, including technological progress: availability of oil resources as a function of economic price*

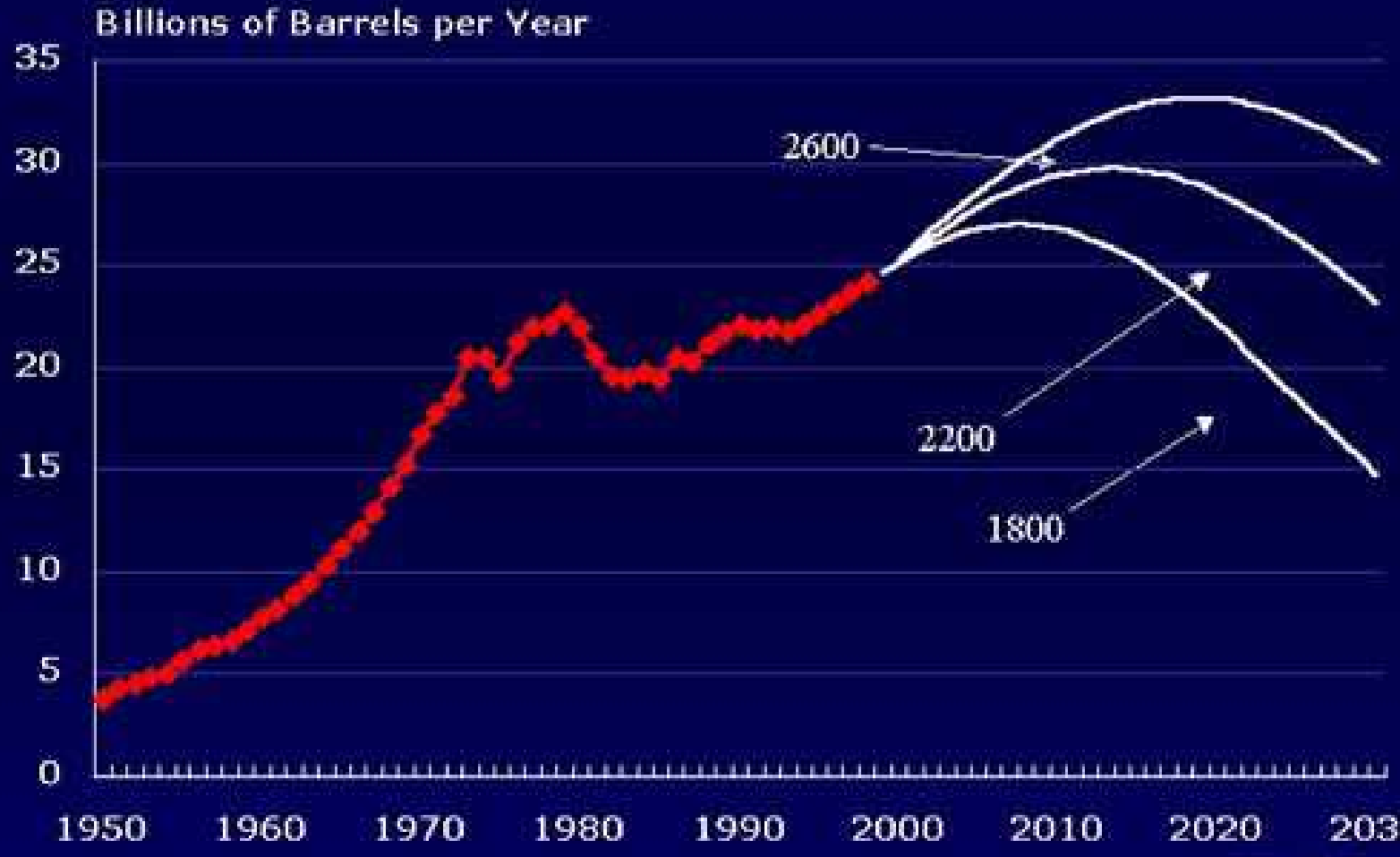


Source: IEA.

Deeper and deeper



Global Oil Production for Resources of 1800, 2200, and 2600 Billion Barrels



World Resources Institute

“Peak” Oil in the 21st Century?

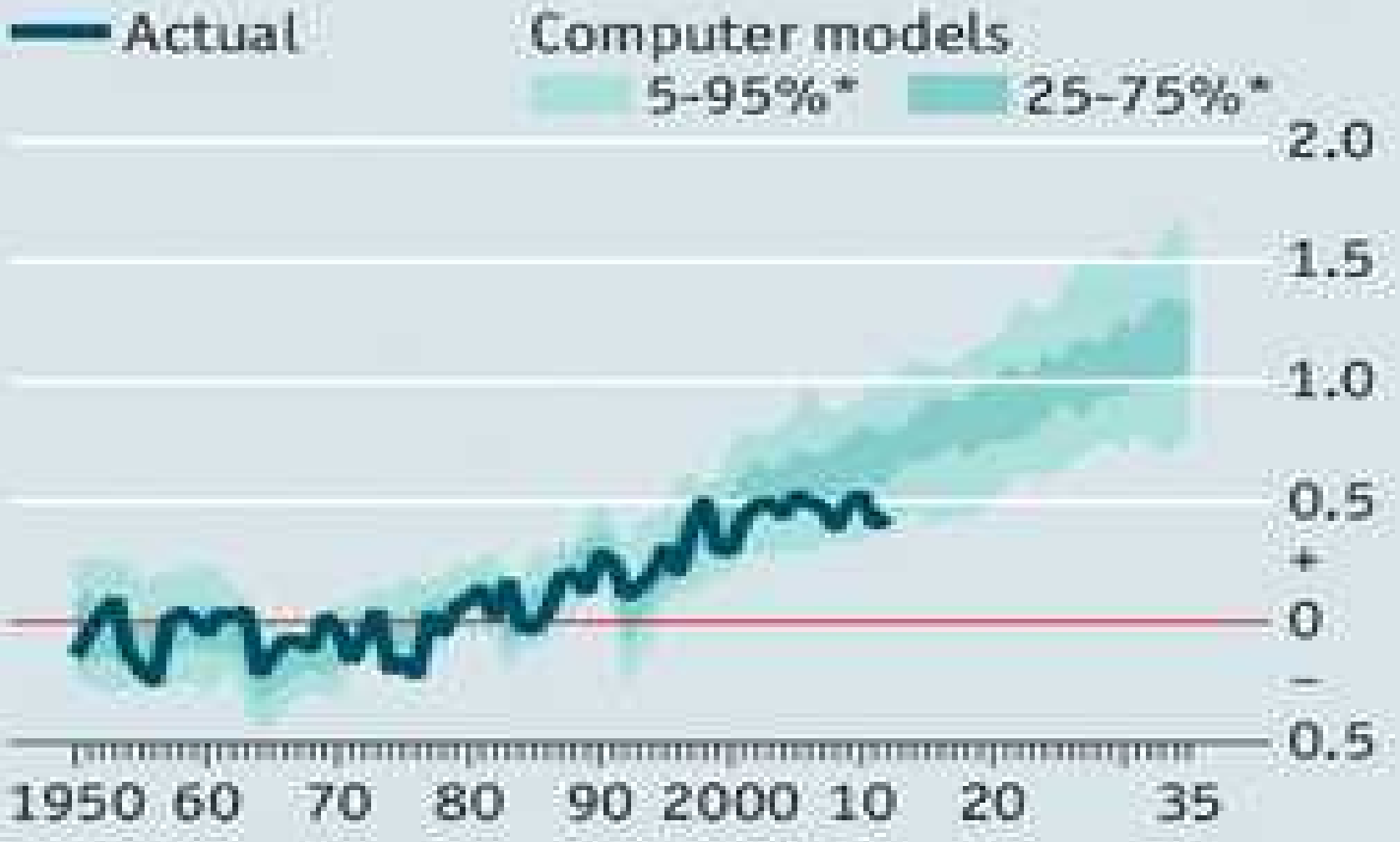
- **The Stone Age did not end because of lack of stones, and the Oil Age will end soon and not because of lack of oil.**

Sheik Ahmed Yamani, 2000
Saudi Arabia

“Peak” Whale Oil in the 19th Century

Falling off the scale

Change in global mean temperature, °C

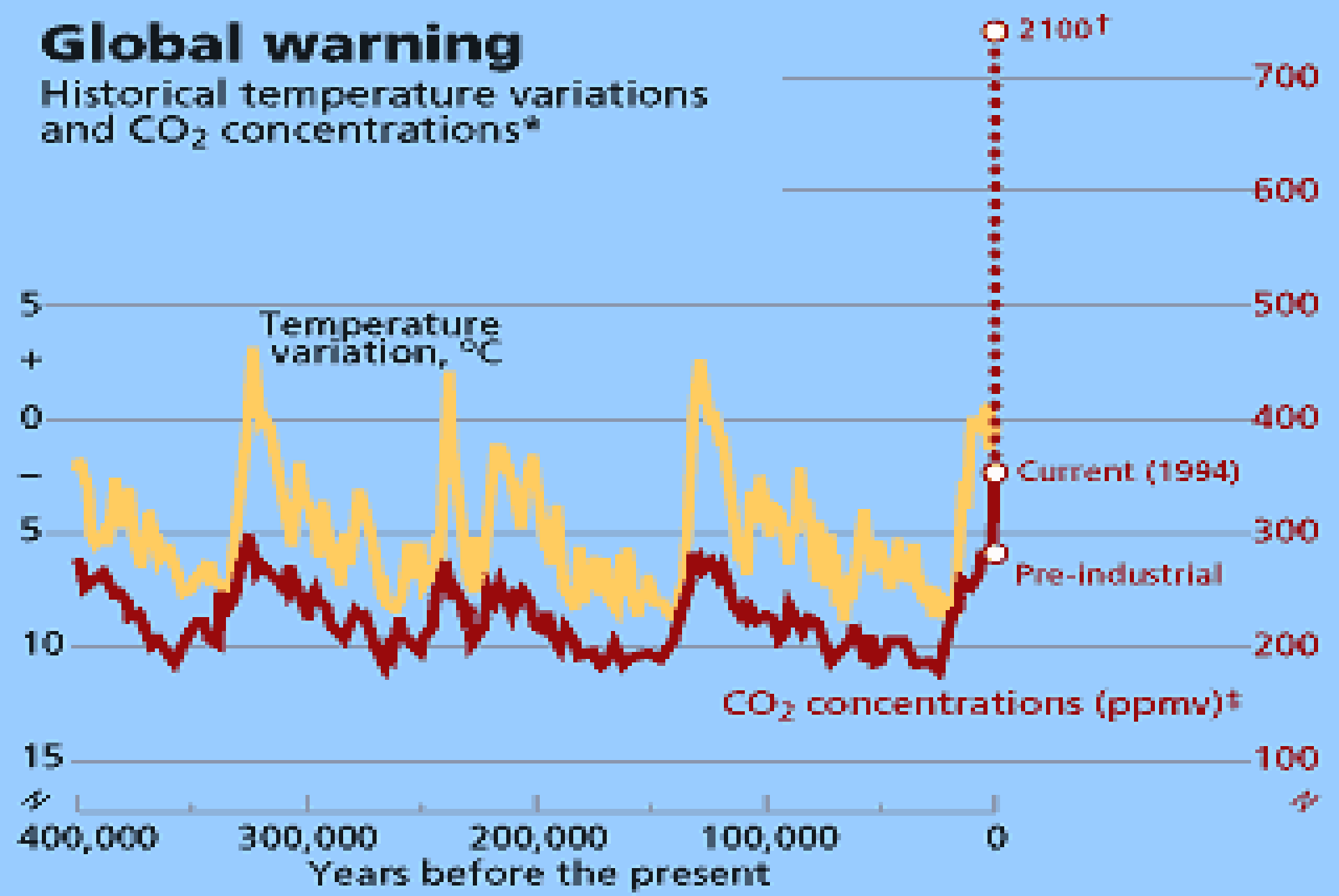


Source: Ed Hawkins, University of Reading: CMIP5 model dataset

*Confidence interval

Global warming

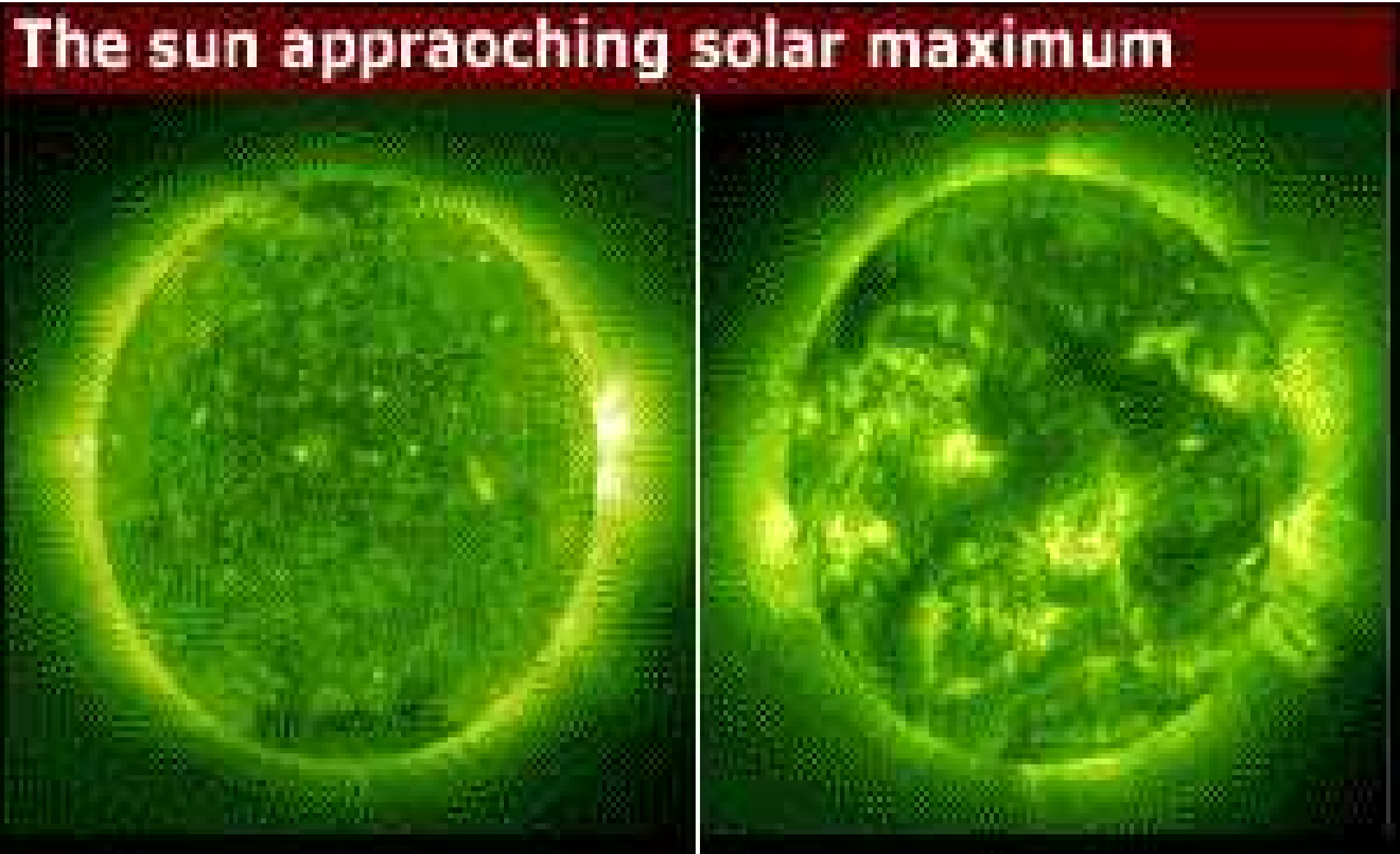
Historical temperature variations and CO_2 concentrations*



*Taken from the Vostok ice core, Antarctica
†UN IPCC forecast, assuming business as usual
‡Parts per million volume

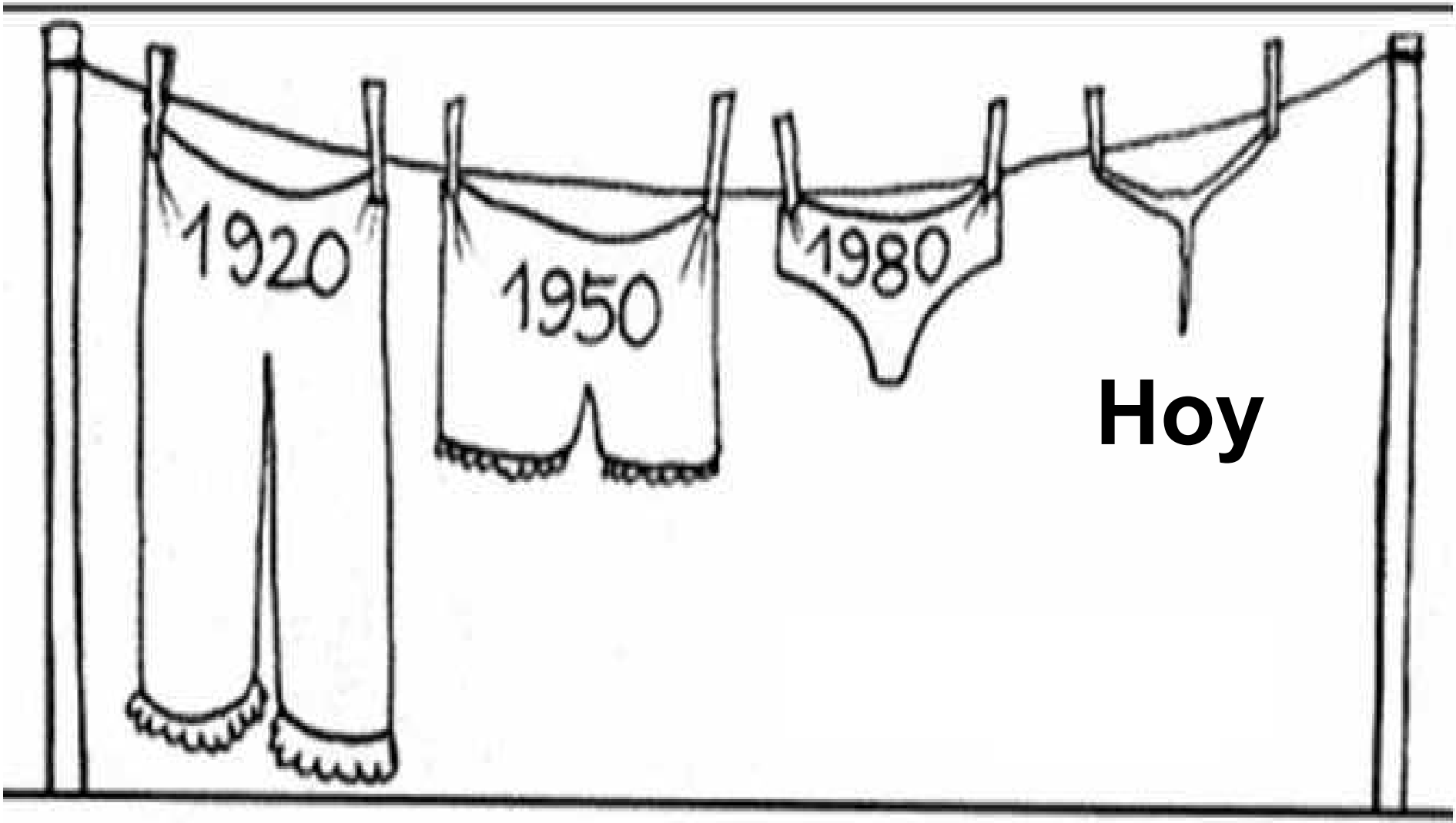
Source: CDIAC, Oak Ridge National Laboratory

Sun activity has increased during the last few years

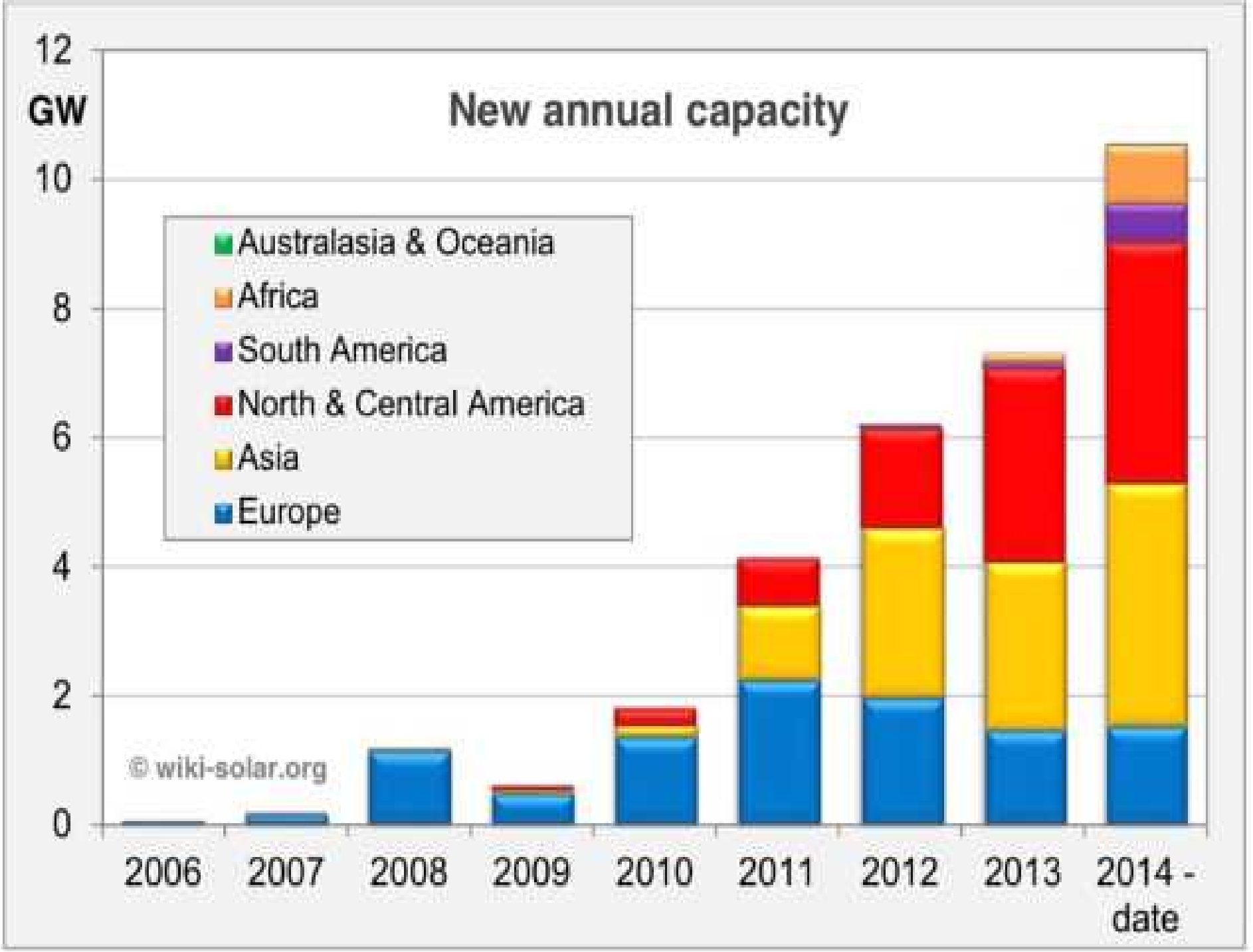


Juanita: la momia inca

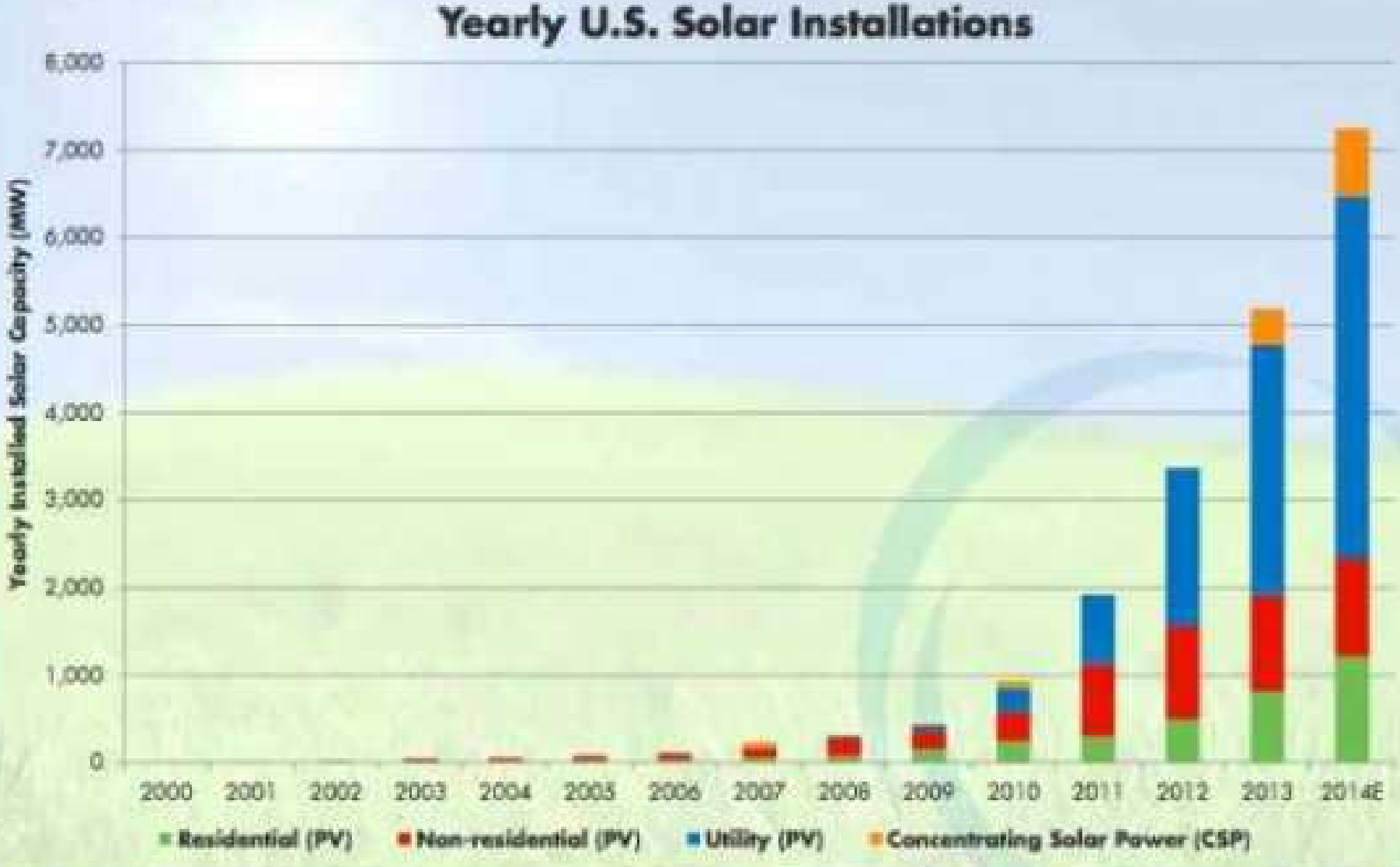
Prueba del calentamiento del planeta.



Masdar City: Abu Dhabi, UAE


New annual capacity
GW
12
10
8
6
4
2
0
Australasia & Oceania
Africa
South America
North & Central America
Asia
Europe
© wiki-solar.org
2006
2007
2008
2009
2010
2011
2012
2013
2014 - date

Solar in America: Strong and Getting Stronger



ENVIRONMENT

Report: Solar Will Dominate World Energy Supply in Just 15 Years

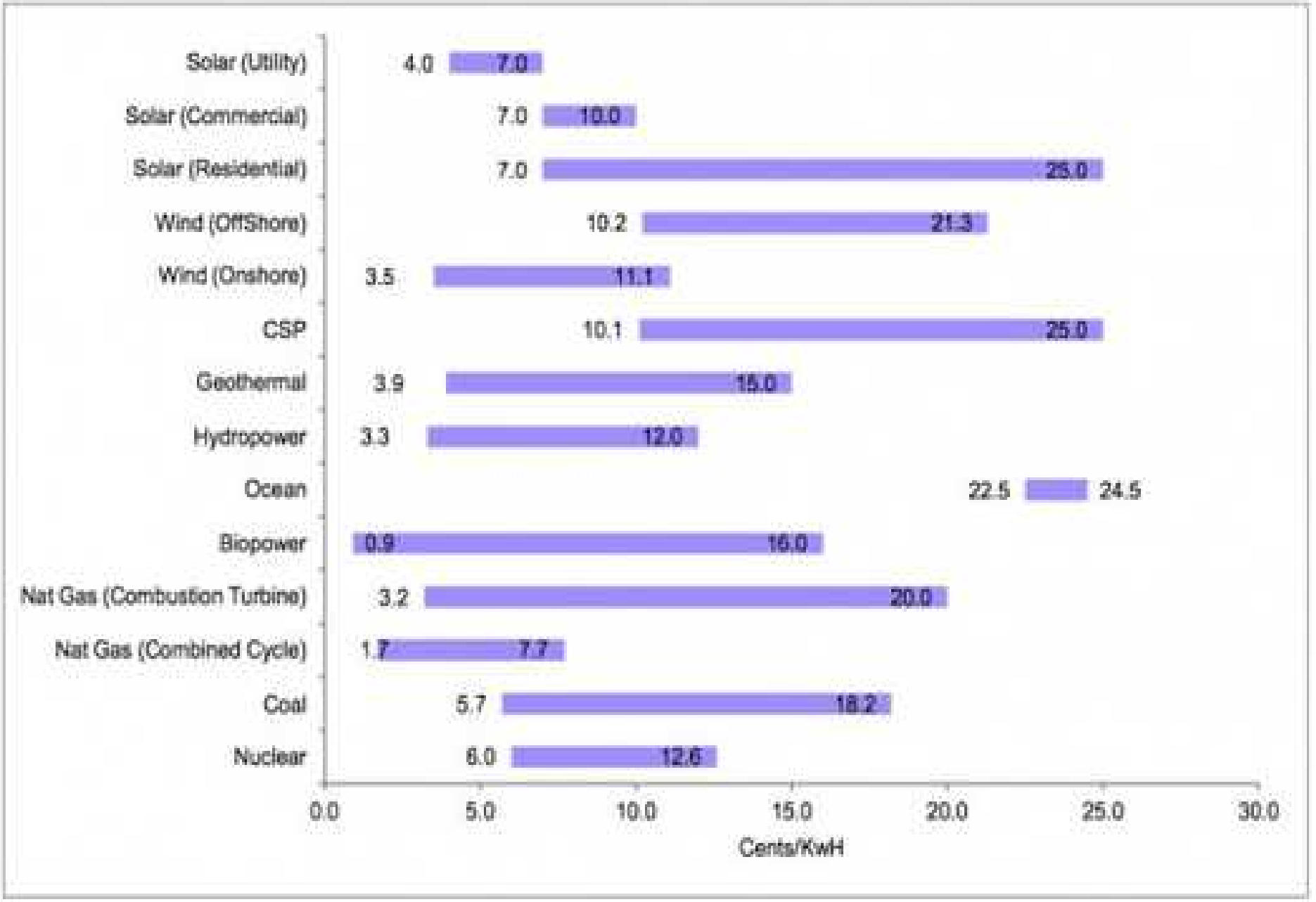
We should really feel for those poor fossil fuel barons....not!

By Gwenned / Daily Kos | March 6, 2015

Deutsche Bank has produced a 175 page report that will have the Koch bros and their bought and paid for minions as well as every oil, coal and natural gas company weeping in their Chevas Regal or Glenfiddich.

The report suggests that solar generated energy will be the dominant source of energy worldwide within the next 15 years. Not only that, but the solar industry

Figure 5: Solar Today Vs Other Forms of Utility Scale Electricity Generation (Cents/KwH)



Source: Deutsche Bank, Open EI Transparent Cost Database

API Energy Report Says Solar Will Double In 2015-16

January 7th, 2015 by Sandy Dechert

Yes, you did hear that right. For the first time ever, speaking for the oil and gas industry, the American Petroleum Institute is including solar among the energy sources that should be taken seriously in the next couple of years.

API's *State of American Energy Report*, released yesterday, includes a serious analysis of the U.S. solar energy industry. The API

SunEdison Buys Solar Grid Storage for Battery-Backed PV and Wind Power

It's the first big solar player to dive into energy storage—but it won't be the last.

Jeff St. John
March 5, 2015

MOST COMMENTED MOST PO

01 Why Did Apple Pay So Much For 130 Megawatts Of PV Fro First Solar?

02 SolarCity Files Lawsuit Against Salt River Project For Antitrust Violations

03 Arizona Utility Gets Approval

PREVIOUS ARTICLE
GE's Smart-Grid-as-a-Service...

NEXT ARTICLE
Internet and Cable Giant Comcast...

Grid-Scale Energy Storage Photos and Milestones

AES Energy Storage shares some dramatic views of its energy storage facility in Chile's Atacama Desert.

Eric Wesoff
January 23, 2014

MOST COMMENTED MOST POPU

01 Arizona Utility Gets Approval For High Monthly Demand Charges On Solar Customers

02 SDG&E's James Avery On The Promise Of EVs And The Pitfalls Of Solar


CALIFORNIA REPUBLIC

Costa Rica Powered By 100% Renewable Energy For First 75 Days Of 2015

March 20th, 2015 by Guest Contributor

Originally published on *RenewEconomy*.
By Sophie Vorrath

The Latin American country of Costa Rica has achieved the milestone of generating 100 per cent of its energy from renewable resources, with a combination of hydropower and geothermal for 75 days in a row, the the state-owned Costa Rican Electricity Institute (ICE) said.

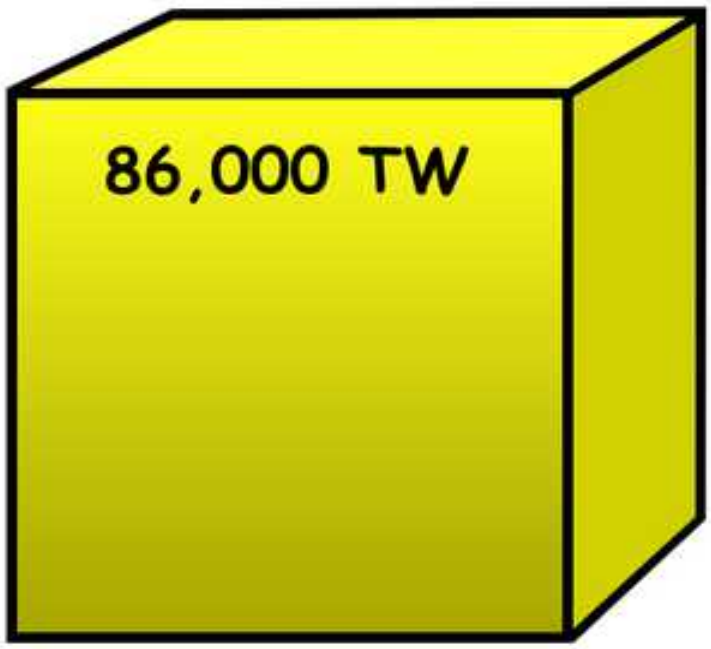
Texas city to go 100% solar, wind – because it's cheaper, more reliable

By Sophie Vorrath on 19 March 2015

A city in Texas – home to the "Gusher Age" of American oil – is aiming to become 100 per cent renewable within two years, after finalising a deal with SunEdison to supply it with solar power for 25 years.

Georgetown – population 54,000 – will take the output from the 150MW solar plant and another 144MW

Available Renewable Energy

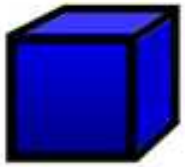


Solar

7.2 TW

Hydro

870 TW



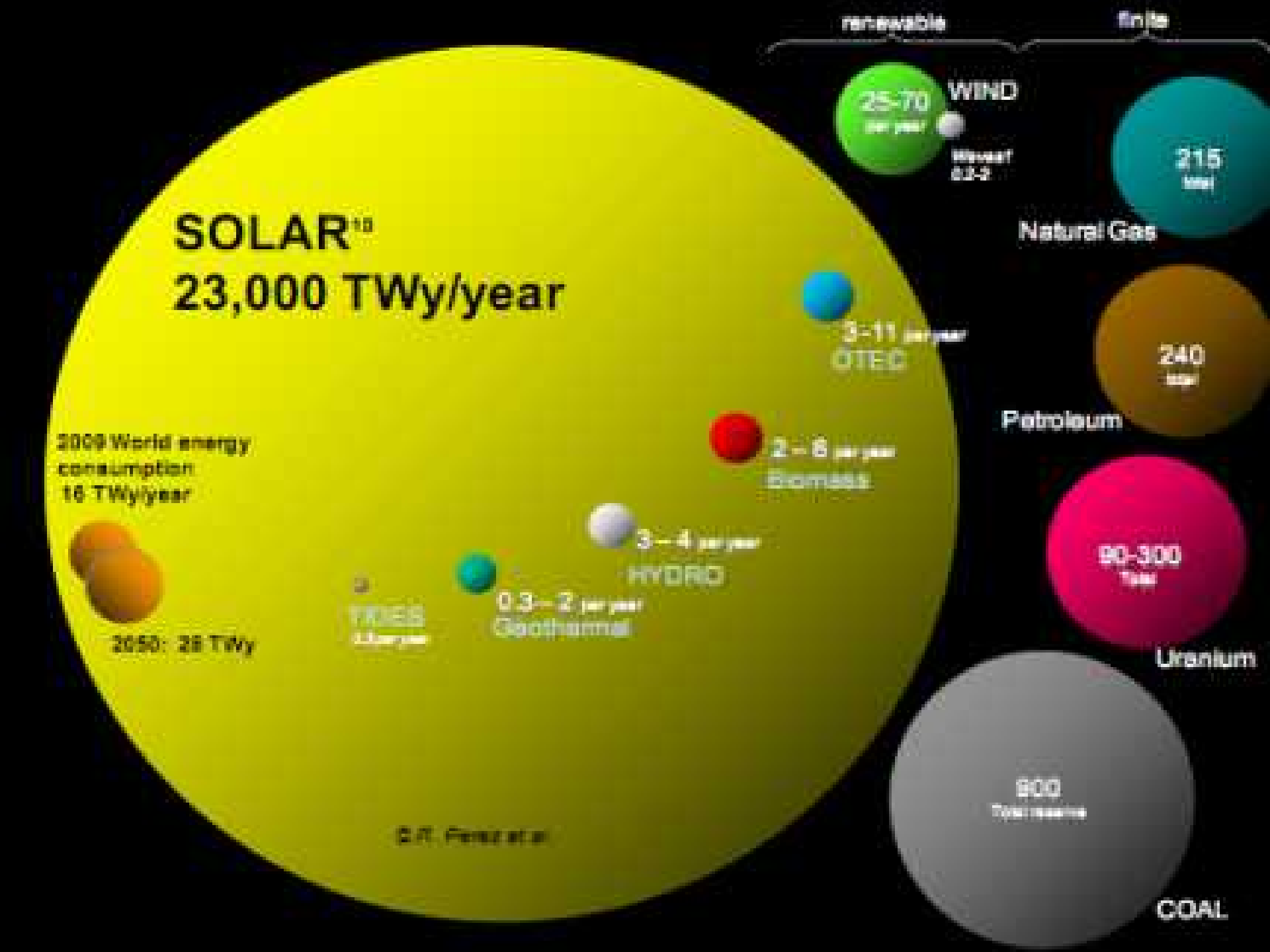
Wind

32 TW

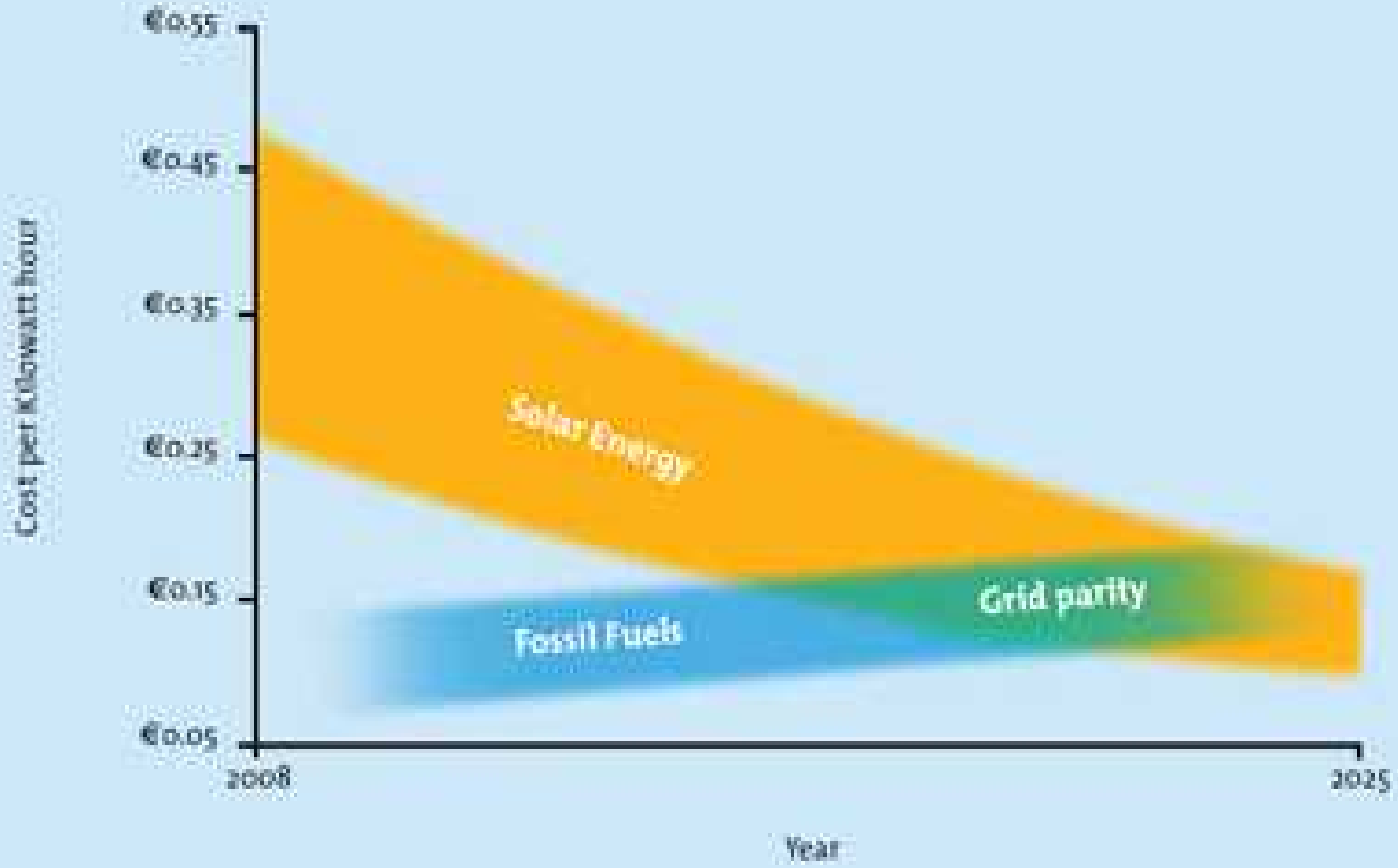
Geothermal

15 TW

Global Consumption


renewable
finite
SOLAR[13]
23,000 TWy/year
2009 World energy consumption 16 TWy/year
2050: 28 TWy
25-70 per year
WIND
TPES
3-11 per year
OTEC
2 – 6 per year
Biomass
3 – 4 per year
HYDRO
0.3 – 2 per year
Geothermal
215
Natural Gas
240
Petroleum
90-300
Uranium
800
COAL

THE PATH TO GRID PARITY



2111

ACERCA DEL SHOW

2111 es una serie histórica que permitirá descubrir cómo será Latinoamérica dentro de 100 años. A lo largo de 6 programas, encontrará las respuestas a los grandes interrogantes acerca del futuro: ¿Cómo serán nuestras ciudades dentro de 100 años?¿Cómo nos transportaremos?¿Cómo será la vida cotidiana del hombre del mañana?

Con 2111 develaremos el futuro a partir de pistas que ya existen en el presente. Conoceremos los proyectos más vanguardistas y sorprendentes del mundo, y los relacionaremos con nuestra región. También contaremos con el testimonio de renombrados expertos de la ciencia, la tecnología y la cultura. Todos ellos son los hacedores del futuro, y se ocuparán de acercarlo a la actualidad.

En cada episodio el Host viajará por Latinoamérica y el mundo. Al presentar e interactuar con los distintos desarrollos, será el hilo conductor de la historia y también quien le dará unidad y continuidad al relato, que por momentos transcurrirá en el futuro, y por momentos en el presente.

La inclusión de las más avanzadas técnicas de animación computada para construir ciudades en 3D, casas, espacios públicos, objetos o medios de transporte del futuro, será un recurso que estará presente a lo largo de todos los capítulos

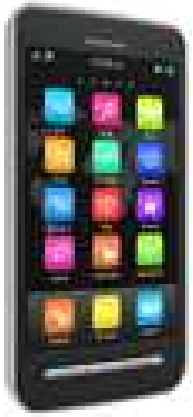
Las temáticas que abordará la miniserie serán:

- Arquitectura y Desarrollo urbano
- Vida cotidiana
- Transporte y Energía
- Entretenimiento
- Salud y Bienestar
- Trabajo y Educación

1G
1981

2G
1992

3G
2001



4G
2011

5G
2020


PRIUS
Google™
self-driving car

Google self-driving cars

Will Nissan Beat Google and Uber to Self-Driving Taxis?

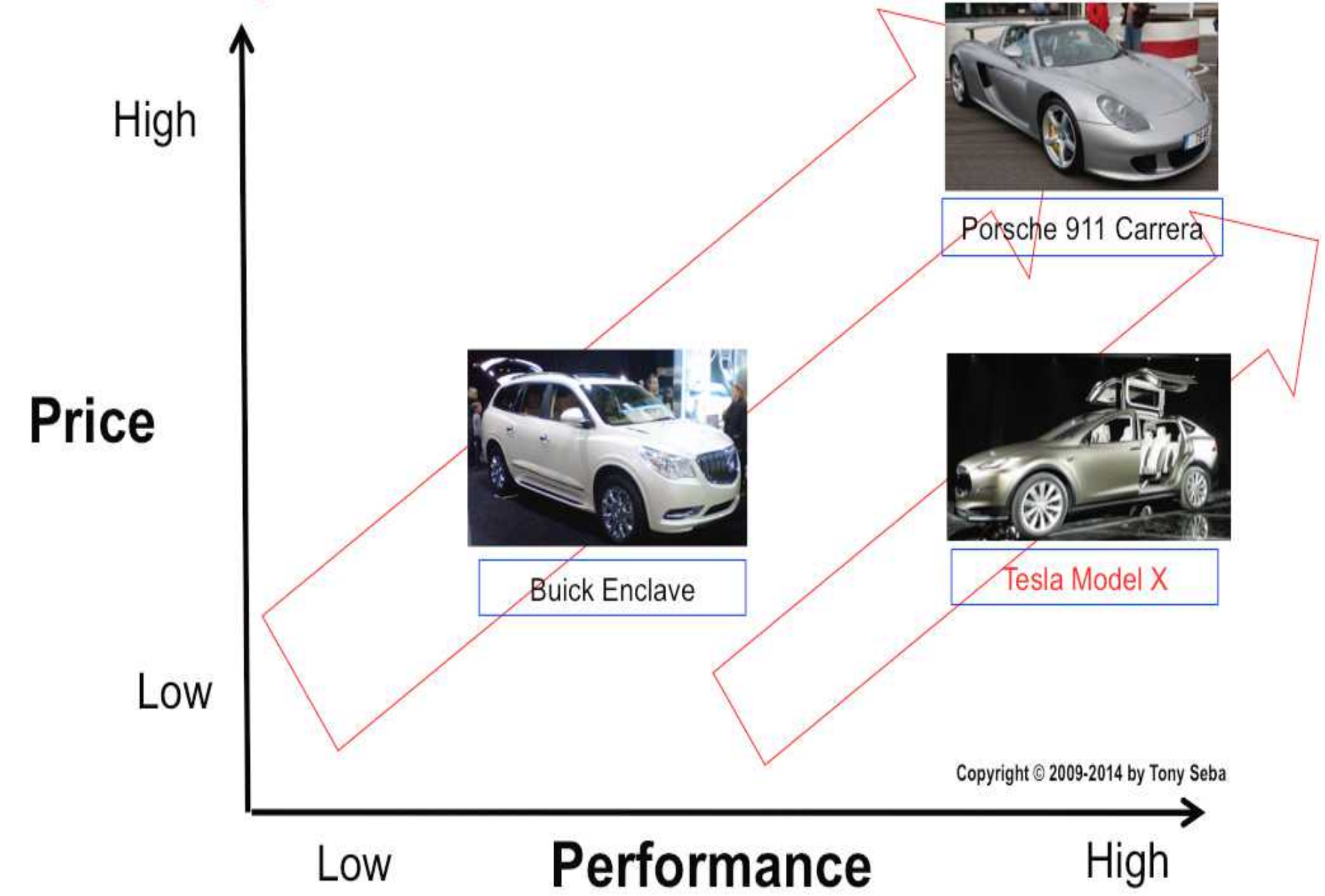
By Mark Harris
Posted 26 Feb 2015 | 15:43 GMT

Britain Will Rewrite Its Traffic

BMW forecasts 2025

TESLA: The end of gasoline cars!

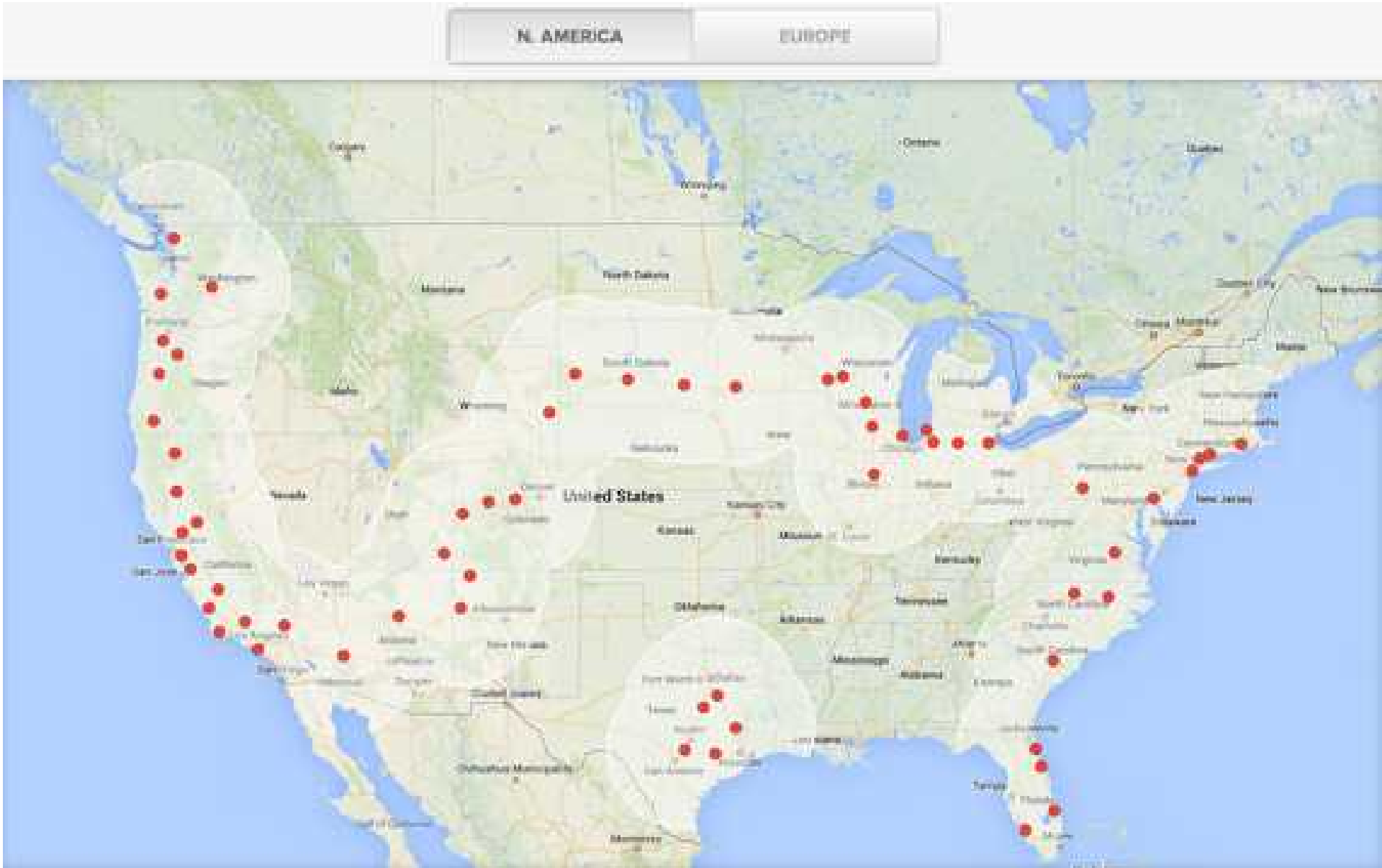
EVs Disrupt the BASIS of COMPETITION



SUPERCHARGER

THE FASTEST CHARGING STATION ON THE PLANET

Superchargers TESLA



Company	July 2013	July 2012	% Change	YTD 2013	YTD 2012	% Change
Daimler						
Smart ED	58	0	-	173	0	-
Fiat						
Fiat 500e	?	0	-	?	0	-
Ford	**6817**	**1791**	**280.63%**	**53014**	**10783**	**391.64%**
Ford C-Max Hybrid	2267	0	-	20125	0	-
Ford C-Max Energi PHEV	433	0	-	2915	0	-
Ford Escape Hybrid	0	50	-	0	1331	-
Ford Focus Electric	150	38	294.74%	1050	135	677.78%
Ford Fusion Hybrid	2914	1109	162.76%	23197	6097	280.47%
Ford Fusion Energi PHEV	407	0	-	1991	0	-
Lincoln MKZ Hybrid	646	594	8.75%	3736	3220	16.02%
GM	**4010**	**5067**	**-20.86%**	**28969**	**29666**	**-2.28%**
Chevy Volt	1788	1849	-3.30%	11643	10666	9.16%
Chevy Spark EV	103	0	-	130	0	-
Conventional hybrids	2119	3218	-34.15%	17216	19000	-9.39%
Honda	**1609**	**1337**	**20.34%**	**10911**	**12049**	**-9.44%**
Honda Civic Hybrid	578	471	22.72%	3719	4589	-18.96%
Honda CR-Z	384	330	16.36%	2799	2734	2.38%
Honda Insight	420	419	0.24%	2782	4460	-37.62%
Honda Fit EV	63	7	800.00%	354	7	4957.14%
Honda Accord PHEV	54	0	-	254	0	-
Acura ILX Hybrid	110	110	0.00%	1003	259	287.26%
Mitsubishi						
Mitsubishi i	46	33	39.39%	928	366	153.55%
Nissan						
Nissan Leaf	1864	395	371.90%	11703	3543	230.31%
Porsche	**68**	**95**	**-28.42%**	**440**	**1004**	**-56.18%**
Porsche Cayenne S Hybrid	39	60	-35.00%	333	729	-54.32%
Porsche Panamera Hybrid	29	35	-17.14%	107	275	-61.09%
Tesla Motors						
Tesla Model S (estimated based on quarterly sales)	700	19	3584.21%	10550	31	33932.26%
Toyota	**32808**	**23044**	**42.37%**	**209314**	**192157**	**8.93%**
Toyota Prius Liftback	15252	9936	53.50%	92061	93141	-1.16%
Toyota Prius C	3797	3065	23.88%	24372	19316	26.18%
Toyota Prius V	3428	2954	16.05%	22044	25805	-14.57%
Toyota Prius PHEV	817	688	18.75%	5031	5035	-0.08%
Toyota Camry Hybrid	4193	3197	31.15%	28027	26735	4.83%
Toyota Highlander Hybrid	410	469	-12.58%	3370	3520	-4.26%
Toyota Avalon Hybrid	1139	0	-	9487	0	-
Toyota RAV4 EV	109	0	-	517	0	-
Lexus Hybrids	3663	2735	33.93%	24405	18605	31.17%
Volkswagen						
Volkswagen Jetta Hybrid	417	0	-	2636	0	-
Total 100% Electrics	**3093**	**492**	**528.66%**	**25405**	**4082**	**522.37%**
Total PHEVs	**3499**	**2537**	**37.92%**	**21834**	**15701**	**39.06%**
Total Conv. Hybrids	**41805**	**28752**	**45.40%**	**281419**	**229816**	**22.45%**
TOTAL	**48397**	**31781**	**52.28%**	**328658**	**249599**	**31.67%**

TESLA
GIGAFACTORY

BYD Plans To Rival Gigafactory Battery Output

March 17th, 2015 by Christopher DeMorro

Top Posts & Pages


15 Electric Cars Hitting The Ma
In 2015


Electric Cars 2015 — Prices,
Efficiency, Range, Pics, More


BYD Plans To Rival Gigafactory
Battery Output


Cleantech Talk #5: Elon Musk's
"Ending Range Anxiety" Tweet,
Dubai Police Get BMW i8, Tesla
CPO Program, & Audi


India To Replace Garbage
Pushcarts With EVs

Tesla plans self-driving 'autopilot' Model S feature via software update this summer

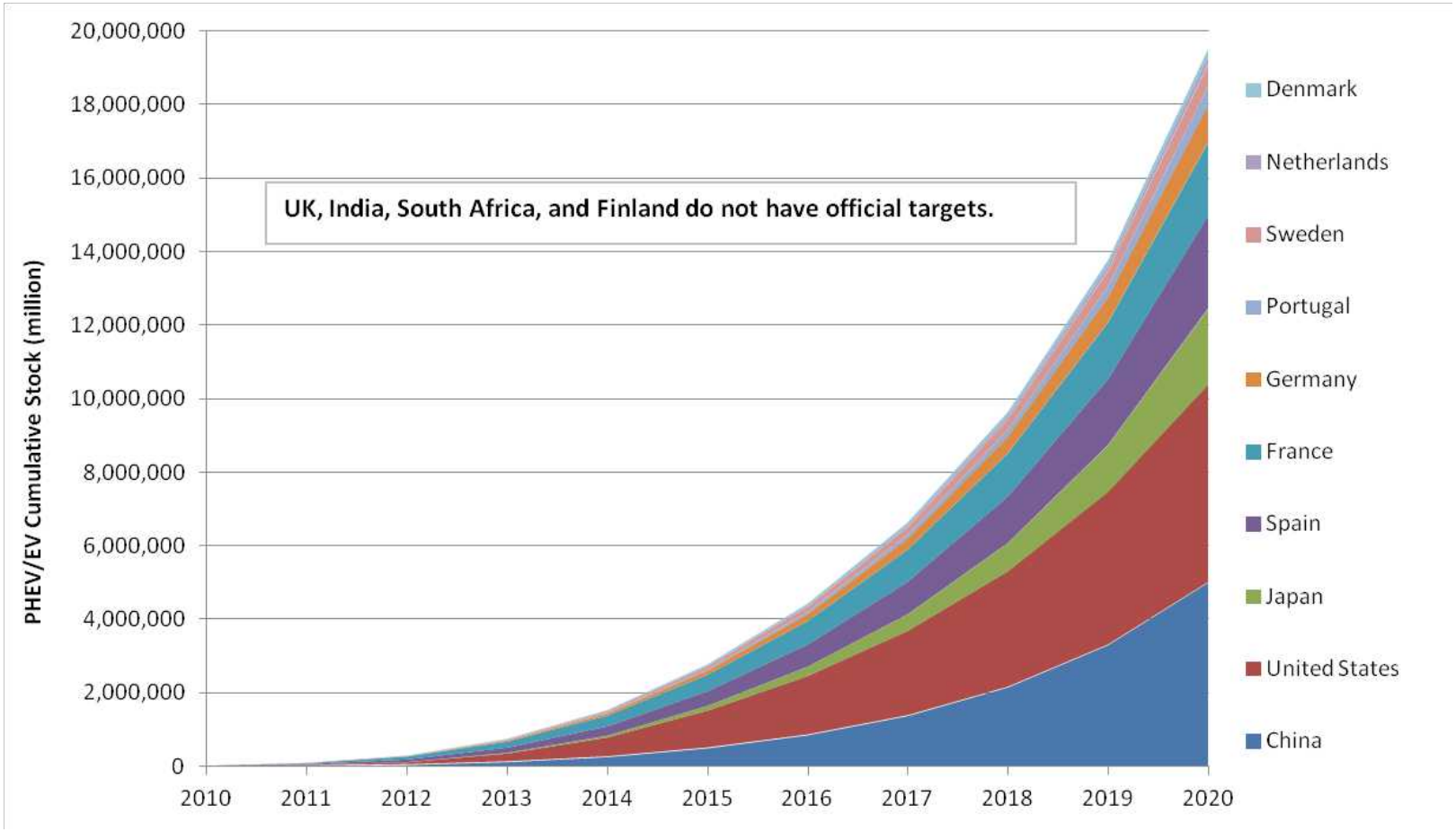
Car is "sophisticated computer on wheels," says Musk

March 19, 2015

Model S (credit: Tesla Motors)

A software update will give Tesla Model S cars the ability to start driving themselves in "autopilot" mode on "major roads" like highways this summer, Tesla Motors chief executive Elon Musk announced today (March 19).

Electric Vehicles deployment



20 million BEVs and PHEVs on the road by 2020.

Electric Vehicles Initiative

5th Avenue, New York, April 15, 1900

5th Avenue, New York, March 23, 1913

De Caballos (1900) a Carros (1913)

5ta Avenida, Nueva York, 15 de abril de 1900

5ta Avenida, Nueva York, 23 de marzo de 1913

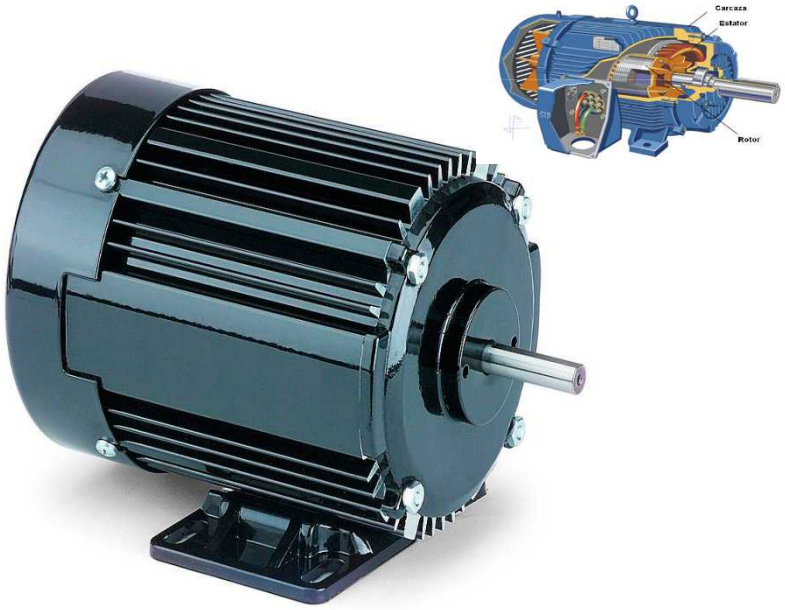
- *El automóvil venció al caballo por ser una tecnología superior, una **tecnología exponencial o disruptiva.***
- *No había **nada que el productor de carruajes de caballo pudiera hacer.***
- *Fue **cuestión de tiempo** para traer los costos abajo y mejorar la calidad*

¿Son los Vehículos eléctricos disruptivos?

1. El motor eléctrico: 5x mas eficiente energéticamente

Motor de combustión interna

15% - 20% Eficiencia

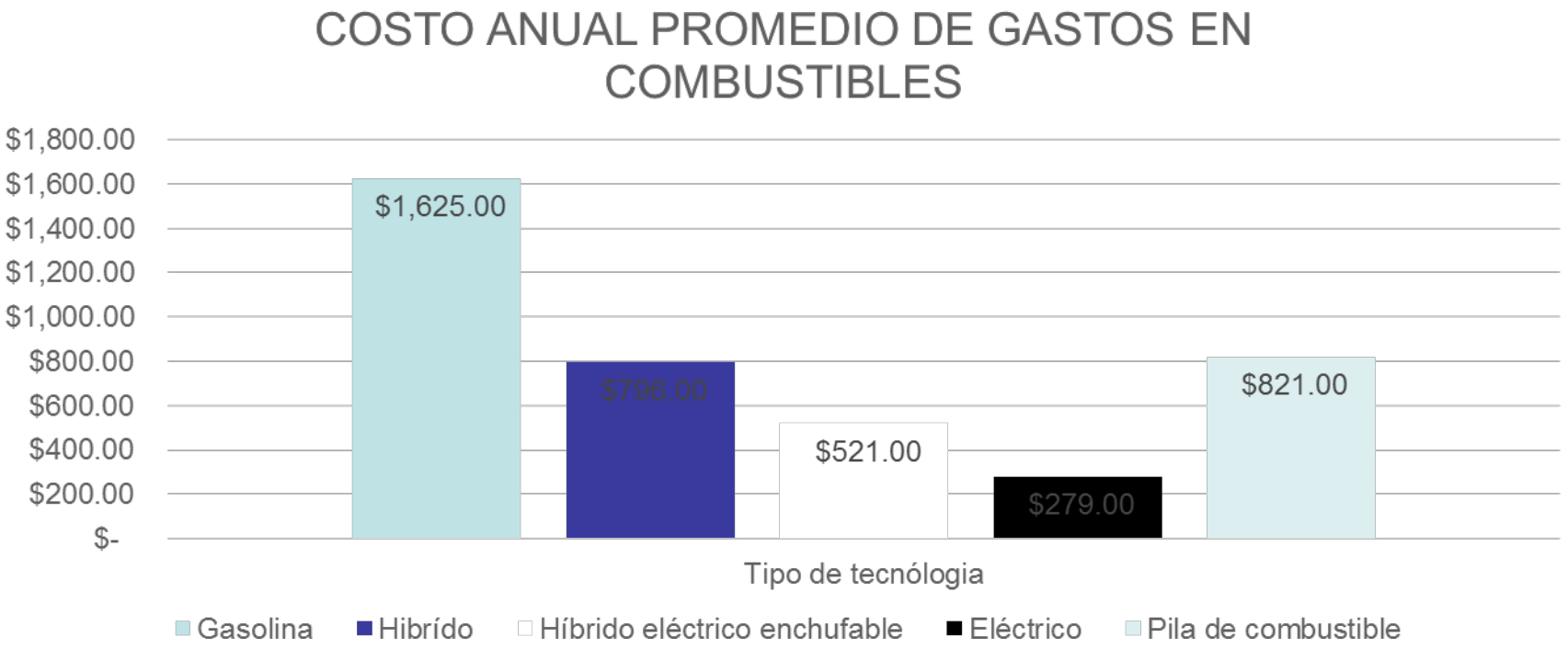


Motor eléctrico

85% - 90% Eficiencia

Fuente: Autoblog

2. Vehículo eléctrico es entre 5x-10x más barato en combustibles

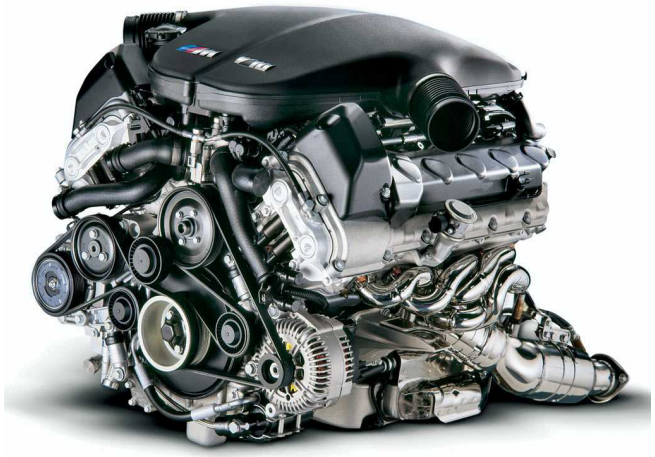


El tanque lleno de un Tesla Roadster W: **$5 vs $50**

Fuente: TESLA MOTORS

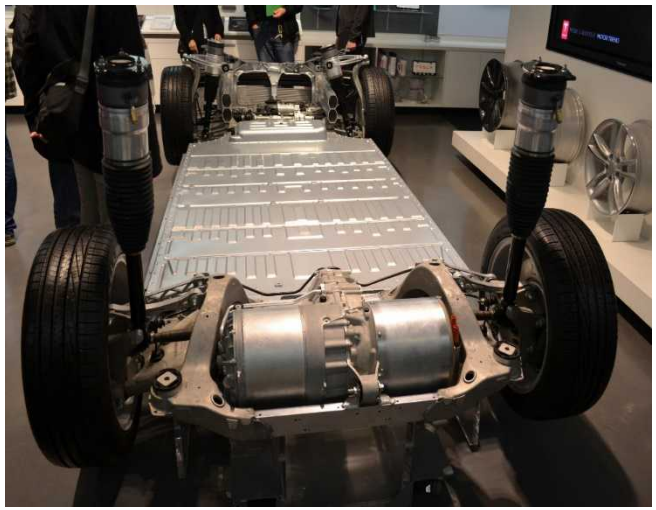
3.V.E. es entre 5x-10x mas barato en mantenimiento

- **V.E. tiene entre 80-90% menos partes móviles**
- **Los motores eléctricos pueden durar décadas con un pequeño mantenimiento**
- **V.E= 2¢/milla VS V.C.I= 10¢**



- **V.C.I (Carro de gasolina)**

(Culata, múltiple de admisión, múltiple de escape, filtro de aire, árbol de levas, poleas, balancines, válvulas, inyectores, bujías, juntas de aceite, bloque de motor, cigüeñal, pistones, bomba de aceite, etc…)



- **Vehículo eléctrico**

Fuente: The Economist.
Fotografías: Tesla Motors & Wikipedia

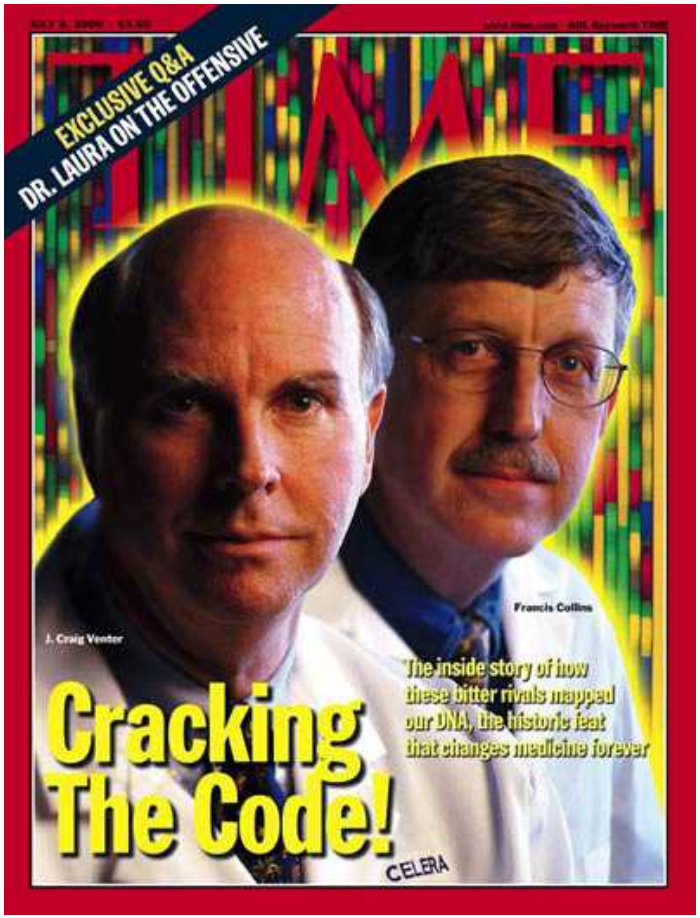
Fuel type	Energy content (MJ/kg)
Pumped stored water at 100 m dam height	0.001
Bagasse	10
Wood	15
Sugar	17
Methanol	22
Coal (anthracite, lignite, etc.)	23 - 29
Ethanol (bioalcohol)	30
LPG (liquefied petroleum gas)	34
Butanol	36
Biodiesel	38
Oil (medium petroleum average)	42
Gasohol or E10 (90% gasoline and 10% alcohol mix)	44
Gasoline	45
Diesel	48
Methane (gaseous fuel, compression-dependent)	55
Hydrogen (gaseous fuel, compression-dependent)	120
Nuclear fission (Uranium, U 235)	90
Nuclear fusion (Hydrogen, H)	300
Binding energy of helium (He)	675
Mass-energy equivalence (Einstein's equation)	89,880,000
Antimatter as fuel (estimated according to $E = mc^2$)	180,000,000

Bioenergy and "eternal" energy

- The cells of life
- Photosynthesis

  $CO_2 + 2\ H_2O + light$

  $\rightarrow (CH_2O) + O_2 + H_2O$
- From fossil hydrocarbons to live carbohydrates
- Craig Venter and his petroleum bacteria



NIF

National Ignition Facility & Photon Science

Bringing Star Power to Earth

Laser Inertial Fusion Engine (LIFE)

LIFE is an advanced energy concept under development at Lawrence Livermore National Laboratory. Based on physics and technology developed for the National Ignition Facility, LIFE has the potential to meet future worldwide energy needs in a safe, sustainable manner without carbon dioxide emissions.

News

Initial NIF Experiments Meet Requirements

Development Plan

4 years

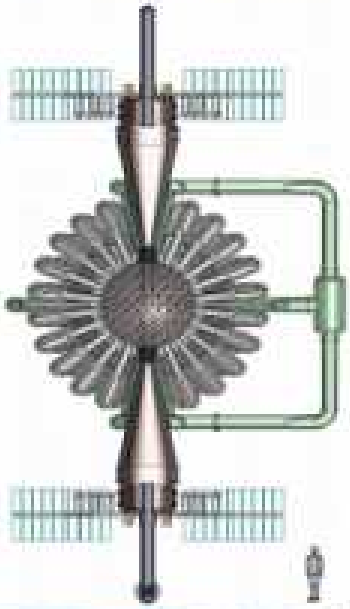
PHASE I
Proof of principle
Completed

2009 PHASE IIa
Construct key components at full scale
Prove system can be built
Plasma compression tests

3.5 years
$50M

Progress to Date

PHASE II
Demonstration of Net Gain
2013



2013 PHASE IIb
Build net gain prototype

2 years
$80M

2016 PHASE IIc
Test prototype –
Net Power out

8 months
$20M

5 years

PHASE III
Electricity generation and commercialization
$1 billion+
2020

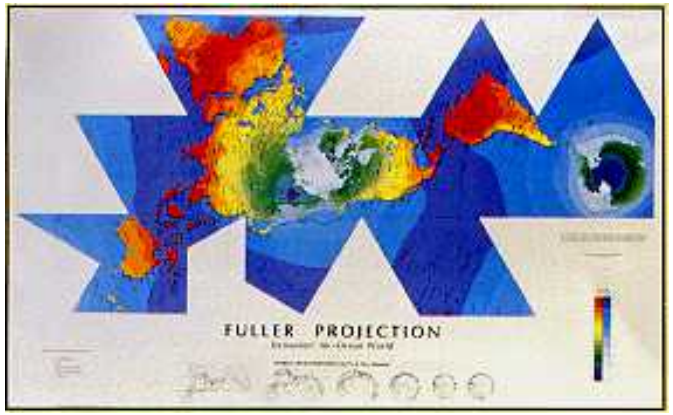
The Enernet: Energy Internet

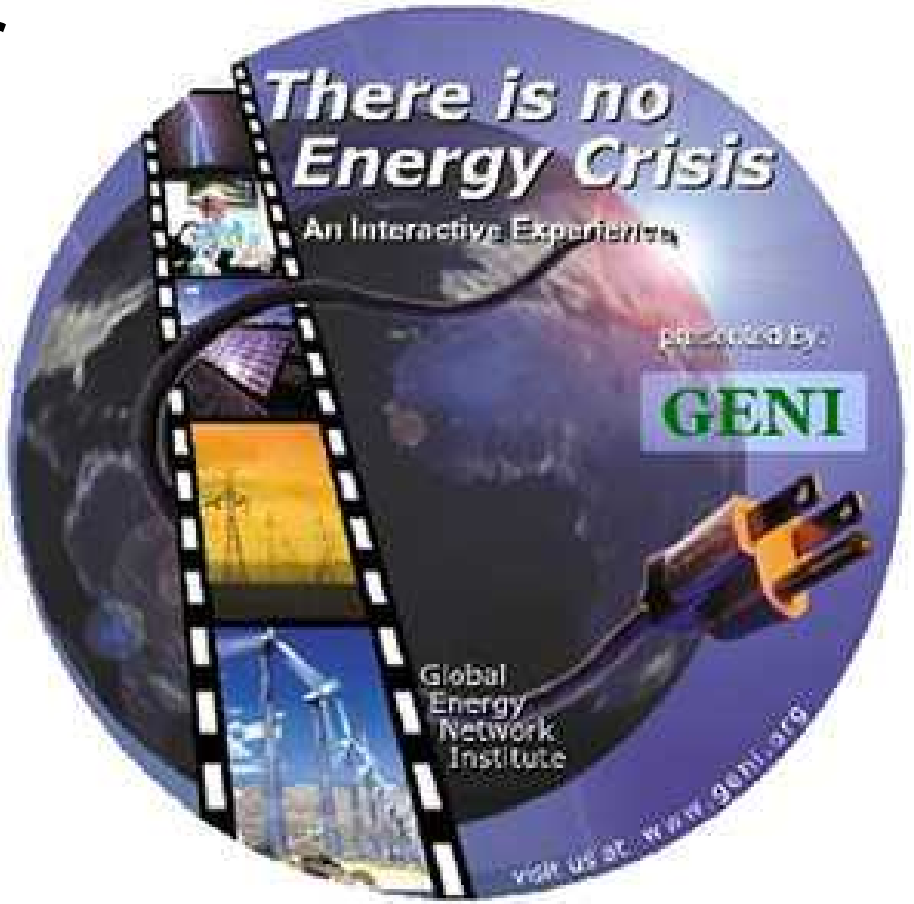
- Dirty energy
- Dumb grid
- Inefficient systems
- Expensive energy
- Centralized system
- Low redundancy
- Fossil fuels
- Producers control
- Big oil and utilities

- Clean energy
- Smart grid
- Efficient systems
- Cheap energy
- Distributed system
- High redundancy
- Renewable sources
- Prosumers control
- Entrepreneurs

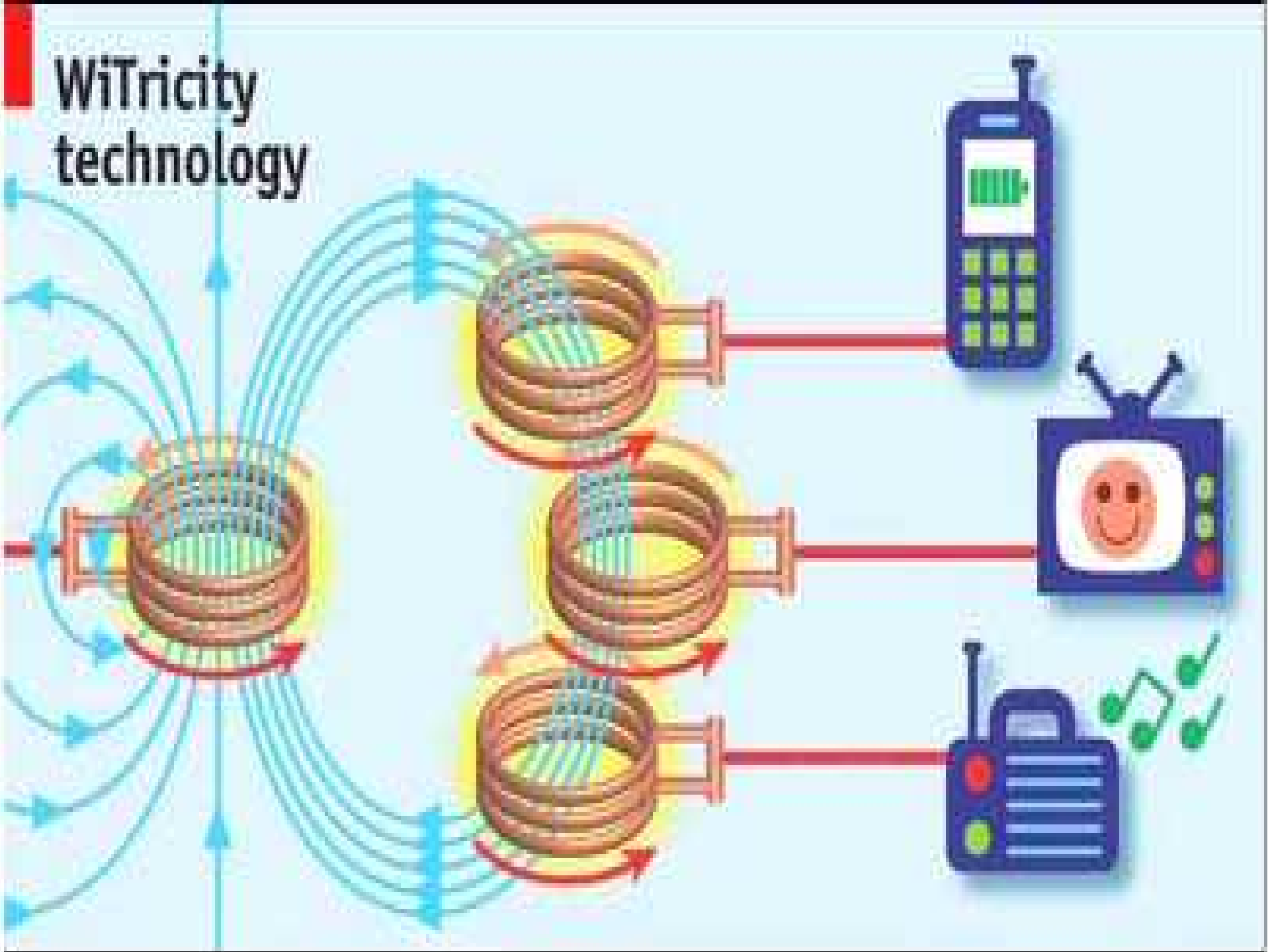
The Energy “Internet”

- Buckminster Fuller
- Global Energy Network Institute
- GENI.org





WiTricity technology



Zero-power systems

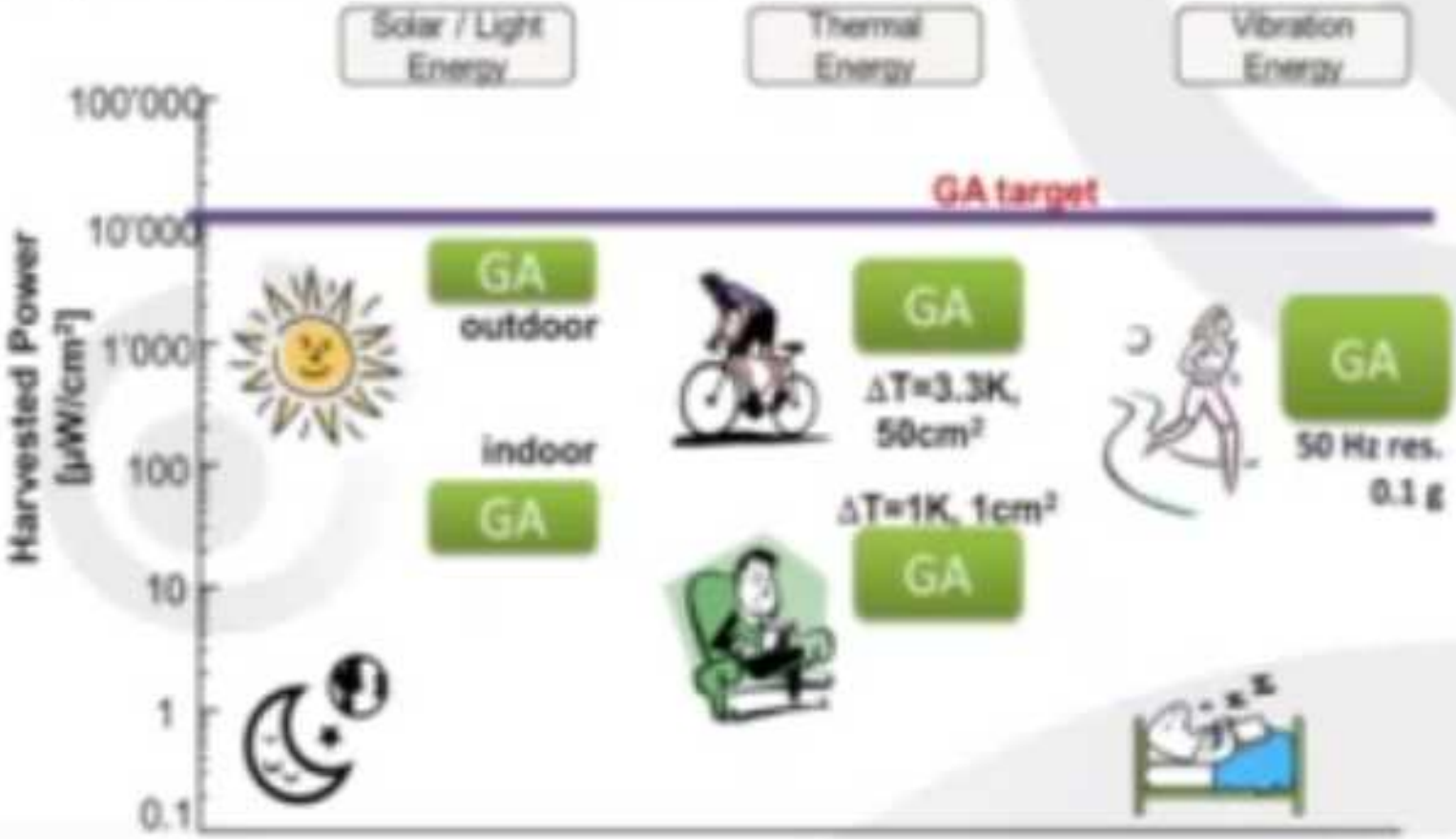
Guardian Angels are future **zero-power smart autonomous systems** featuring **sensing, computation communication** and **energy harvesting** features beyond human aptitudes.

100aJ/op	**1nJ/bit**	**10mW**	**100µW/cm²**
to	to	to	to
0.1aJ/op	10pJ/bit	100nW	10mW/cm²

Guardian Angels

Energy harvesting

- Dynamic, real life, requirements
- Multiple harversting interfaces, storage, power management



Hotels

Eliminating charging cables to improve the hotel experience

Restaurants

Grab a charge while you grab a bite with Qi wireless power

Automobiles

Charge up your driving experience with Qi

Smart Phones

Dial up the convenience of wireless charging

Airports

Low charge? Qi makes charging at airports easy and convenient

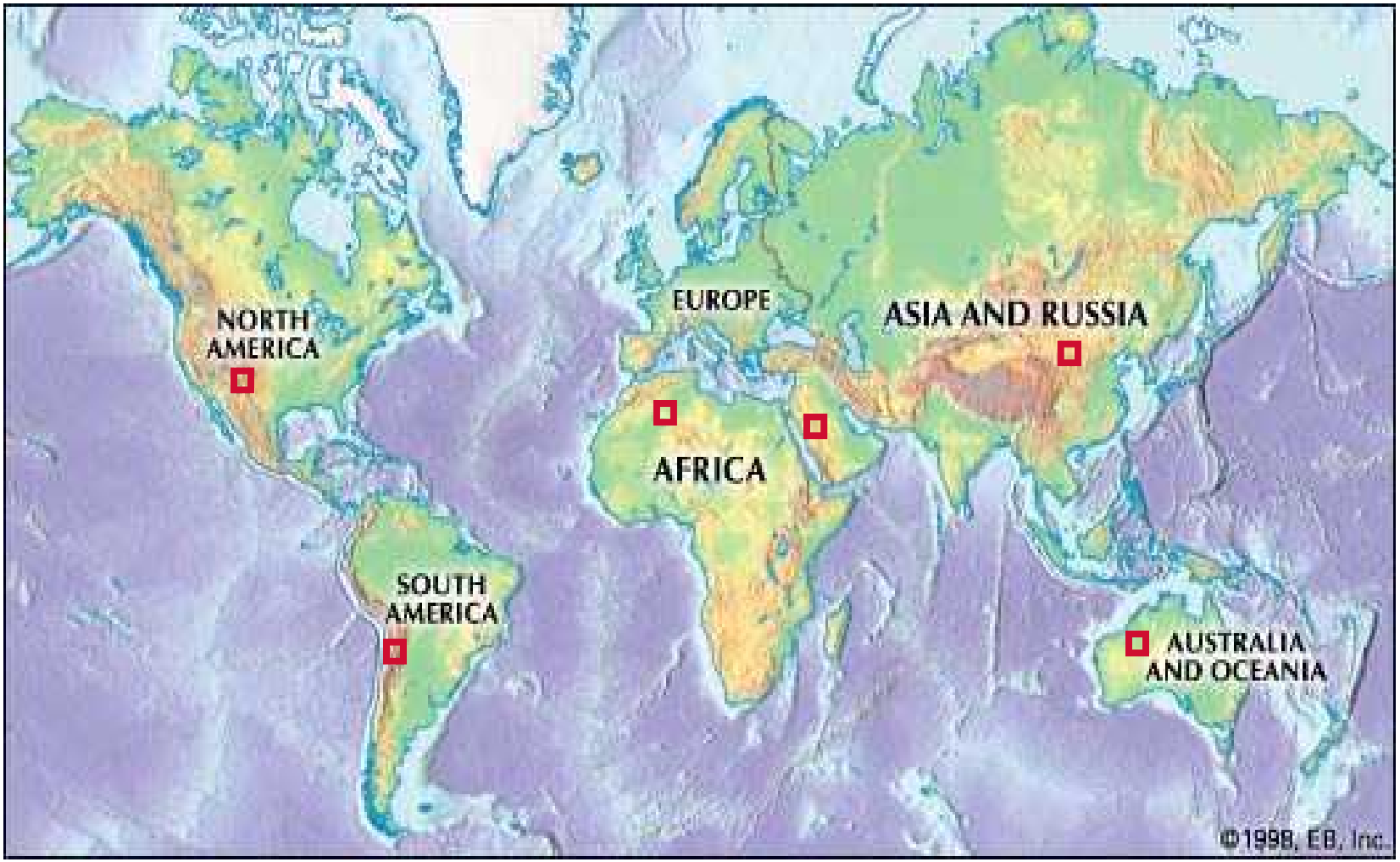
Public Venues

From shopping malls to sports stadiums, Qi cures battery anxiety

Offices

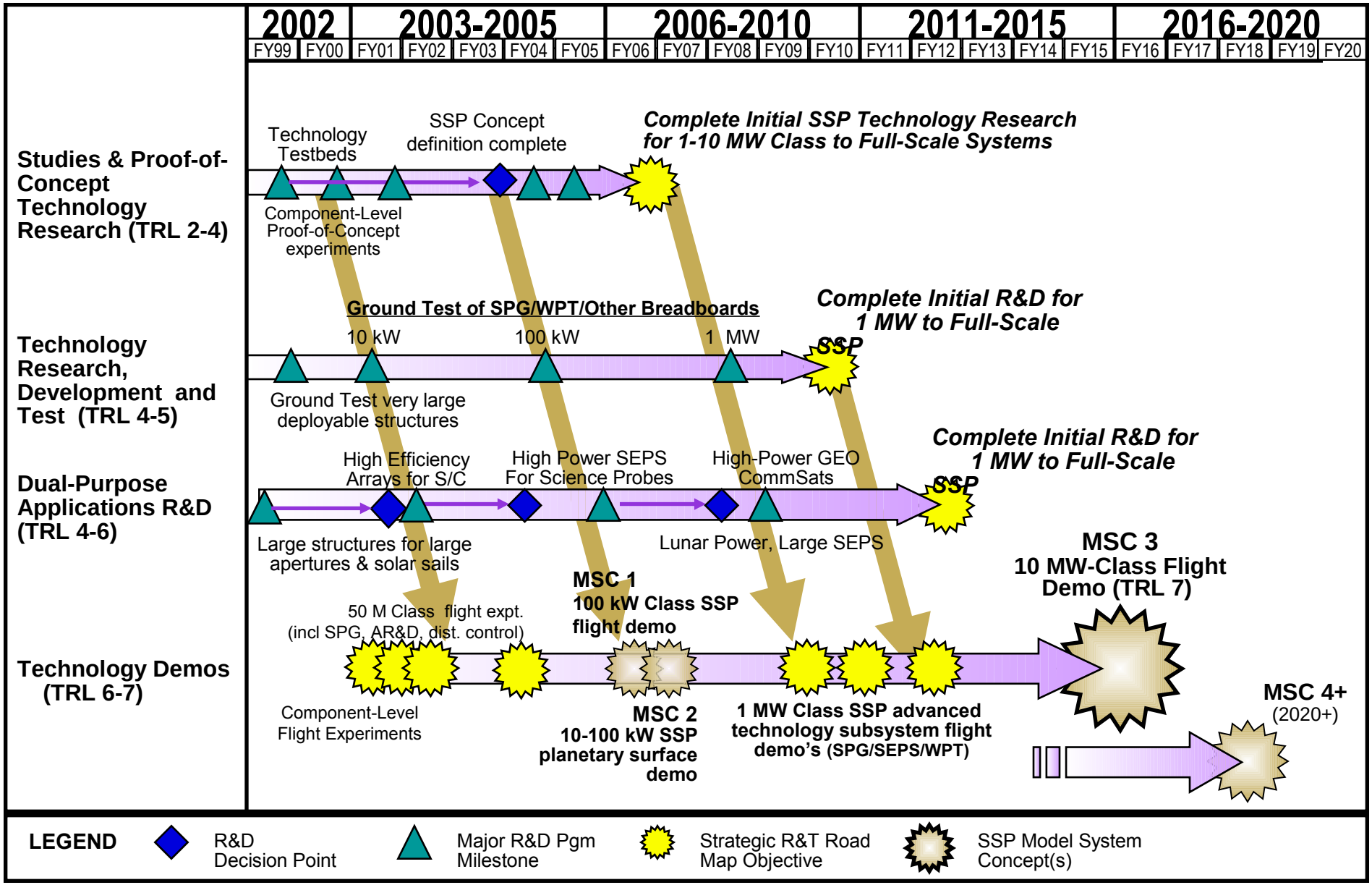
With Qi in offices, you can take clumsy, corded charging off the table

Earth Based Solar Power



6 land blocks of 100 km2 with 3 TW are enough for humanity today

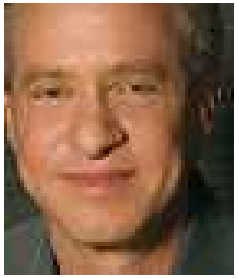
NASA: Space Solar Power (stand-by)



JAXA: Space Solar Power (2030)

Moon Energy ≥ 20 TW

Energy Singularity: "Energularity"



Technological Singularity:

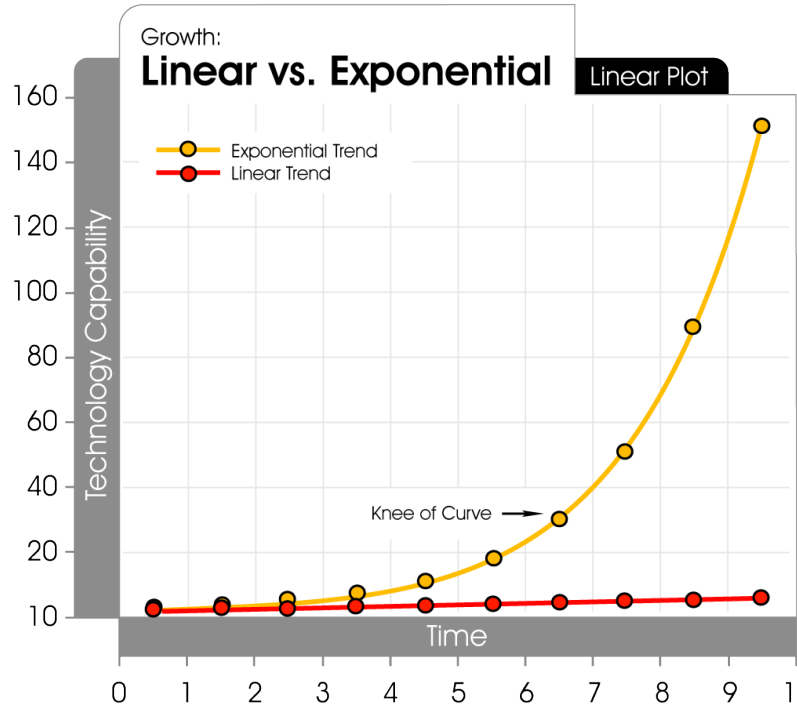
- Ray Kurzweil

Methuselarity!

- Aubrey de Grey

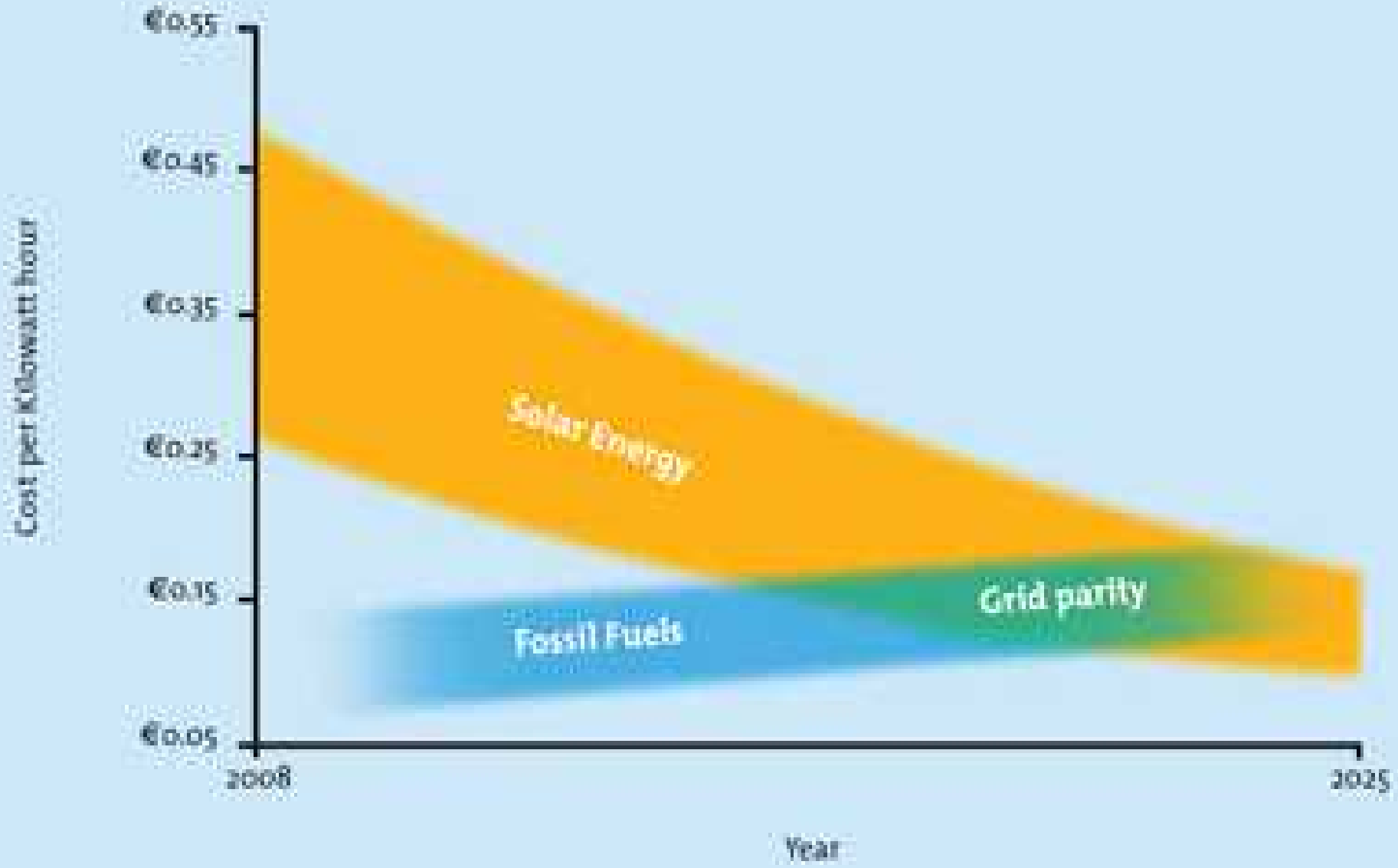
Energularity?

- Jose Cordeiro

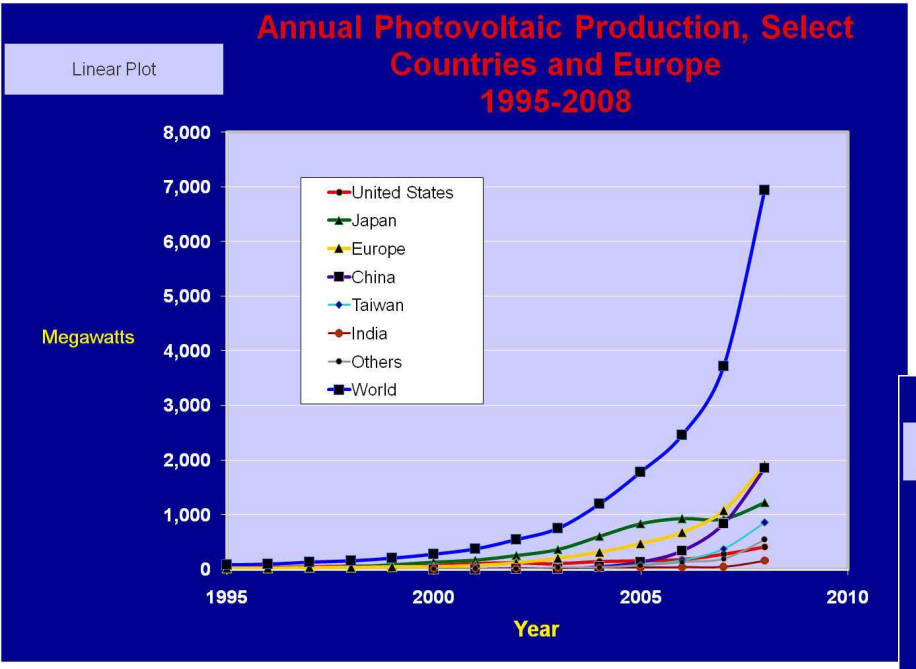


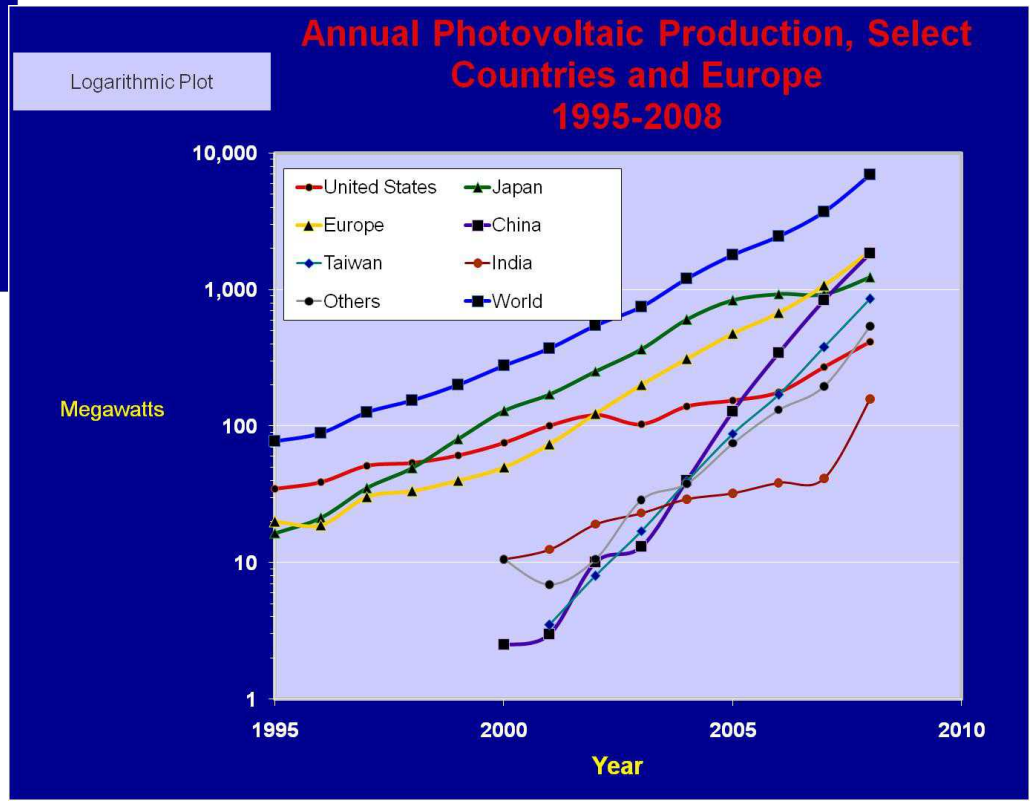
Example	Power	Scientific notation
Power of Galileo space probe's radio signal from Jupiter	10 zW	10×10^{-21} watt
Minimum discernable signal at an FM antenna terminal	2.5 fW	2.5×10^{-15} watt
Average power consumption of a human cell	1 pW	1×10^{-12} watt
Approximate consumption of a quartz wristwatch	1 μW	1×10^{-6} watt
Laser in a CD-ROM drive	5 mW	5×10^{-3} watt
Approximate power consumption of the human brain	30 W	30×10^{0} watt
Power of the typical household light bulb	60 W	60×10^{0} watt
Average power used by the human body	100 W	100×10^{0} watt
Approximately 1000 BTU/hour	290 W	2.9×10^{0} watt
Power received from the Sun at the Earth's orbit by m2	1.4 kW	1.4×10^{3} watt
Photosynthetic power output per km2 in ocean	3.3 - 6.6 kW	$3.3 - 6.6 \times 10^{3}$ watt
Photosynthetic power output per km2 in land	16 - 32 kW	$16 - 32 \times 10^{3}$ watt
Range of power output of typical automobiles	40 - 200 kW	$40 - 200 \times 10^{3}$ watt
Mechanical power output of a diesel locomotive	3 MW	3×10^{6} watt
Peak power output of largest class aircraft carrier	190 MW	190×10^{6} watt
Power received from the Sun at the Earth's orbit by km2	1.4 GW	1.4×10^{9} watt
Peak power generation of the largest nuclear reactor	3 GW	3×10^{9} watt
Electrical generation of the Three Gorges Dam in China	18 GW	18×10^{9} watt
Electrical power consumption of the USA in 2001	424 GW	424×10^{9} watt
Electrical power consumption of the world in 2001	1.7 TW	1.7×10^{12} watt
Total power consumption of the USA in 2001	3.3 TW	3.3×10^{12} watt
Global photosynthetic energy production	3.6 - 7.2 TW	$3.6 - 7.2 \times 10^{12}$ watt
Total power consumption of the world in 2001	13.5 TW	13.5×10^{12} watt
Average total heat flux from earth's interior	44 TW	44×10^{12} watt
Heat energy released by a hurricane	50 - 200 TW	$50 - 200 \times 10^{12}$ watt
Estimated heat flux transported by the Gulf Stream	1.4 PW	1.4×10^{15} watt
Total power received by the Earth from the Sun (Type I)	174 PW	174×10^{15} watt
Luminosity of the Sun (Type II)	386 YW	386×10^{24} watt
Approximate luminosity of the Milky Way galaxy (Type III)	5×10^{36} W	5×10^{36} watt
Approximate luminosity of a Gamma Ray burst	1×10^{45} W	1×10^{45} watt
Energy output of a galactic supercluster (Type IV)	1×10^{46} W	1×10^{46} watt
Energy control over the entire universe (Type V civilization)	1×10^{56} W	1×10^{56} watt

THE PATH TO GRID PARITY

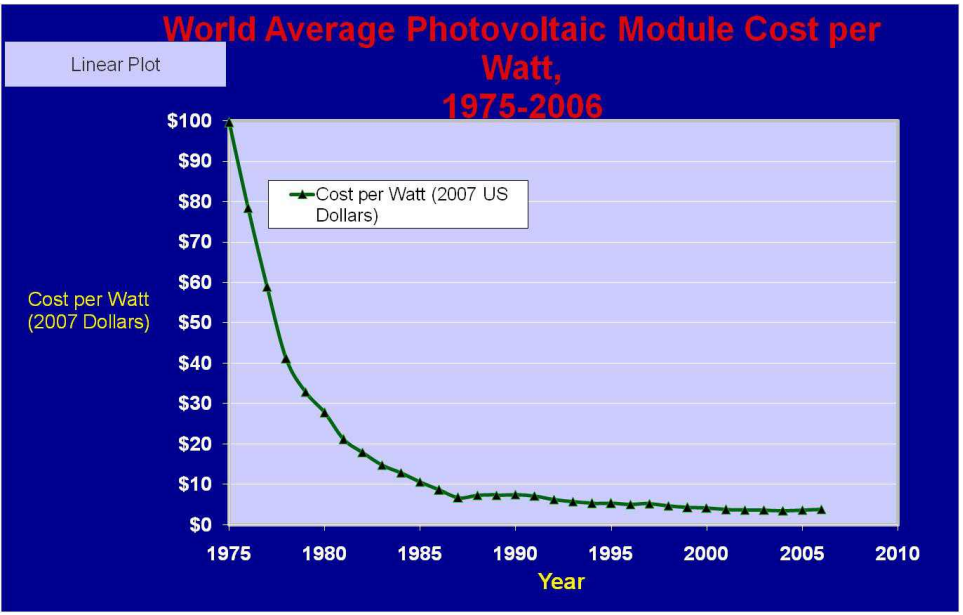


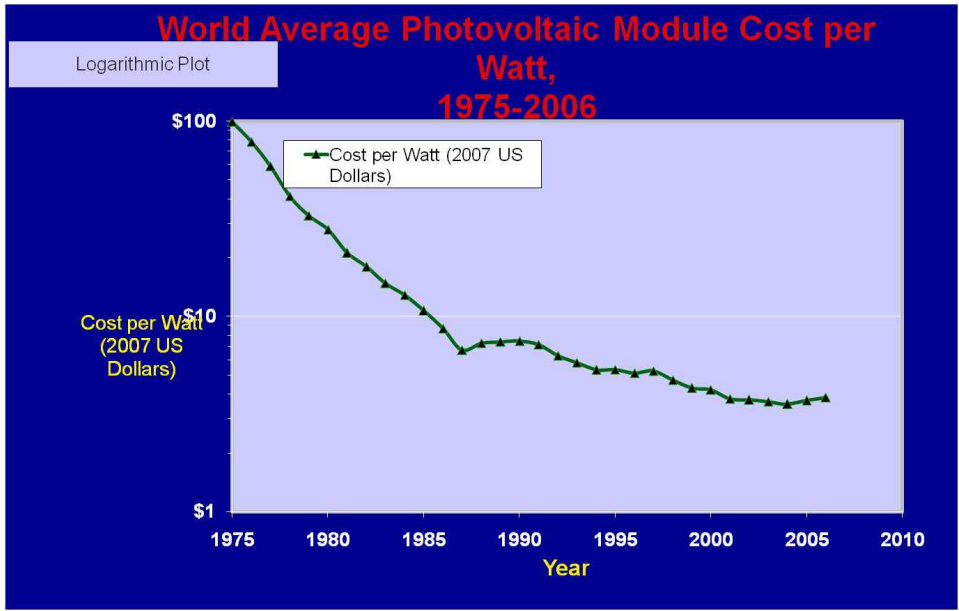
Exponential increase in solar power



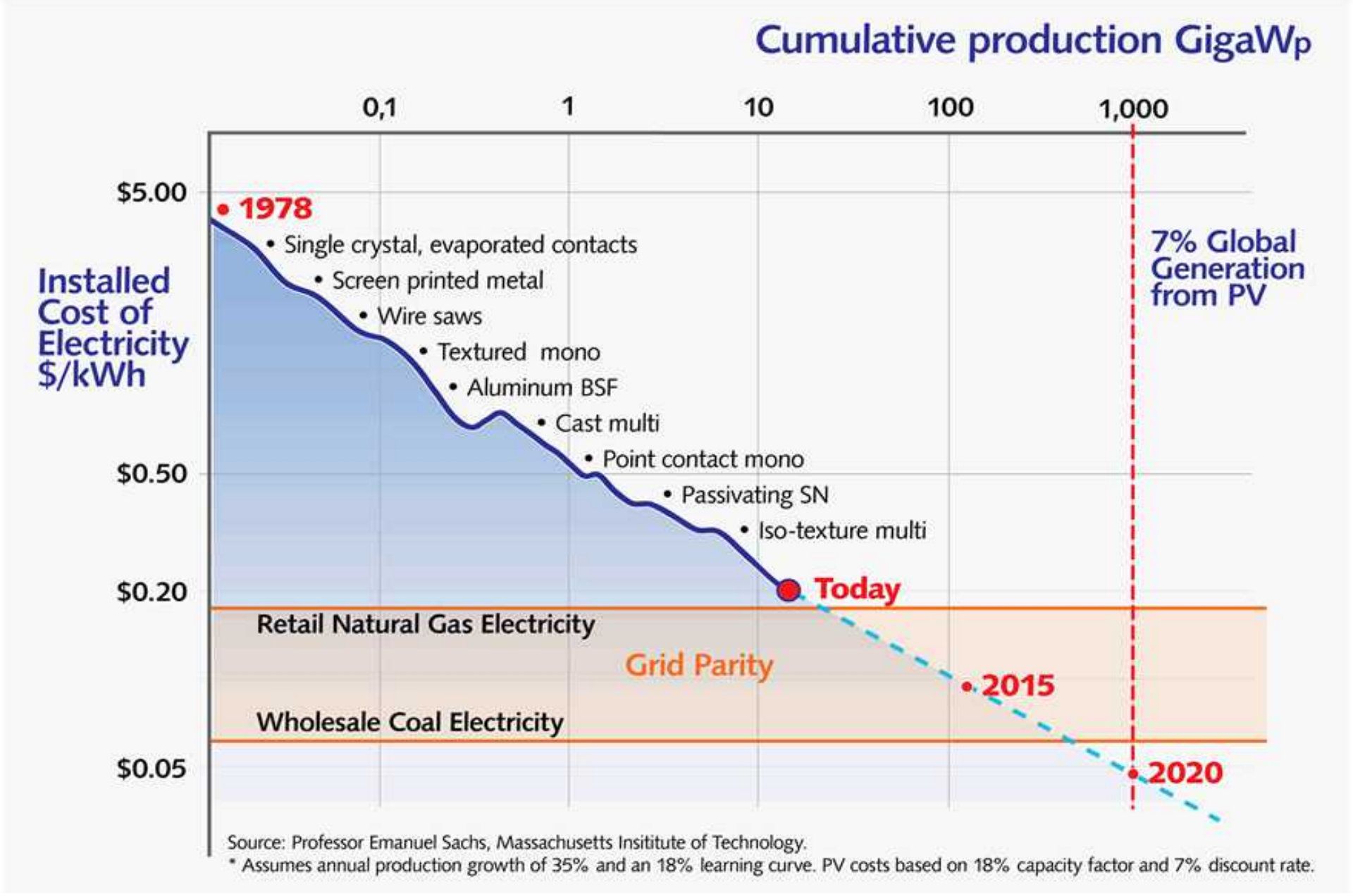


Exponential decrease in solar costs



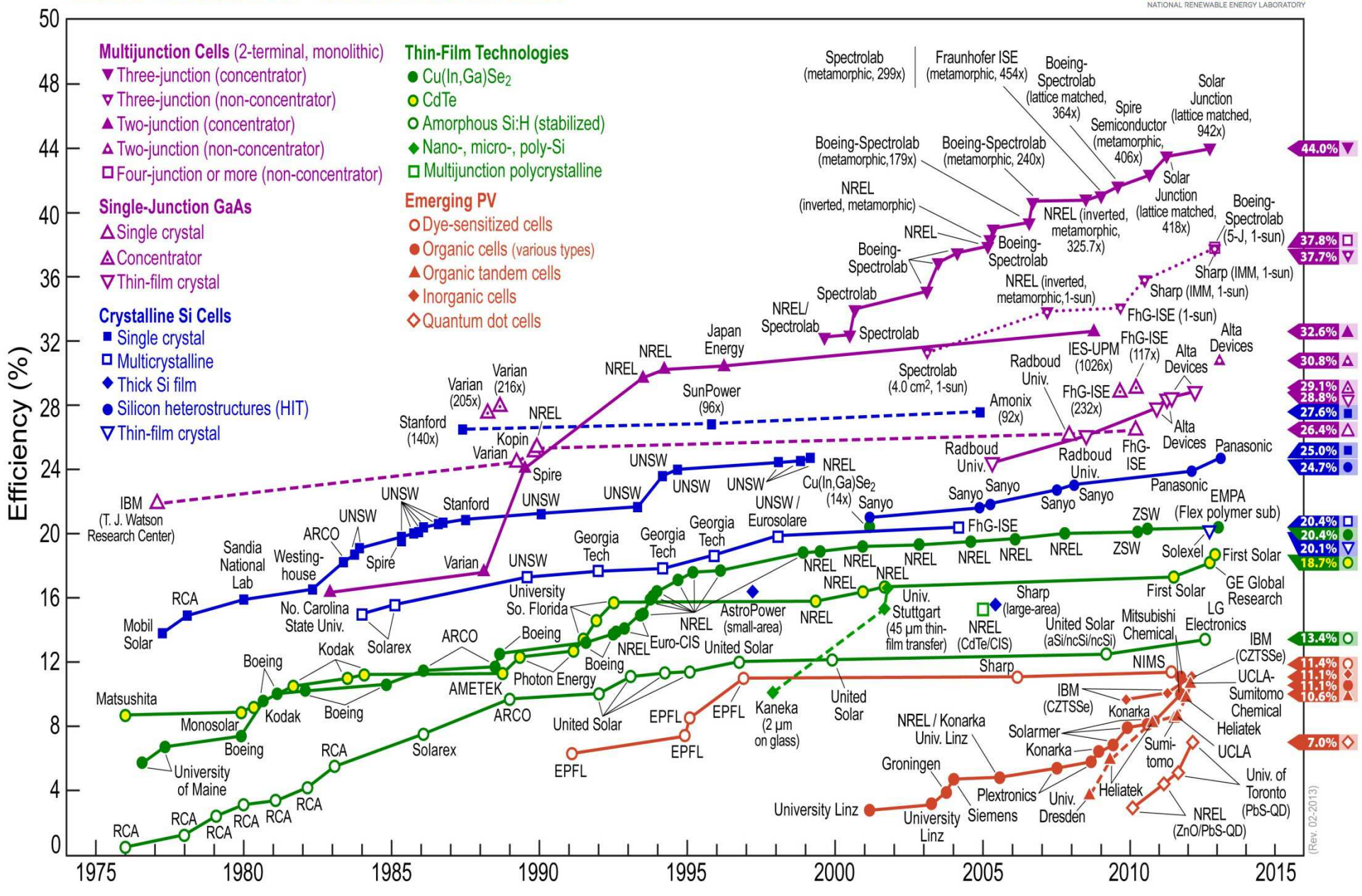


Solar costs decreasing 10% per year

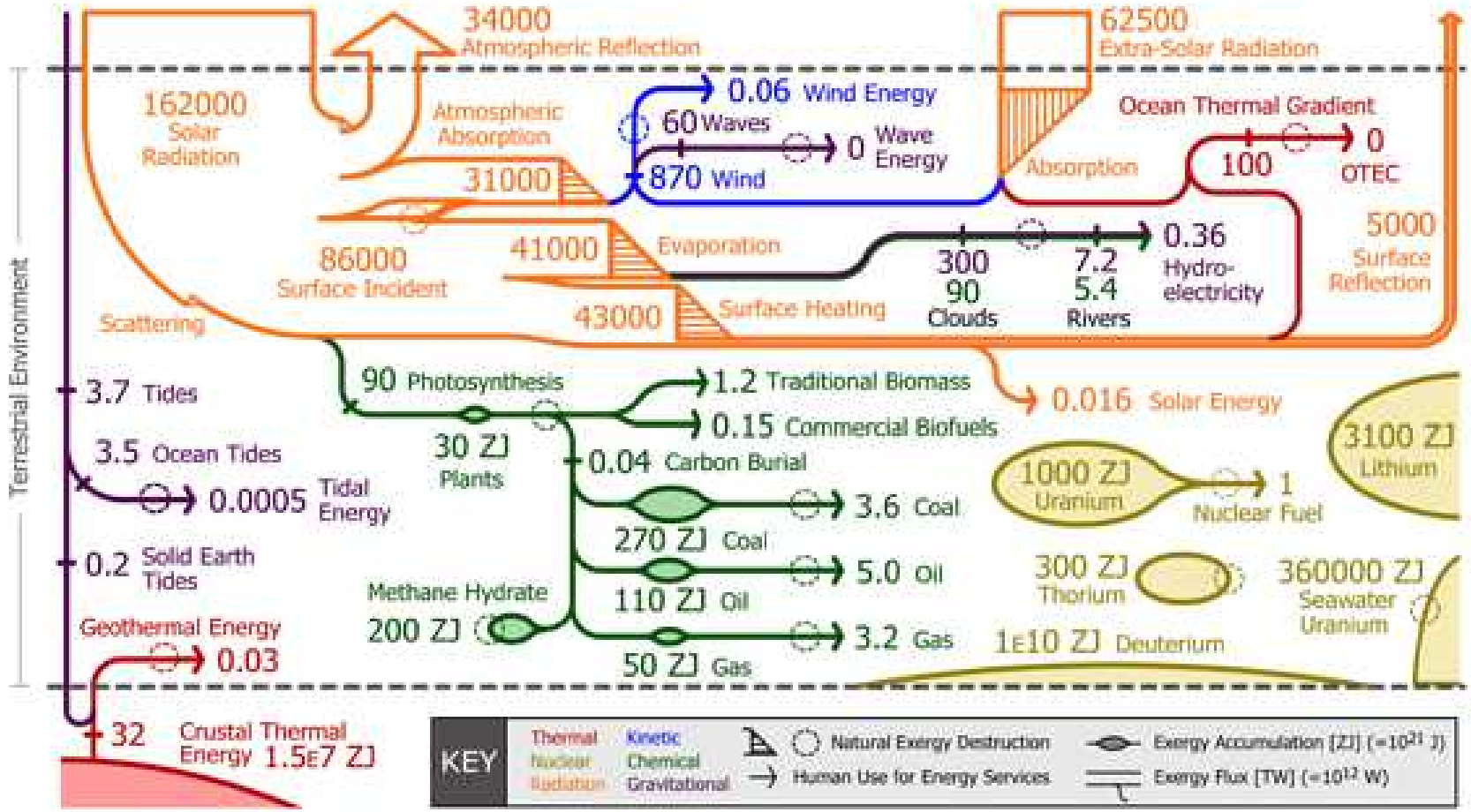


Best Research-Cell Efficiencies

NREL
NATIONAL RENEWABLE ENERGY LABORATORY



Global Exergy Flux, Reservoirs, and Destruction

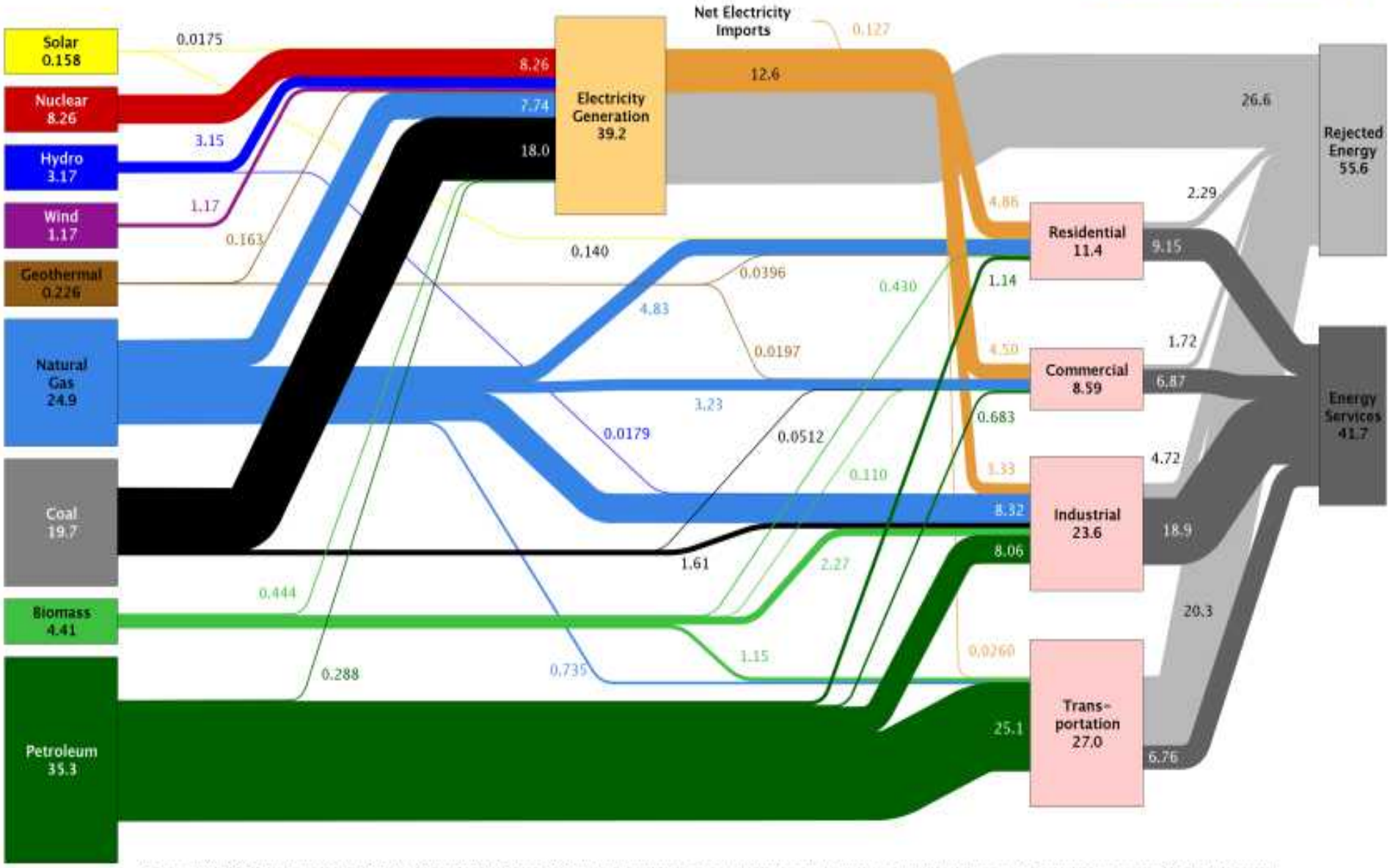


Exergy is the useful portion of energy that allows us to do work and perform energy services. We gather exergy from energy-carrying substances in the natural world we call energy resources. While energy is conserved, the exergetic portion can be destroyed when it undergoes an energy conversion. This diagram summarizes the exergy reservoirs and flows in our sphere of influence including their interconnections, conversions, and eventual natural or anthropogenic destruction. Because the choice of energy resource and the method of resource utilization have environmental consequences, knowing the full range of energy options available to our growing world population and economy may assist in efforts to decouple energy use from environmental damage.

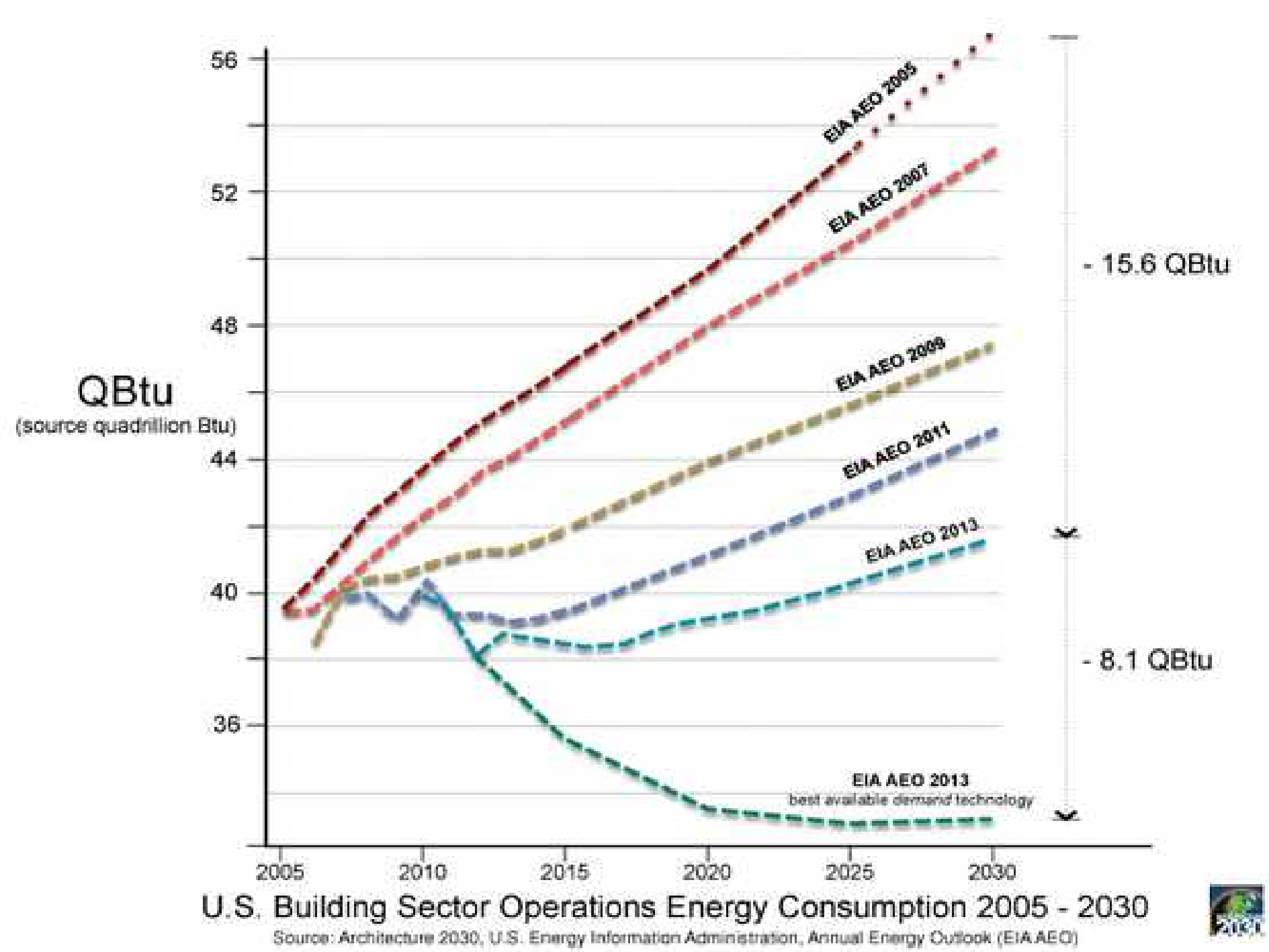
Prepared by Wes Hermann and A.J. Simon
Global Climate and Energy Project at Stanford University (http://gcep.stanford.edu)

Estimated U.S. Energy Use in 2011: ~97.3 Quads

Lawrence Livermore National Laboratory



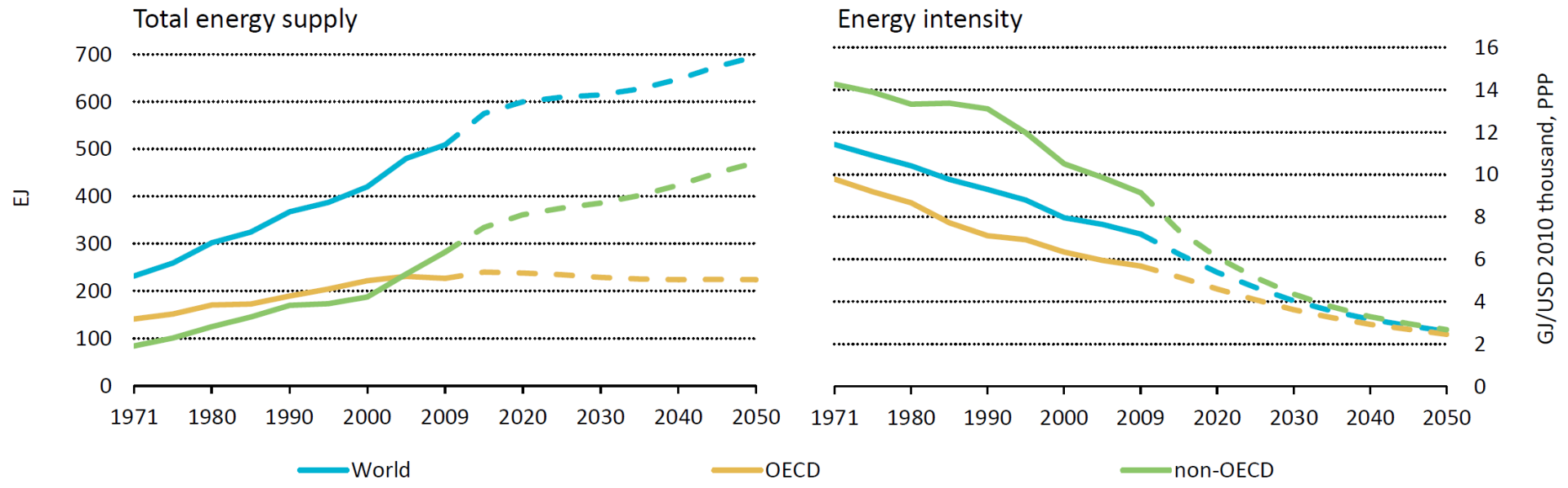
Source: LLNL 2012. Data is based on DOE/EIA-0384(2011), October, 2012. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports flows for non-thermal resources (i.e., hydro, wind and solar) in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 80% for the residential, commercial and industrial sectors, and as 25% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527



U.S. Building Sector Operations Energy Consumption 2005 - 2030

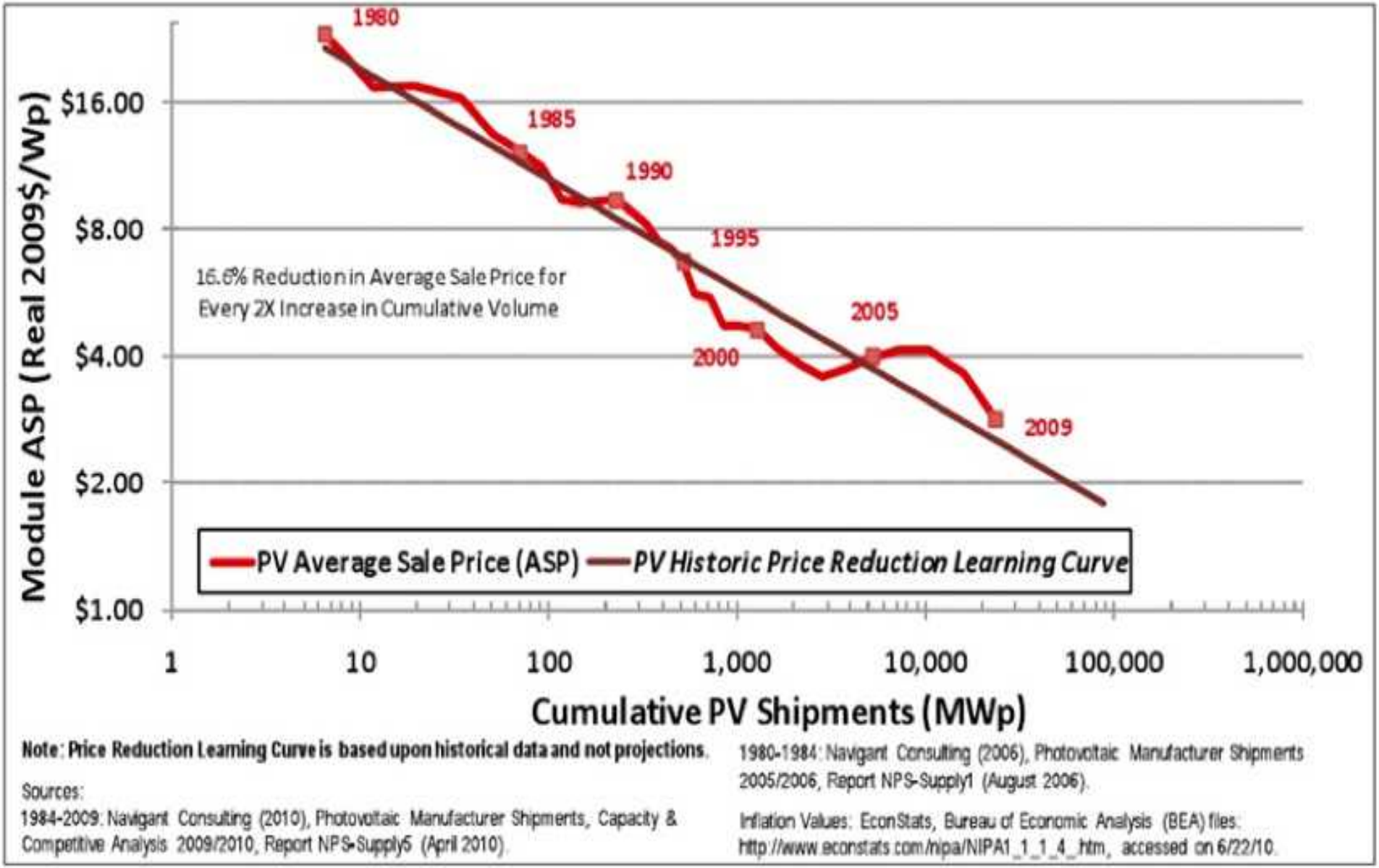
Source: Architecture 2030, U.S. Energy Information Administration, Annual Energy Outlook (EIA AEO)

Decoupling energy use from economic activity



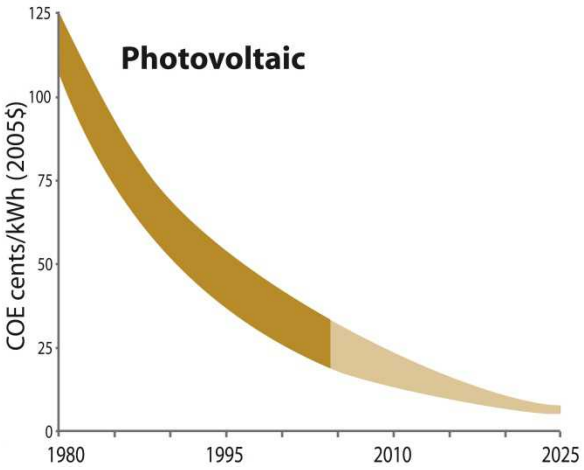
Reducing the energy intensity of the economy is vital

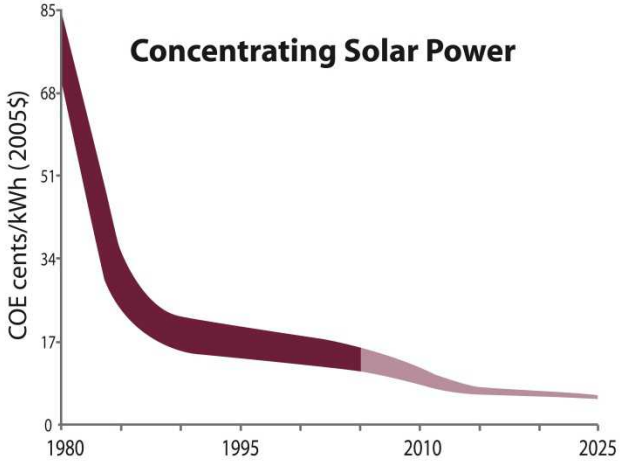
http://www.greentechmedia.com/articles/read/Guest-Post-Brad-Mattson-on-

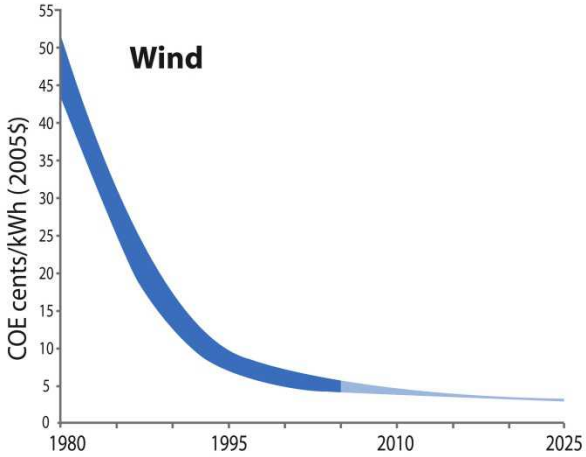


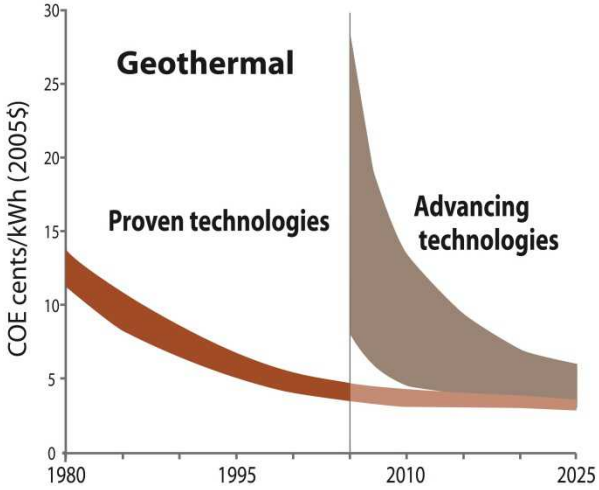
Renewable Energy Cost Trends

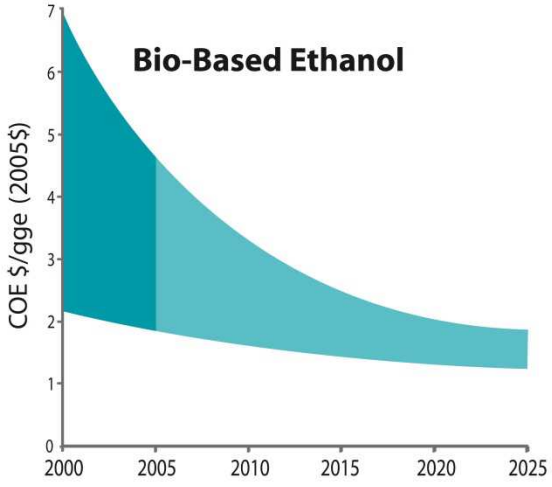
Levelized cost of energy in constant 2005$[1]





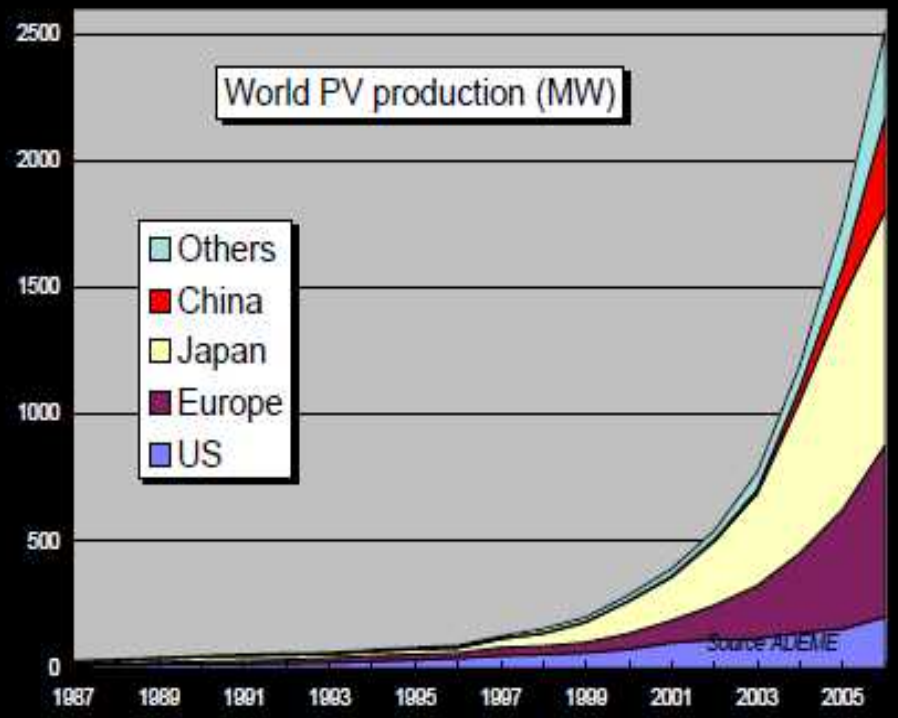






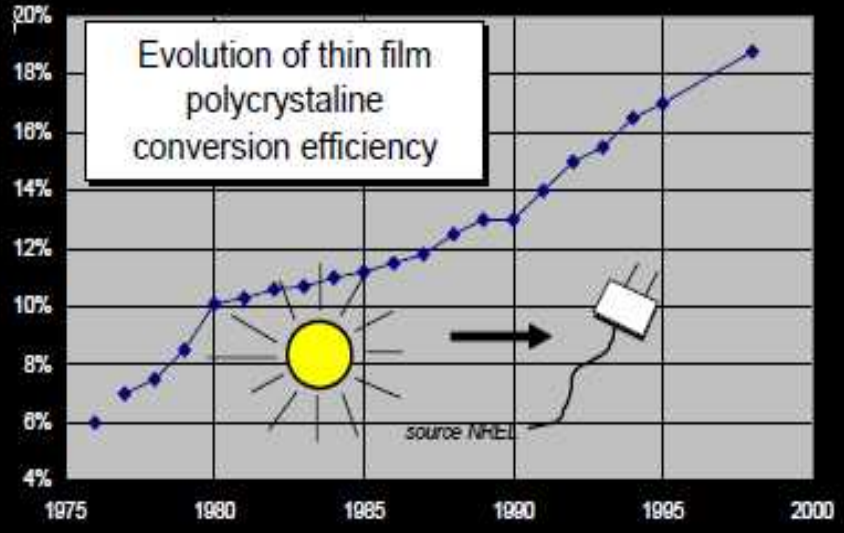
Source: NREL Energy Analysis Office (www.nrel.gov/analysis/docs/cost_curves_2005.ppt)

[1]These graphs are reflections of historical cost trends NOT precise annual historical data. DRAFT November 2005

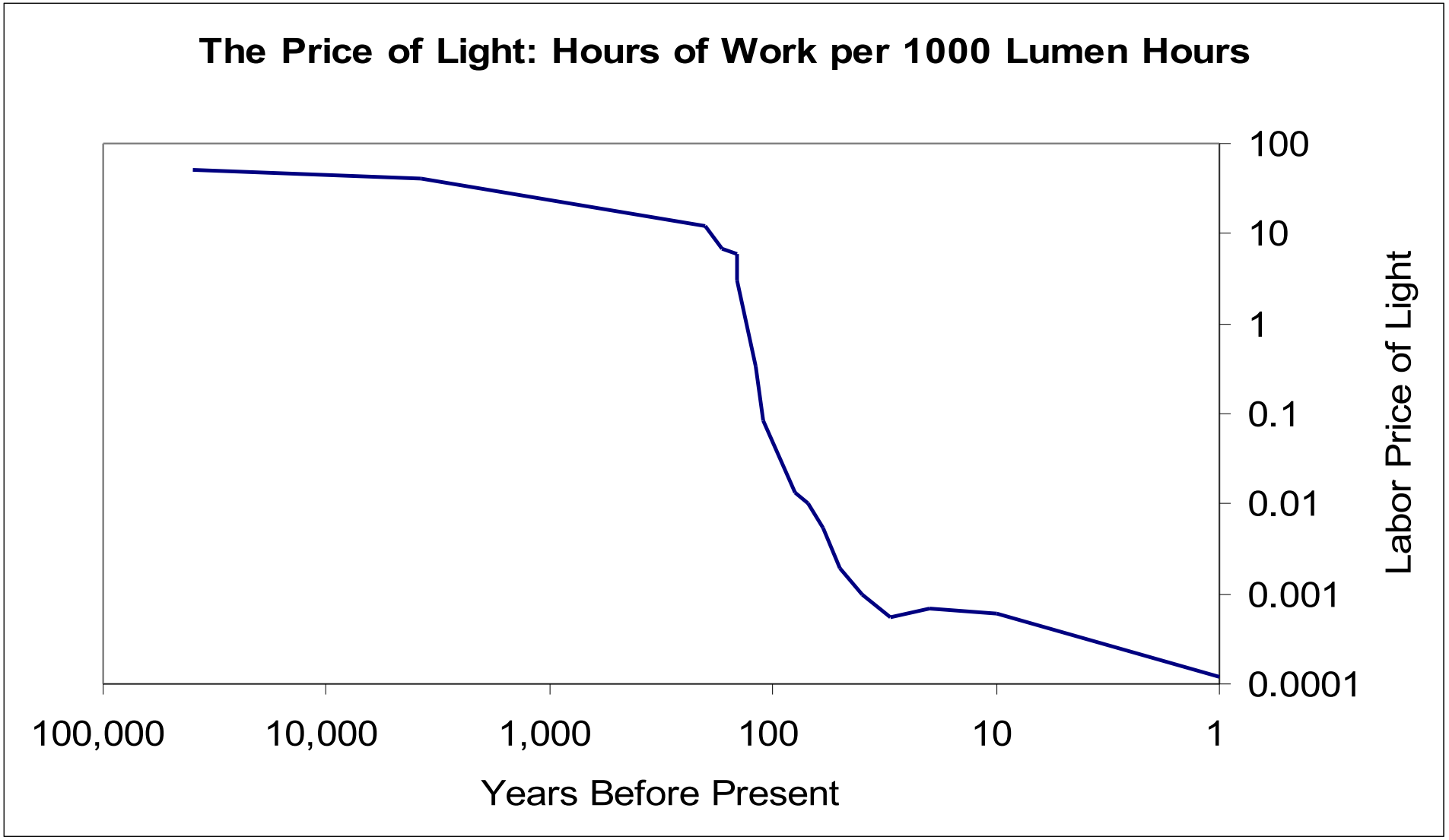


PHOTOVOLTAIC TENDENCIES

- PRODUCTION
- COST
- EFFICIENCY

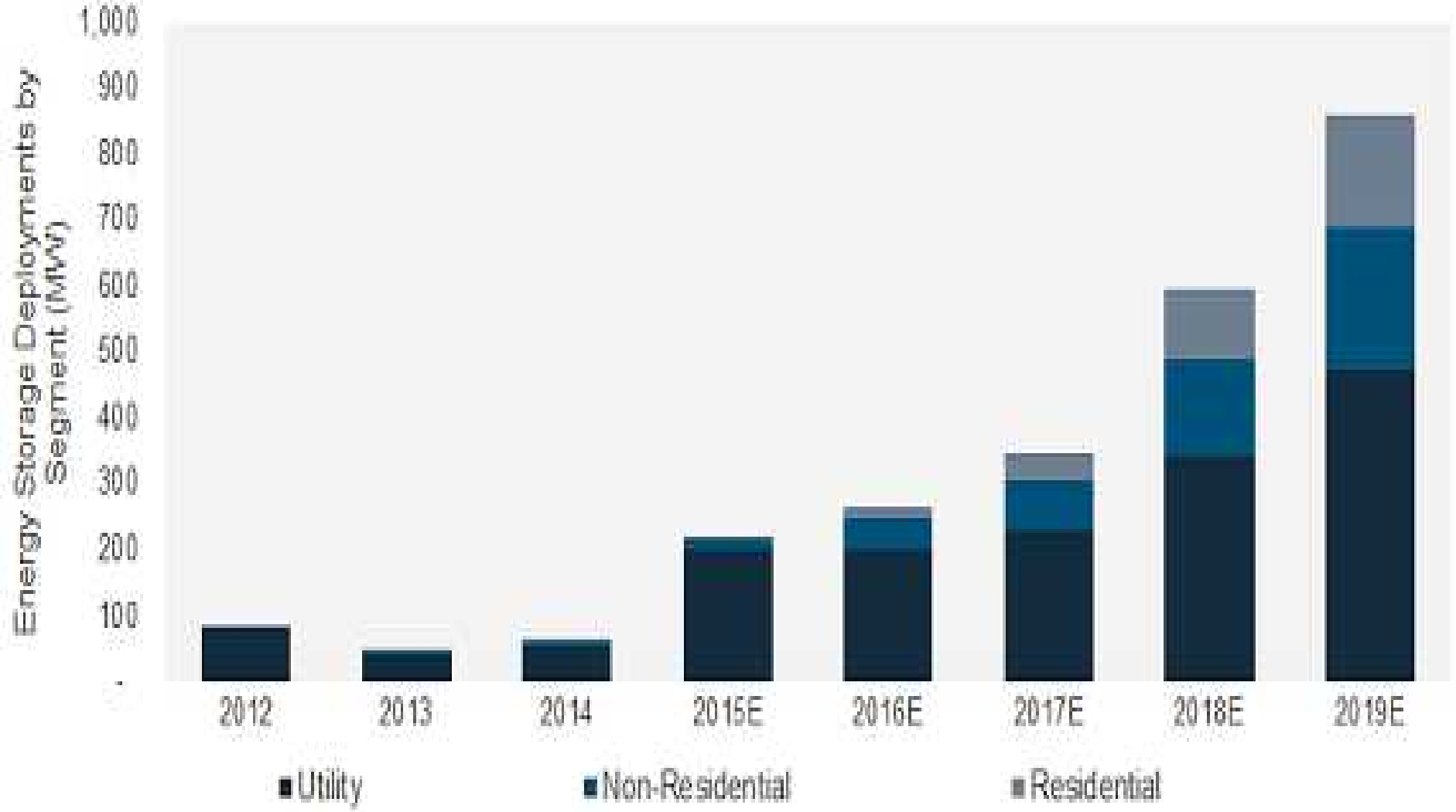


Energy: reduction of light costs



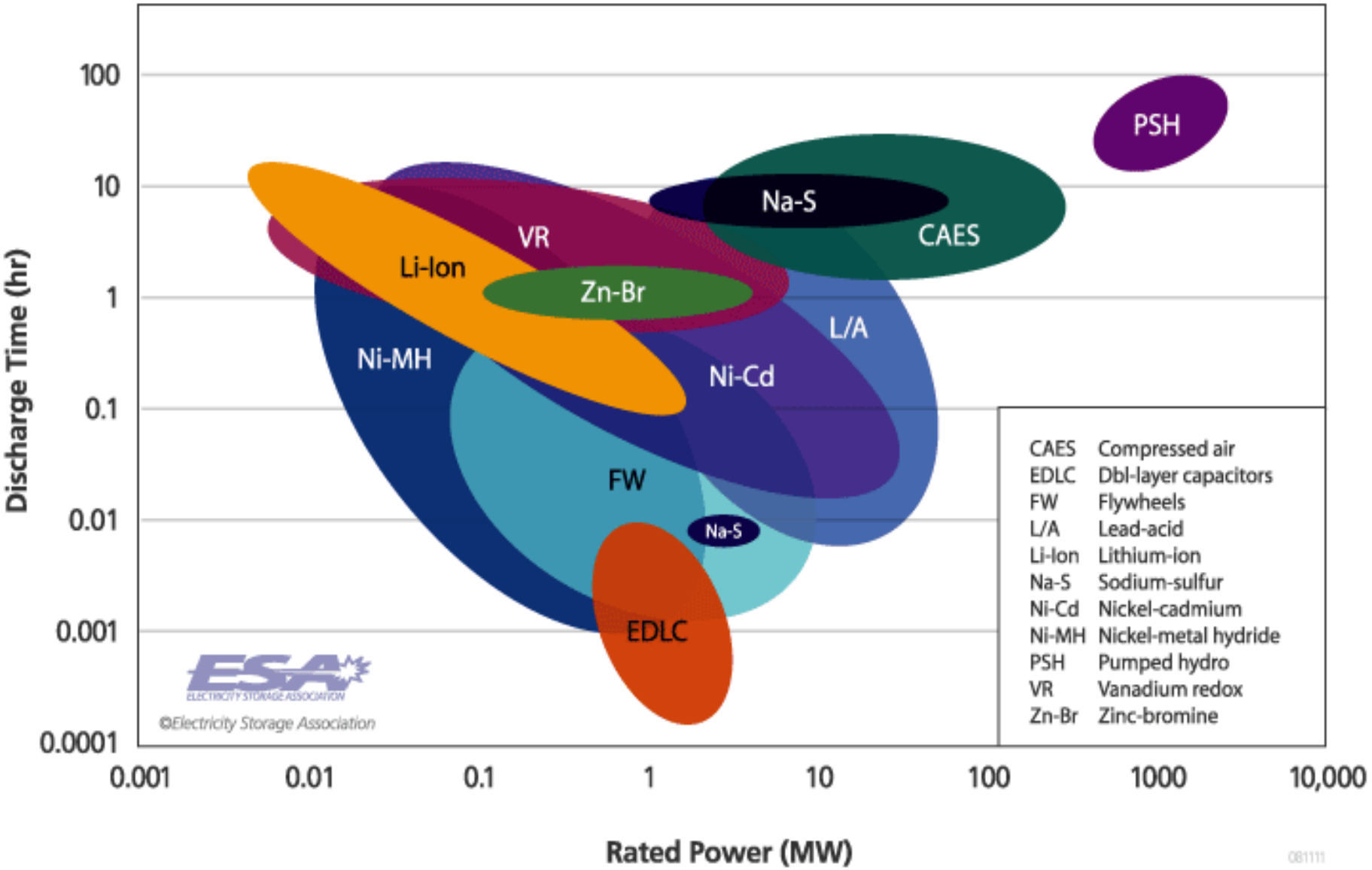
Source: Cordeiro (2008) based on Nordhaus (1997) and DeLong (2000)

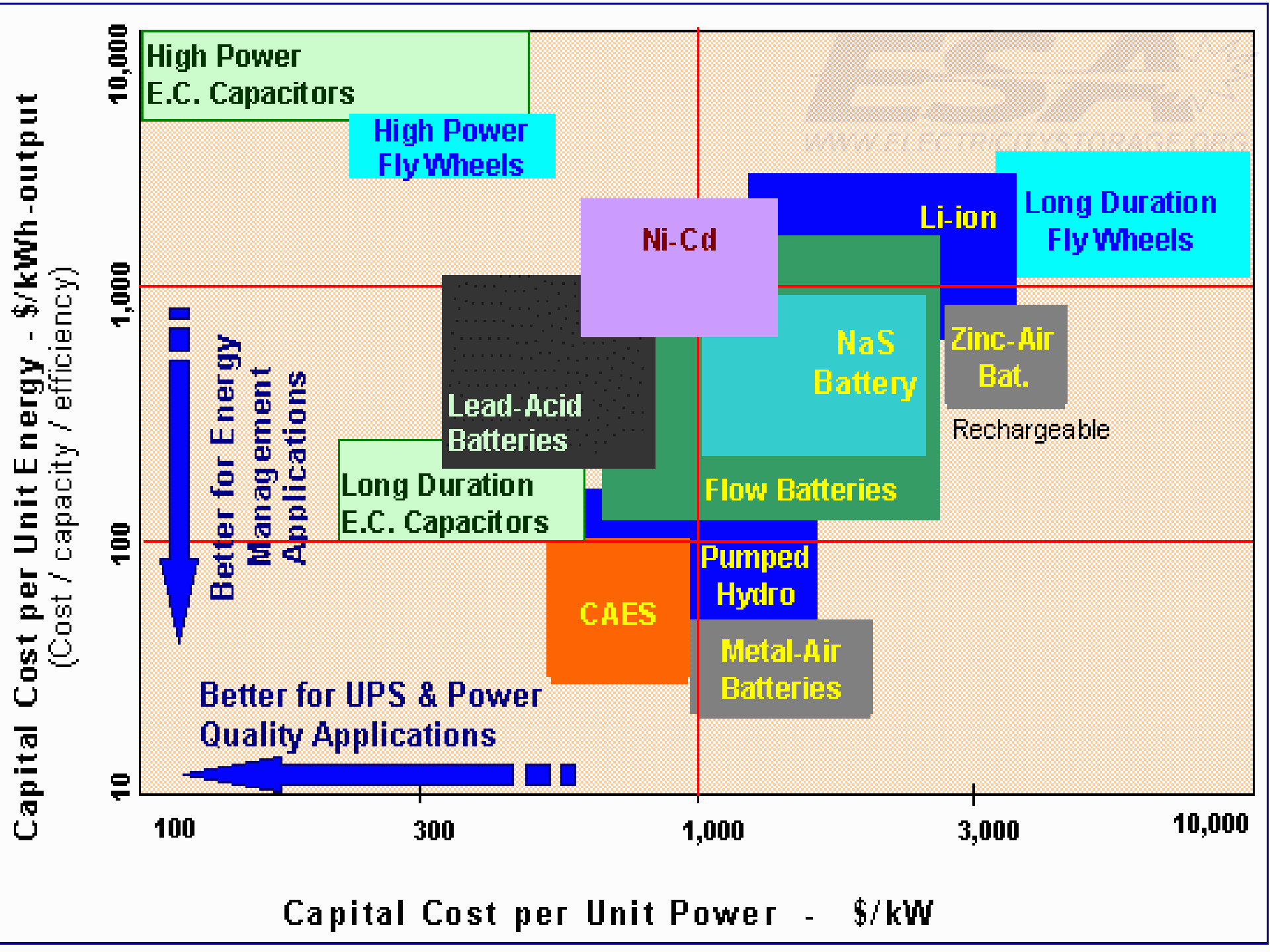
Energy Storage Deployments by Segment (MW), 2012 - 2019E



System Ratings

Installed systems as of November 2008



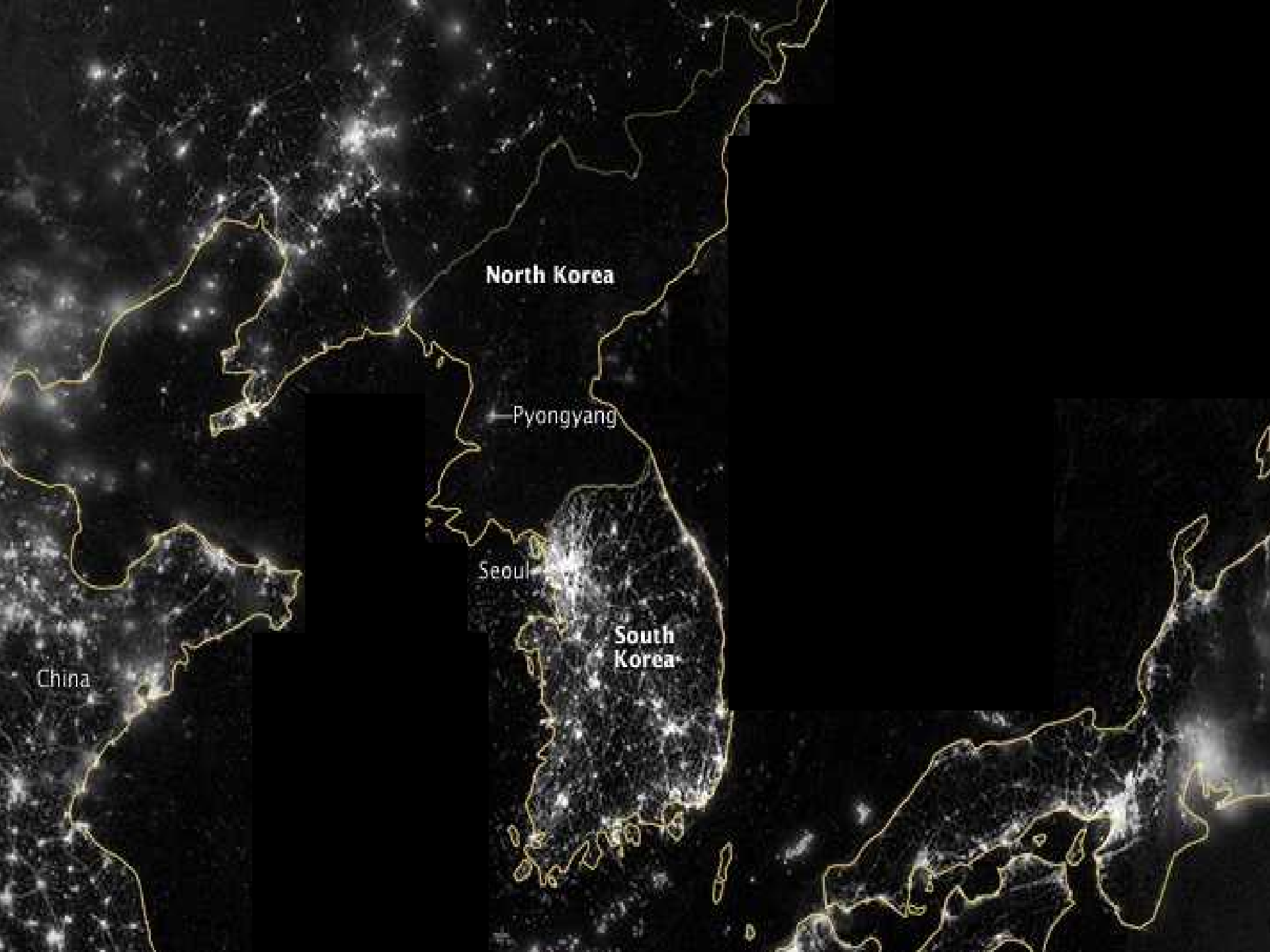

Capital Cost per Unit Energy - $/kWh-output
(Cost / capacity / efficiency)
10,000
1,000
100
10
High Power
E.C. Capacitors
High Power
Fly Wheels
Ni-Cd
Li-ion
Long Duration
Fly Wheels
NaS
Battery
Zinc-Air
Bat.
Rechargeable
Lead-Acid
Batteries
Long Duration
E.C. Capacitors
Flow Batteries
Pumped
Hydro
CAES
Metal-Air
Batteries
Better for Energy
Management
Applications
Better for UPS & Power
Quality Applications
100
300
1,000
3,000
10,000
Capital Cost per Unit Power - $/kW

Hydro pump storage for wind in Belgium

Cheap Energy for the Earth

- The end of energy poverty
- Move beyond scarcity into abundance
- Solve water and food problems
- Improve infrastructure and transportation
- Increase energy security
- Eliminate oil rents by political demagogues
- Open space to (post)human civilization
- Terraform other planets

Light up the world


North Korea
Pyongyang
Seoul
South Korea
China


2005
Luca Bruno / AP
2013
NBC NEWS
Michael Sohn / AP


1987
2013

Yin-yang 阴阳 (and more yin-yang)

Guru Cordeiro meditating in India (Hinduism) and in Japan (Buddhism)

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La era industrial de la energía y el transporte está a punto de disrupción. Este libro demuestra que la tecnología solar, los vehículos eléctricos y autónomos y otras tecnologías exponenciales están abriendo paso a la nueva era de la energía limpia, basada en el conocimiento.

La Edad de Piedra no se acabó porque nos quedáramos sin piedras. Se terminó porque las rocas fueron desplazadas por una tecnología superior: el bronce. La era de las fuentes de energía centralizadas, de "control y mando", basadas en la extracción de recursos, no se terminará porque nos quedemos sin petróleo, gas natural, carbón o uranio.

Se terminará porque estas fuentes de energías, los modelos de negocio que utilizan, y los productos que las sostienen se volverán obsoletos gracias a tecnologías, arquitecturas de producto y modelos de negocios superiores. Tecnologías exponenciales como la energía solar, eólica, los vehículos eléctricos y autónomos traerán la disrupción y barrerán las industrias de la energía y el transporte tal como las conocemos.

Esta es una disrupción basada en la tecnología, reminiscente de cómo el teléfono móvil, internet o las computadoras personales barrieron industrias como la telefonía fija, la publicación y la fotografía con rollos de película. Así como estas disrupciones voltearon la arquitectura de la información, así la disrupción limpia volteará la arquitectura de la energía y traerá una energía limpia, abundante y participativa. Similarmente la disrupción limpia es inevitable y será rápida. La era industrial de la energía y el transporte se acabará para 2030. O quizá antes.

Disrupción Limpia es un libro visionario sobre la transición energética exponencial de energías fósiles a energías limpias. España ha sido pionera en algunas áreas de energía renovable y podría seguir siendo con una clara visión de futuro. Latinoamérica también podría convertirse en la Arabia Saudita de las energías renovables.
Ramón Tamames, miembro de número de la Real Academia de Ciencias Morales y Políticas, economista, político, y colaborador en prensa y radio.

Disrupción Limpia es un libro realmente revolucionario que visualiza la evolución exponencial de las industrias de la energía y el transporte durante las próximas dos décadas. ¿Serán acertadas las predicciones de Tony Seba una vez más? Sinceramente creo que así será, ¡para el beneficio de toda la humanidad!
José Luis Cordeiro, director del Millennium Project, profesor fundador de Singularity University, autor, y experto en energía y tecnología.

www.tonyseba.com

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TONY SEBA

DISRUPCIÓN LIMPIA

DISRUPCIÓN LIMPIA

DE LA ENERGÍA Y EL TRANSPORTE

Tony Seba

Cómo Silicon Valley
Hará Obsoletos al Petróleo, Gas Natural, Carbón, Energía Nuclear, Empresas Eléctricas y Vehículos Convencionales para 2030.

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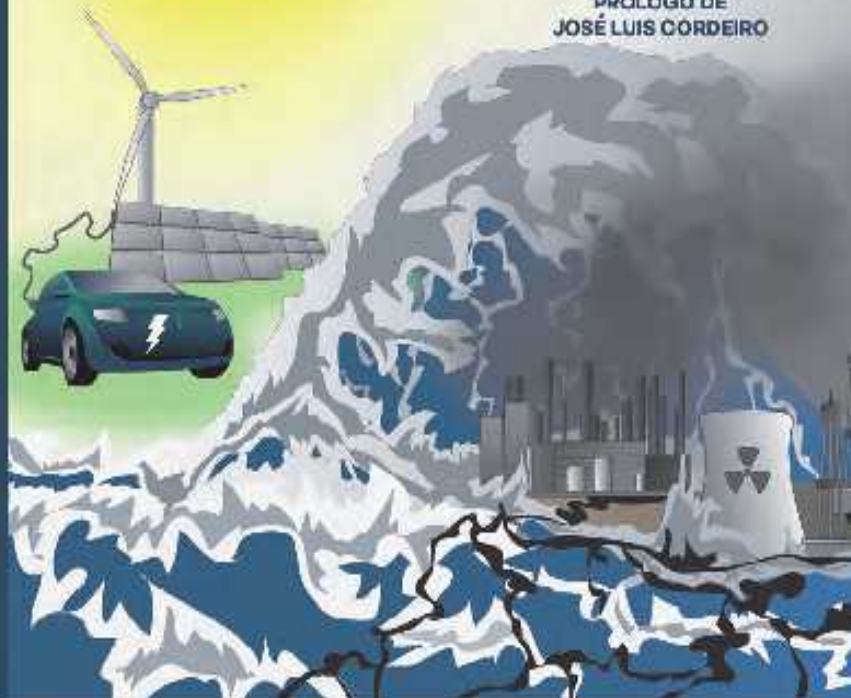

Thank you!

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