

A National Energy Program The Apollo Program of Our Time

Planning, Financing and Achieving Energy Independence and National Transformation

<http://www.ourenergypolicy.org/a-national-energy-program-the-apollo-program-of-our-time-3/>



Presentation at:

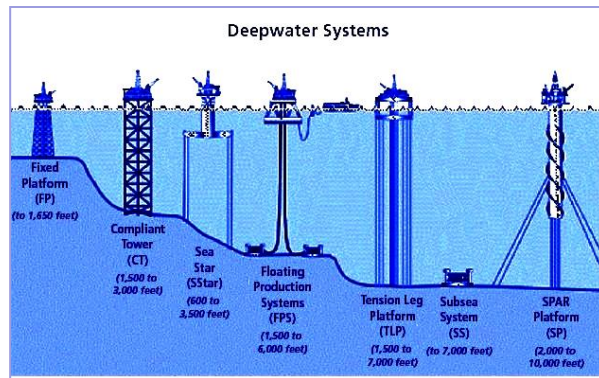
The Eisenhower Institute

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Realization of growing threat to the oil supply will provide common ground for clean energy and fossil fuel interests to break the gridlock to achieve a national security goal

Presentation Outline

Part One: What? When? Why?

- **Why must America treat energy as a matter of national security?**
 - To Avoid Chaos
- **What is the proposed goal? When will we achieve it?**
 - Eliminate “Oil Gap” and reduce GHG emissions in a decade as milestone on the road to a sustainable energy future.

Q&A, Roundtable and Coffee Break

Part Two: How?

- **How will we achieve the goal?**
 - Use methods proven “at scale” by NASA, DOD and private sector
- **How will NEP operate?**
 - Public/private sector “equal” partnership will manage the “program”
 - Technical and financial assistance provided for “projects and products” R,D&D
- **How will we start?**
 - Core team sets up and supports NEP planning project to achieve the goal
- **Summary: A National Energy Program - What? When? Why? How?**

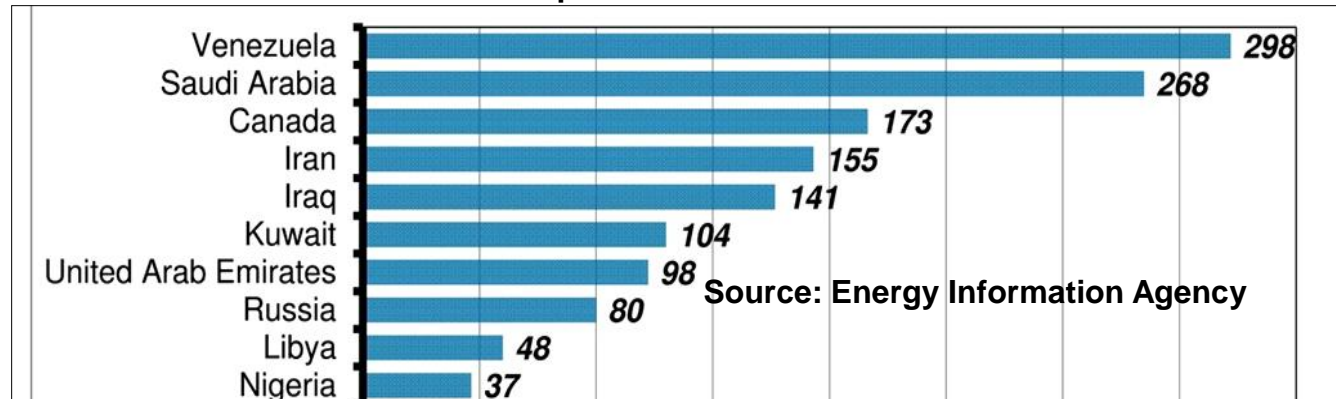
Q&A and Roundtable

Why Must America Treat Energy As A Matter Of National Security?

“To Avoid Chaos”

- **“Arc of instability” from North Africa to Southeast Asia [the region] could become an “arc of chaos” involving forces of many nations**
 - Joint Operating Environment 2010 report, Joint Forces Command, DOD
- **With 7 of top 10 nations with largest oil reserves in the region and reduced defense budgets affecting our ability to defend the oil supply the oil fields are no longer safe.**
 - **Shrunken fleet stays deployed longer, gets repaired less**
 - John Lehman, former Secretary of the Navy , WSJ
 - **Countries develop capabilities [A2/AD] to deny our forces access to theater based energy supplies and global commons at significant ranges from their borders.** – JOE 2010
 - **China has DF-21D anti-ship ballistic missiles with a range of 1,500km** - globalsecurity.org
- **Implications for future combat are ominous, should nations see the need to militarily secure energy resources** - JOE 2010

Proved Oil Reserves by Country, 2013
Top 10 Countries



Billions of Barrels of oil

Region broken down by sub-region - Middle East, South Asia, Asia-Pacific, Central Asia, North Africa. Relationship of region and energy to Russia, China, Europe, U.S. explored.

The U.S. Is Often Dependent On The Same Nations That Pose The Greatest Threats - JOE 2010

Saudis and extremism: both the arsonists and the firefighters - NYT

- **Alliance between Saud family and cleric Abdul-Wahhab dates back to the 1750's**
 - A Concise History of the Middle East, Goldschmidt and Davidson
 - **“Sunni Wahhabi inspired terrorism”** would be a trace element in Islam without Saudi support
 - Al-Qaeda and ISIS are hegemonic, Sunni Wahhabi offshoots (not Shiites).
- **Stability of Saudi Arabia not assured**
 - **As oil prices bottom out Saudis cut back on subsidies increasing support for internal resistance**
 - ISIS is a symptom not a cause of Middle East's disintegration, The Nation
 - **25 terrorist attacks in Saudi Arabia in last eight months** - NYT
 - **Terrorist movement adopts elements of Wahhabism to delegitimize the monarchy**
 - ISIS Turns Saudis Against the Kingdom, and Families Against Their Own, NYT
 - **Potential for outbreak of sectarian violence with Shiites in oil fields** - Global Risk Insights

Going for the Jugular



Terrorist attack on Ras Tanura, world's largest oil processing facility thwarted



ISIS bombs Mosque of Mohammed, second holiest site In Islam

As Empire Declines Barbarians Gather at the Gates

Precision air strikes remain an option...unduly reducing American ground forces risks creating a vacuum - Colonel Michael Eastman, U.S. Army, WSJ

- **Terrorists and organized crime are intermingling in shadow markets enabling them to coordinate activities at global scale**
 - **Current size of these markets \$2-3 trillion and growing faster than legal and commercial trade** - JOE 2010
 - **ISIS moves half of all heroin supplies from Afghanistan to Europe** - TASS
 - **Central aspect is informal series of overlapping pipelines [supply chains] to move products, money, weapons, personnel, and goods**
 - **Recombinant chains links can merge and separate to meet networks best interests**
 - **As they grow, adversaries able to generate attacks at higher level of sophistication**
 - Terrorist-Criminal Pipelines and Criminalized States: Emerging Alliances, National Defense University
- **ISIS and other non-state actors impact on oil supply growing**
 - **Sabotage to key oil pipelines have driven global supply outages to "elevated" levels estimated at more than 3 MBD** - Royal Bank of Canada
 - **Seven wars in Muslim countries where ISIS is powerful or growing**
 - Independent.co.uk
 - **Many of these nations contain energy resources under threat**

We Can No Longer Consider The Oil Fields Safe

Where an increase in terrorist activity [and warfare] intersect energy supplies the need for immediate action may require significant conventional capabilities - JOE 2010

Yesterday



Oil tanker ablaze in the 1987 Tanker War during the Iran-Iraq War



F-16s fly over burning oil fields in Kuwait in 1991

Today



Fire at Libya's biggest oil terminal destroys 1.8 million barrels of oil



Pipeline carrying 300,000 barrels of oil bombed in Nigeria

Tomorrow?

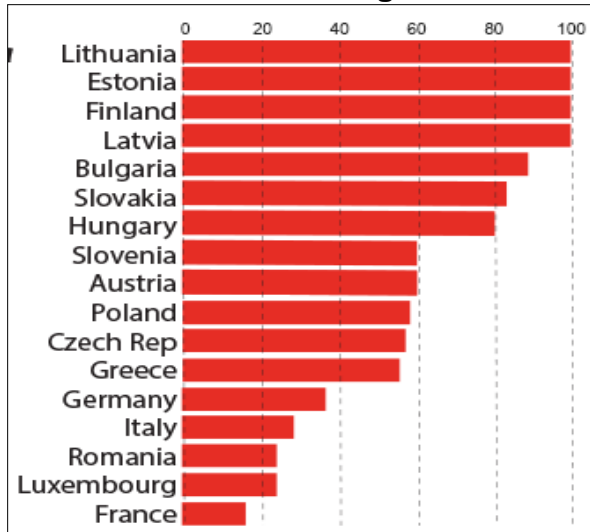


**If proxy wars turn into regional war
key energy facilities will be at risk.**
Saudi oil fields just a short range missile
away from Iran

European Scenario Reminiscent of Cold War Ignores “Elephant the Room” – Energy NATO – Addicts Living in Denial

- **Russia could turn off the lights and heating in Europe *again* in a conflict with NATO**
 - E.U. imports about 30% of its crude oil, gas and hard coal from Russia - Eurostat
 - Countries closer to Russian border import energy at much higher rates
- **Conflict between NATO and Russia could lead to gas lines in U.S. *again***
 - Refining capacity is a key constraint on energy supply.
 - Significant mismatch between needs of the world’s consumers and refineries’ capabilities
 - U.S. sends diesel to Europe. Europe sends gasoline to US - The Oil Drum
 - Russia buying up European oil refineries compromises EU bloc’s energy security - EurActiv.com
 - National security goal for energy must include crude oil and refined products
 - **U.S. must have gas for cars on our roads and tanks on the battlefield no matter what happens**

Gas supplied by Russia
Source: Eurogas



Percent of gas supplied

Some European nations import 80-90% of their energy needs from Russia

Imports from Russia, % of total imports: 2012*			
Country	Coal	Petroleum	Gas
Austria	2.8	7.0	61.8
Belgium	21.9	9.1	23.8
Czech Republic	2.0	35.0	66.0
Finland	41.5	68.5	100.0
France	12.6	15.1	16.1
Germany	19.3	28.6	34.6
Greece	4.8	29.4	79.3
Hungary	1.9	78.6	81.4
Ireland	0.6	N.A	N.A
Italy	11.8	16.3	20.4
Netherlands	11.7	29.7	14.5
Poland	51.3	83.7	82.6
Slovakia	19.5	71.6	92.7
Spain	13.4	14.2	N.A
UK	34.8	10.1	N.A
EU27	19.2	24.5	29.4

Source: UNCTAD, BP Statistical Review

NATO countries must work together to strike a proper balance between investment in weapons procurement and energy R,D&D to address a major strategic vulnerability

Control of Pipelines Shifts Power in Europe to Russia

Forward gas hubs would enable Russia to cut off Eastern Europe, still supply Western Europe

Nord Stream 2 bypasses Poland



Doubles Nord Stream capacity

- **Nord Stream 2: 55 BCM**
 - Gazprom has 50% stake, and five European companies, each have 10% stake.
 - Poland's antimonopoly watchdog blocked joint venture – Natural Gas Europe
 - Nord Stream 2 starts requesting construction permits - Interfax Global Energy
 - If Germany wants pipeline it will get it

Turkish Stream bypasses Ukraine



EU insisted South Stream violated its monopoly law

- **Turkish Stream: 63 BCM**
 - Turkey grants Turkish Stream construction permits to Gazprom - Daily Sabah
 - Greece and Russia sign MOU for pipeline through Greece with Russian financing - Reuters
 - Pipeline from gas hub near Greek border could connect with South Stream route
 - Extension appears subject to negotiations between Russia, Turkey and EU - Eurasia.net

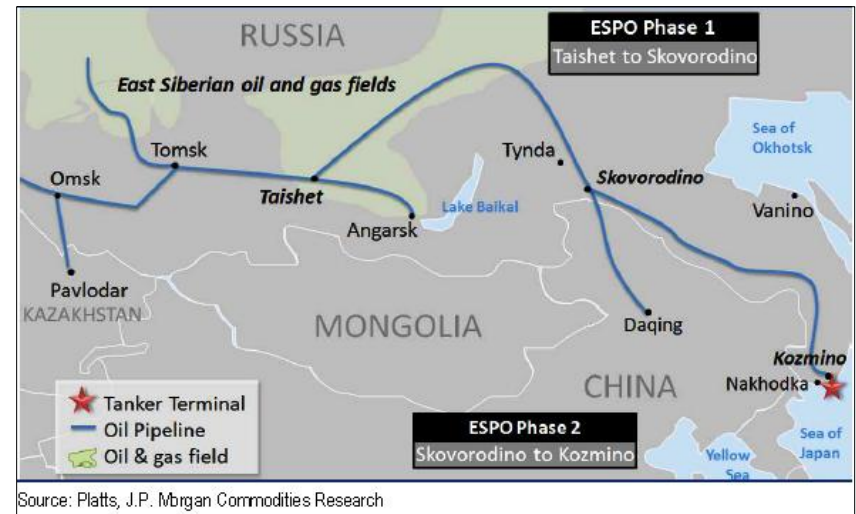
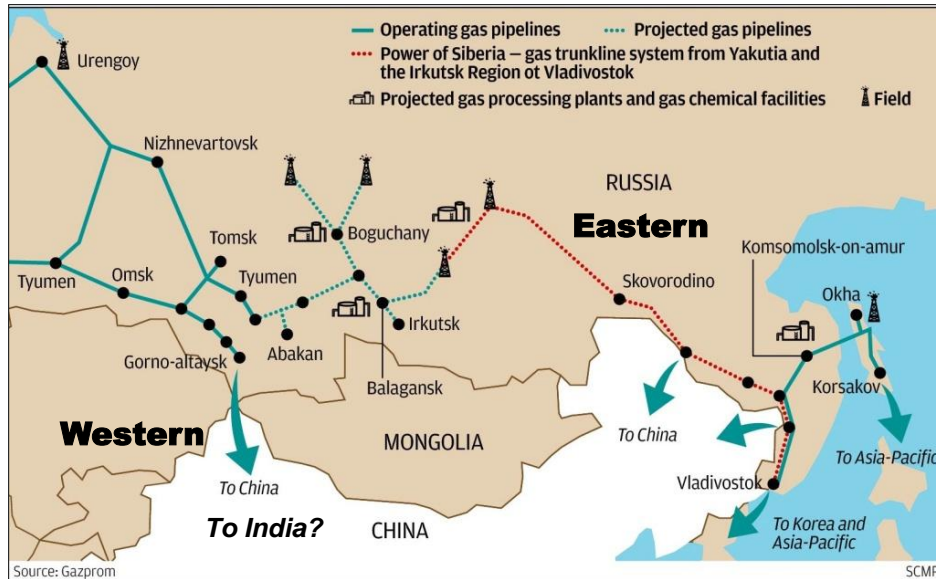
It is important to bear in mind that building an international pipe is the most difficult part of the gas chain - Natural Gas World

Russia Able to Shift Oil/Gas From Europe to China/Pacific Via Pipelines

Gas pipelines towards Russia, Iran and China draw gas from any of the fields

- Russia, China, Iran redraw energy map, Asia Times

- **China moves to buy a maximum of energy as far away from the U.S. Navy as possible**
 - Reshuffling Eurasia's Energy Deck, Iran, China and Pipelineistan, Asia Times
 - **Russia, China sign 30 year \$400 Billion gas/pipeline** - Reuters
 - **Russia becomes China's largest oil supplier** - Bloomberg
 - **Russia Seals Deal With China on Currency Swap in "de-dollarization" effort** - WSJ



Western and Power of Siberia Eastern Route to China/Pacific 68 BCM capacity

Western route could grow to 60 or 100 BCM - Reuters

Eastern Siberia Pacific Ocean (ESPO) oil pipeline 1.6 MBD capacity
China to double Russia ESPO pipeline imports in Oct 2017
- Shipping News

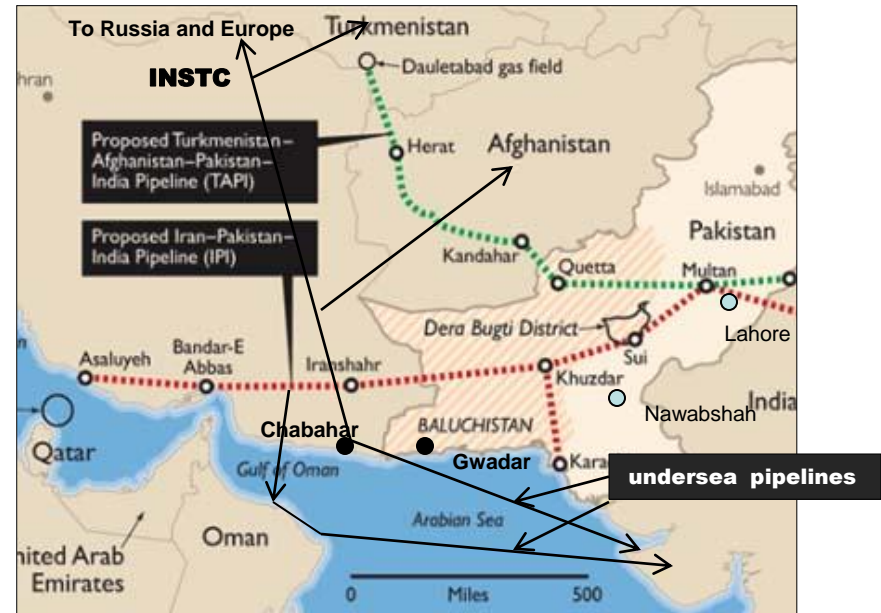
Will Russian oil and gas pipelines be built through China to India?

Power Shift From U.S. to Iran and China Seen in Pipelines and Infrastructure

Power shift to China from US



Power shift to Iran from US

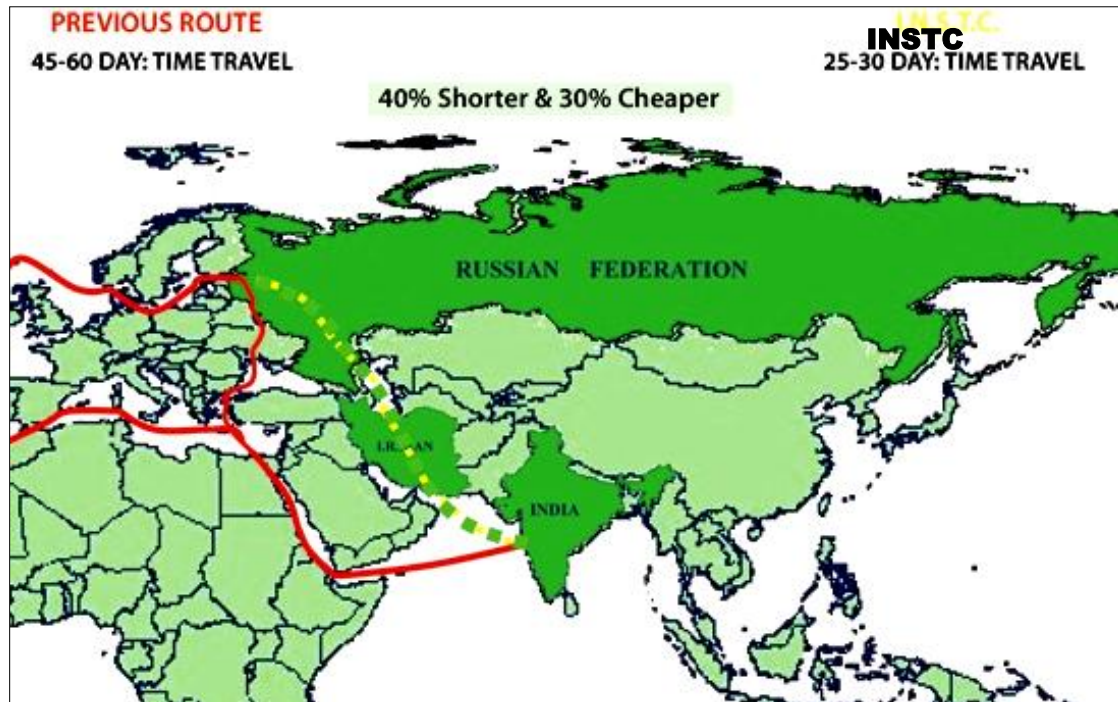


- **IPI gas pipeline** stopped by US sanctions
 - IP to be completed by 2018 - Press TV
- **TAPI gas pipeline** an American pipe dream without security in Afghanistan
- **Connection to India a delusion**
 - India unwilling to let Pakistan have chokehold on energy supply - The Hindu
 - Undersea pipelines from Iran to India will provide gas flow equal to TAPI and IPI

America Can't Sanction Geography

As America tries to corner Russia, China and Iran they get together in the same corner

- **India North-South, road, rail, pipeline, port corridor (INSTC) being built.**
 - India able to transport goods to/from Central Asia, Russia and Europe, bypassing Pakistan.
 - Provides access to warm water Chabahar port for Afghanistan and Central Asian Republics
- **One Belt and One Road: China building a new Eurasia without U.S one project at a time**
 - €315 Billion China European Fund focuses on infrastructure to bind Central, South and Southeast Asia to China and Europe – New Europe
 - Pacific rim nations will move goods faster, cheaper, safer overland than by sea lanes



India North-South port, road, rail, pipelines Transit Corridor



Eurasian rail links for regular container train service open



China agrees to build China-Iran Railway₁

Fortunes of nations in Eurasia rise and fall with relationship of overland to littoral trade routes

China's "String of Pearls" Maritime Silk Road Strategy

Protects China's energy security, negates U.S. influence and projects power overseas

- Participation in economic and infrastructure projects builds leverage that could soon subordinate U.S. relations with the same countries
 - Chinese army personnel participate in overseeing projects
 - Washington Institute for Near East Policy

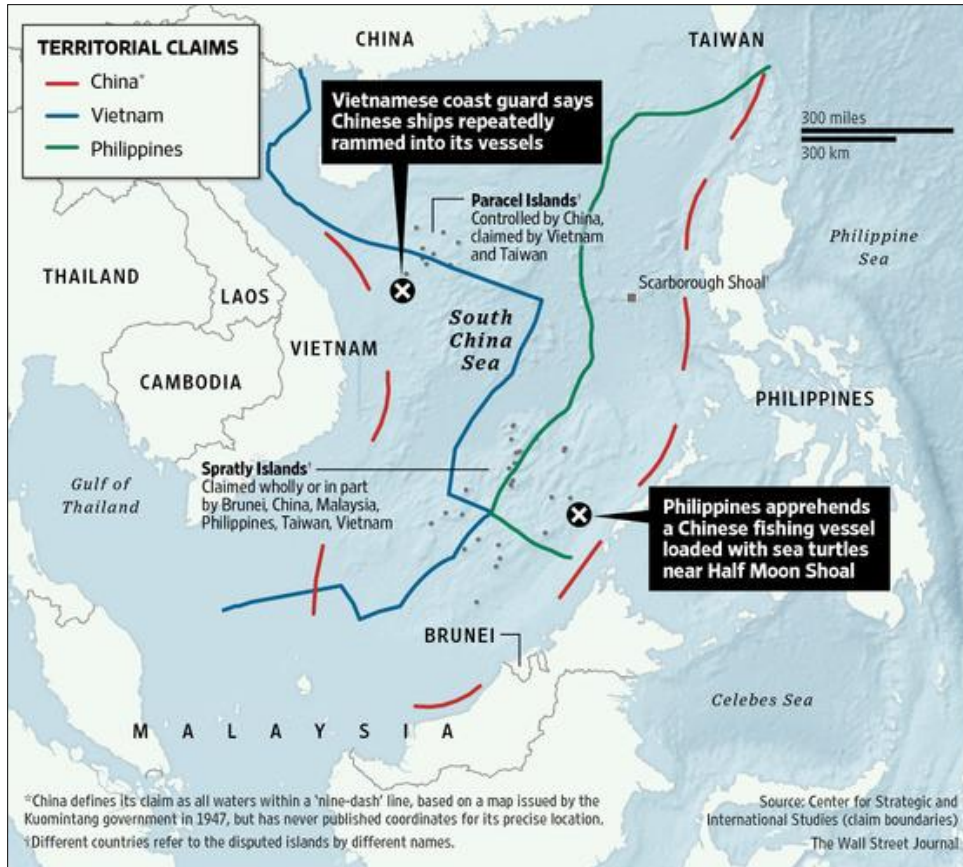


- Maritime power projection becoming increasingly vulnerable to whole range of systems able to find and sink them
 - In submarine warfare, space, and cyberspace, China can compete with U.S. on nearly equal footing - JOE 2010
- U.S. - India sign Logistics Exchange Memorandum of Agreement
 - Allows India and US to use each other's land, air and naval bases for repair and resupply
 - Step toward building defense ties to counter growing maritime assertiveness of China
 - Reuters

Is America's "Pivot to Asia" Really A Pivot To A New Energy War?

China rapidly expanding offshore oil fleet – adding coast guard vessels to protect it – as it ventures farther into the sea, threatening more altercations with neighbors - WSJ

China's "Nine-Dash" chart not in accord with UNCLOS
U.S. must sign UNCLOS to be credible



Dispute over territorial boundaries defining drilling and fishing rights.



Chinese coast guard vessels protecting oil rig ram Vietnamese vessel in disputed waters in South China Sea



Mature network of military facilities would extend China's ability to project power by over 800 kilometers

Sea floor thought to be repository of large oil and gas deposits in contention by nations in region

Treat Energy as a Matter of National Security to Avoid Chaos

Implications for future combat are ominous, should nations see the need to militarily secure energy resources

Force won't change conditions – competent American leadership will

Force

- **Stumble into a war trying to cut China off from energy resources in the China Seas**
 - Growing tensions in the East and South China Seas have raised the risk of a “miscalculation” spilling over into a regional conflict
 - China encirclement could spark war, The Diplomat
 - Russia's new naval doctrine singles out China as core partner in the Pacific
 - The Hindu

Leadership

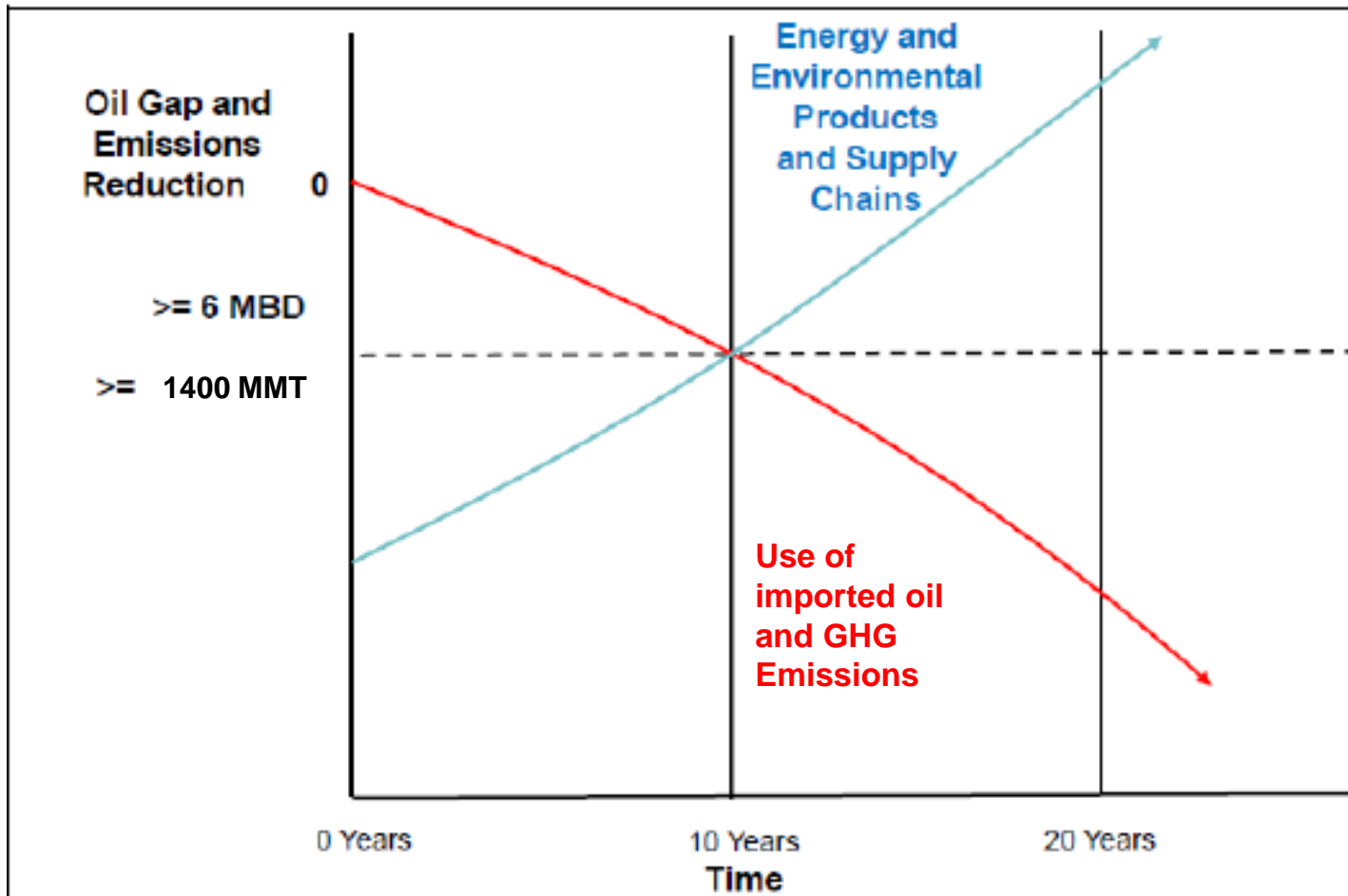
- **U.S. works with China to secure energy resources to avoid a new energy war**
 - China's needs:
 - Oil imports will rise from 6.3 MBD in 2013 to 9.2 MBD in 2020 - Forbes
 - China used 170 BCM of gas in 2013 will use 400- 420 BCM in 2020 - Fortune
 - 83% of global energy demand growth in non-OECD countries - EIA

What Is The Proposed Goal? When Will We Achieve It?

- **Eliminate the gap between U.S. oil consumption and production and reduce GHG emissions in a decade as a milestone on the road to a sustainable energy future.**
 - **Energy objective: Eliminate “oil gap” of at least 6 million barrels of oil a day**
 - High end of EIA, IEA forecasts for US oil gap in 2025
 - Oil Gap includes crude oil and refined products
 - Domestic natural gas plentiful, eliminating oil gap achieves energy independence
 - **GHG emissions objective: Reduce emissions by at least 1,400 million metric tons of CO₂ equivalent by 2025** - President Obama at Paris Climate Summit
 - **“All-of-the-above” energy/efficiency/environmental mix needed to meet the goal**
- **Goal is “placeholder” for goal to be set by the President**
 - **Goal set after sorting through other alternatives during many years of discussions, presentations and workshops that led to NEP white paper**

NEP Isn't a "One-Off" Like Apollo

Supply chains built during program are "takeoff points" on road to a sustainable future



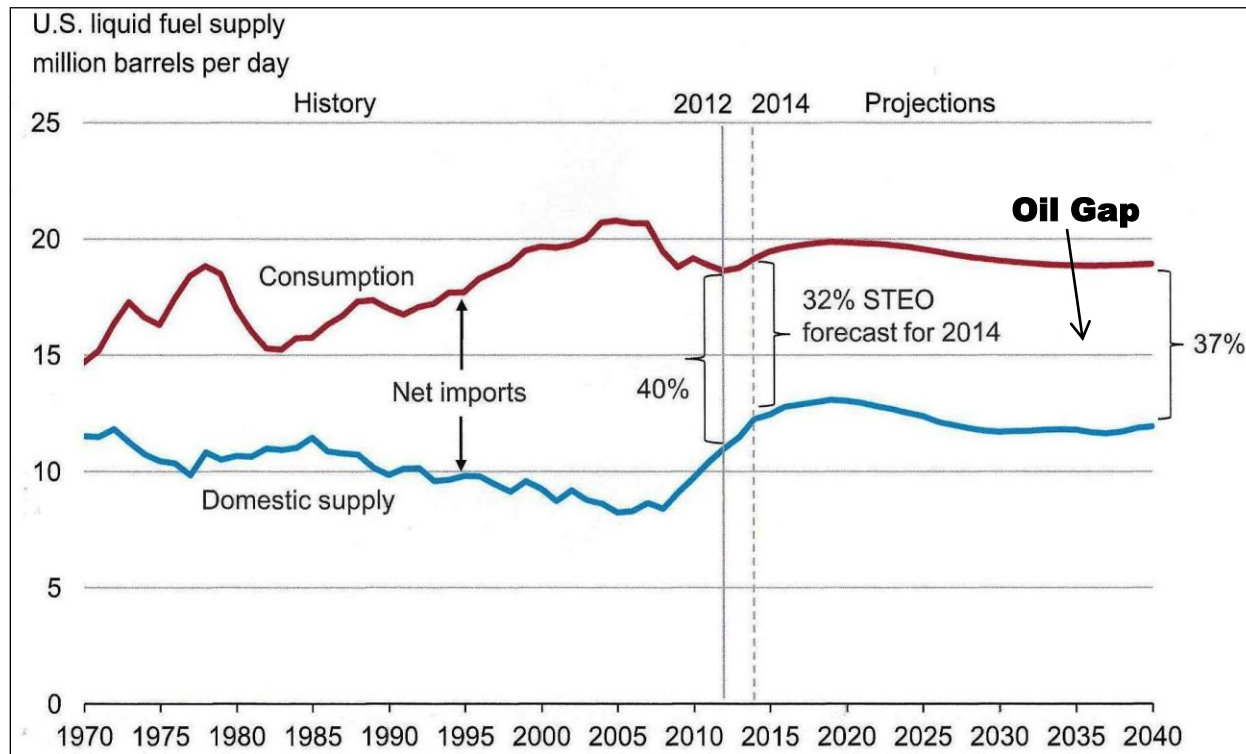
Long term planning needed to deal with large, growing problems

Projected Oil Gap 4-7 MBD in 2025 – IEA, EIA

Long term business as usual forecasts ignore darkening landscape abroad

- **Velocity of instability is ever increasing around the world**
 - General Raymond Odierno, former Chief of Staff U.S. Army
 - **Prudent to frontload NEP activity while market conditions are favorable to avoid being blindsided by unforeseen events again**

U.S won't achieve energy independence close oil gap on the current track



Source: EIA annual energy outlook 2013

Short Term Energy Euphoria Ignores Long Term Reality

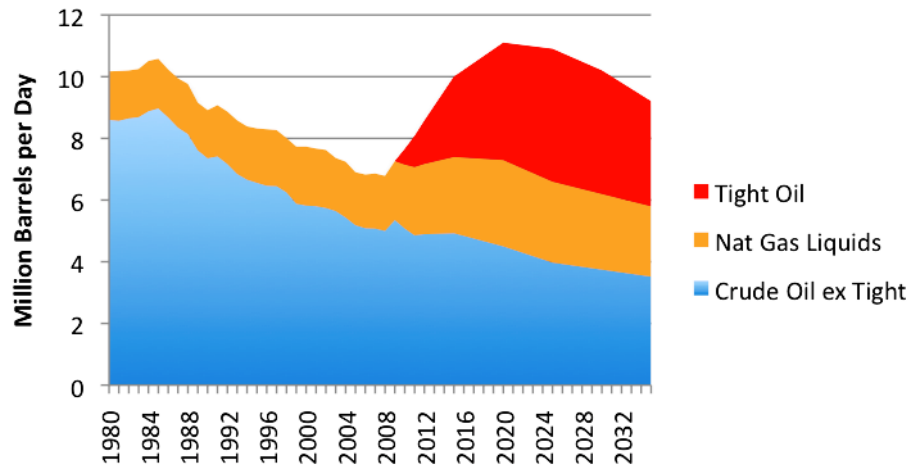
Euphoria

More oil produced at home than we buy from the rest of the world – the first time that’s happened in nearly 20 years ... The all-of-the-above energy strategy I announced a few years ago is working, and today, America is closer to energy independence than we’ve been in decades

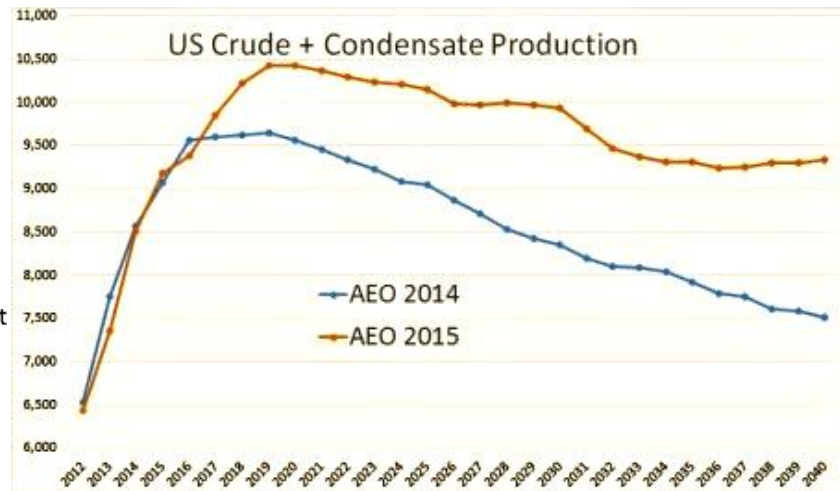
- President Barak Obama, 2014 State of the Union Address

Reality

IEA, EIA forecast U.S. oil production will peak by 2020 then decline



IEA Forecast of US Oil Production, 2013



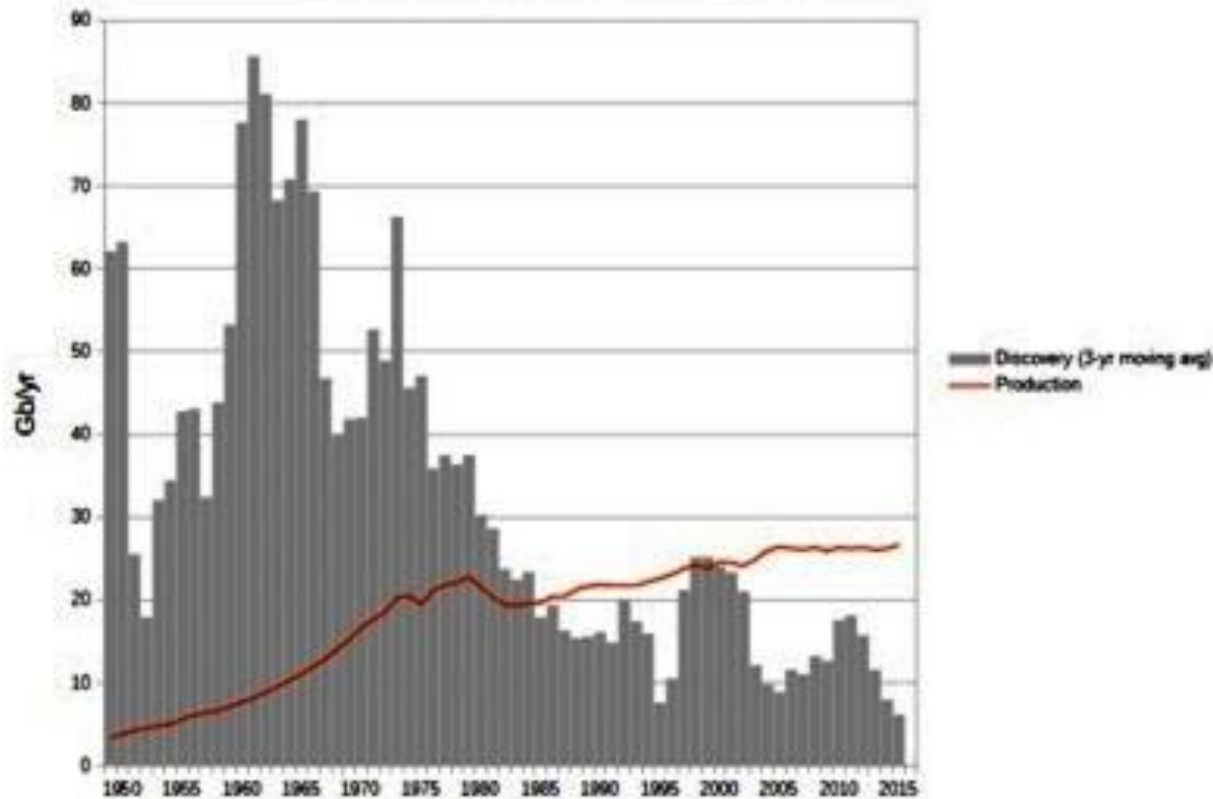
EIA Early Release Annual Energy Outlook, 2015

We have been on the imported oil roller coaster too long to have learned nothing from the experience

Production Won't Eliminate U.S. and World Wide Oil Gap

World's major oil companies all suffer from some version of the same problem: spending more money to produce less oil. The world's cheap, easy-to-find reserves are basically gone; the low-hanging fruit was picked decades ago. The new stuff is harder to find, the older stuff is running out faster and faster.

- "Big Oil Has Big Problems", Bloomberg Businessweek



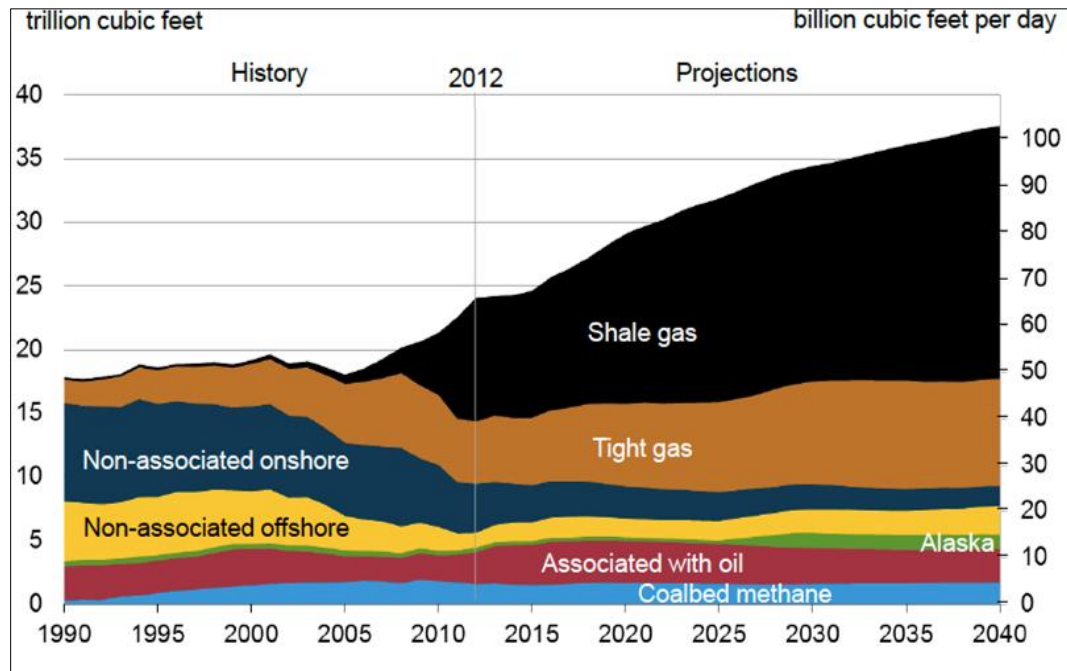
Source: <http://www.resilience.org/stories/2016-09-08/peak-oil-by-any-other-name-is-still-peak-oil>

U.S. Has Oil Problem, Plenty of Natural Gas

Use abundant natural gas as “transition fuel” to a cleaner energy future

- America needs an open fuel standard to convert gas to liquids for transportation
 - GTL could compete in liquids market if Congress enacted an open fuel standard requiring new cars to run on all-alcohol fuels, including methanol - U.S. Senate Hearing
- Better for China to convert U.S. natural gas to methanol than go to war with China over energy resources in the China Seas
 - Chinese company considering two Gulf Coast locations for a \$4.5 billion, 7.2 million ton methanol manufacturing and exporting plant
 - Chinese group plans \$4.5-billion methanol complex at Texas City, IHS Chemical Week

US Natural Gas Production 1990-2040



Source: DOE AEO2014 early Release Review

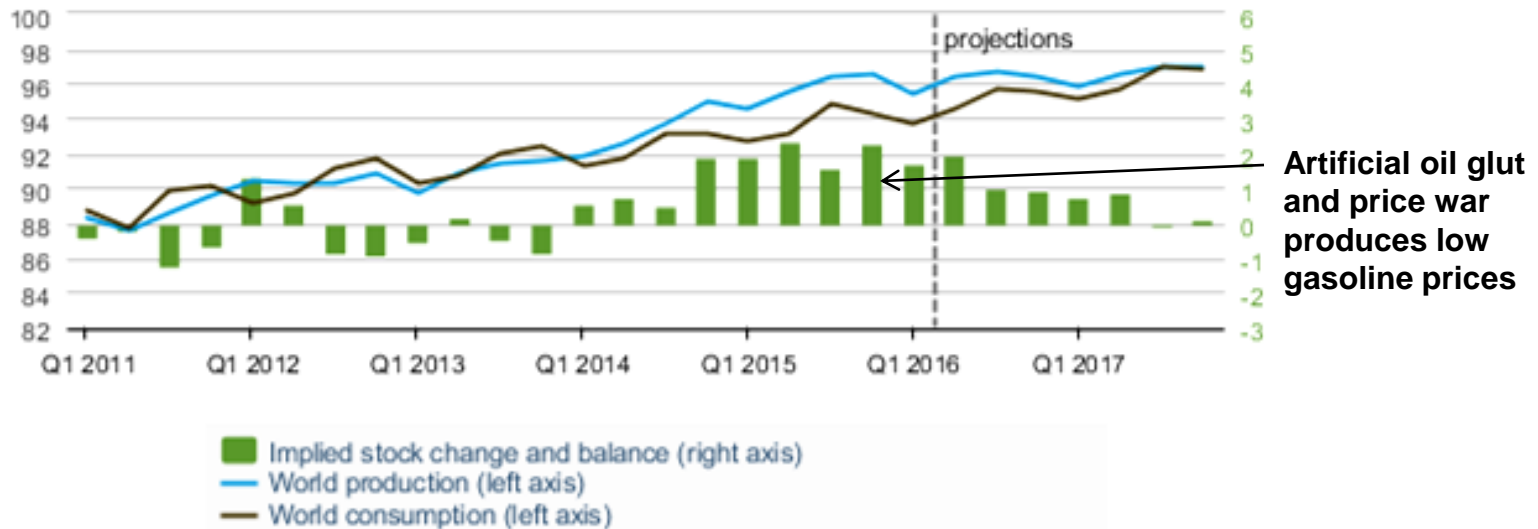
America must lead by example to achieve its goal to induce and enable other energy consuming nations to achieve their energy and environmental goals

- **It's not just about us!**
 - Our security and stability is becoming inextricably linked to security and stability elsewhere in the world - National Security Strategy 2013 , DOD
 - **World must cut 16 MBD from projected demand in 2025 just to keep demand flat**
- **Carrying EIA demand curve into the future, global demand will grow from 94 MBD today to surpass 110 million MBD by 2025**
 - **If America cuts 6 MBD, rest of the world needs to cut 10 MBD to keep demand flat**

World Production - Consumption Balance

Millions of barrels per day

Millions of barrels per day



EIA Short term energy outlook April 2016

At current usage rate world must replace Saudi Arabia and Kuwait reserves in ten years.

How Will We Achieve The Goal?

Use Methods Proven “At Scale” by NASA, DOD and Industry

- **“Apollo like” program planning and management will achieve the goal**
- **Technical and financial assistance for projects and products R,D&D that achieve goal**
- **Supply chains built during program will be takeoff point to achieve longer term goals by mid-century**
- **First step: NEP planning project will prepare a plan to achieve the goal**

The basic principles of strategy are so simple that a child may understand them. But to determine their proper application to a given situation requires the hardest kind of work from the finest staff officers. This planning meant the toilsome drudgery of grinding countless unrelated facts into homogenous substance.

- Dwight D. Eisenhower, Crusade in Europe

Start by Ending Project/Program Confusion

President Obama mentioned “funding the Apollo projects of our time” in energy. He then mentioned electric cars and passenger rail in the same breath as Apollo as though all were projects. - 2010 State of the Union message

Apollo wasn't a project. It was a program.

- **Programs achieve “ends” - goals and objectives**
 - **Ends must be defined and agreed upon FIRST**
 - Go to the moon, build a national highway system, achieve energy independence, etc.
- **Projects are “means” to achieve ends**
 - **Means defined and “rank ordered” to achieve goals and objectives**
 - Keystone Pipeline, cap and trade, electric cars, energy efficiency, passenger rail, etc.
- **Focus on means before ends = gridlock since Carter - Reagan**
 - **Can't see forest for the trees**
 - Each interest hugs its tree, fights “below tree line” to cut down trees of opposing interests

Perfection of means and confusion of ends seem to characterize our age - Albert Einstein

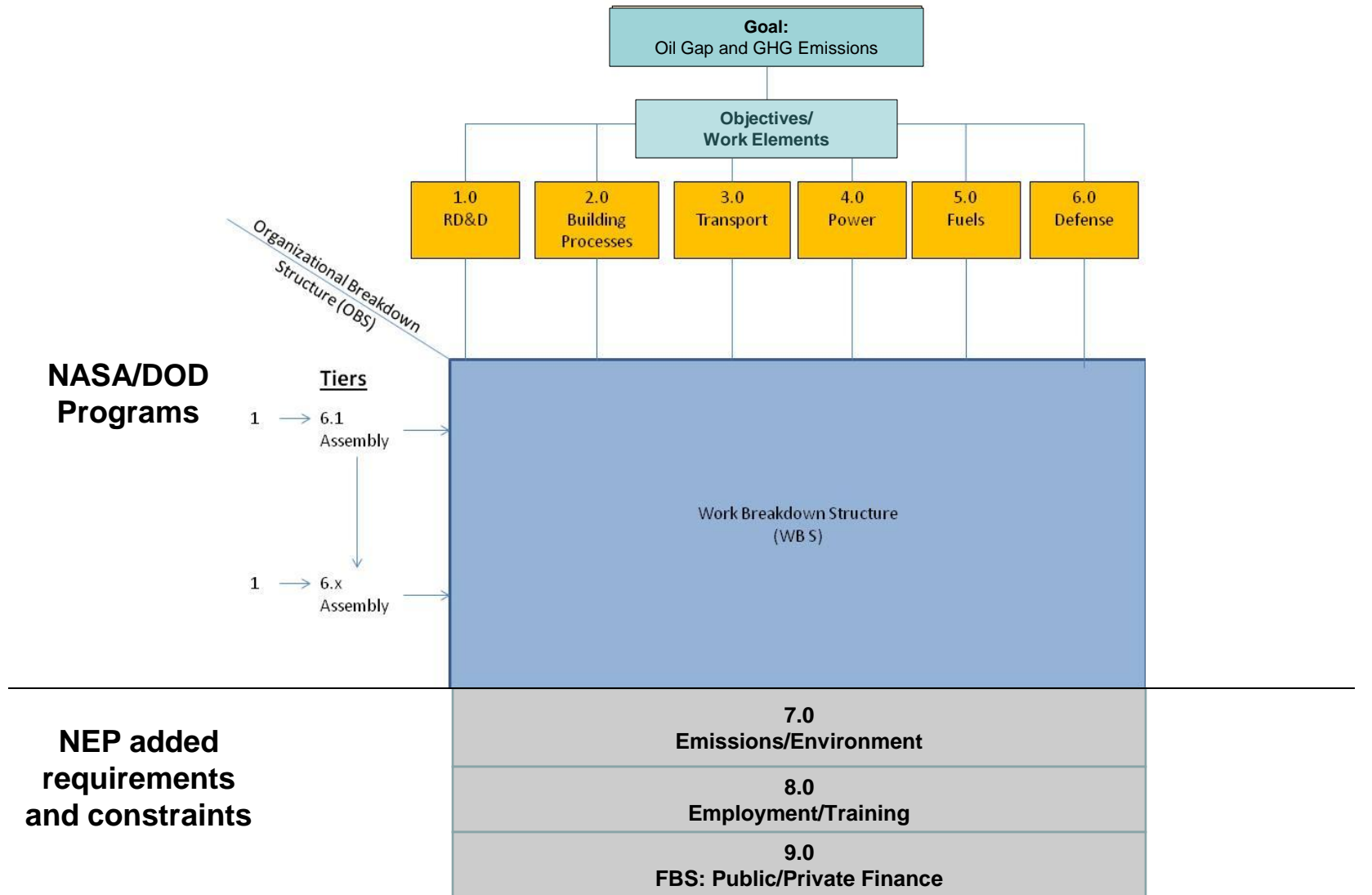
Apollo like” Program Planning and Management

Method to define and achieve goals and objectives from inception to completion

- **The President defines a goal and timeline**
 - **Goal in NEP white paper is a “placeholder” for goal to be set by next President**
- **Objectives/work elements to achieve goal defined in work breakdown structure (WBS) by stakeholders**
- **Means (projects, products, assemblies) related to objectives defined “in tiers” “down and across” work elements in WBS**
- **Means related to performing organizations using an organization breakdown structure (OBS)**
- **Finance sources related to means using a financial breakdown structure (FBS)**
 - **FBS unique to NEP which differs from publicly funded DOD and NASA programs**
 - **Government investment “leverages” private sector investment with ROI to taxpayers**
- **Cost/schedule system developed to manage all work elements and means**
- **Structured within a dynamic management framework wherein a change in any work element immediately translates into impacts on all other elements**
 - **Dynamic system enables new technologies to replace older technologies as required**

NEP Program Breakdown Structure

Scenarios for each objective/work elements presented in NEP white paper



Apollo Program Breakdown Structure Methodology Adapted for a National Energy Program

Apollo WBS/OBS at a NASA Center

CHRYSLER	S-1/S-1B STAGES	SATURN 1 & 1B		
NORTH AMERICAN AVIATION (ROCKETDYNE)	H-1 ENGINE			
DOUGLAS	S-1V STAGE			
PRATT AND WHITNEY	RL-10 ENGINE			
DOUGLAS	S-1VB STAGE			
NORTH AMERICAN AVIATION (ROCKETDYNE)	J-2 ENGINE			
INTERNATIONAL BUSINESS MACHINES	INSTRUMENT UNIT			
BENDIX				
RADIO CORPORATION OF AMERICA	COMPUTER			GROUND SUPPORT EQUIPMENT
GENERAL ELECTRIC	ELECTRICAL CHECKOUT EQUIPMENT			
BOEING SATURN V LAUNCH VEHICLE INTEGRATION				
BOEING	S-1C STAGE	SATURN V		
NORTH AMERICAN AVIATION (ROCKETDYNE)	F-1 ENGINE			
NORTH AMERICAN AVIATION (SPACE AND INFORMATION DIV.)	S-1I STAGE			
NORTH AMERICAN AVIATION (ROCKETDYNE)	J-2 ENGINE			
DOUGLAS	S-1VB STAGE			
INTERNATIONAL BUSINESS MACHINES	INSTRUMENT UNIT			
BENDIX				
GENERAL ELECTRIC	ELECTRICAL CHECKOUT EQUIPMENT			GROUND SUPPORT EQUIPMENT
RADIO CORPORATION OF AMERICA	COMPUTER			
TELECOMPUTING CORPORATION	STRUCTURE SYSTEMS STUDY			SUPPORTING RESEARCH & TECHNOLOGY
MIDWEST RESEARCH INSTITUTE	ENVIRONMENTAL CONTROL STUDY			
GENERAL ELECTRIC	STABILIZATION CONTROL SYSTEMS STUDY			
REPUBLIC	STRUCTURE SYSTEMS STUDY			
LOCKHEED	STRUCTURE SYSTEMS STUDY			
FAIRCHILD STRATOS CORPORATION	MICROMETEOROID EXPERIMENT	FACILITIES		
GENERAL ELECTRIC	MISSISSIPPI TEST OPERATIONS			
BOEING				
AEROJET GENERAL/AETRON				
SVERDRUP AND PARCEL				
PAUL HARDEMAN INC.				
CORPS OF ENGINEERS				
LEAR SIEGLER				
TELECOMPUTING	SLIDELL			
MASON - RUST	MICHIGUO			
AERO SPACE LINES	AIR TRANSPORTATION	LOGISTICS		
MECHLIG BARGE LINE	BARGE			
MILITARY TRANSPORT SERVICE	SHIPS			
UNITED STATES AIR FORCE		PARTICIPATING AGENCIES		
UNITED STATES ARMY				
CORPS OF ENGINEERS MAPPING				
ATOMIC ENERGY COMMISSION				
UNITED STATES NAVY				
DEPARTMENT OF STATE				
DEPARTMENT OF DEFENSE				
FEDERAL AVIATION AGENCY				
UNITED STATES COAST GUARD				
FEDERAL COMMUNICATION COMMISSION				
UNITED STATES COAST AND GEODETIC SURVEY				
BELLCOMM MANNED SPACEFLIGHT SYSTEM - ENGINEERING				

MSFC

NASA HDQRS MSF

- NEP will use excess capacity at NASA centers, DOD bases, DOE appropriate labs, NNMI's
 - EF working with KSC will be NEP coordinator
 - Work goes to other organizations that have:
 - Applicable excess capacity
 - Skills related to tasks not found at KSC
 - Applicable deployed technology
- Energy Florida “energy innovation ecosystem” analogous to NASA WBS/OBS
 - EF/KSC manage activities of government, energy industry, finance, laboratories, academia in SE region on projects
 - EF will work to build network of energy innovation ecosystems across the country that can work together on NEP
- NASA program management systems link activities of performing organizations at all centers (OBS) to work elements/tasks (WBS)
 - National program requires formal management structure

Build Supply Chains for a Sustainable Energy Future

Example: Transportation Sector Supply Chain

- **Transportation Sector receives top priority based on oil usage**
 - 70% of all the petroleum used in U.S.
 - 96% of energy used in the transportation sector is oil
 - **Concentrate on motor vehicles - 59% of oil use in sector for light duty cars and trucks**
 - Blue Print for Securing America's Energy Future, US Chamber of Commerce
 - **Other transportation modes may be included with support from related industries (Aerospace, Shipping, Rail, etc)**
- **Defense Sector should receive equal priority**
 - **Other sectors won't be properly served if "operational energy" isn't available to defend the oil supply.**

What is needed is an integrated, multi-pronged approach that cuts across Administrations and covers transportation fuels and vehicles

- Fuel Choice for American Prosperity, Institute for the Analysis of Global Security

What is Supply Chain Planning and Management?

- **“Cradle to grave” planning and management of flow of information, materials, products, services from raw material to customer fulfillment and life cycle support**
- Supply chains are built “down and across” objectives/work elements

Transportation Sector

Vehicles



Customer/System Interface (Charging/Fueling Stations)



Power and Fuels Sectors

Power/fuels



Planning Transportation Sector Supply Chains

Make “apples to apples” comparisons to prioritize means and develop strategy
How Much? How Fast? How Clean? What Risk? What Cost?

Examples of transportation sector supply chains

- **Gases:** Use existing gas production and distribution systems
 - Gases plentiful and lower cost than gasoline
 - Need engine conversion, new fueling station network – varies by fuel
 - Natural gas less polluting than gasoline, Hydrogen eliminates emissions
- **Liquids:** Retrofit existing vehicles and gas station network
 - Need R, D&D, new plants, pipelines, freight transportation - varies with fuel
 - Methanol requires new plants, CTL requires new pipelines or rail roads
 - Emissions reduction varies by liquid
- **Electricity:** EV's use existing power grid that will need upgrade
 - Need R,D&D for “competitive” vehicle batteries, charging systems and fueling network
 - Buying new vehicles costs more than retrofitting existing vehicles
 - Eliminates emissions
- **Hybrids:** Transitional vehicles
- **Other:** Dynamic management process brings new technologies to market

Transportation Sector Supply Chain – Department of Defense

“DOD Deploys”

- Over 70% of tonnage to position U.S. Army into battle is fuel
 - Number of convoys to transport an ever increasing requirement for fossil fuels is a root cause of casualties - Energy Security: America’s Best Defense, Deloitte
 - A2/AD problem will require much lighter energy footprint in the future
 - **Clean energy fuels vs. fossil fuels not the issue, must reduce tonnage of all liquid fuels**
- **Focus on R,D&D of more energy efficient, hybrid and alternative vehicles**
 - Example: Oshkosh Defense HEMTT A3 Diesel Electric Tactical Truck
 - Improves fuel efficiency up to 20%
 - 100 kW of clean, exportable AC power, enough to run a field hospital
 - Single-unit, power-generating solution, eliminates need for additional vehicles
 - Uses DOD “Co - investment” methods. Part of comprehensive NEP finance program

Operational Energy



HEMTT A3 Diesel Electric Heavy Expanded Mobility Tactical Truck

Source: Oshkosh Defense

Installation Energy

US Army Net Zero Program



Fred Smith was so impressed with the effectiveness of wartime logistics that he used that knowledge he learned in the U.S. Marines in Vietnam to build FedEx. - Battlefield to Boardroom

How Will NEP Operate?

Public/private sector “equal partnership” will manage the program

- **Outside government, freed from political interference and earmarking**
 - A Business Plan for America’s Future, American Energy Innovation Council
 - **Industry leads. Government provides support, coordination, deregulation, finance, oversight.**
 - **Operation divided in two major parts – Operational and Installation energy.**
 - **Enables alignment with DOD activities and cross investment**
- **Provide real business opportunities to gain real business and financial institution participation**
 - **Example: Solve “chicken and egg” NGV vehicle and fueling network problem**
 - **Bring together stakeholders to plan and finance conversion of number of vehicles (possibly two million trucks) required to build core NGV fueling network**
 - **Pilot project in Florida and Southeastern U.S. managed by EF/KSC**
- **Provide technical and financial assistance for project/product R,D&D**
 - **Setting a national goal enables comparison of each project/product on a cost/benefit basis.**
 - **FOCUS: NEP won’t throw money at science projects that can’t be justified to meet goal**
 - **Assistance led by EF/KSC with support from other NASA centers, DOD, industry, financial institutions, laboratories, universities and think tanks**

**The skills necessary to maintain and launch a high-performance turbo pump used
In Space Shuttle main engines are the skills necessary for developing
and testing new turbine systems for energy - Mike Aller**

Energy Florida

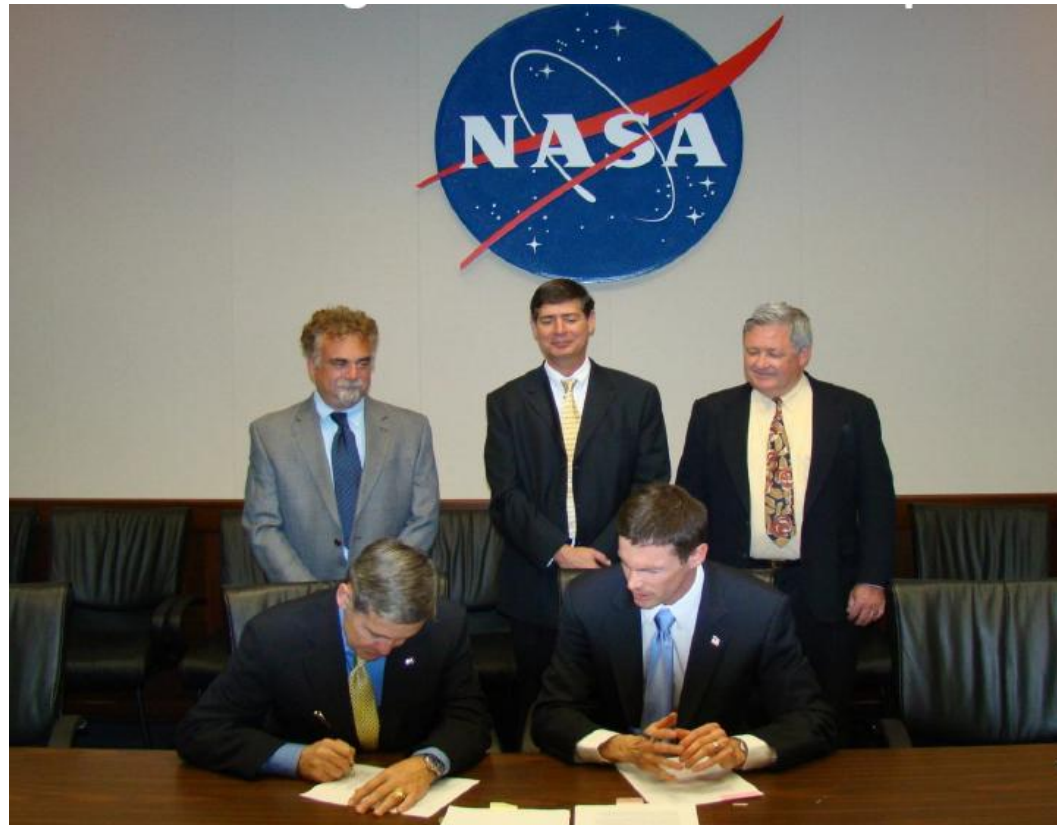


Energy Florida is the industry-led nonprofit association of businesses and communities gathering resources and developing partnerships to grow the energy sector and related industries across Florida, the Southeastern United States and the “near abroad” of Latin America & the Caribbean basin

We are Building America’s Energy Economy

Memorandum of Understanding with Kennedy Space Center

- Leverage KSC's technical expertise and facilities to develop sustainable energy energy products and services
- Develop Space and Energy Regional Innovation Center to sponsor, support and accelerate commercialization of energy products
- Focus on end-stage technology development and demonstration that can lead to commercial applications



KSC Director Robert Cabana & Energy Florida leadership signing Space Act Agreement on Space & Energy Technology Demonstrations

Kennedy Space Center Has Unique Capabilities For Advanced Manufacturing, Technology Testing & Demonstration



Tech Transfer from US Space Programs



Fully instrumented testing & demonstration

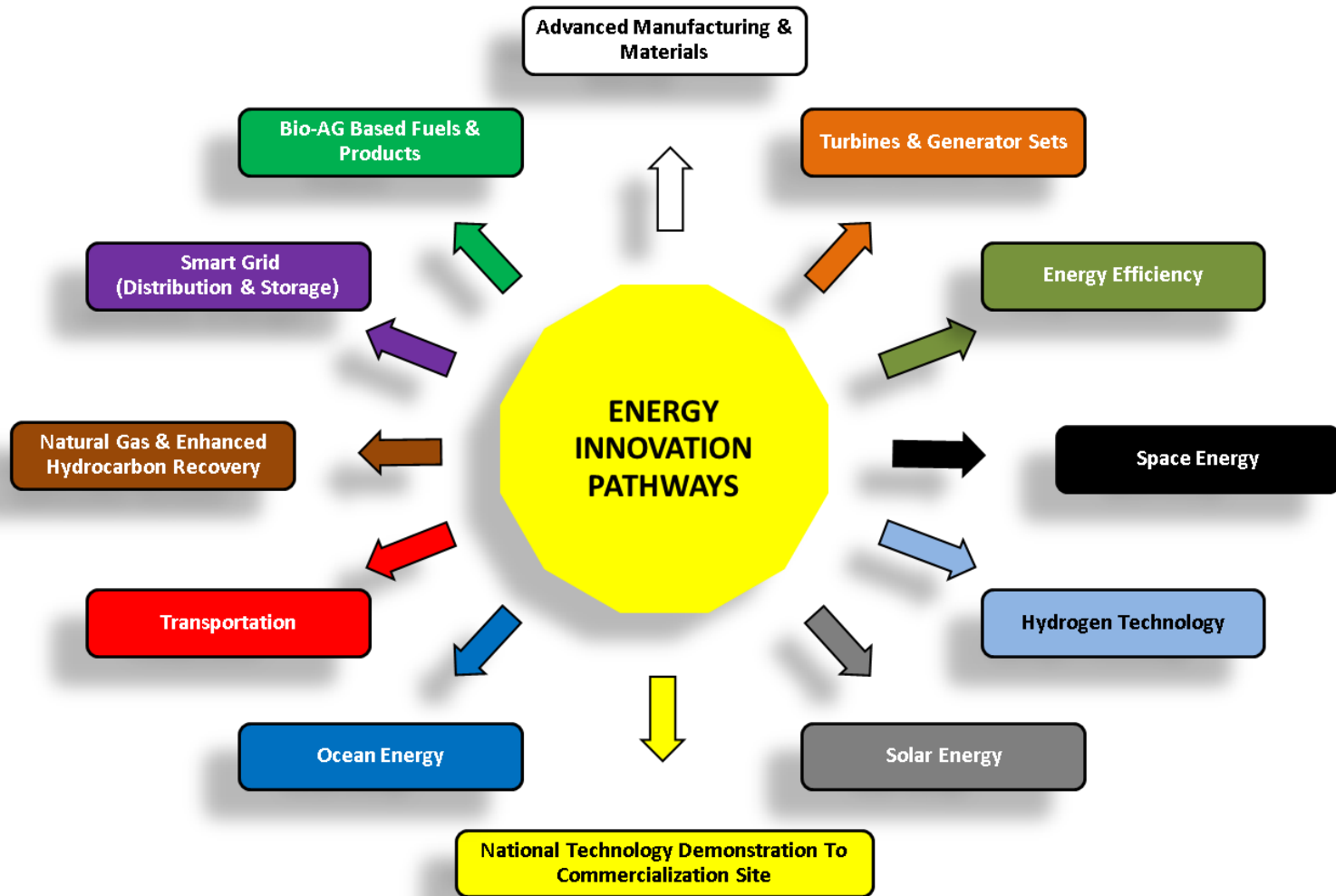


Vacuum & vibration test capabilities



Industrial gas handling facilities & full-scale physical test stands

Energy Florida Technology Focus Areas



Exploiting Regional Energy Clusters and Spaceport Capabilities
Working with Government, Industry and Academia to address key challenges

Clean Energy Technology Valleys of Death

Focus on end-stage technology development and demonstration
that can lead to commercial applications

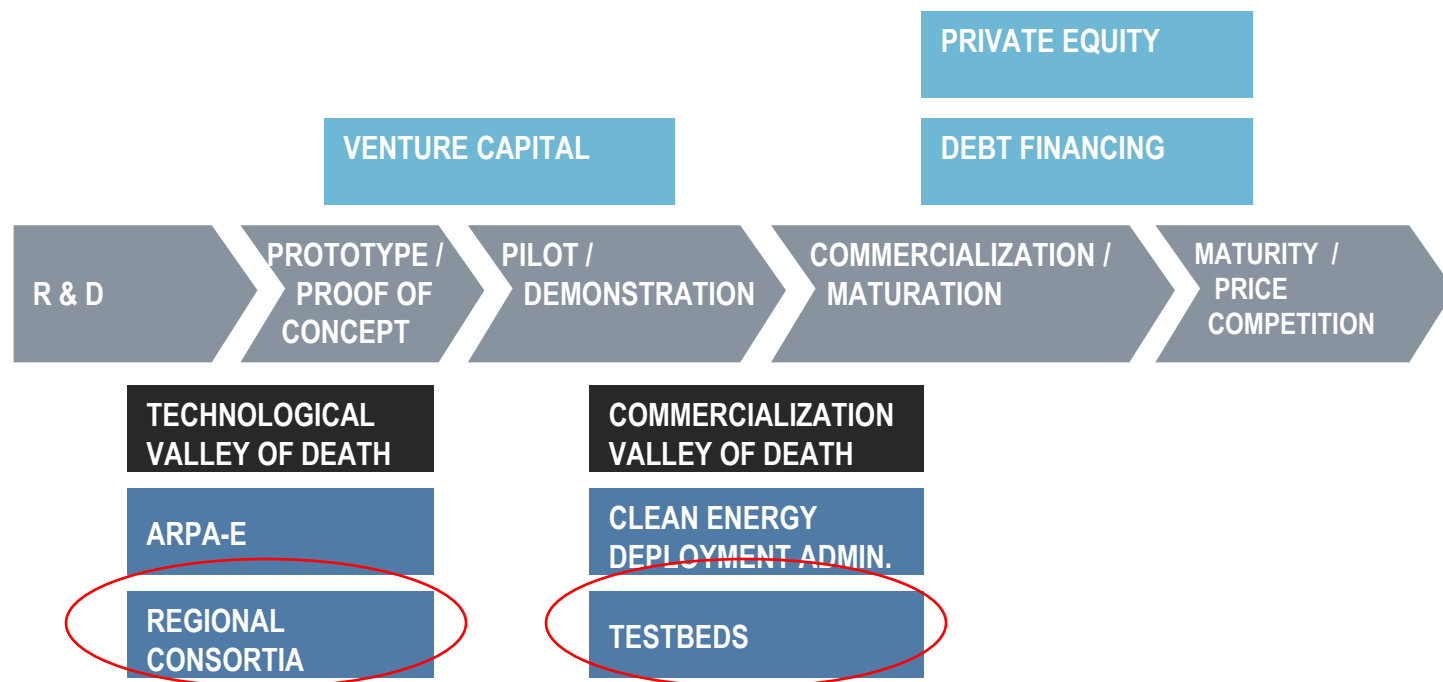
Two obstacles currently block the progress of energy innovation, obstacles which can only be addressed through effective public policy.

The Technological of Valley of Death occurs early in the development of a technology, as breakthrough research and technological concepts aim to develop commercially viable products.

The Commercialization Valley of Death exists between the pilot/demonstration and commercialization phases of the technological development cycle. This financial gap plagues advanced energy technologies that have already demonstrated proof of concept but still require large amounts of capital ...to demonstrate that their design and manufacturing processes can be brought to full commercial scale.

- “Bridging the Clean Energy Valleys of Death” – Breakthrough Institute

Best Practices: Responses to the Clean Energy “Valleys of Death”



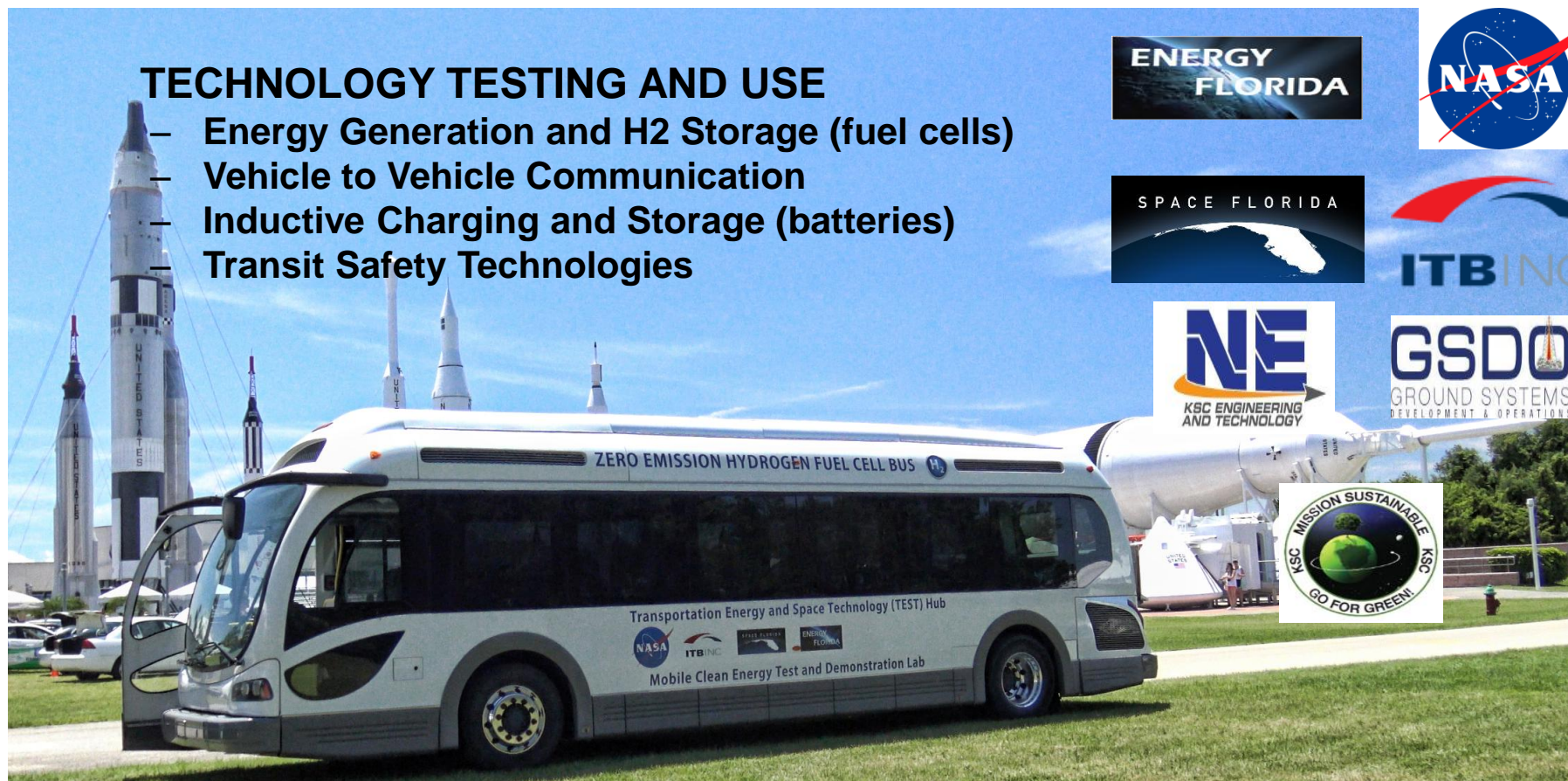
Adapted from “Bridging the Clean Energy Valleys of Death” – the Breakthrough Institute, 2011

Advanced Transportation Supply Chain Technology & Infrastructure

- Mobile educational and testing platforms for Hydrogen, Electric or Transit-based technology

TECHNOLOGY TESTING AND USE

- Energy Generation and H₂ Storage (fuel cells)
- Vehicle to Vehicle Communication
- Inductive Charging and Storage (batteries)
- Transit Safety Technologies



Proterra Gen2 Fuel Cell Electric Bus at KSC

Kennedy Space Center has largest alternative vehicle fleet in U.S. government

Building Transportation Supply Chains

Fleet Operations

Central Florida Natural Gas Fleet Implementation

- **Frito Lay Orlando**
 - Centralized delivery fleet operations
- **Waste Management**
 - CNG Sanitation Vehicle Fleet
- **Saddle Creek Logistics**
 - Long-Haul CNG Trucking Network
- **School Districts**
 - CNG bus fleet(s)



Building Transportation Supply Chains

Fueling Stations

H2 Fueling Station
NASA KSC

H2 Supply Device
Multi-Fuel Station

Water Supply
Fueling Station
Local Source



Electric Supply
Fueling Station
Grid-tied or
Renewable Sources



CareerSource FL
Workforce Training

Fuel Cell
Introduction into
Regional Bus Fleet



Attract New Business
Possible
Bus Fleet Retrofits
Fuel Cell Industry



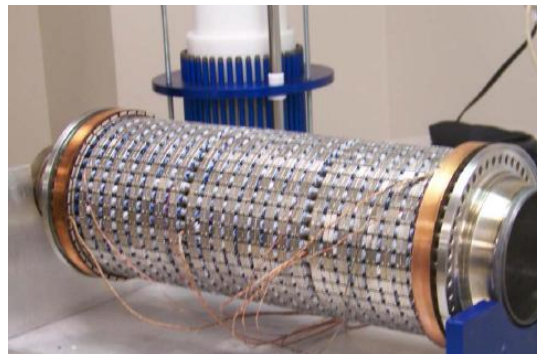
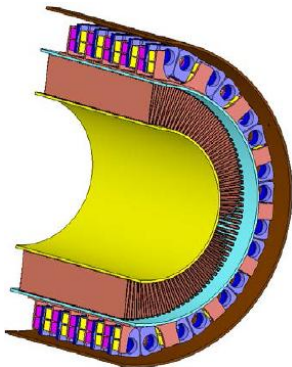
Multi-Fuel Station Demonstration Project

Energy Florida and US DOT Federal Transit Administration Thermo-Electric Generation Transit Bus Demonstration

- Develop, install and test a prototype Thermal Waste Heat Recovery (TWHR) system on a diesel transit bus donated by LYNX (Greater Orlando transit authority), and monitor system performance in regular transit operations over 6 months
- **First application in transit environment** – TWHR originally developed for spacecraft, adapted for military vehicle (tank/Humvee) and diesel truck applications through research funded by US DoD, Dept of Energy and National Science Foundation



Thermal Waste Heat Recovery is the 1st energy technology to leave our solar system (Voyager 1 & 2 space probes)



Central Florida Electric Vehicle & Hydrogen Corridor

Central FL Clean Cities Electric Vehicle Charging Network

- Coordinated over 300 charging stations in greater Orlando, and over 500 across I-4 Corridor

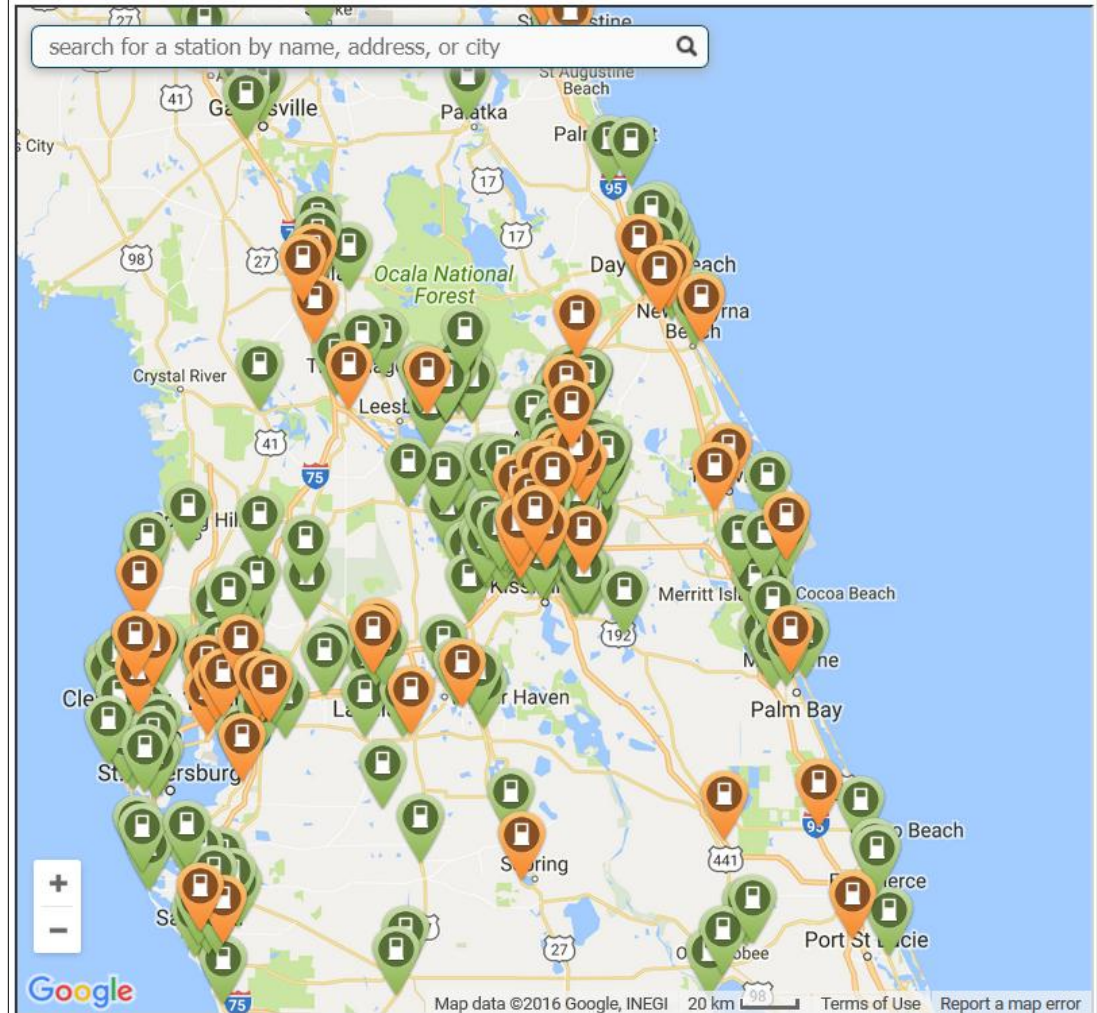
Drive Electric Orlando – first-of-its-kind EV car rental program

Hydrogen Corridor – Fuel Cell Vehicles



Find a Charging Station

The map below only shows the general Orlando area. The greater Central Florida area has over 300 charging stations.

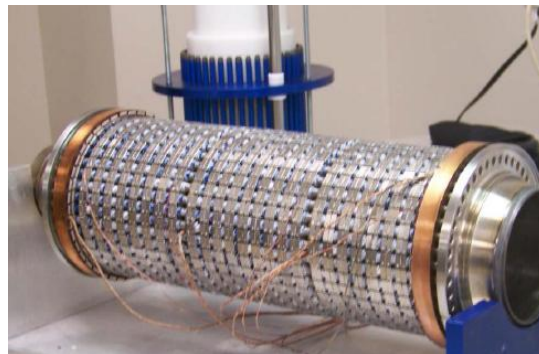
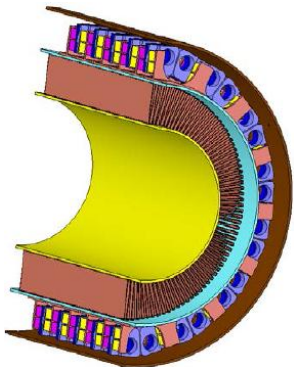


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Energy Florida and Gas Turbine Association

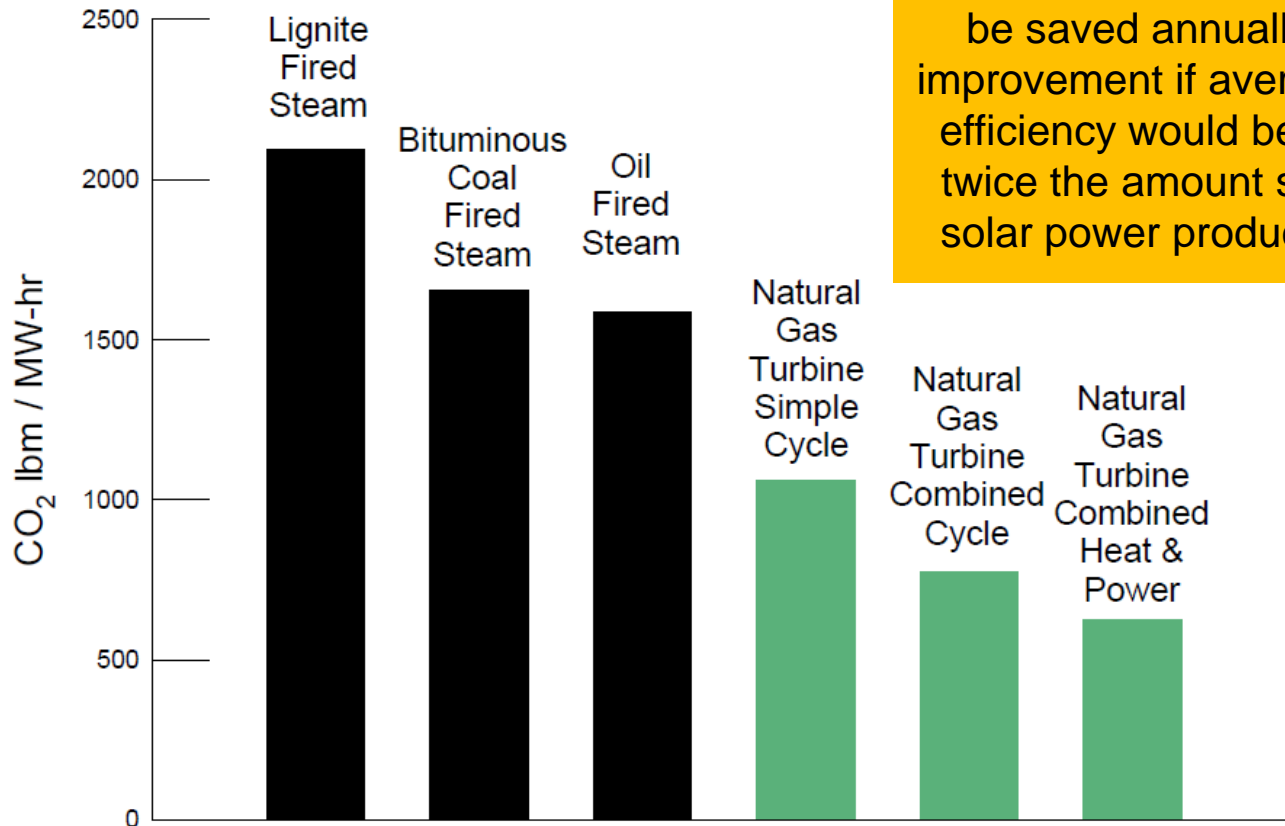
NIST AMTech Consortium for Advanced Production and Engineering of Gas Turbines & Rotating Machinery (CAPE)

- Coordinating national strategy for future development of the U.S. gas turbine industry
- “Apex Technology” at the convergence of aviation, aerospace & power generation
- Major Strengths of the U.S. Turbine Cluster
 - High Level of Innovation
 - Re-shoring Manufacturing to U.S.
 - Supply Chain Diversity/Depth
 - Over 200,000 jobs in U.S. tied to turbine design, manufacturing & maintenance
- Enormous market opportunity as demand for turbines and related parts and components expands around the world
 - \$1 trillion market in power generation by 2035
 - \$2 trillion in aviation gas turbine engines by 2035



Advanced Gas Turbines in Power Generation: Cleaner use of fossil fuel, and backstop for renewable generation sources

CO2 Creation



Fun Fact

The amount of CO₂ that would be saved annually by a 1% improvement in average GT fleet efficiency would be more than twice the amount saved by all solar power produced in 2014

High Thermodynamic Efficiency + Low Carbon Fuel = Low CO₂ Emissions

CAPE Focus Areas: Next-Generation Gas Turbine Manufacturing

- **Additive Manufacturing / Rapid Prototyping**
 - Material Characterization & Quality
 - Baseline Process Parameters
 - In-situ monitoring & data analysis tools
- **Advanced Materials and Alloys**
 - Ceramics & Ceramic Matrix Comp (CMCs)
 - Refractory Metals & New Alloys
 - Thermal Barrier Coatings (TBCs)
- **Manufacturing Processes & Supply Chain**
 - Joining of Disparate Materials
 - New Non-Destructive Evaluation and Modeling techniques
 - Impact of manufacturing process(es) on material properties
- **Maintenance, Repair & Overhaul (MRO)**
 - Repair/Reconditioning techniques
 - On-Demand & Legacy Parts
- **F-33 Engine Sustainment & Upgrades**



USAF B-52 could be the first airplane with 100-year service life

Federal and State Support to Develop a Clean Energy “Innovation Ecosystem” In Florida and the Southeastern U.S.

Consortium for Advanced Production and Engineering of Gas Turbines & Rotating Machinery (CAPE)
Transportation Energy and Space Technology Hub (TEST Hub)

Space Coast Clean Energy Jobs Accelerator (CEJA)
Florida Cleantech Accelerator Network (FL-CAN) / GrowFL
Commercial Energy Efficiency Finance (CEEF)

Funding Agencies:



Program Partners:



How Does Energy Florida Help Clean Energy Businesses to Succeed?

- **Connecting the Dots for Business Growth**

- Identify Funding Opportunities and Provide Subject Matter Expertise
- Clean Energy, Manufacturing, Transportation, Waste-to-Energy
- Supply Chain Resources: Sector-Specific Asset Maps and Key Data Resources
- Business to Business Matchmaking, including Evaluation of Prospective Partners

- **Delivering Financing Solutions**

- New Funding Resources – Crowdfunding, Angel Investment Network, EB-5
- Energy Efficiency Finance Programs – Commercial PACE, Loan Programs
- Industrial Development Bonds

- **Public-Private Partnership Development**

- Clean Energy, Transportation Technology and Economic Development

Energy Florida: Thinking Globally, Acting Locally



National Energy Program: Thinking Globally, Acting Nationally

How Will We Start? NEP Planning Project

- **Planning of work elements by stakeholders with related interests**
 - Stakeholders will have incentive to work with their constituencies in Congress
- **President Roosevelt's actions prior to Pearl Harbor an example**
 - Saw danger and prepared for war “off-line” in a nation living in denial
 - **NEP similar to NDAC set up by FDR to ramp up production prior to WWII**
 - NDAC had no legal status, influence depended on how it presented the problem to turn butter into guns - Freedom's Forge, Arthur Herman
 - NDAC charter was national industrial transformation. NEP only energy domain.
- **Hopefully, NEP won't require a new national calamity to be implemented**
 - At a minimum, project will produce a plan available to deal with unforeseen events
- **Planning project has to start somewhere**
 - NEP white paper presents a goal, objectives and implementation scenarios “for discussion purposes” to begin the project.

It wasn't my job to tell industry how to do its job; it was our function to show industry what had to be done and then do everything in our power to enable industry to do it - including stepping in if the marketplace couldn't deliver fast enough

- Donald Nelson, Director of the WWII War Production Board, Freedom's Forge, Arthur Herman

Core Team Sets Up NEP Planning Project, Recruits Participants, Coordinates and Supports Project

Stakeholders and foundations with related interests provide funding and in-kind services

Whitewashing the fence

Companies that see the threat and business opportunity will participate.



Illustration from *Tom Sawyer*
Courtesy The Mark Twain House, Hartford

Short list of stakeholder and participant skill sets

- Program and project management
- Supply chain management and logistics
- Investment banking, commercial and public finance
- Infrastructure planning and finance
- Coal, Oil and Gas operations
- Conventional and alternative automotive industries
- Trucking associations and haulers
- Highways and vehicle fueling stations
- Residential, Commercial, Industrial buildings energy systems
- Utility transmission, distribution, efficiency, regulation
- Solar, wind, distributed generation
- Environmental management, engineering, mitigation, law

An effort that began with a phone call from FDR to William Knudsen, President of GM, grew into a network of a half million companies that won WWII and transformed the nation

Transform Education of Tomorrow's Leaders to be Able to Plan and Manage Large Programs and Enterprises

Integrate planning and operations studies into government/public policy education

- **Education**

- Teach “hard skills” not taught in public policy programs to enable students to become competent leaders
 - Comparative organization; systems engineering; program and project management; supply chain management and logistics; infrastructure history and economics; management information systems; accounting and finance; contracts; negotiation and conflict resolution; planning tutorial.
- Integrate courses from a number of institutions into complete curriculum
 - West Point has excellent systems management program

- **Programs and Projects**

- Students work as interns on real world projects with government and industry to gain experience and build relationships
 - NEP planning first project

- **Research and Development**

- Develop courses, seminars, briefings and publications to support and develop education program and inform national discourse
 - Students participate in R&D

A college that provides a public policy curriculum that enables its students to plan, finance and manage large public enterprises has a competitive advantage over colleges turning out policy wonks

Summary: A National Energy Program

What? When? Why? How?

What and When

- **Eliminate gap between U.S. oil consumption and production and reduce GHG emissions in a decade as a milestone on road to a sustainable energy future.**
 - Eliminate “oil gap” of at least 6 million barrels of oil a day
 - Crude oil and refined products
 - Domestic natural gas plentiful, closing oil gap achieves energy independence
 - Reduce emissions by at least 1,400 million metric tons of CO₂ equivalent by 2025
 - All-of-the-above” energy/efficiency/environmental mix that meets objectives

Why

- **Must treat energy as a national security matter and achieve the goal to avoid chaos**
 - “Arc of instability” running from North Africa to Southeast Asia could become an “arc of chaos” involving forces of many nations - DOD Joint Operating Environment 2010 report
 - With 7 of top 10 nations with largest oil reserves in region and reduced defense budgets affecting our ability to defend the oil supply we can no longer consider the oil fields safe.

How

- **Use methods proven “at scale” by NASA, DOD and industry**
 - “Apollo like” program planning and management achieves the goal
 - Supply chains built during program position U.S. for a sustainable future
 - First step: prepare a NEP plan to achieve the goal



Lawrence Klaus began his career as an architect in the offices of Emery Roth & Sons working on projects including working drawings for the World Trade Center. As a research engineer in the Boeing Aerospace Group (ASG) he designed and implemented automated business systems concerned with the design, manufacture, test, delivery, and installation of major military missile, space, and associated programs. He also participated in internal business planning to define ASG program management and information systems capabilities with civilian applications. At Peat Marwick Mitchell (now KPMG) he designed Program planning and budgeting (PPB) systems and management and reporting systems for federal government agencies. This included projects such as design of a program planning system for regional plans for the Public Health Service. He founded and was president of Development Management Consultants Inc. and planned and managed company operations on dozens of projects working with utilities, lenders, contractors, non-profit organizations and government. This work included projects such managing local and federal disaster rapid emergency mass home repair. As a manager in the network systems group of Unisys Corporation he worked with company engineers to design networked PC to mainframe systems that integrated company and vendor software and hardware. This included projects such as the user friendly IDEAS online education system for the Air National Guard. As a consultant at Synergic Resources Corporation (now Navigant Consulting) he worked on energy efficiency projects for utilities such as MidAmerican Energy. As an independent consultant has worked on projects on energy policy, networks and distributed generation.

Lawrence Klaus holds a B.S, Bachelor of Architecture and M.B.A. from the City College of New York.

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Mike Aller is executive director, of Energy Florida and is responsible for managing day-to-day operations and community outreach. He helps to coordinate several of Energy Florida's industry working groups. Mike has over a dozen years' experience in economic and policy analysis, including five years as a researcher at the Brookings Institution and the Peterson Institute for International Economics in Washington DC, and two years of service with the White House Office of Management and Budget (OMB). He is also an adjunct faculty member at Rollins College in Winter Park, Florida, teaching courses on international economics, emerging economies (China and India), and global energy and resource issues. He holds a Masters in international economics and environmental policy from the University of California at San Diego, and a Bachelor's degree in science, technology and international affairs from Georgetown University's Walsh School of Foreign Service. He speaks Mandarin Chinese and French. Mike is also a former US National Team rower and lives with his wife and son in Winter Park, Florida.

Mike has substantial expertise in energy systems and markets, as well as economic analysis and strategic planning. He has especially strong expertise in the dynamics and regulation of commodities and futures markets. Mike grew up in the agriculture industry as well - his grandfather served a distinguished 30+ year career as a farm advisor for the horticultural industry with the University of California Extension Service.

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