Assured U.S. Electrical Power

And

Economic Opportunity of New Energy

Vice Admiral Lee Gunn, USN (Retired)
Vice Chair CNA Military Advisory Board
Former Department of the Navy Inspector General

March 2019

CNA
ANALYSIS & SOLUTIONS

CNA's Leadership on Energy & National Security

CNA -- Research organization since 1942 providing in-depth analysis & solutions for government leaders

MAB -- 2006-2019 Over 30 Members (Rotational)

- General Lori Robinson, USAF (Ret)
- General James Conway, USMC (Ret)
- Admiral "Skip" Bowman, USN (Ret)
- General Paul Kern, USA (Ret)
- General "Chuck" Wald, USAF (Ret)
- General Ron Keys, USAF (Ret)
- Vice Admiral Lee Gunn, USN (Ret)
- General Don Hoffman, USAF (Ret.)
- Vice Admiral Ann Rondeau, USN (Ret.)

CNA ANALYSIS & SOLUTIONS

CNA Military Advisory Board
Energy and National Security

- **The Electrical Grid**
- **A Changing Energy Landscape**
- **Economic Opportunities**

CNA
ANALYSIS & SOLUTIONS

CNA Military Advisory Board
"National Security and Assured Electrical Power " (2015)

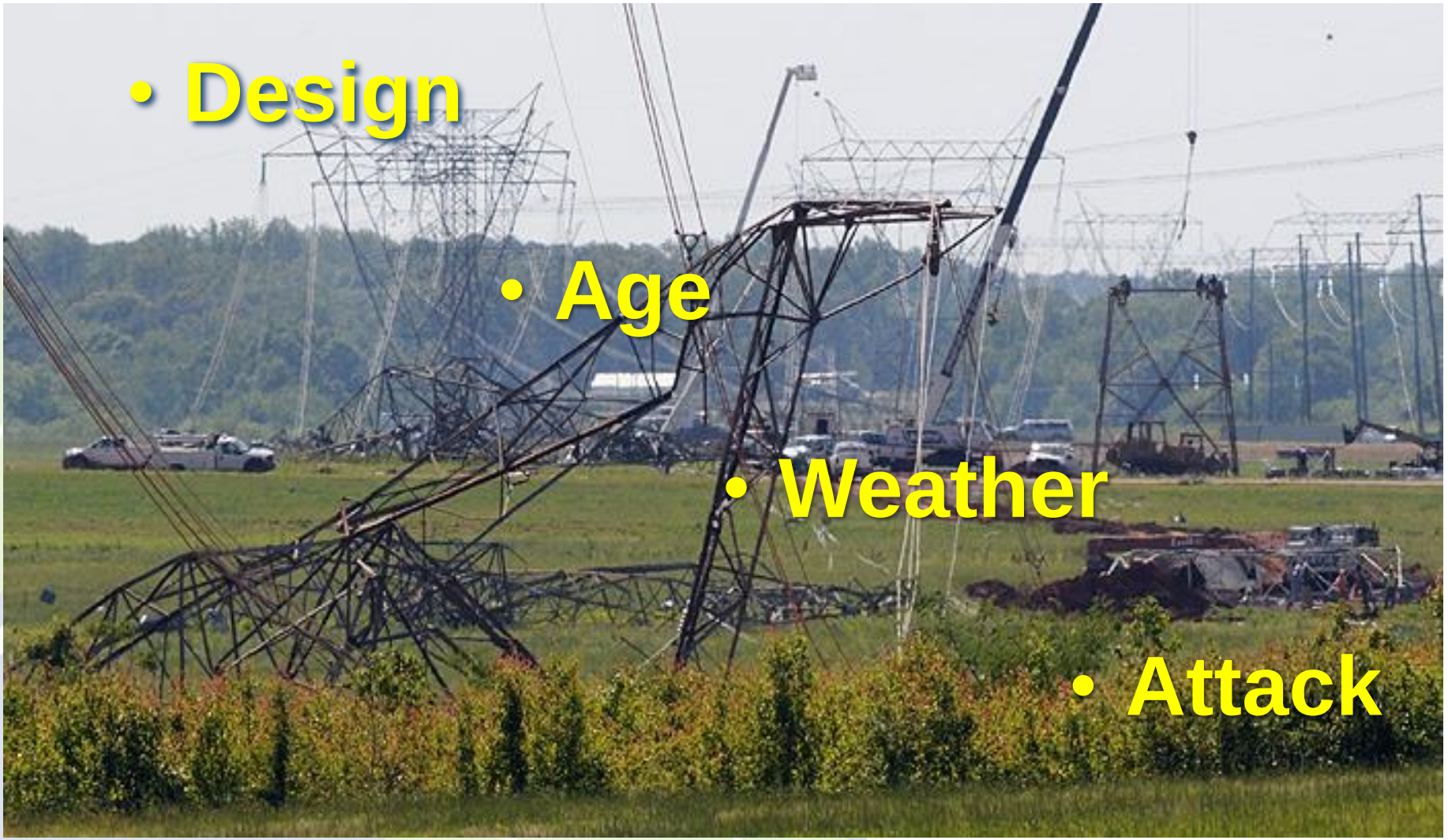
National Security and Assured U.S. Electrical Power (2015): Our fragile electrical lifeline

- **Dependence**
- **Vulnerability**
- **Trends and Technologies**
- **Military Initiatives**
- **…and Nevada's Choices**

CNA ANALYSIS & SOLUTIONS

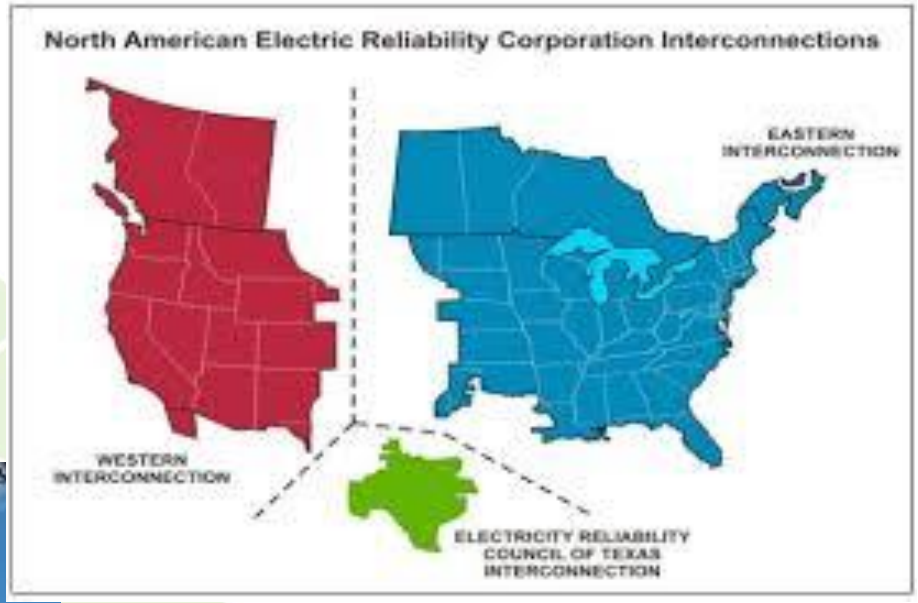
Electrical Dependencies

Vulnerabilities



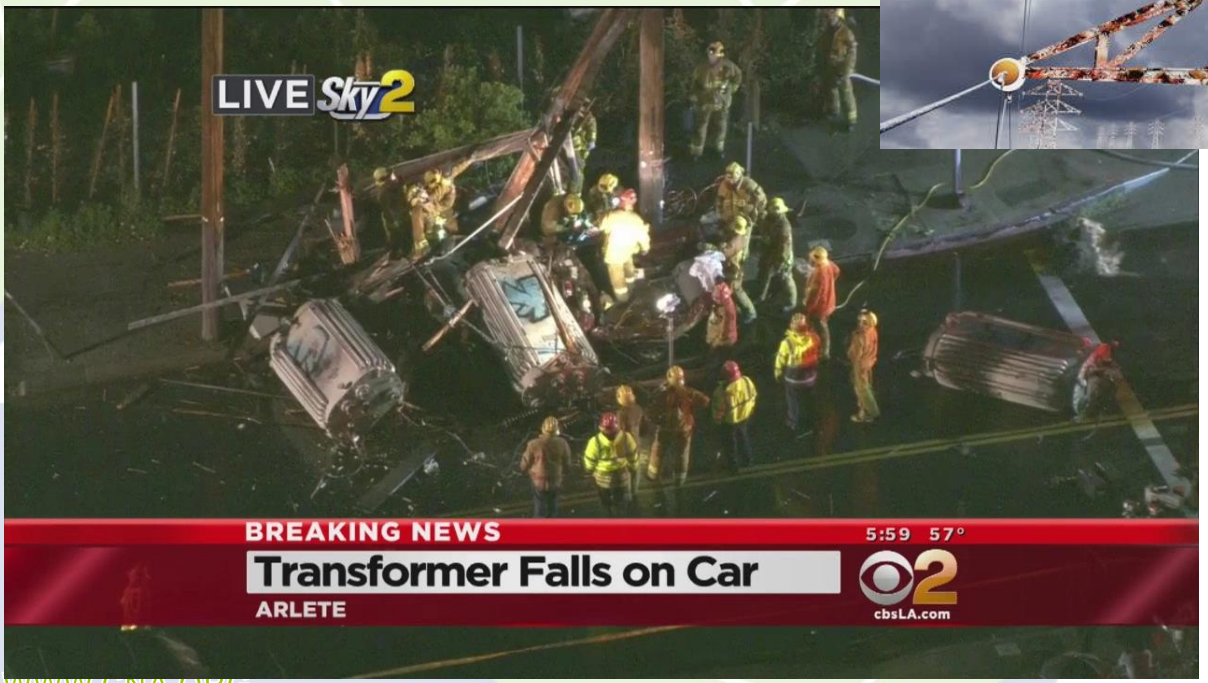
Vulnerability -- Design

- **Design**



Vulnerability -- Age

- Age



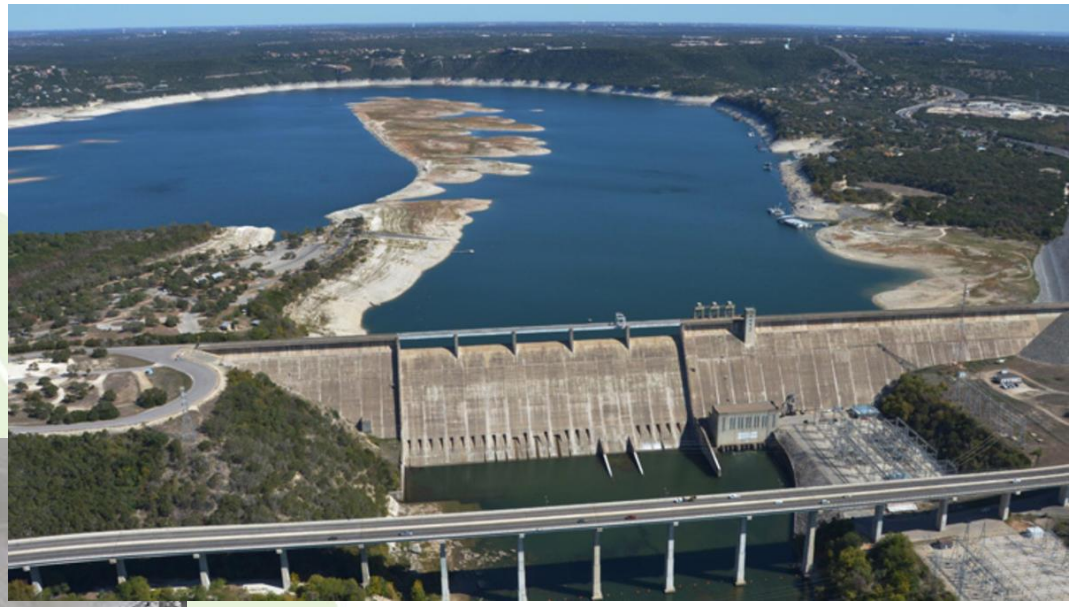
CNA
ANALYSIS & SOLUTIONS

Vulnerability -- Weather

- **Weather**

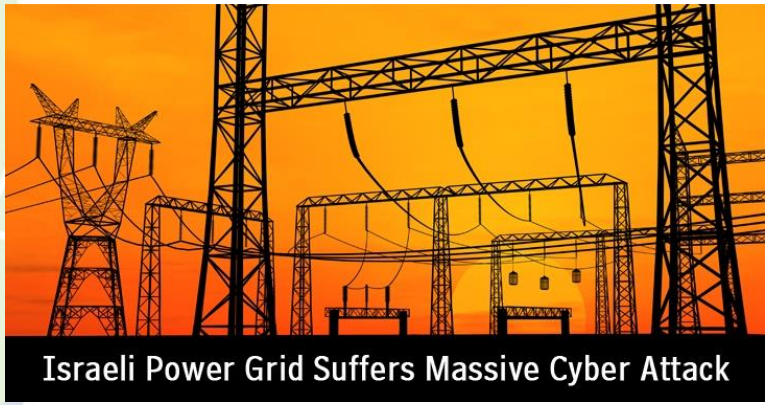
Vulnerability – Weather -- Drought

- **Drought**



Vulnerability -- Attack

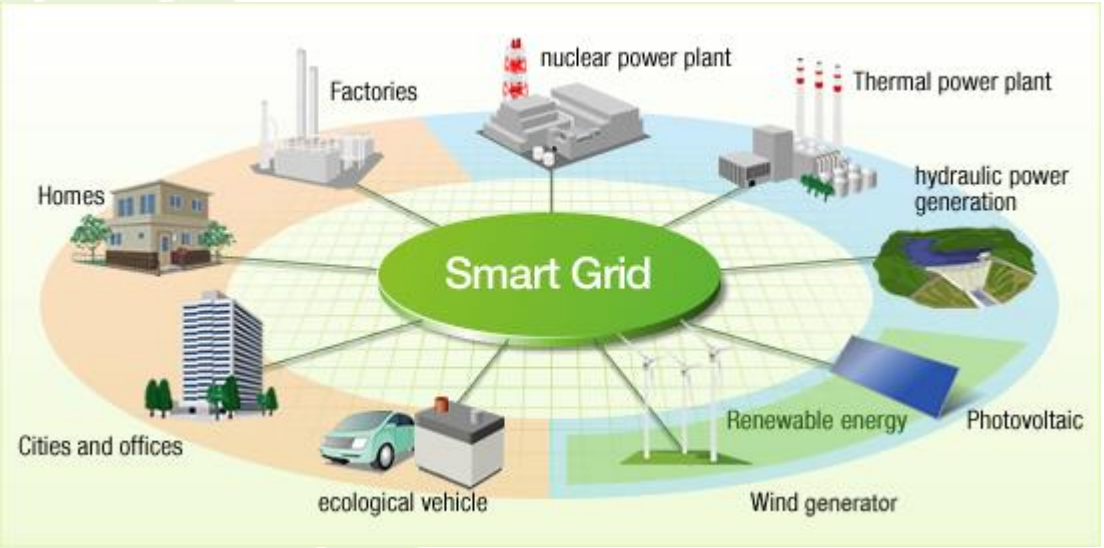
- **Attack**


Israeli Power Grid Suffers Massive Cyber Attack

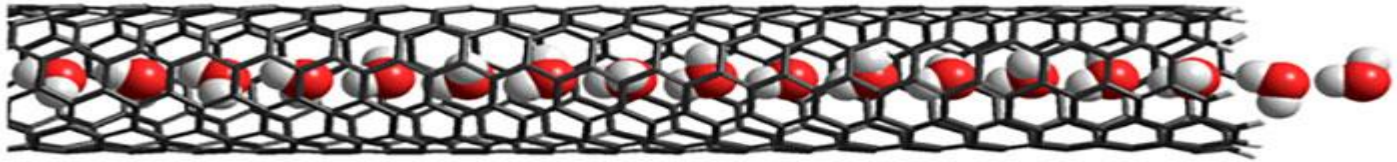
Solutions – Technology trends

- **Distributed**

- **Smart**



- **Nano**

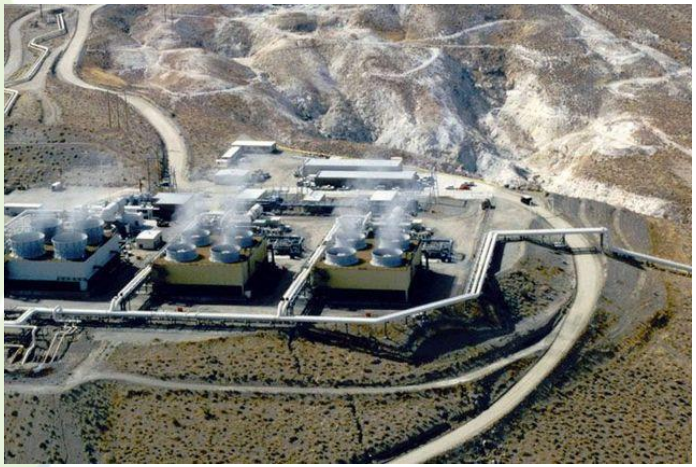


Military leading the way

Afghanistan 2009– one in 8 convoys lead to a casualty

Marines Prove Energy Efficiencies in Afghanistan

Second solar-power project, a 15-megawatt photovoltaic panel array on Nellis Air Force Base,



180-megawatt geothermal energy generating plant at Naval Air Weapons Station China Lake

WWW.CNA.ORG

Nevada leading the way

TESLA gigaplant, Nevada

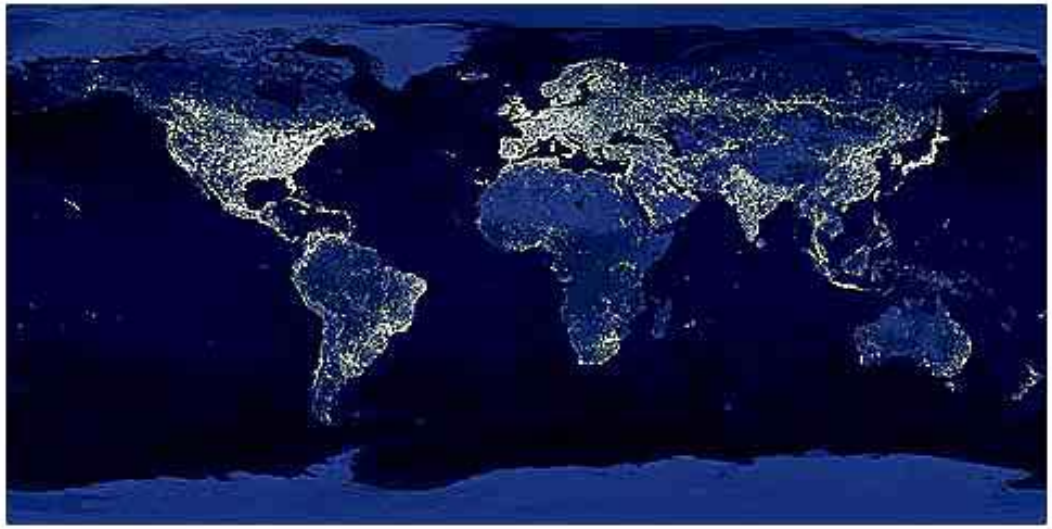
CNA Military Advisory Board
Energy and National Security

- The Electrical Grid
- ***A Changing Energy Landscape***
- Economic Opportunities

CNA
ANALYSIS & SOLUTIONS

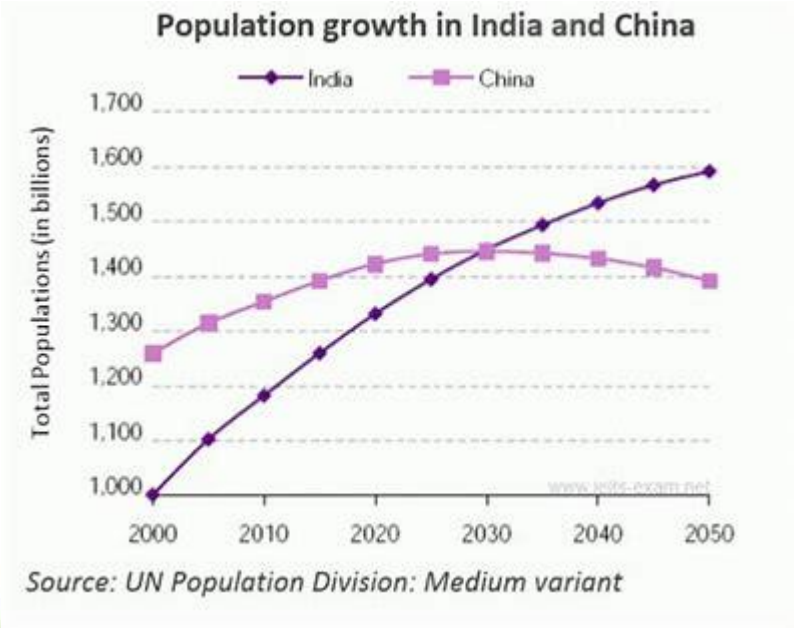
Changing Energy Landscape
"National Security and Advanced Energy" (2017)

1. Changing population and demographics
2. Electrification of transportation
3. Fracking and advanced fossil recovery
4. Renewables



Trend 1 – Population and Demographics

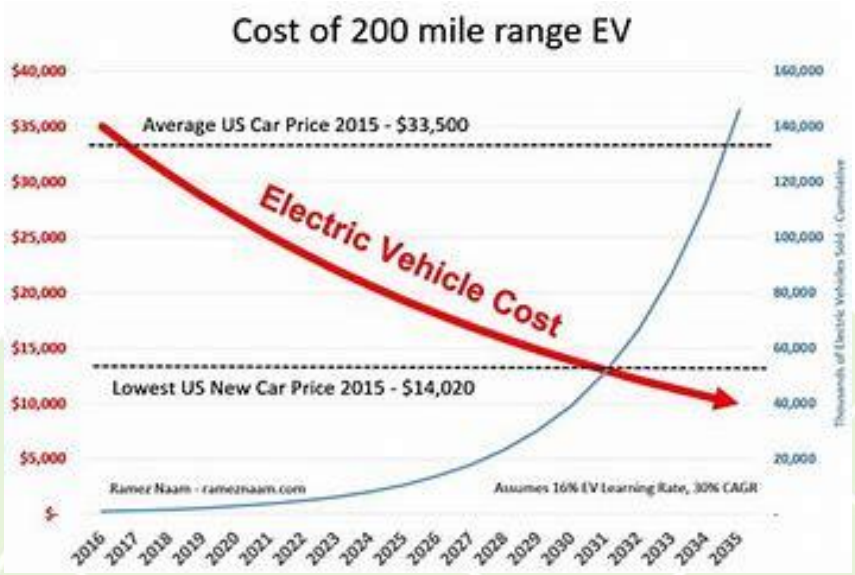
- World expects +1.5 B people
- Most growth in India & Africa
- Middle class growth = more per capita energy

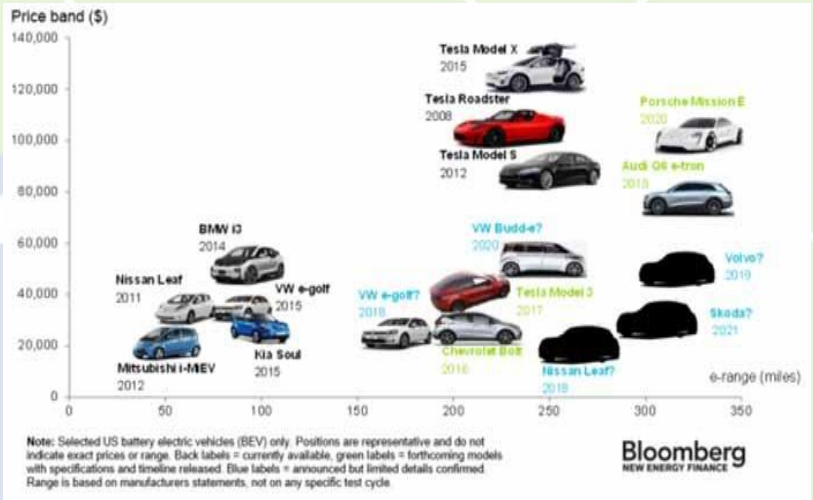


40% Increase in demand for energy

CNA ANALYSIS & SOLUTIONS

Trend 2 – Electrification of Transportation



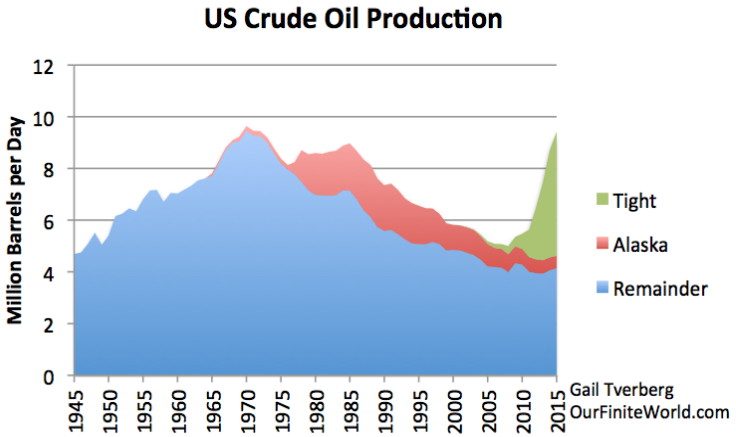


- Cost and performance parity
- 300+ miles per charge
- Market penetration
- Infrastructure growing
- Government mandates
  - NO IC --China 2025; UK 2030

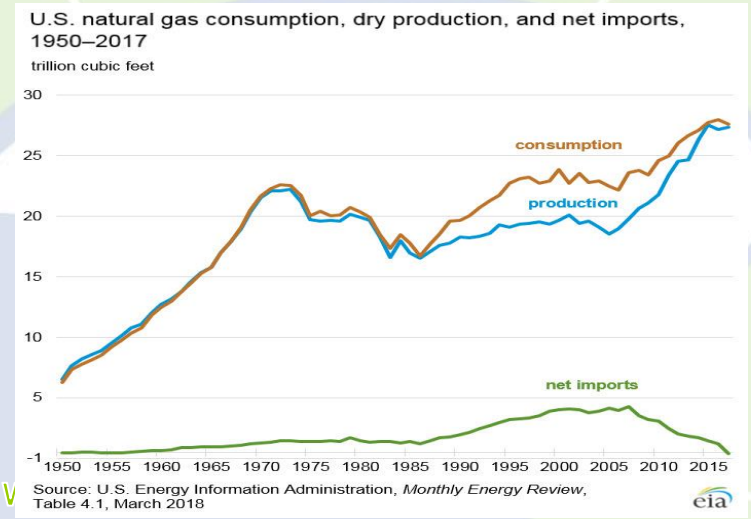
Shift from Oil to Electricity

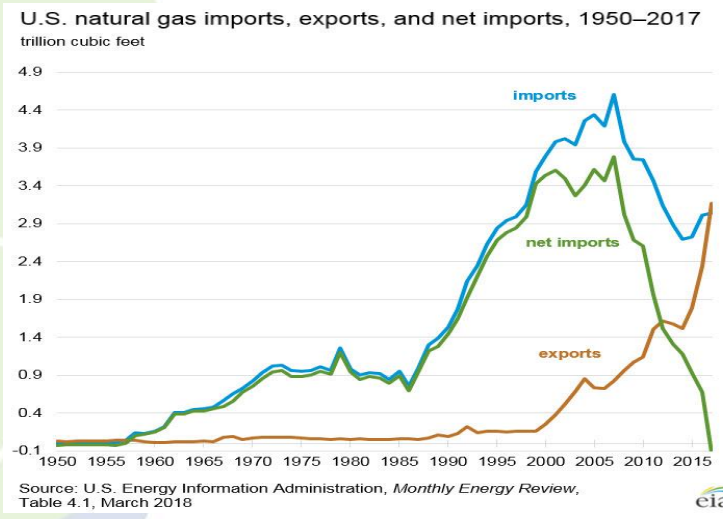
CNA ANALYSIS & SOLUTIONS

Trend 3 – Fracking and New Fossil Accessibility



- Fracking and “tight oil” revolution
- Production is & will be driven by price
- U.S. again world’s largest oil producer
- U.S. now net energy exporter
- Oil and Gas still a global commodity

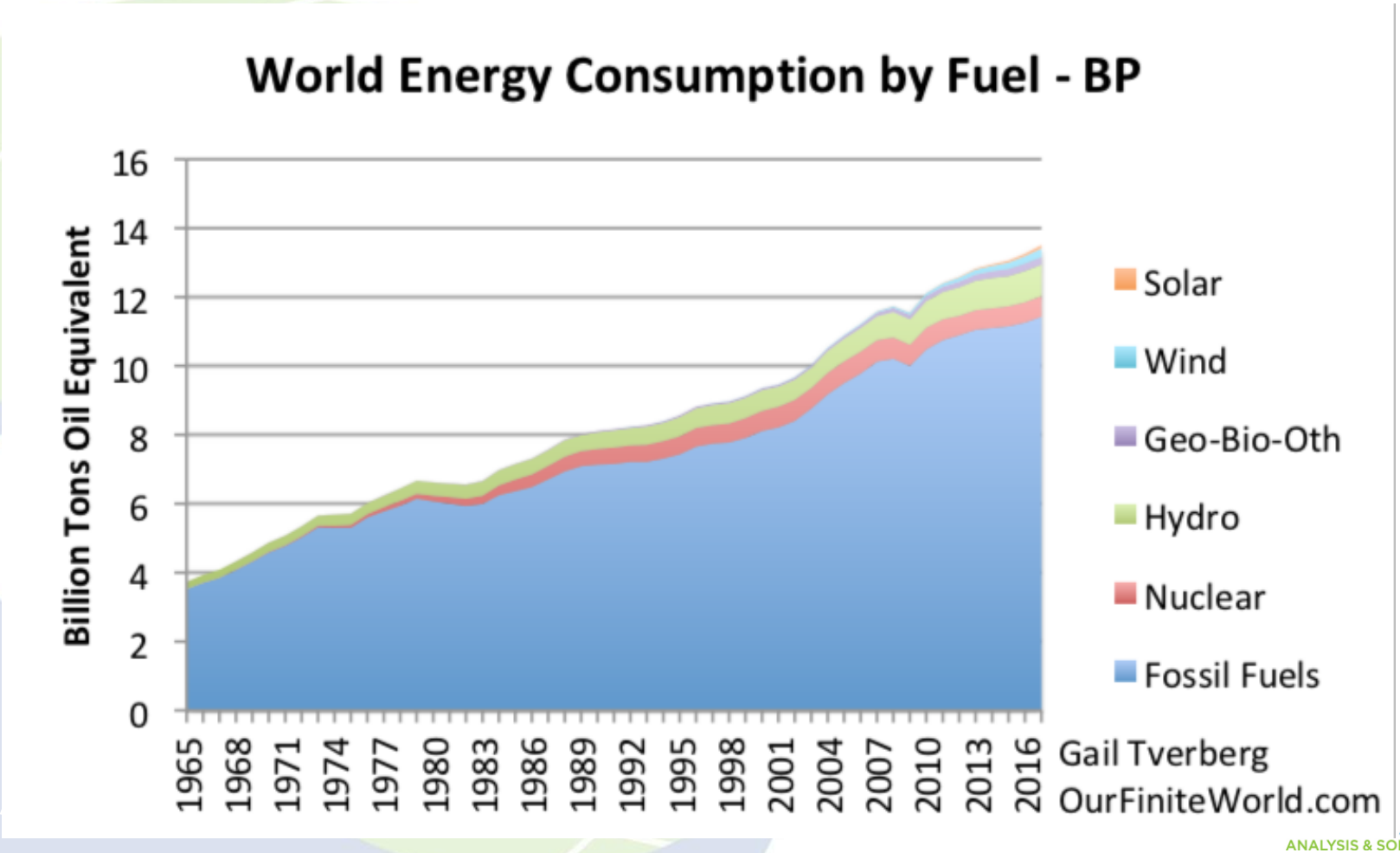




CNA ANALYSIS & SOLUTIONS

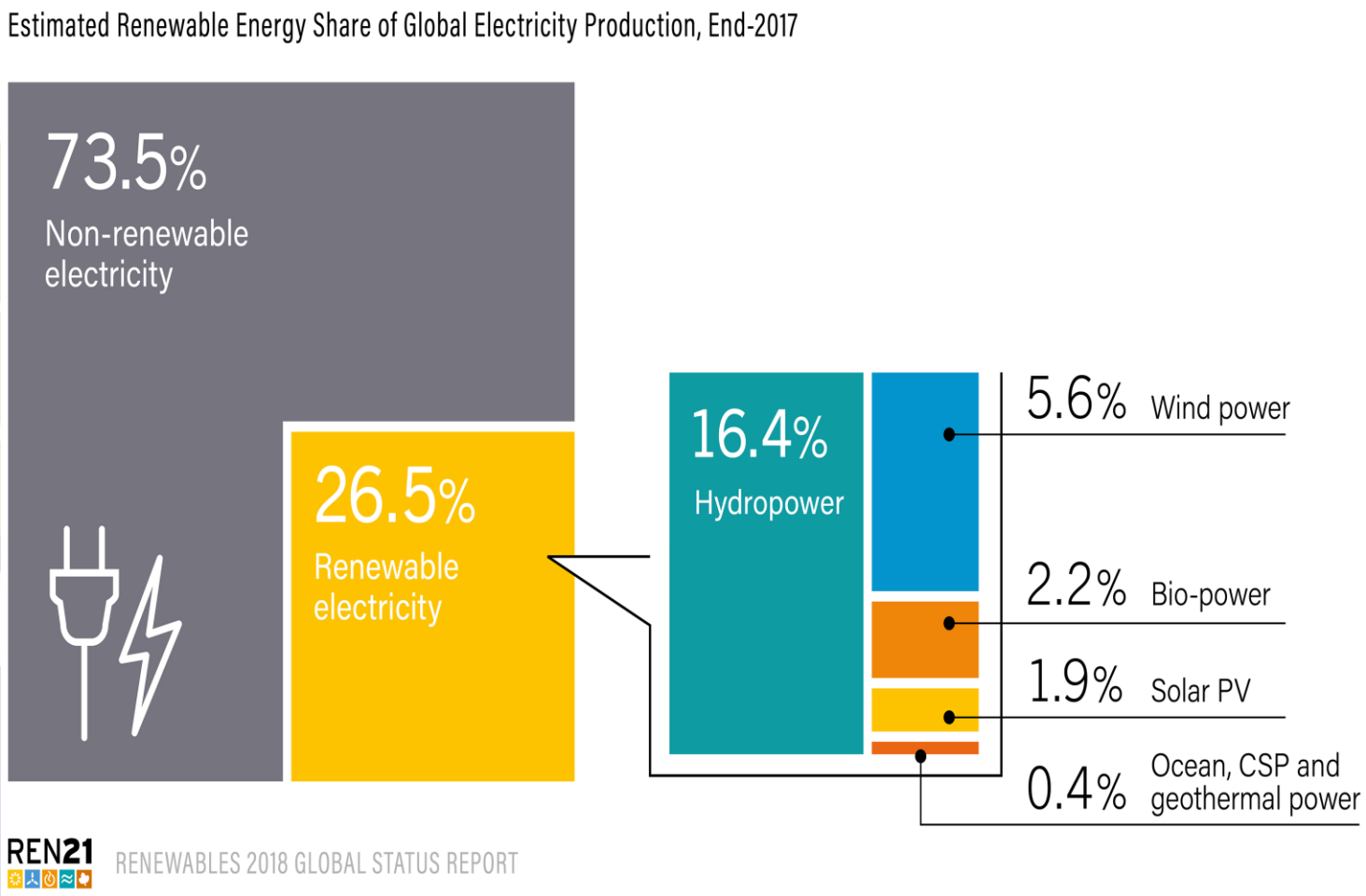
Trend 4 – Renewables

- Exciting things are happening
- Challenge small starting point



Trend 4 – Renewables

- One problem is how do we talk about “renewables”

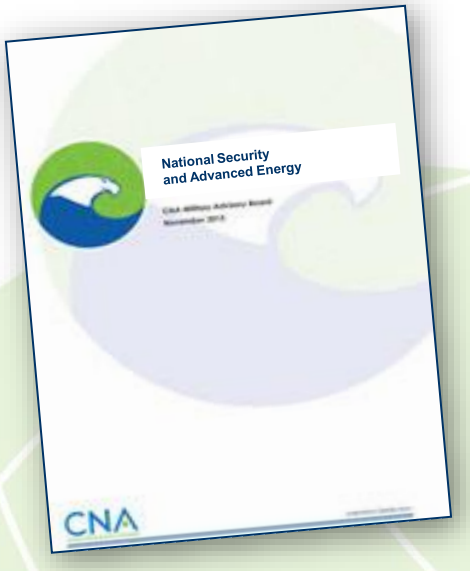


CNA Military Advisory Board
Energy and National Security

- The Electrical Grid
- A Changing Energy Landscape
- ***Economic Opportunities***

CNA
ANALYSIS & SOLUTIONS

Changing Energy Landscape
"National Security and Advanced Energy" (2017)



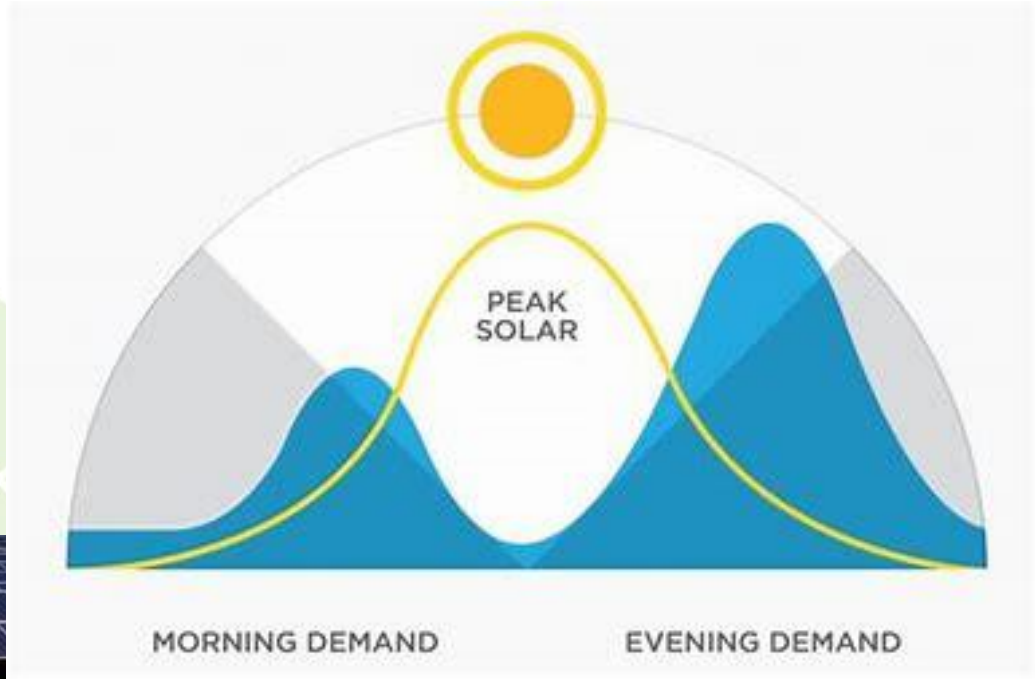
National Security and Advanced Energy (2017)

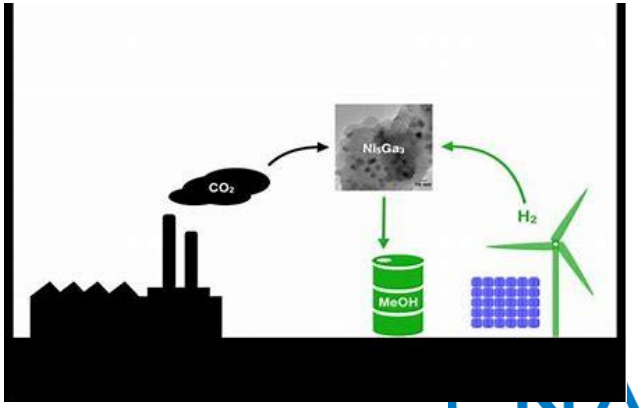
"As new energy options emerge to meet global demand, nations that lead stand to gain; should the U.S. sit on the sidelines, it does so at considerable risk to our national security."

CNA
ANALYSIS & SOLUTIONS

Among Challenges of Renewables:

Intermittency
and
Storage





CNA
ANALYSIS & SOLUTIONS

Findings
"National Security and Advanced Energy" (2017)

- A changing global energy landscape will have economic, diplomatic, and military effects, impacting the national security of the U.S. and its allies.
- A historic global transition toward advanced energy is accelerating and will give rise to economic challenges–and opportunities–for the U.S., our allies, and our adversaries.
- Electric vehicles will drive significant reduction in oil demand for the U.S. and other nations where petroleum is mostly used in light-duty transit.
- Advanced energy systems will temper rising global demand for oil, impacting global diplomacy and influence, with direct national security implications for the U.S.

Findings
"National Security and Advanced Energy" (2017)

- The transition to advanced energy can provide the U.S. military with additional options to improve mission effectiveness, reliability, and cost mitigation.
- Growing demand for reliable electric power will drive the need for more resilient, more efficient, and more distributed electric power generation systems. Today, a critical hindrance to intermittent energy sources fulfilling this need is energy storage.
- The wide portfolio of advanced energy technologies provides options for U.S. energy independence through clean and safe development of our vast energy resources, while enhancing our geopolitical security.

CNA Military Advisory Board
National Security – Energy and Nevada

Employs 25,400 in Nevada -- (3.4 M nationwide)

- **10,300 jobs in energy efficiency -- 4% job growth in 2016-2017**
- **11,800 in advanced electricity generation (6,500 in rooftop solar)**
- **2,000 in advanced grid and energy storage**
- **1,000 in advanced vehicles**
- **190 jobs in advanced fuels**

"/

ww

Solar array in downtown Reno

- **2016 to 2017, 10.6% increase in clean energy generation and a 7.9% decrease in natural gas**
- **Nevada ranked**
  - **2nd for geothermal energy**
  - **4th for utility-scale solar energy generation**

CNA
ANALYSIS & SOLUTIONS

CNA Military Advisory Board
Energy and National Security

- Global energy landscape is changing.
- Burgeoning populations together with rising affluence, are shifting major centers of demand and increasing the world's overall demand for energy.
- New technologies are making clean, affordable advanced energy widely available as well as allowing the extraction of fossil fuels from previously inaccessible sources.
- Tectonic shift in the global energy posture will impact every nation.
- U.S. must lead – not sit on sidelines

CNA
ANALYSIS & SOLUTIONS

CNA Military Advisory Board
Energy and National Security

We must make choices now,
knowing that the impact of these choices may not be felt for a decade or more down the road.

When it comes to energy, we need to focus on our national security and,

Energy is Security

The stakes are too high to wait while others set the course.

CNA
ANALYSIS & SOLUTIONS

Back-up

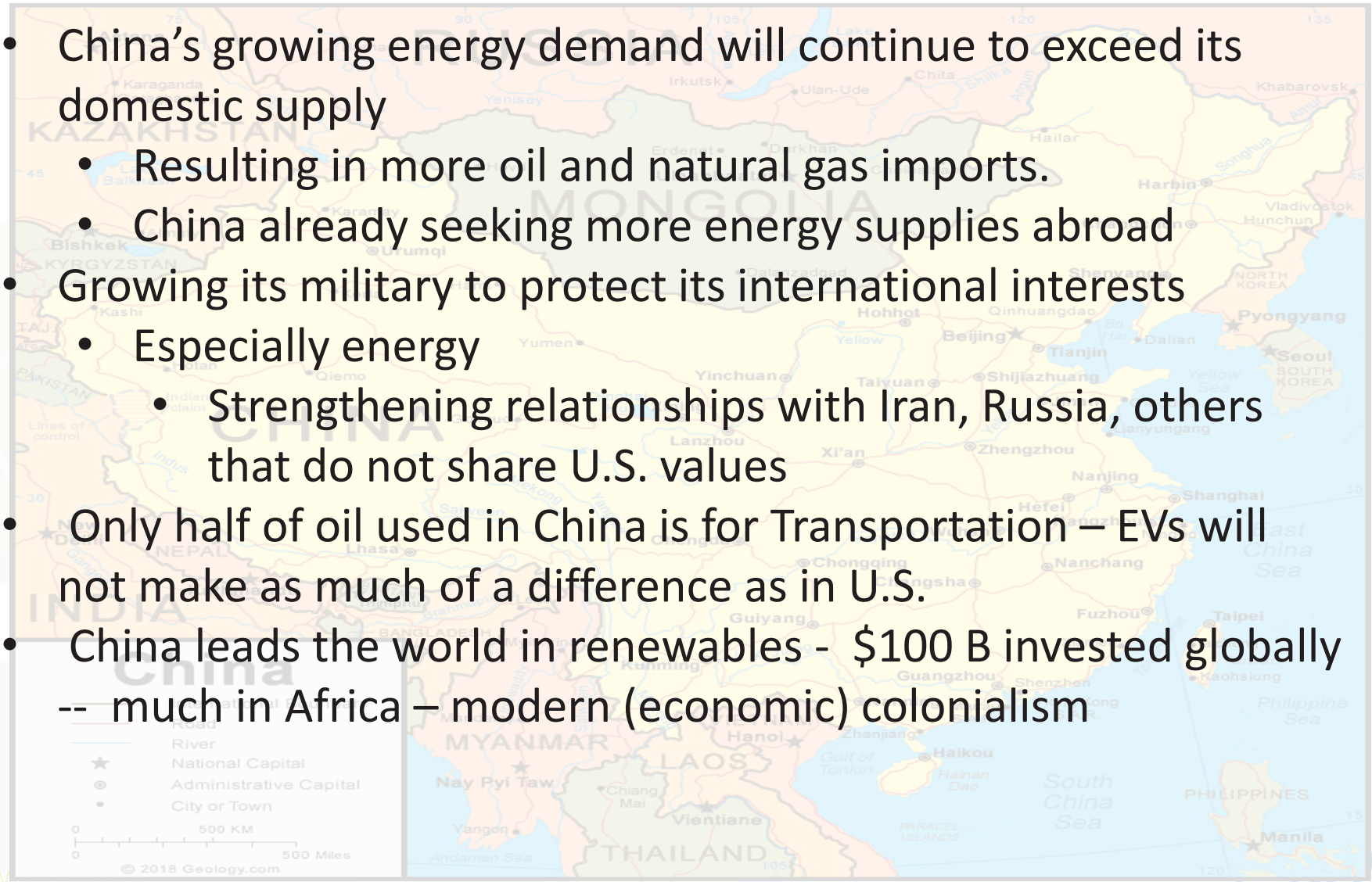
CNA Military Advisory Board
Russia- Europe

- Russia-- 2 percent of the world's population and just 3 percent of the world's GDP *but…*
  - Third largest energy producer
  - Fourth largest energy consumer
- Largest exporter of total hydrocarbons (oil, NG, coal)
- Oil and gas account for over 70 percent of total Russian exports *and…*
  - 16 percent of GDP
  - 52 percent of their federal budget revenues
- E.U. energy posture directly tethered to Russia, supplies over 30 percent of its coal, oil, and natural gas imports
- Russia moving to sell more hydrocarbons to India and China

CNA ANALYSIS & SOLUTIONS

CNA Military Advisory Board
China

- China's growing energy demand will continue to exceed its domestic supply
  - Resulting in more oil and natural gas imports.
  - China already seeking more energy supplies abroad
- Growing its military to protect its international interests
  - Especially energy
    - Strengthening relationships with Iran, Russia, others that do not share U.S. values
- Only half of oil used in China is for Transportation – EVs will not make as much of a difference as in U.S.
- China leads the world in renewables - $100 B invested globally -- much in Africa – modern (economic) colonialism



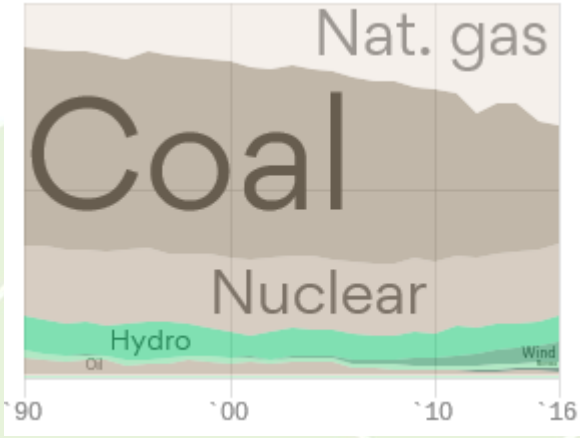
CNA Military Advisory Board
India

- Will soon exceed (or has exceeded) China as most populace country
- Will add 400 million people by 2050
- Establishing ties with Russia for oil, coal and NG
- Use of coal expected to triple and surpass China soon
- Will be the largest consumer of energy by 2060
- Expect $2.8 Trillion in energy investment by 2050
- Strong commitment to renewables, but….. starting from very small amount

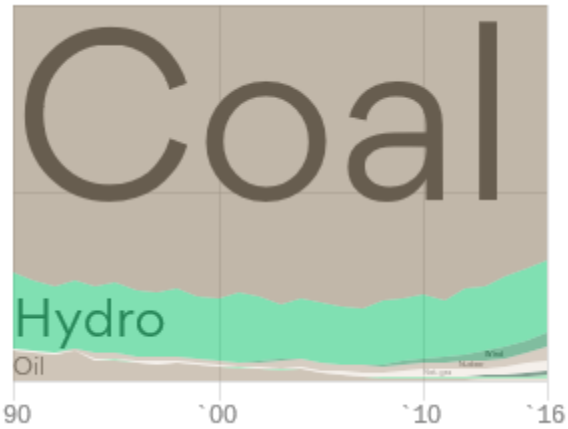
CNA Military Advisory Board

Share of total electricity generation from different sources by country

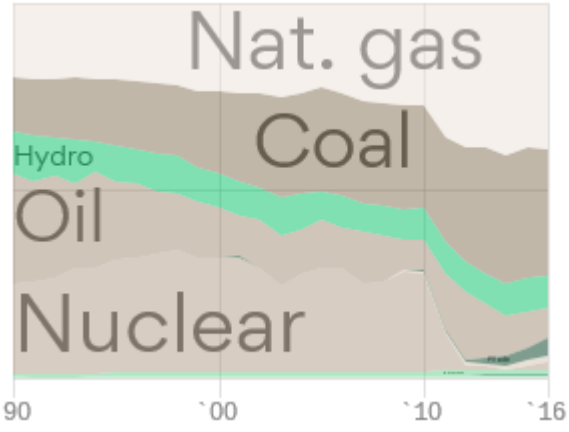
United States



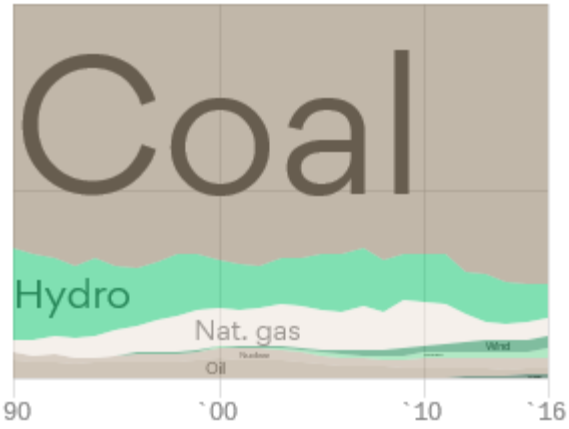
China



Japan



India



CNA
ANALYSIS & SOLUTIONS

Assured U.S. Electrical Power

And

Economic Opportunity of New Energy

Vice Admiral Lee Gunn, USN (Retired)
Vice Chair CNA Military Advisory Board
Former Department of the Navy Inspector General

March 2019

CNA
ANALYSIS & SOLUTIONS