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



The Millennium Project



Global futurist think-tank with 50 nodes around the world



Singularity University



Medicine, Neuroscience
and
Human Enhancement

AI and Robotics

Singularity University
Preparing Humanity for
Accelerating Technological Change

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Preparing Humanity for
Accelerating Technological Change



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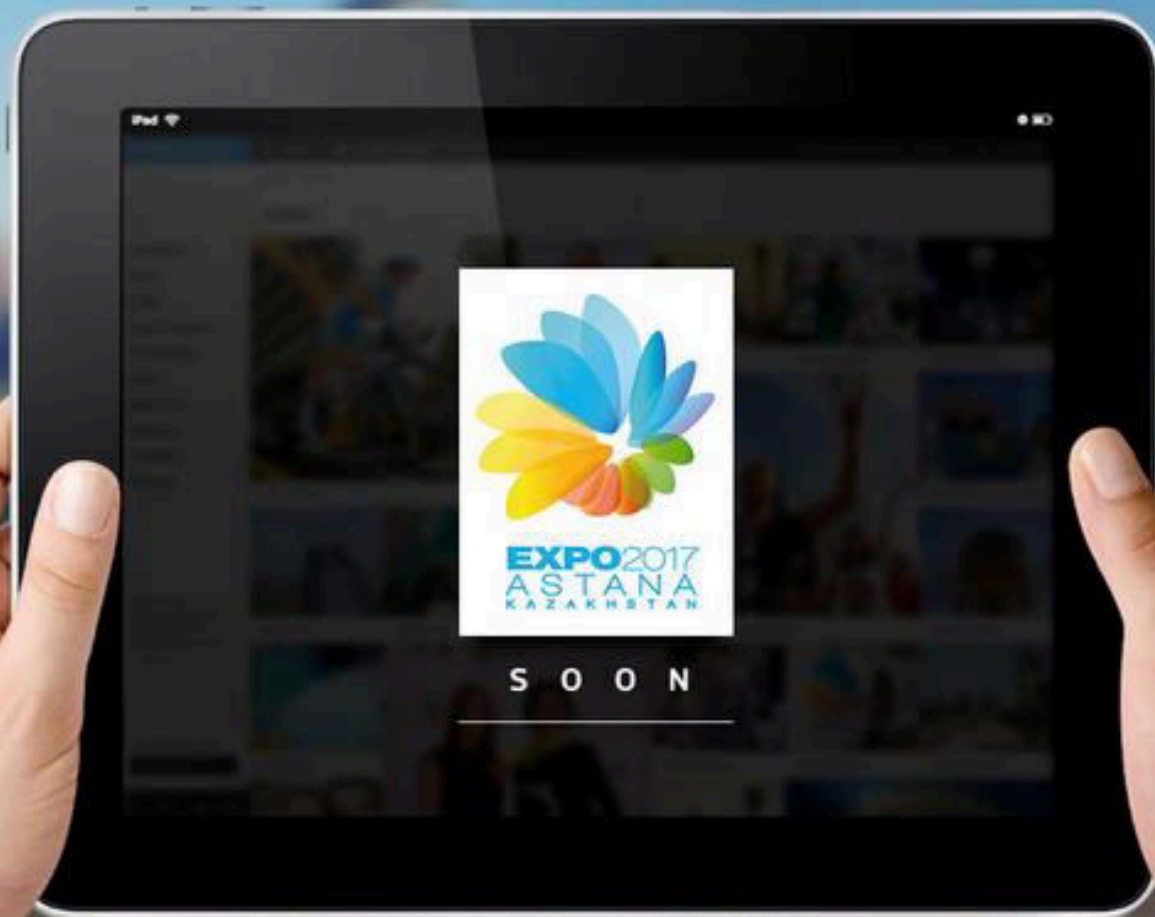
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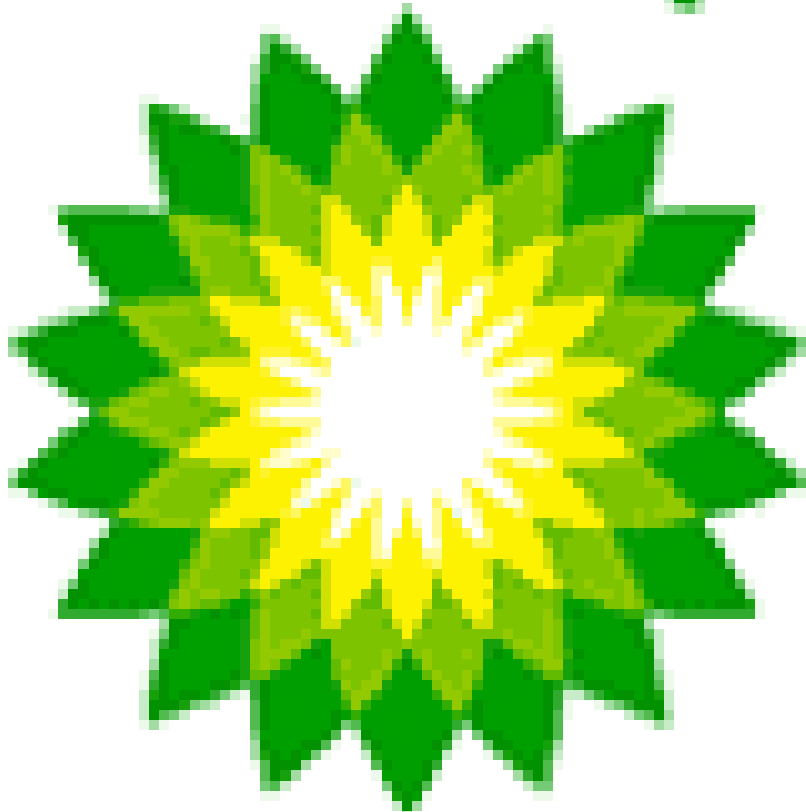
“Peak” Oil in the 21st Century?

- **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

Towards a post-petroleum world

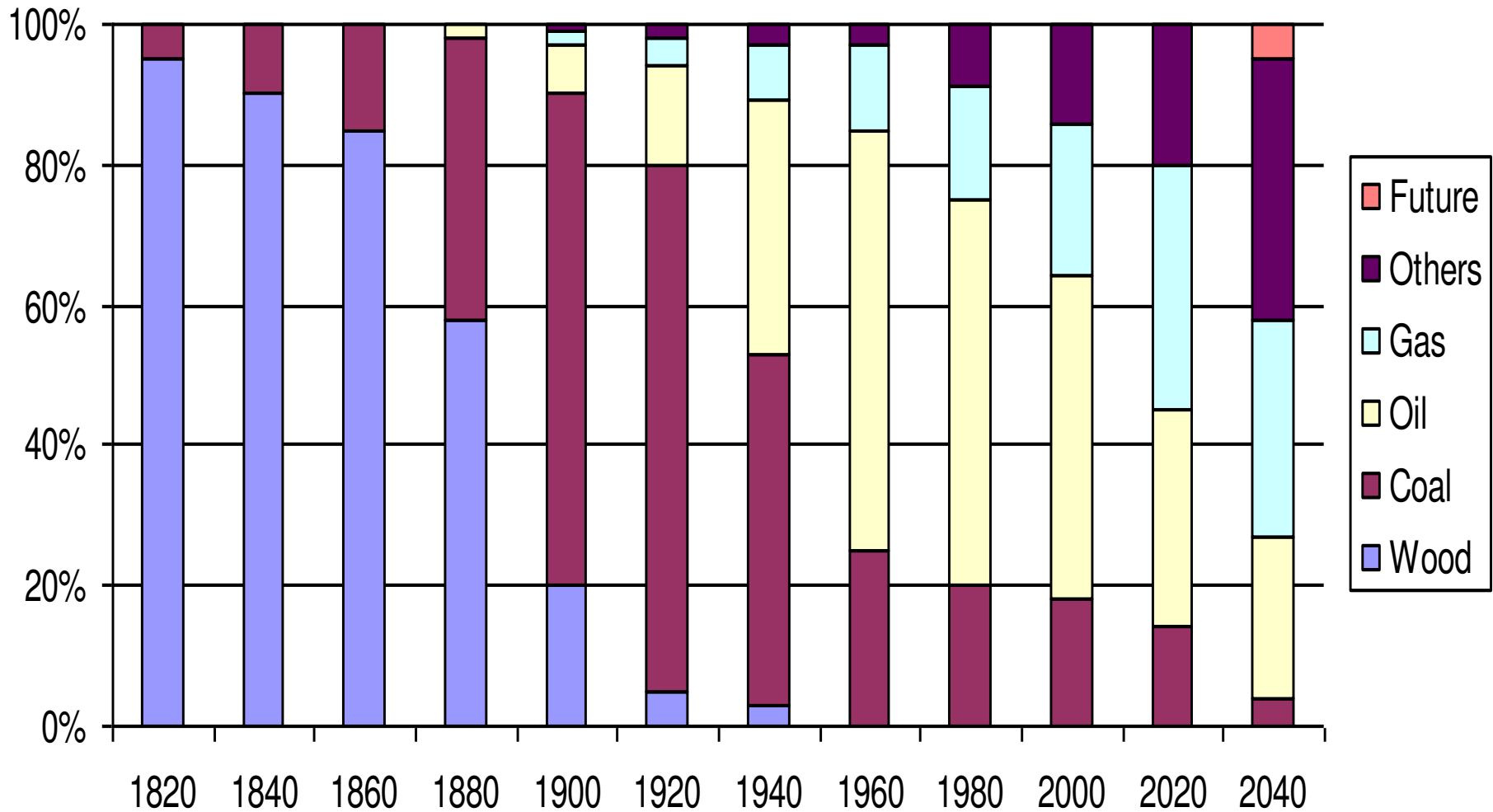
bp



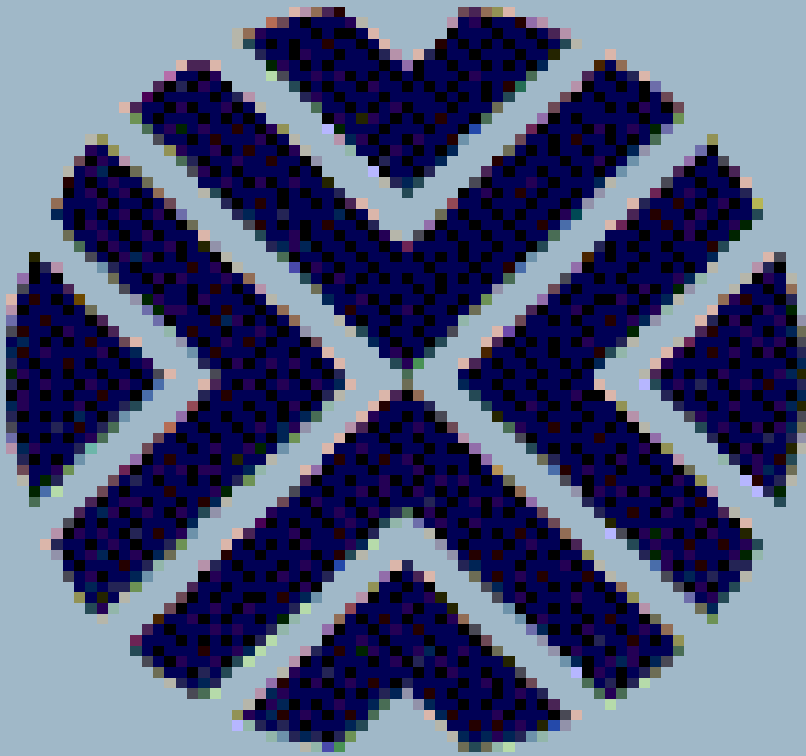
British Petroleum

Beyond Petroleum

Energy “waves”: “decarbonization”



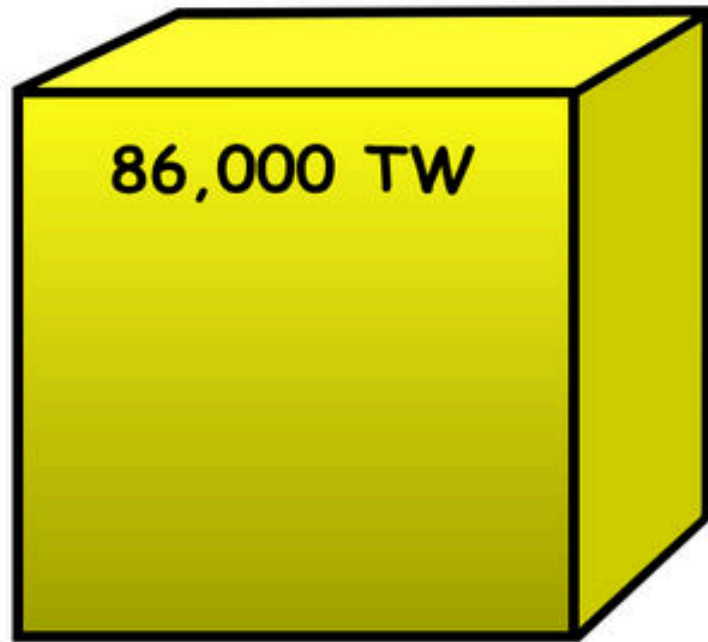
From manufacturing to **mindfacturing**



PDVSA



Available Renewable Energy



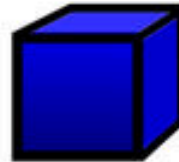
Solar

7.2 TW



Hydro

870 TW



Wind

32 TW



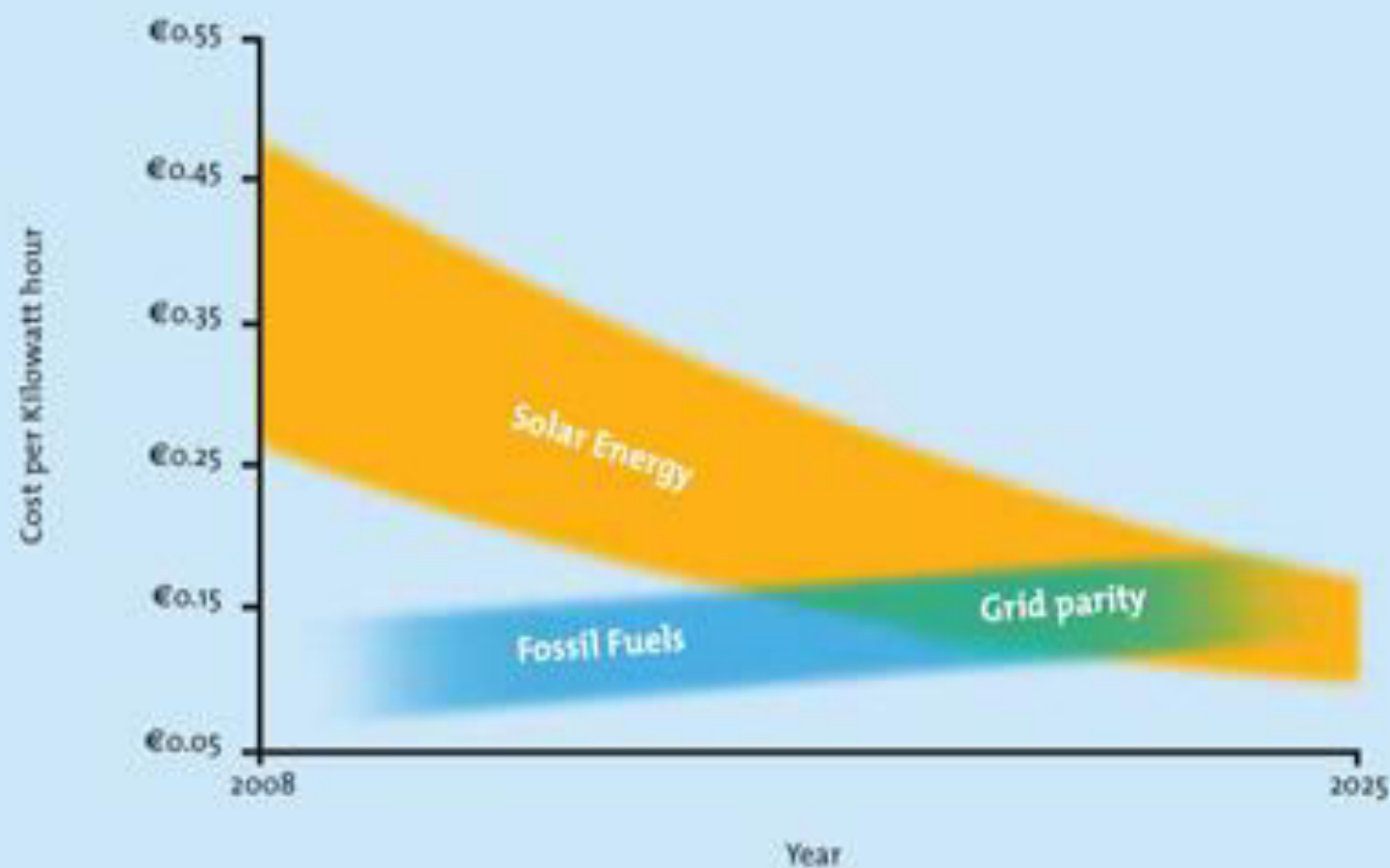
Geothermal

15 TW



**Global
Consumption**

THE PATH TO GRID PARITY





PRUIS

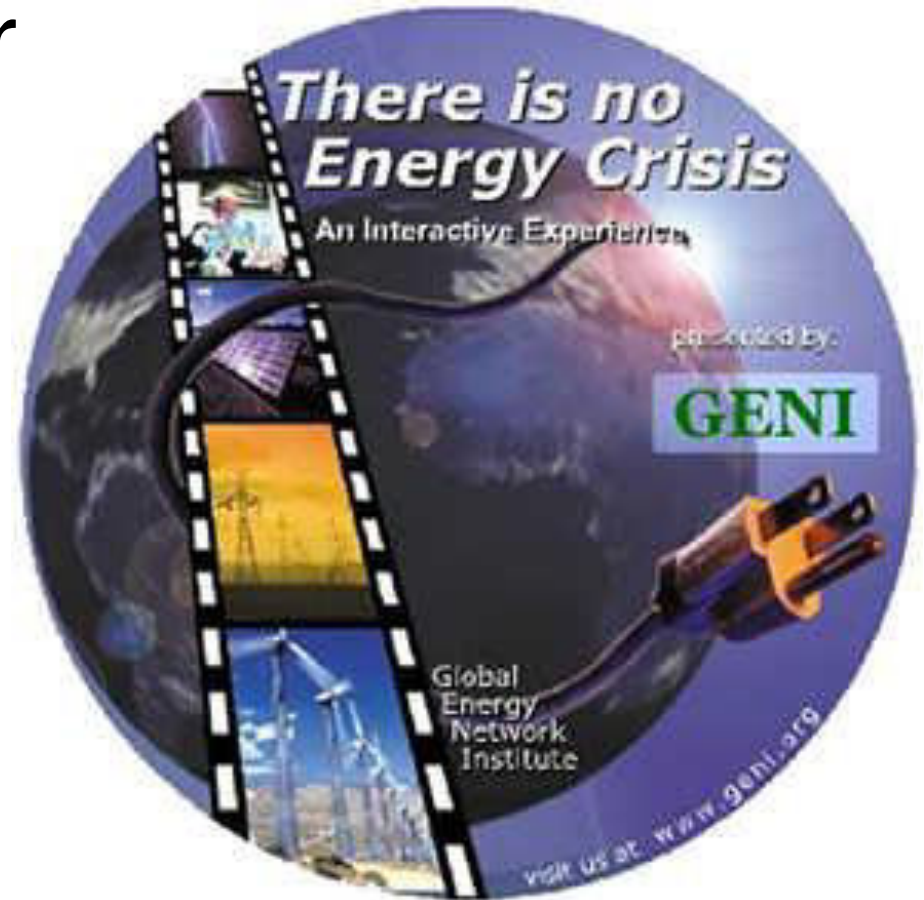
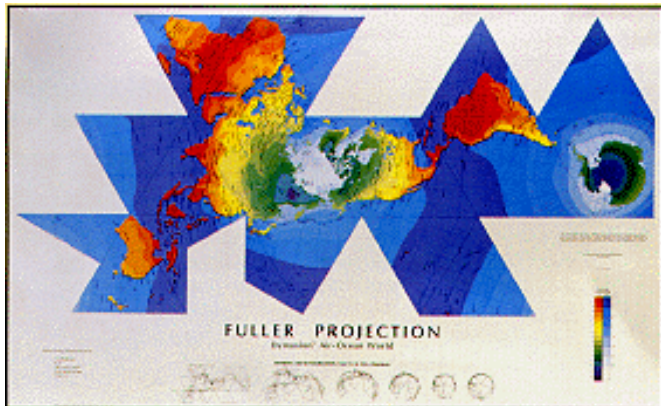
HYBRID
SYNERGY
DRIVE

Google™

self-driving car

The Energy “Internet”

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



The Enernet

- **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**

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 μ W	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	7 TW	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

Energy Singularity
ENERGULARITY

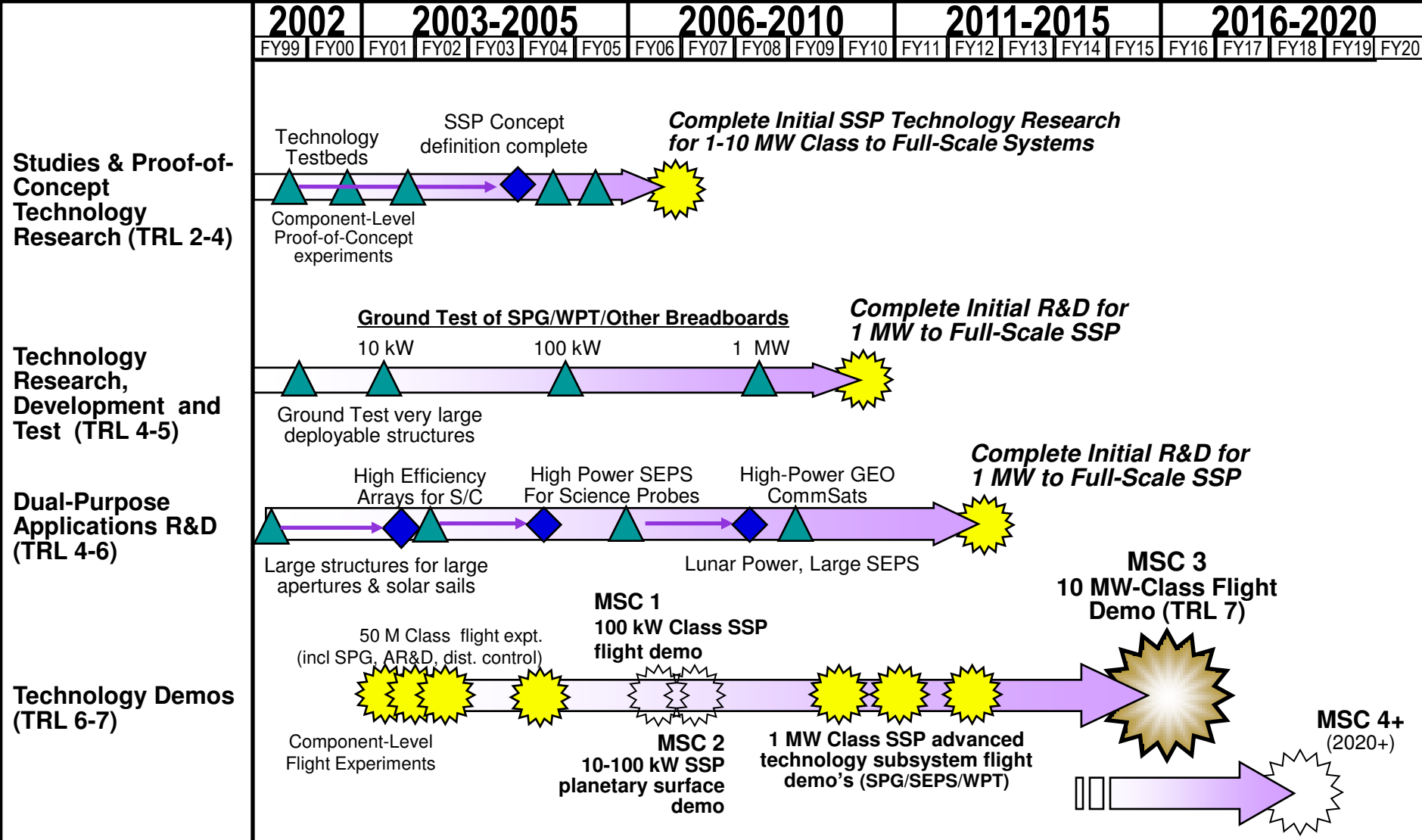
Nikolai Kardashev Energy Scale

Earth Based Solar Power



6 land blocks of 3 TW are enough for humanity today

NASA: Space Solar Power (stand-by)



LEGEND	Symbol	Description
	Blue Diamond	R&D Decision Point
	Green Triangle	Major R&D Pgm Milestone
	Yellow Starburst	Strategic R&T Road Map Objective
	White Starburst	SSP Model System Concept(s)



JAXA: Space Solar Power (2030)



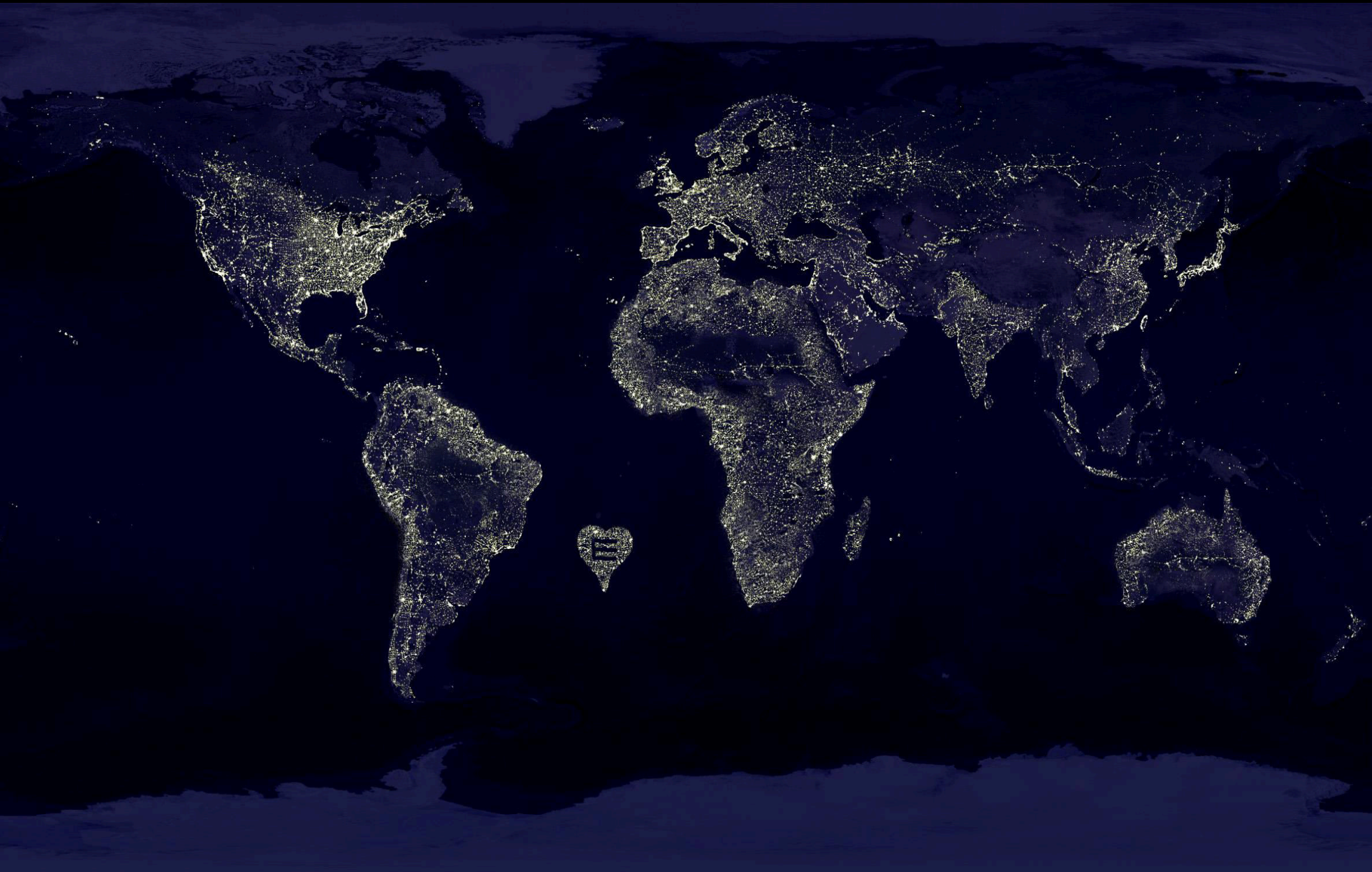
Moon Energy \geq 20 TW







And then there was Light!





Yin-yang 阴阳 (and more **yin-yang**)



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



危 櫻

后

木器

木器

包

危 櫻



Thank you! Sağ olun !
José Cordeiro (www.cordeiro.org)