Scenarios for a 100% Renewable Energy Global Architecture

Presenters:

Janine Finnell, Leaders in Energy
Silvia Leahu-Aluas, Leaders in Energy
Adriaan Kamp, Energy for One World and Leaders in Energy Without Borders Partner

Google Hangout Session
February 29, 2016
1 pm EST

Leaders in Energy Without Borders (LEWB) Session Format

- Janine: Leaders in Energy & Overview of Renewable Energy Analyses (15 min)
- Silvia: Support for 100% RE by 2030 (10 min)
- Adriaan: Our roadmap (20 min)
- Discussion (15 min)

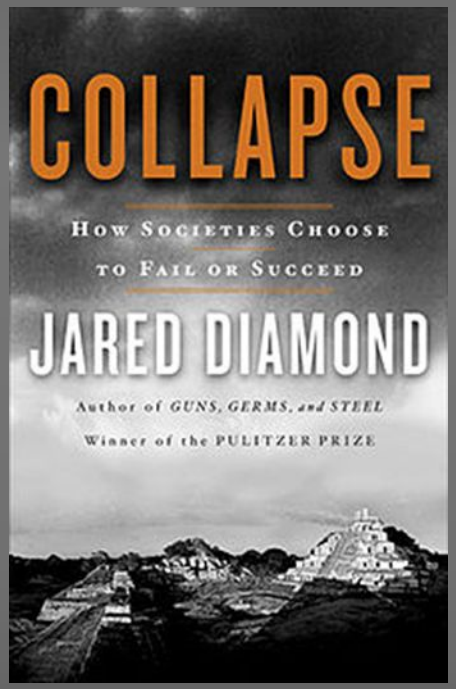
Overview - Leaders in Energy Mission and 100% Renewable Energy Scenario Studies

Presented by:

Janine Finnell
Clean Energy Ambassador & Founder,
Leaders in Energy

LEADERS in ENERGY
RESEARCH, COMMUNICATIONS, POLICIES & ANALYSIS (LERCPA)

The Bad News We Are All Increasingly Becoming Aware Of:



Challenges:

- Deforestation and habitat destruction
- Soil problems (erosion, salinization, and soil fertility losses)
- Water management problems
- Overhunting
- Overfishing
- Effects of introduced species on native species
- Overpopulation
- Increased per-capita impact of people
- Anthropogenic climate change
- Buildup of toxins in the environment
- Energy shortages
- Full human use of the Earth's photosynthetic capacity

Clean Energy & Sustainability Developments Offer Potential to Transform Economy

Connecting Thought Leaders

- Building a global community of professionals:
  - members connecting from around the world
- Enabling members to pursue professional development objectives
- Transforming ideas from thought leaders all over the world:
  - bringing them together to create synergies into action and change
  - making a difference in the world

Leaders in Energy Mission & Key Building Blocks

Mission: Building a community of leaders to enable solutions to move us towards a more sustainable energy system, economy, and world.

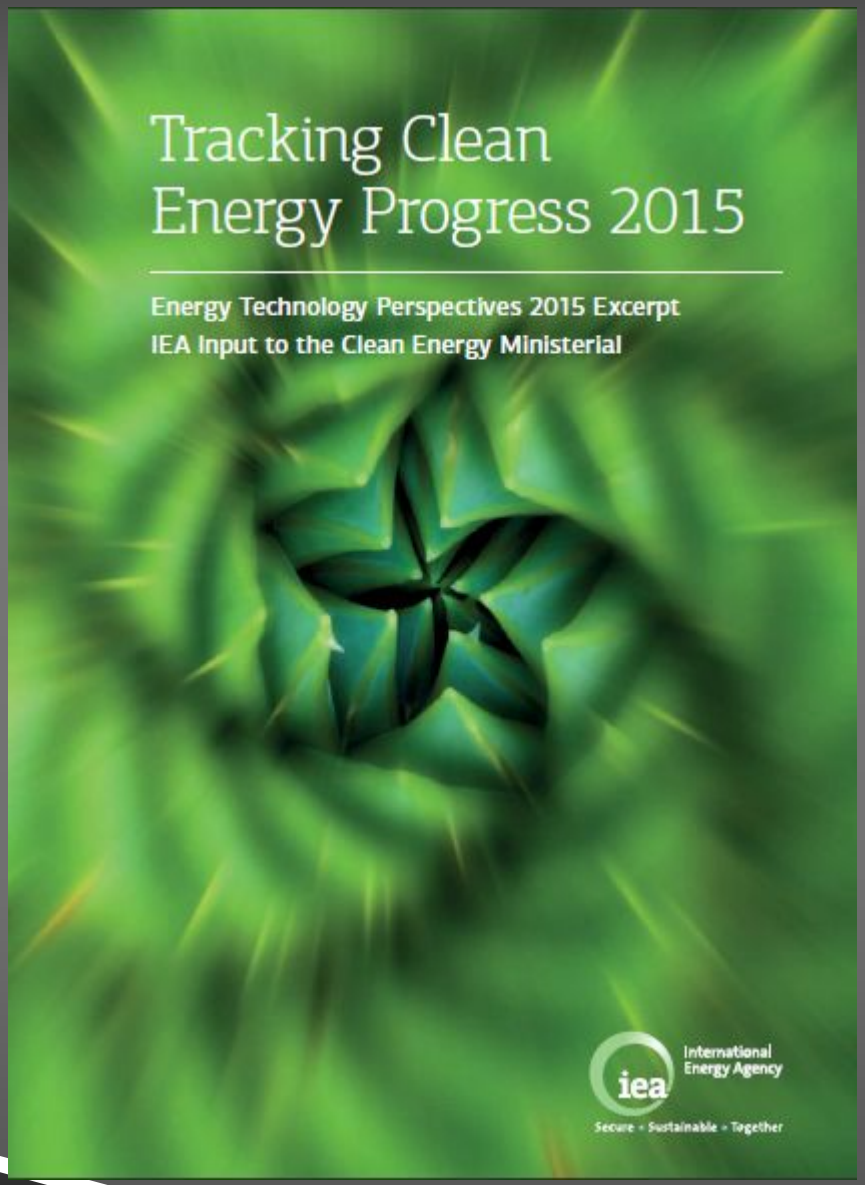
- Attract and cultivate leadership talent from all generations in energy, environmental, and sustainability arena, e.g., Millennial, Gen X, Baby Boomer, and World War II Generation, of individuals
- Open to ALL energy and sustainability solutions, e.g., technologies, policies, social innovation, etc.
- Utilize systems thinking and interdisciplinary collaboration
- Help people to connect for green jobs and business opportunities to create a more regenerative economy and world

Our Work and Activities

- Exchange information and engage on clean energy, environmental, and sustainability topics
  - Utilize on-line platforms
    - **LinkedIn group** (Leaders in Energy Research, Communications, Policies & Analysis –LERCPA) with 2000+ members in Washington DC Metro Area, other areas of the United States, and world; additional 1200 in DC area in email announcements
    - Leaders in Energy **Blog**
    - **Google Hangout Sessions**
  - Conduct monthly **professional networking and educational events** to CONNECT members on green jobs, business, research, professional development, and project opportunities to create sustainable solutions
    - **Workshops**, e.g., Circular Economy
    - Collaborate and partner with other organizations on events with similar objectives, e,g, United Nations Association, American Council for Renewable Energy, etc.

Overview of 7 Analyses on Moving Towards 100% Renewable Energy Architectures

1. **Tracking Clean Energy Progress,** International Energy Agency, 2015
2. **"100% clean and renewable wind, water, and sunlight (WWS) all-sector energy roadmaps for the 50 United States,"** Mark Z. Jacobson et al; Stanford University, 2015
3. **Deep Pathways to Decarbonization, 2014 & "Deep Pathways to Decarbonization in the United States,"** 2015 Sustainable Development Solutions Network
4. **New Energy Outlook – Long Term Projections of the Global Energy Sector**, Bloomberg New Energy Finance, 2015
5. **Energy (r)evolution,** Greenpeace et al, 2015
6. **"Cost-minimized combinations of wind power, solar power and electrochemical storage, powering the grid up to 99.9% of the time,"** Corey Budischak et al. , University of Delaware, 2013
7. **The Net Benefits of Low and No-Carbon Electricity Technologies**, Charles R. Frank et al, Global Economy and Development at BROOKINGS, 2014



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Access report here

International Energy Agency,
2015

Message from IEA Director, Maria van der Hoeven, Executive Director International Energy Agency

- ETP 2015 demonstrates that strategic action on clean energy technologies at national, regional and international levels has the capacity to move the world closer to shared goals for climate change mitigation
- Unfortunately, this report also shows **that the current pace of action is falling short of the aim of limiting climate change to a global temperature rise of 2°C (in ETP modelling, the 2° Scenario or 2DS).** Indeed, despite positive signs in many areas, for the first time since the IEA started monitoring clean energy progress, **not one of the technology fields tracked is meeting its objectives.**
- As a result, **our ability to deliver a future in which temperatures rise modestly is at risk of being jeopardised**, and the future that we are heading towards will be far more difficult unless we can take action now to radically change the global energy system.

19 Technologies and Sectors Examined in IEA Tracking Clean Energy Progress (TCEP)

- Report is divided into 19 technology or sector sections.
- TCEP focuses on whether the actions needed to decarbonize the energy sector over the ten years to 2025 are progressing. It also uncovers areas that need additional stimulus.

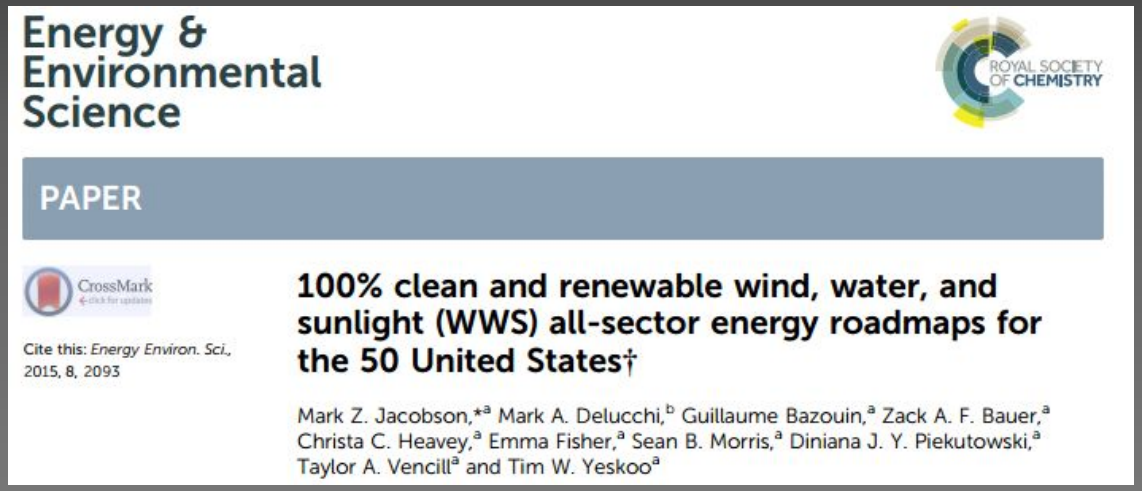
- Renewable power
- Nuclear power
- Natural gas-fired power
- Coal-fired power
- Carbon capture and storage
- Industry
- Iron and steel
- Cement
- Transport
- Fuel Economy
- Electric vehicles
- Buildings energy efficiency
- Building envelopes
- Appliances, lighting and equipment
- Co-generation and DHC
- Renewable heat
- Smart grids
- Energy storage
- Hydrogen and fuel cells

Key Findings of IEA Tracking Clean Energy Progress – Renewable Power Generation

- Renewable electricity generation is expected to grow by 45% between 2013 and 2020, reaching 7 310 TWh, and is currently at risk of falling short of the 2DS target of 7 537 TWh.
- If current trends continue, the shortfall will increase even further by 2025, when the 2DS target is 10 225 TWh. This result is subject to strong regional differences across technologies and regions.

Status of Renewable Energy Generation

- Hydropower - Improvement needed
- Bioenergy - Not on track
- Geothermal - Not on track
- Solar thermal electricity - Not on track
- On Shore Wind - Not on track
- Solar PV – On track
- Offshore wind - Not on track
- Ocean – Not on track



Energy & Environmental Science

ROYAL SOCIETY OF CHEMISTRY

PAPER

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Cite this: *Energy Environ. Sci.*, 2015, 8, 2093

100% clean and renewable wind, water, and sunlight (WWS) all-sector energy roadmaps for the 50 United States†

Mark Z. Jacobson,*[a] Mark A. Delucchi,[b] Guillaume Bazouin,[a] Zack A. F. Bauer,[a] Christa C. Heavey,[a] Emma Fisher,[a] Sean B. Morris,[a] Diniana J. Y. Piekutowski,[a] Taylor A. Vencill[a] and Tim W. Yeskoo[a]

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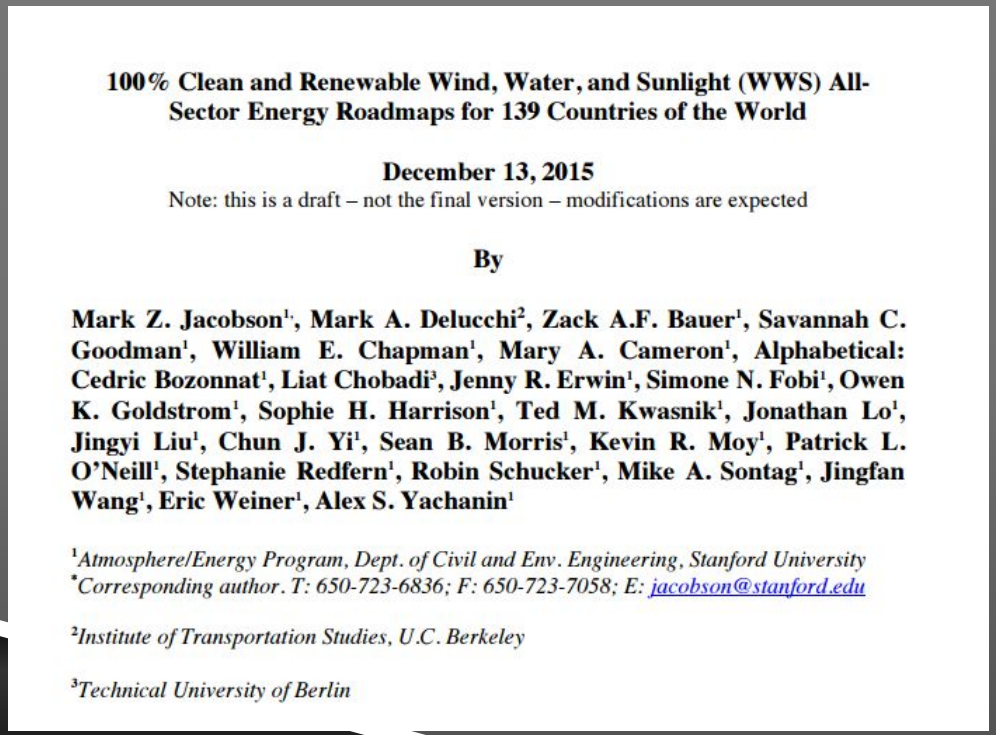
Access report here.



100% Clean and Renewable Wind, Water, and Sunlight (WWS) All-Sector Energy Roadmaps for 139 Countries of the World

December 13, 2015

Note: this is a draft – not the final version – modifications are expected

By

Mark Z. Jacobson[1], Mark A. Delucchi[2], Zack A.F. Bauer[1], Savannah C. Goodman[1], William E. Chapman[1], Mary A. Cameron[1], Alphabetical: Cedric Bozonnat[1], Liat Chobadi[3], Jenny R. Erwin[1], Simone N. Fobi[1], Owen K. Goldstrom[1], Sophie H. Harrison[1], Ted M. Kwasnik[1], Jonathan Lo[1], Jingyi Liu[1], Chun J. Yi[1], Sean B. Morris[1], Kevin R. Moy[1], Patrick L. O'Neill[1], Stephanie Redfern[1], Robin Schucker[1], Mike A. Sontag[1], Jingfan Wang[1], Eric Weiner[1], Alex S. Yachanin[1]

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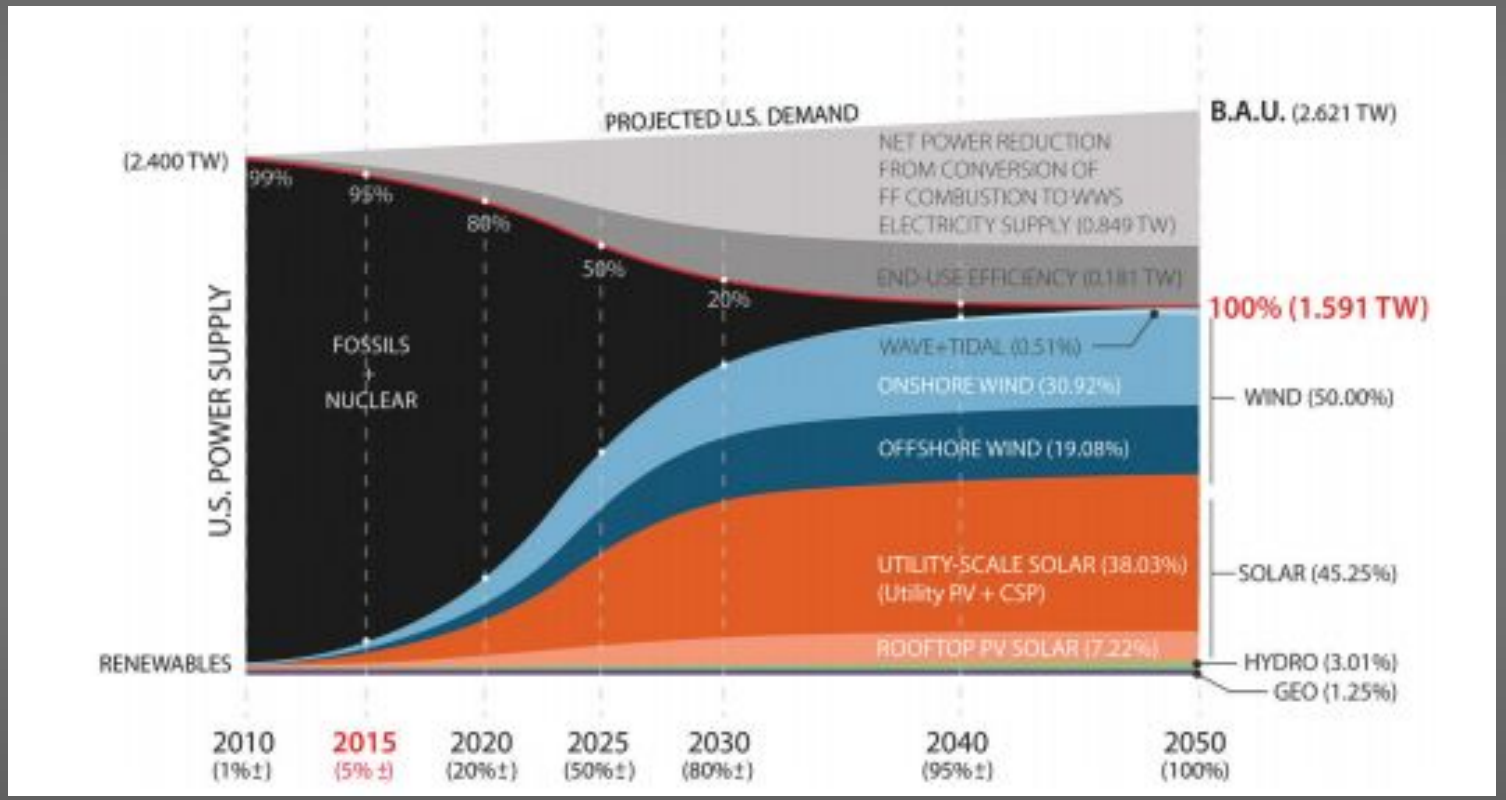
Access report here.

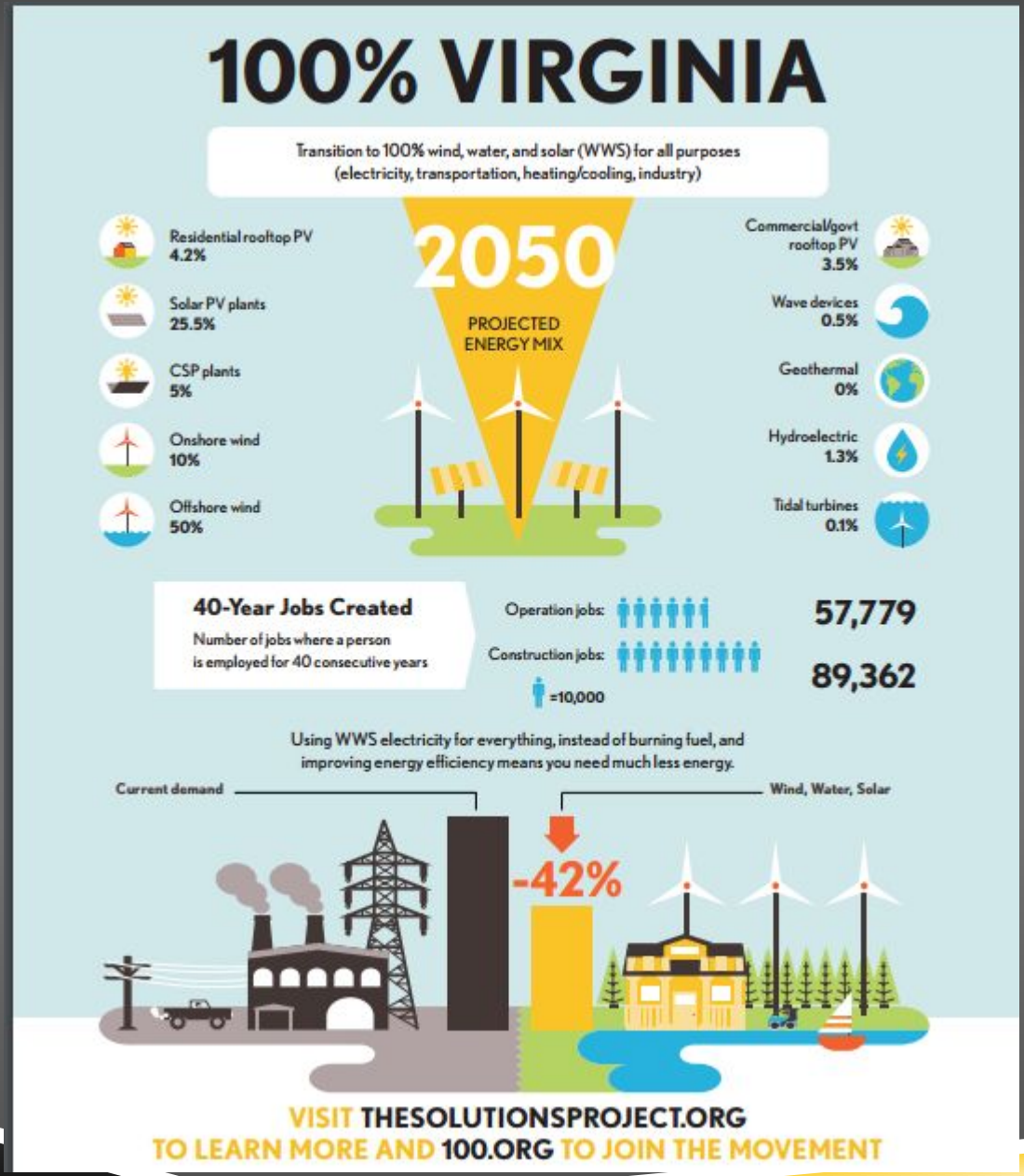
100% clean and renewable wind, water, and sunlight (WWS) all-sector energy roadmaps for the 50 United States
Mark Z. Jacobson et al

- In a new study, Mark Z. Jacobson, a professor of civil and environmental engineering at Stanford, and colleagues, including U.C. Berkeley researcher Mark Delucchi, presents roadmaps for converting the energy infrastructures of each of the 50 U.S. states to **100% wind, water, and sunlight (WWS) for all purposes (electricity, transportation, heating/cooling, and industry) by 2050.**
- The 50 individual state plans call for aggressive changes to both infrastructure and the ways we currently consume energy, but indicate that the conversion is technically and economically possible through the wide-scale implementation of **existing technologies**. The study's authors examined each state's current energy usage in four sectors: **residential, commercial, industrial and transportation**.
- For each sector, they then analyzed the current amount and source of the fuel consumed–coal, oil, gas, nuclear and renewables–and calculated what the fuel demands would be **if replaced with electricity**. (This includes all the cars on the road becoming electric, as well as homes and businesses fully converting to electric heating and cooling systems). They then calculated how **this new electric grid could be powered using only renewable energy resources available in each state**.
- "When we did this across all 50 states, we saw a 39 percent reduction in total end-use power demand by the year 2050," Jacobson said. "About 6 percentage points of that is gained through efficiency improvements to infrastructure, but the bulk is the result of replacing current sources and uses of combustion energy with electricity."

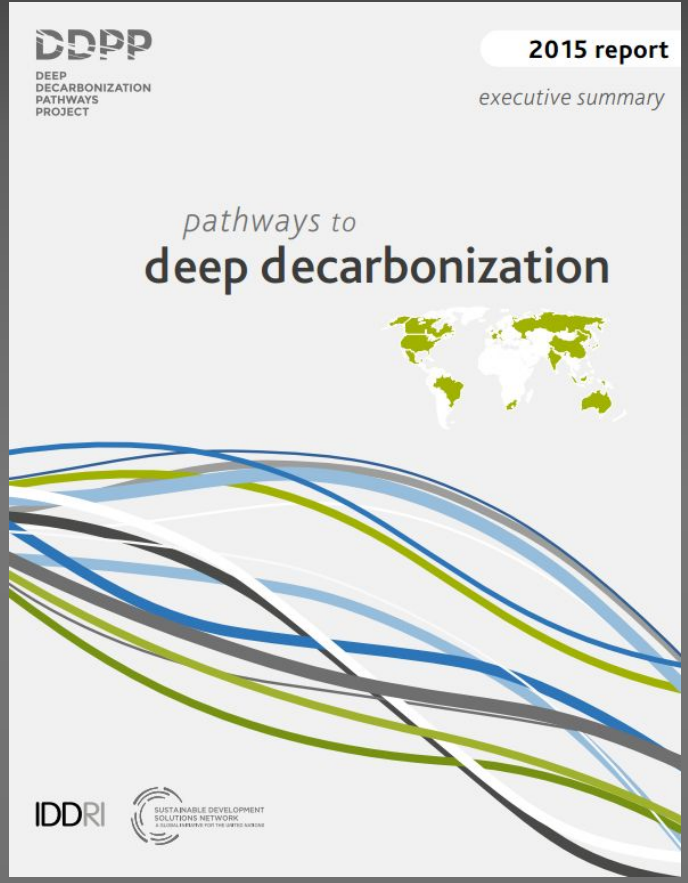
Graphic from Jacobson study showing time-dependent change in U.S. end-use power demand for all purposes (electricity, transportation, heating/cooling, and industry) and its supply by conventional fuels and WWS generators based on the state roadmaps.



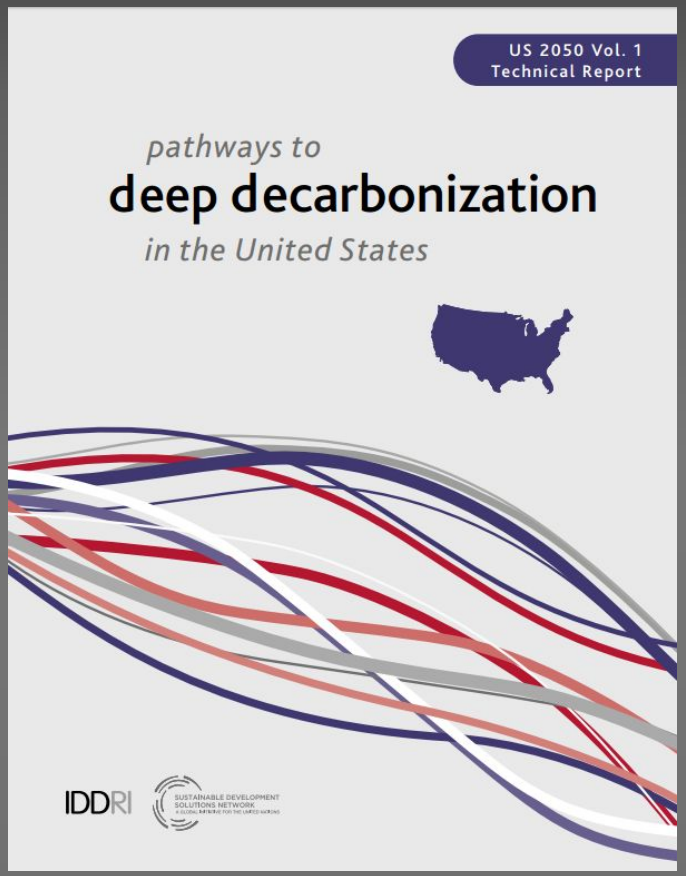
Source: Energy Environ. Sci., 2015, 8, 2093--2117 | 2113



Source: Other state infographics available at – http://thesolutionsproject.org/resource/50-state-visions-infographics/



Synthesis report available here



US report available here

#3

Deep Decarbonization Pathways Project (DDPP)

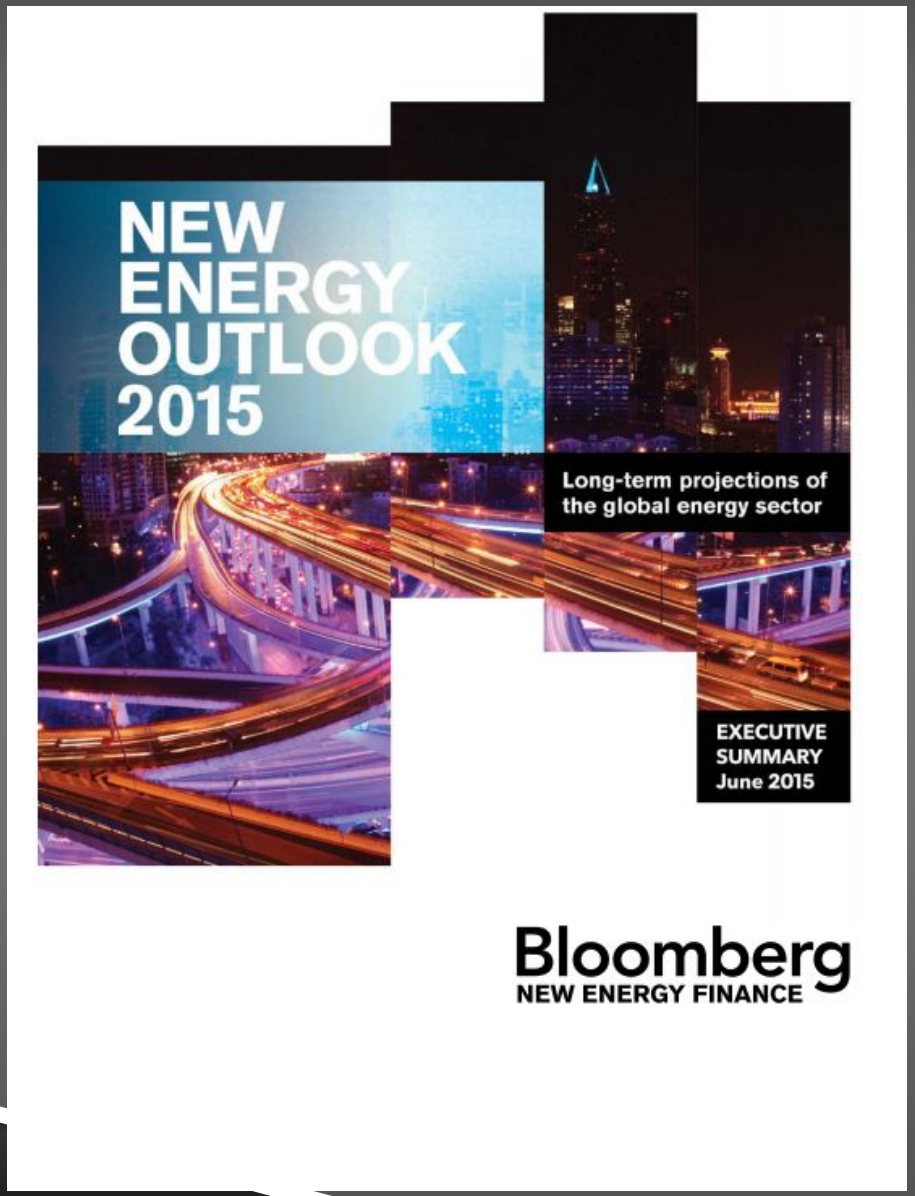
- Conceived by the Sustainable Development Solutions Network, a UN organization, along with the Institute for Sustainable Development and International Relations (IDDRI).
- Idea was to create national working groups, each of which was tasked to determine how individual nations might deeply decarbonize their respective economies -- **the goal being 80% non-fossil by the year 2050**.
- The working group for the US was led by energy consulting firm Energy & Environmental Economics (E3), the Lawrence Berkeley National Laboratory, and the Pacific Northwest National Laboratory.

DDPP Strategy

- The basic strategy for decarbonizing the economy involves:
  - decarbonizing the electric grid first,
  - then switching to fossil-free electricity for numerous other applications that currently burn fossil fuel, such as cars and space heat.
  - This will mean an increase in overall demand for electricity, even with efficiency improvements.

4 Possible Pathways Considered in US Report

- The report considered four possible pathways to a decarbonized future: a mixed-technology case, **a high-renewables case**, a high-nuclear case, and a high-CCS (carbon capture and storage) case. All four pathways will get us to 80% reduction in greenhouse emissions by 2050, but they way they get there, and the costs and investments required, vary widely.
- The bottom line is that in the **high-renewable pathway, we would need to build 2550 GW of new capacity**; in high-CCS, we would need 700 GW of new capacity; but in the high-nuclear, we would need only 400 GW of new capacity, in each case to fully decarbonize the grid and reach 80% total greenhouse reductions by 2050.



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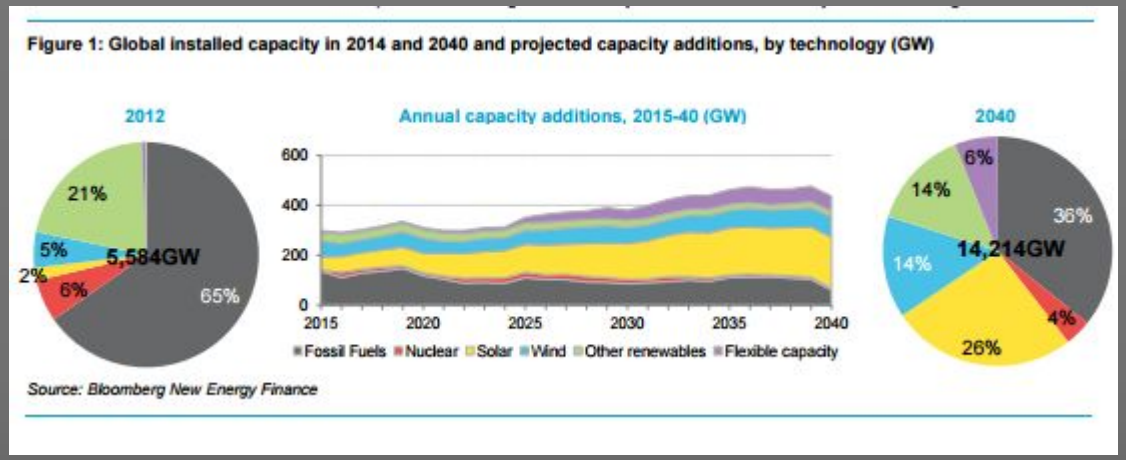
Click here for Executive Summary

Key Projections from Bloomberg Outlook

- By 2040, the world's power-generating capacity mix will have transformed: from today's system composed of **two-thirds fossil fuels to one with 56% from zero emission energy sources.** Renewables will command just under 60% of the 9,786 GW of new generating capacity installed over the next 25 years, and two thirds of the $12.2 trillion of investment



The analysis assumes that renewables globally will see no further policy support – be that feed-in tariffs or net energy metering – from 2018 onwards, except for offshore wind, which will see subsidies end from 2030. It assumes carbon prices continue to exist where they are already in place or where we have some confidence in their emergence. In particular, the forecast does not explicitly take into account the long-term impacts of the US Clean Power Plan as it has not yet been finalised by the Environmental Protection Agency.

#
5

Full report available
here

Source: Summaries and Full report available at http://www.greenpeace.org/international/en/publications/Campaign-reports/Climate-Reports/Energy-Revolution-2015/

Greenpeace International,
Global Wind Energy Council,
Solar Power Europe
Date: September 2015

energy (r)evolution – Key Messages

- **100% renewable energy for all is achievable by 2050.**
- Fossil fuels should be phased out in stages
  - The Energy [R]evolution proposes a phase-out of fossil fuels starting with **lignite** (the most carbon intensive) by 2035, followed by **coal** (2045), then **oil** and then finally **gas** (2050).
- The renewable energy sector is proving it can transform power generation.
  - Within the next 15 years, renewables' share of electricity could treble from 21% today to 64%, so nearly two thirds of global electricity would come from renewable energy
- Heating and transport are the big challenge
- Oil for heating will be replaced by solar collectors, geothermal and heat from renewable hydrogen
- Gas will be the last fossil fuel in use, but is replaced by hydrogen generated by renewable electricity by 2050
- Transport is the most challenging sector, and requires a technical revolution and more R&D – particularly in aviation and shipping.
  - But planes and ships could be powered using biofuels, hydrogen and synthetic fuels produced using electricity.
- The switch to 100% renewable energy will create jobs as are employed in oil and gas today
  - There is a just transition, not an overnight change. There will be 2 million people still working in the coal industry in 2030, so there is time to re-train

Journal of Power Sources 232 (2013) 402

Contents lists available at SciVerse ScienceDirect

Journal of Power Sources

journal homepage: www.elsevier.com/locate/jpowsour

Corrigendum

Corrigendum to "Cost-minimized combinations of wind power, solar power and electrochemical storage, powering the grid up to 99.9% of the time" [J. Power Sources 225 (2013) 60–74]

Cory Budischak [a,b,*], DeAnna Sewell [c], Heather Thomson [c], Leon Mach [d], Dana E. Veron [c], Willett Kempton [a,c,e]

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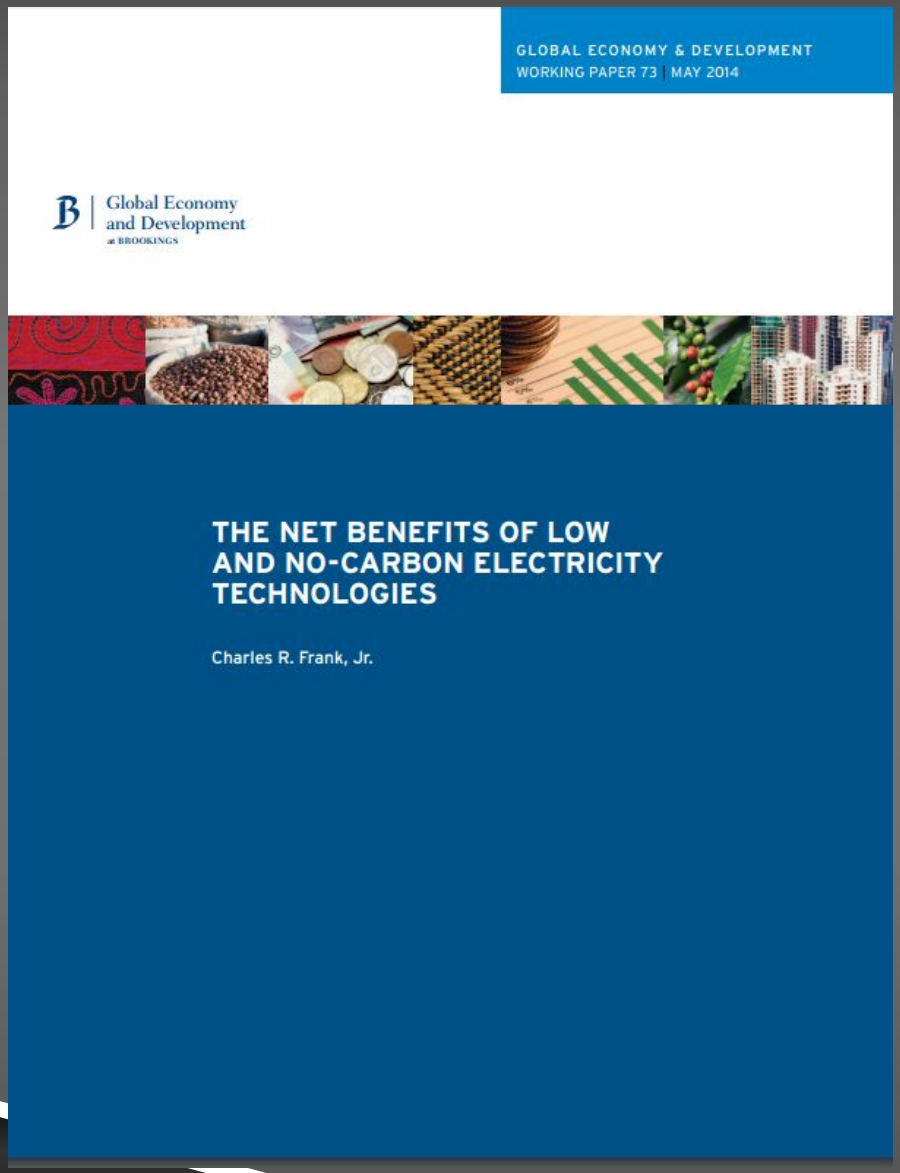
#6

Access report here

Corky Budischak et al, U of Delaware, 2013

- The study models many combinations of renewable electricity sources (inland wind, offshore wind, and photovoltaics) with electrochemical storage (batteries and fuel cells), incorporated into a large grid system.
- Models a number of scenarios using the **PJM Power Grid** to answer these questions on how reliable, and how costly, would be an electric system reliant on renewable energy. Concludes that we can seek an **intermediate 30% target now, and seek a 90% target later,** and with the right mix, at each step the target will move toward lower costs than today's system.
- **At 2030 technology costs and with excess electricity displacing natural gas, we find that the electric system can be powered 90%–99.9% of hours entirely on renewable electricity, at costs comparable to today's—but only if we optimize the mix of generation and storage technologies.**
- Created a new model that his team created called the Regional Renewable Electricity Economic Optimization Model (RREEOM). The model was required to satisfy electrical load entirely from renewable generation and storage, and find the least cost mix that meets that constraint.]



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Click here for report.

Brookings Institute Study (Charles R Frank, Jr. et al, 2014)

- This paper examines five different low and no-carbon electricity technologies -- nuclear, hydro, natural gas combined cycle, wind, and solar -- and presents the net benefits of each under a range of assumptions.
- The study concludes that the net benefits of new nuclear, hydro, and natural gas combined cycle plants far outweigh the net benefits of new wind or solar plants.
- The cost advantage of nuclear vs. renewables is more than three-to-one. That means that for every dollar we spend on renewables, we could be mitigating about **three or four times more carbon** by spending that dollar on nuclear instead.
- If key assumptions to favor wind and solar. For example, if we increase the price of carbon to $100 per ton, reduce the cost of capital to 5 percent, and reduce the capital cost and increase the capacity factor of solar and wind by one-third, we get the results (shown in Table 9C of report). A new nuclear plant becomes the most favored alternative. Wind and solar continue to rank fourth and fifth among all the alternatives, mainly because of the very high capacity cost and the very low capacity factors.

Leaders in Energy
Research, Communications, Policies & Analysis

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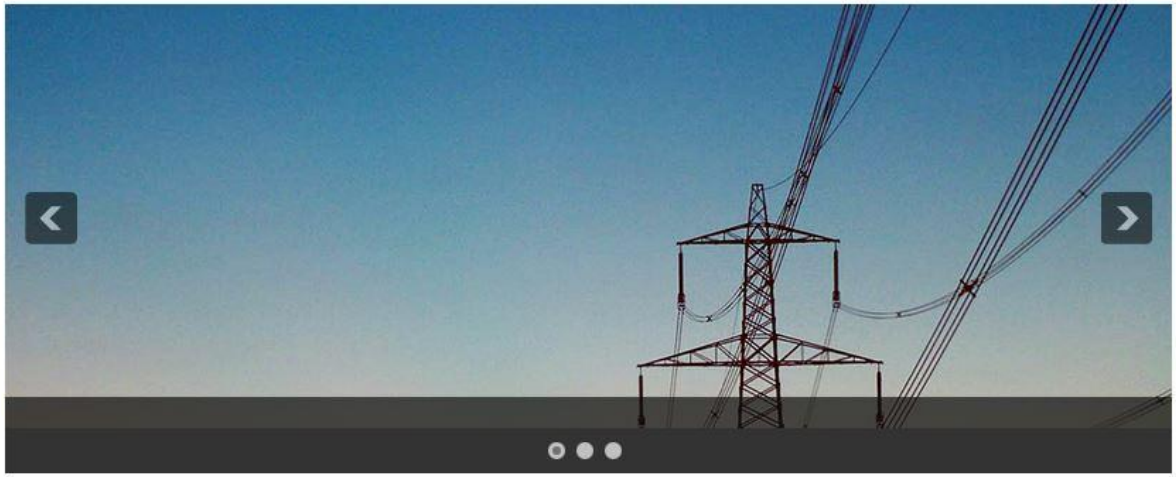

ARE YOU INTERESTED IN ENERGY, ENVIRONMENTAL, AND SUSTAINABILITY TOPICS?

Would you like to connect with other like-minded professionals?

In this select group, energy, environmental and sustainability leaders and other professionals come together to network and share best practices and success stories pertaining to research, communications, policies, and analysis.

The mission of Leaders in Energy, Research, Communications, Policies, and Analysis (LERCPA)

The purpose of this group is to engage professionals who delight in thinking about, discussing, and collaborating on energy, environmental, and sustainability topics to convene on-line and in person through networking events.

We seek to attract like-minded individuals who are passionate about dialoguing, collaborating, and seeking solutions to energy, environmental and sustainability challenges.

Through its LinkedIn site and monthly professional networking events in the Washington, DC area, the group collects and exchanges ideas and information to build a specialized network of professionals who are interested in making a difference through transformative leadership and actions.

Connect To Our Leadership Community

Upcoming Events

December 5, 2014

Leaders in Energy "Four Generations: Leadership in Energy and Sustainability"

Holiday Happy Hour

Volunteer
Ways to Get Involved

FOLLOW US:

Thank You for Your Attention

- Janine Finnell
- Email: CleanEnergyAmbassador@lercpa.org
- 703-203-0766
- @JanineFinnell and @LeadersinEnergy

Join Us!

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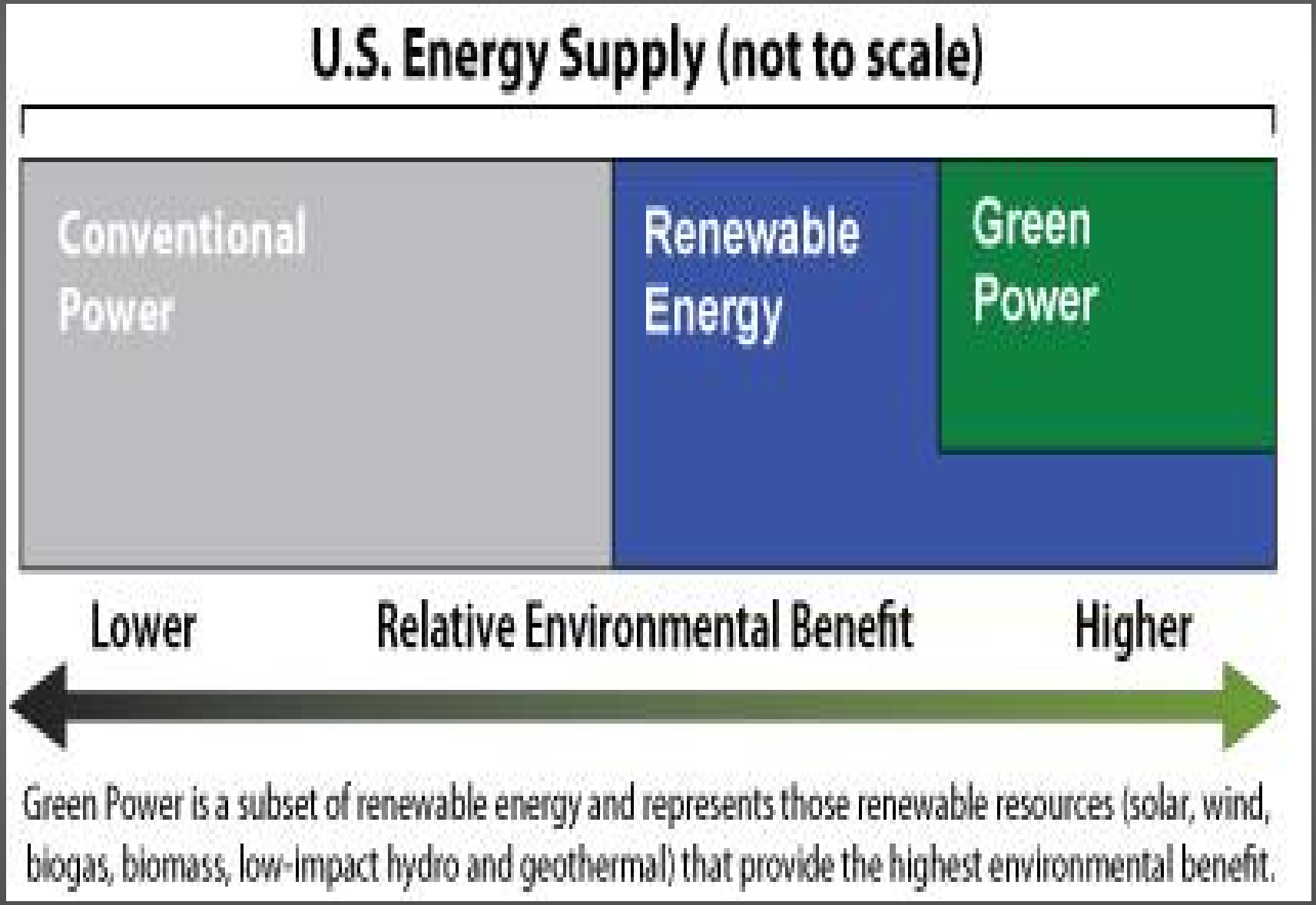
LEADERS in ENERGY
RESEARCH, COMMUNICATIONS, POLICIES & ANALYSIS (LERCPA)

Support for 100% Renewable Energy by 2030

Presented by:

Silvia Leahu-Aluas
Director of Sustainable Manufacturing, Leaders in Energy



https://www3.epa.gov/greenpower/gpmarket/

EPA defines **green power** as electricity produced from solar, wind, geothermal, biogas, eligible biomass, and low-impact small hydroelectric sources.

Renewable energy includes resources that rely on fuel sources that restore themselves over short periods of time and do not diminish. Such fuel sources include the sun, wind, moving water, organic plant and waste material (eligible biomass), and the earth's heat (geothermal). Although the impacts are small, some renewable energy technologies have an impact on the environment. For example, large hydroelectric resources can have environmental trade-offs associated with issues such as fisheries and land use.

Conventional power includes the combustion of fossil fuels (coal, natural gas, and oil) and the nuclear fission of uranium. Fossil fuels have environmental costs from mining, drilling, or extraction, and emit greenhouse gases and air pollution during combustion. Although nuclear power generation emits no greenhouse gases during power generation, it does require mining, extraction, and long-term radioactive waste storage.

https://www3.epa.gov/greenpower/gpmarket/

My thoughts on energy:

- We need a fixed, stretch target year to achieve a complete transition of the global architecture from conventional to renewable energy
- This is one instance when "race to the bottom" is very appealing, a race to the bottom or the end of the conventional energy age
- We keep sliding the timeline on energy transition, while bringing closer the point of no return in anthropogenic climate change as we keep surpassing the wrong kind of records in Anthropocene
- There are no significant technological barriers for this transition
- The barriers are: politics and policies, short-termism, scientific ignorance or denial, unaccounted costs, wrong economic drivers, ethical and social values
- The transition will happen through civic and local action rather than institutional and centralized

My thoughts on energy:

- We are still boiling water to generate steam to rotate turbine blades to turn a shaft that will convert its mechanical energy into electricity at an overall loss of ~60 - 70 %
- It is an old, inefficient and inelegant technical solution, so why do we hang on to it?

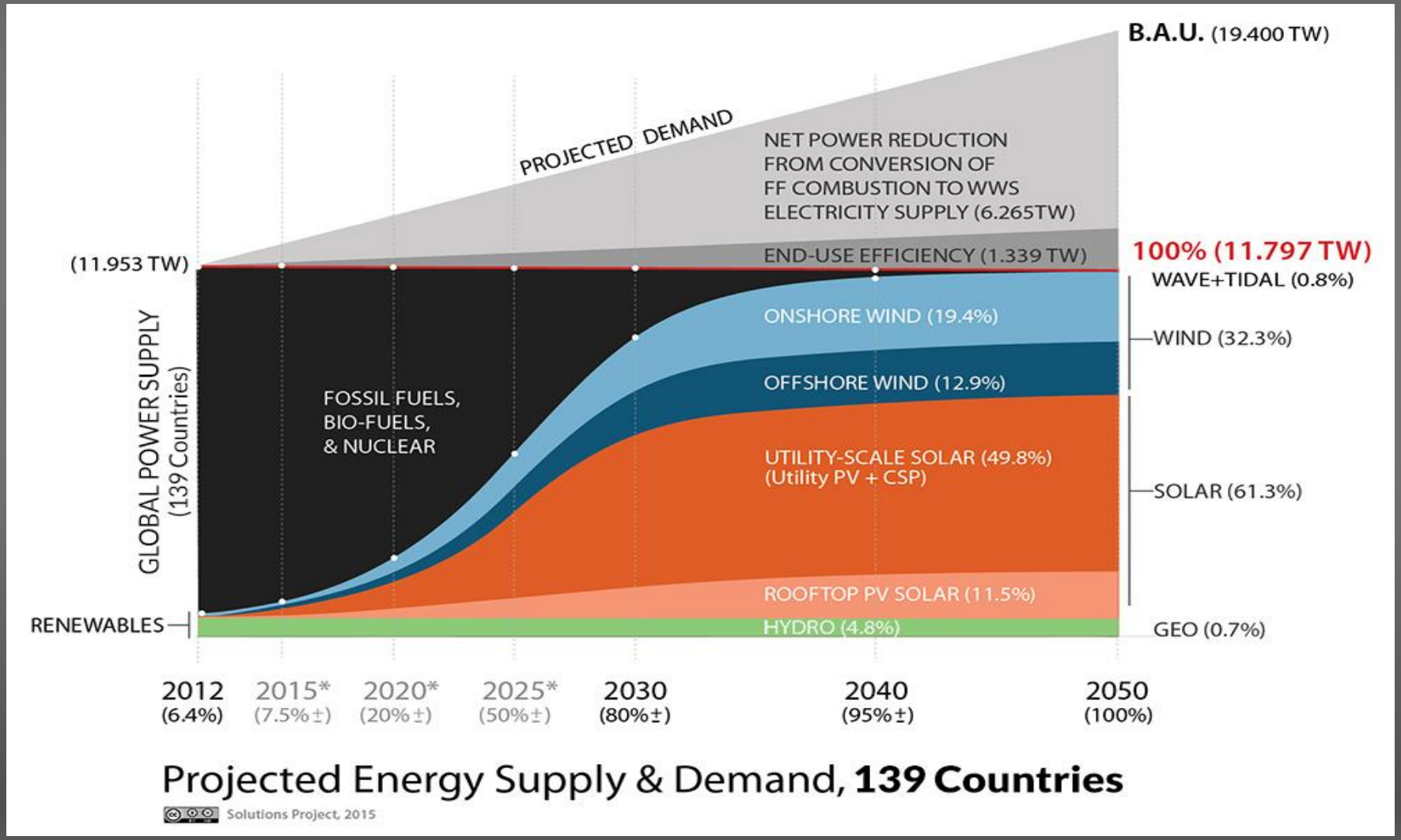
Images from: Union of Concerned Scientists Clean Energy Program

"CO2 concentrations haven't been this high in millions of years. Even more alarming is the rate of increase in the last five decades and the fact that CO2 stays in the atmosphere for hundreds or thousands of years. This milestone is a wake up call that our actions in response to climate change need to match the persistent rise in CO2. Climate change is a threat to life on Earth and we can no longer afford to be spectators."

Dr. Erika Podest, Carbon and water cycle research scientist (one of the NASA scientists reacting to 400 ppm CO_2 milestone measured at Mauna Loa Observatory in Hawaii in 2013)

Given the trend we are on, from my point of view, the target should be 2030

100% Clean and Renewable - Wind, Water, Sunlight

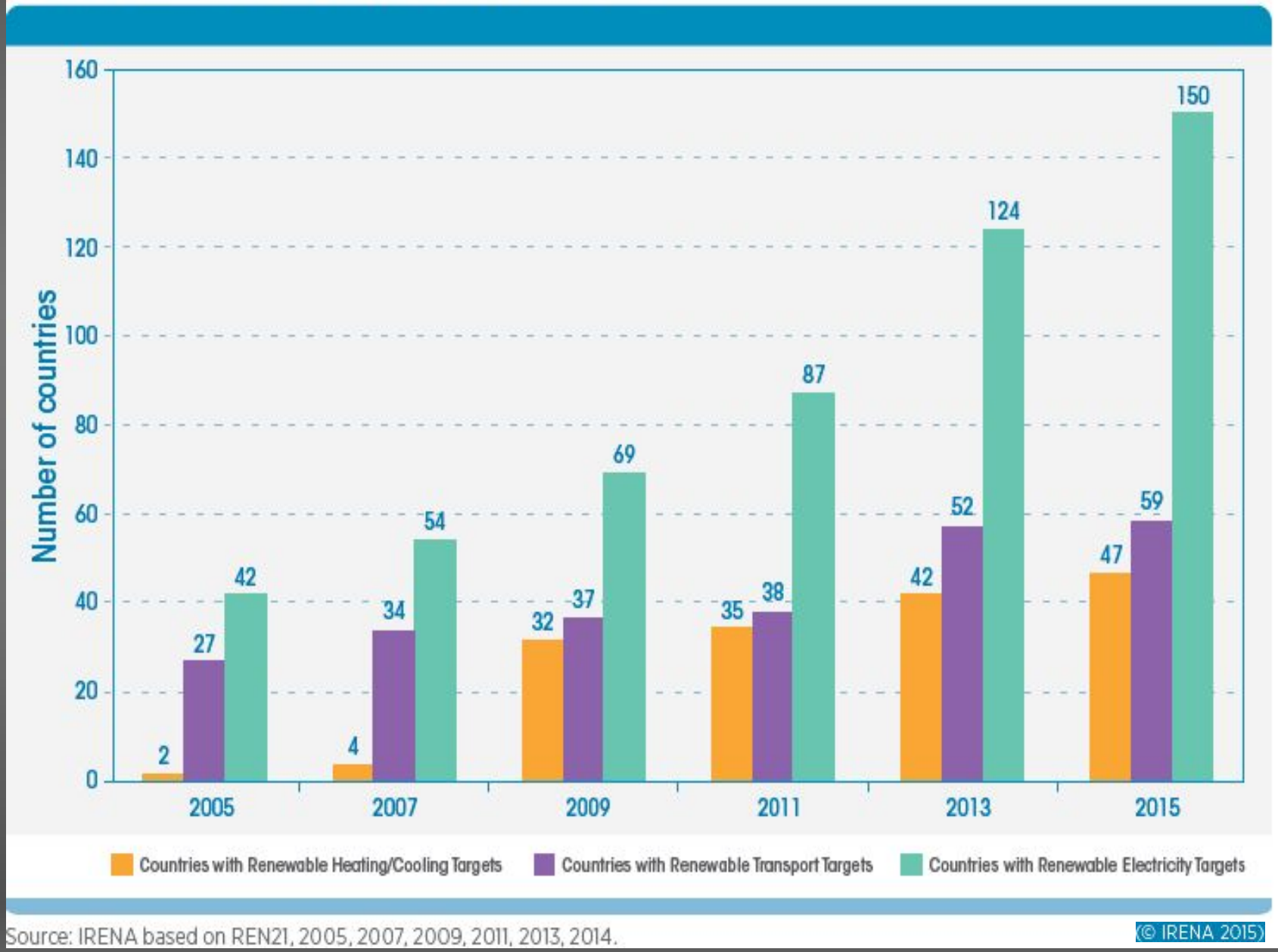


Stanford University Atmosphere/Energy Program

Original target 2030 for 100% Renewable Energy based on total demand of 11.5 TW

Scientific American November 2009 Article, Stanford University Authors Jacobson and Delucchi

Figure 3: Global Renewable Energy Targets by Sector, 2015

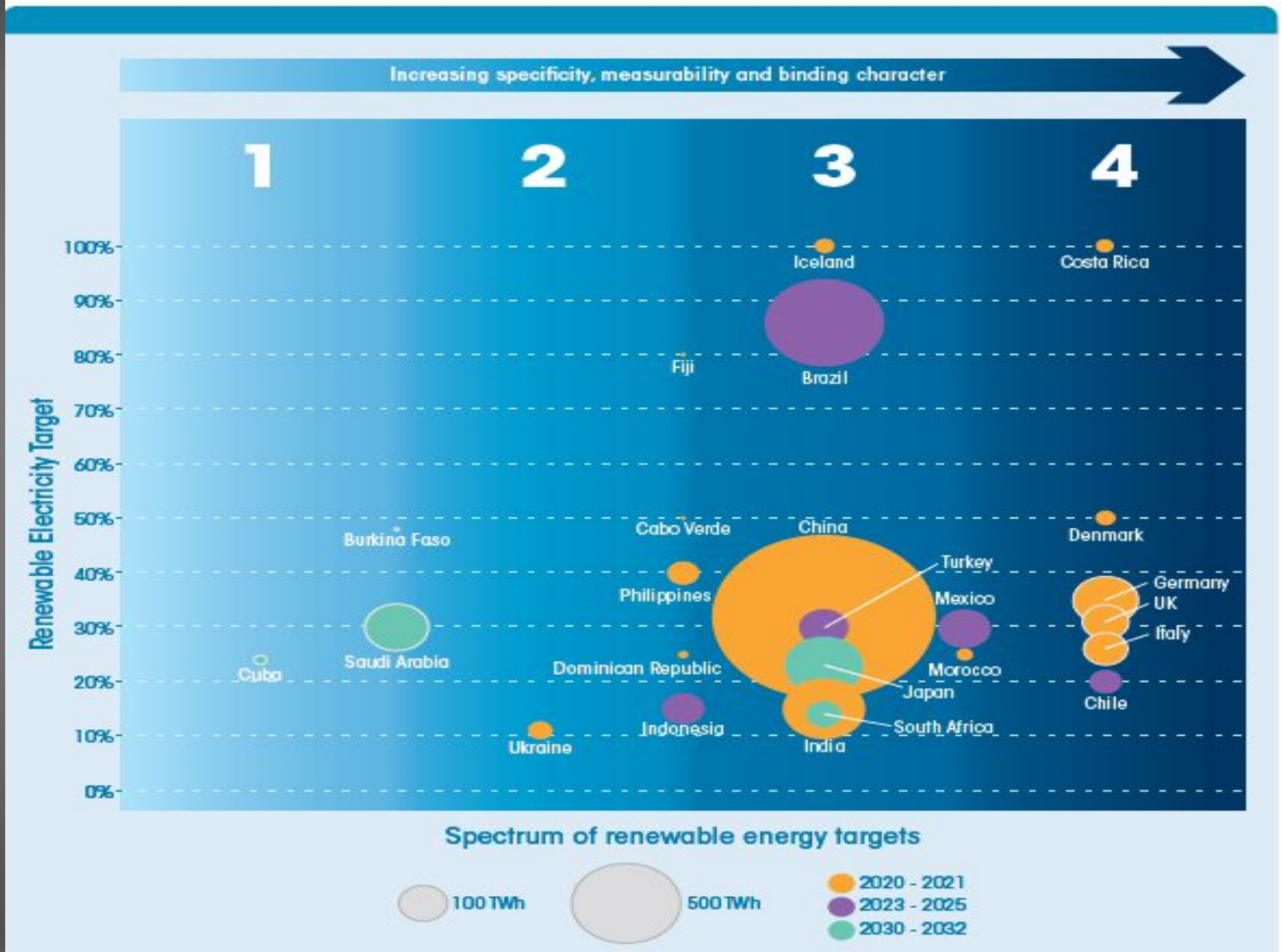


Source: IRENA based on REN21, 2005, 2007, 2009, 2011, 2013, 2014.

(© IRENA 2015)

IRENA (International Renewable Energy Agency)

Figure 5: Renewable Electricity Generation Targets by Target Date for Selected Countries Along Spectrum



IRENA (International Renewable Energy Agency)

African Renewable Energy Initiative (AREI) was launched as the continent's a major contribution to Conference of Parties (COP21) that concluded successfully with a global agreement

The goal is to produce 300 gigawatts (GW) of electricity by 2030

The project will help African countries leapfrog towards renewable energy systems

http://www.afdb.org/en/news-and-events

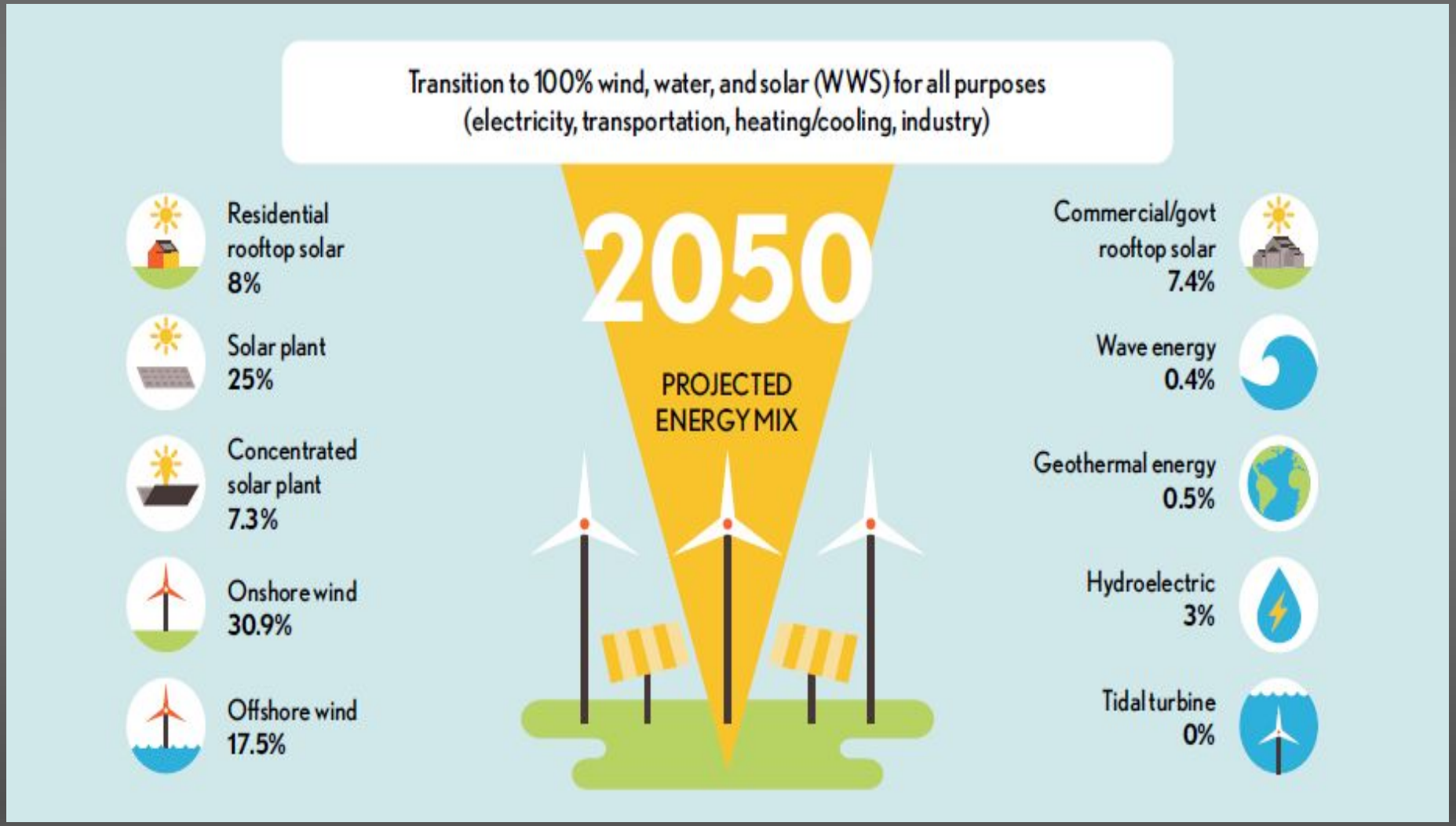
An initiative of EUFORES (The European Forum for Renewable Energy Resources), EREC (European Renewable Energy Council) and Greenpeace with the objective of achieving 100% renewable energy sources in 2050 in the European Union

Another EUFORES project: 20-20 Keep On Track (20% Renewable Energy Sources by 2020)

"Out of the 27 Member States analysed in this publication, ten are expected to meet their 2020 targets (Austria, Bulgaria,Croatia, Cyprus, Estonia, Ireland, Italy, Lithuania, Romania, and Sweden). There are doubts concerning three Member States (Denmark, Finland, Slovakia). It is expected that Belgium, the Czech Republic, France, Germany, Greece, Hungary, Latvia, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovenia, Spain and the UK will not meet their 2020 targets." (EU Tracking Roadmap 2015)

EUFORES

100% United States



The Solutions Project - Data from Stanford University

Morocco - Ourzazate Solar Power Plant (500 MW)

Earth Observatory NASA

A few examples of countries playing to win in the race to 2030

Iceland is at 100% today (hydro and geothermal)

Sri Lanka has just announced a 100% renewable energy target for 2030

Scotland is on track to be 100% renewable energy by 2030

Costa Rica has a 100% renewable electricity target of 2021

Fiji has a 100% renewable electricity target of 2030

Georgetown, Texas (population ~ 55,000)

- Municipal utility will provide 100% electricity from renewable sources by 2017
- One of the largest municipal utilities in the United States to supply its customers with a combination of sun and wind power

Burlington, Vermont (population ~ 43,000)

- 100% renewable public power achieved (direct supply and contracting)

San Francisco, California (population ~840,000)

- 100% renewable electricity by 2020

Go100percent.org

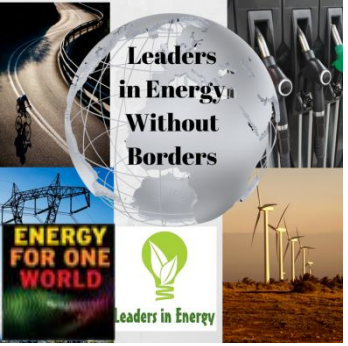
Malmö, Sweden

Expects to be climate neutral by 2020

100% Renewable Energy for Municipal Operations by 2030

Western Harbor district with 100% local renewable energy

http://malmo.se/English/Sustainable-City-Development/Bo01---Western-Harbour/Energy.html



2016 Year of Organization for Change on
Energy, Climate Change Agreement and the Sustainable
Development post-2015 Agenda

Leaders of Energy without Borders:
Our roadmap to a 100% renewables energy architecture

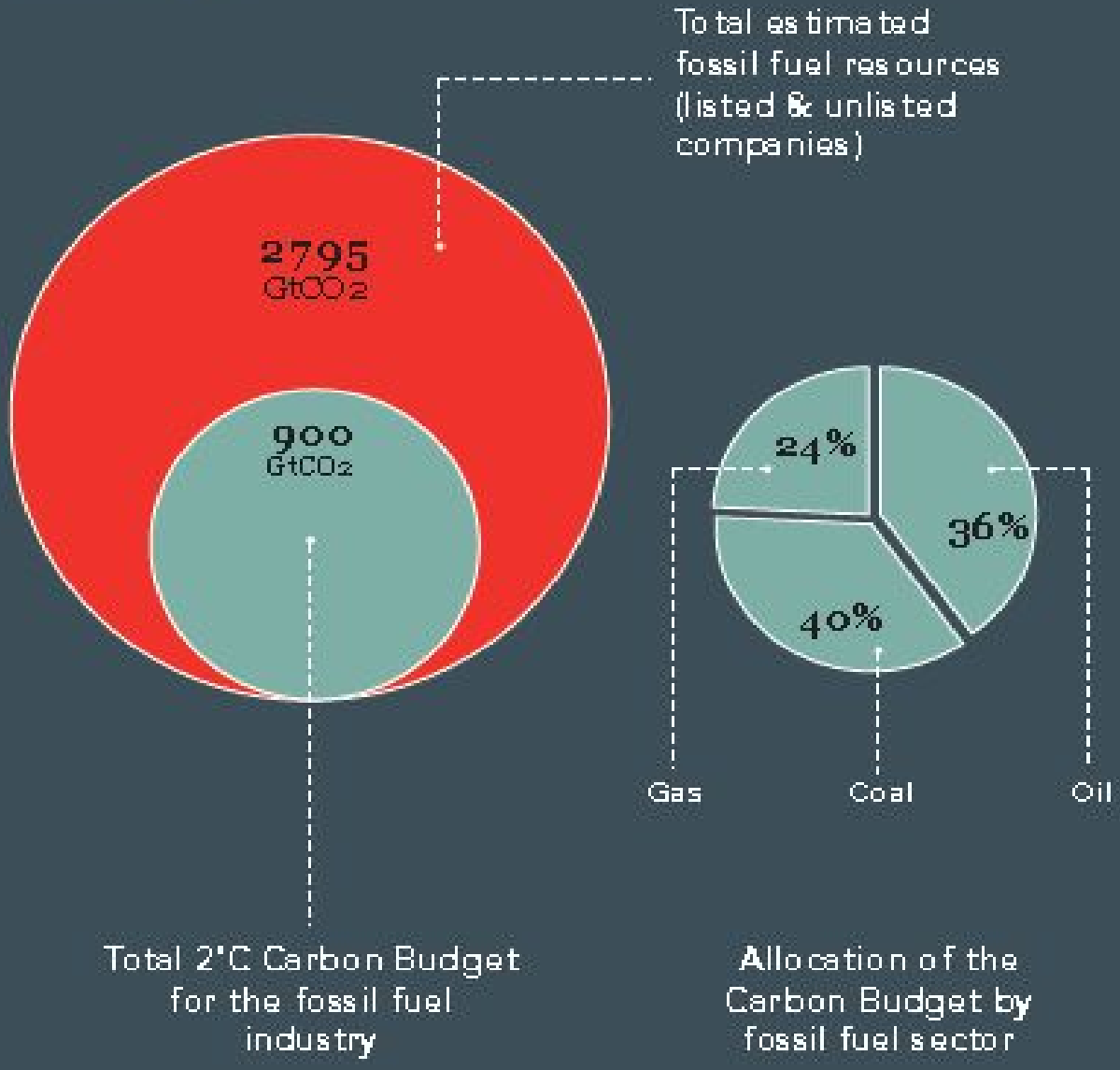
Adriaan Kamp - Founder

29 th February 2015: Open Google Hangout

2016 Year of Organization for Change on Energy, Climate Change Agreement and the Sustainable Development post-2015 Agenda

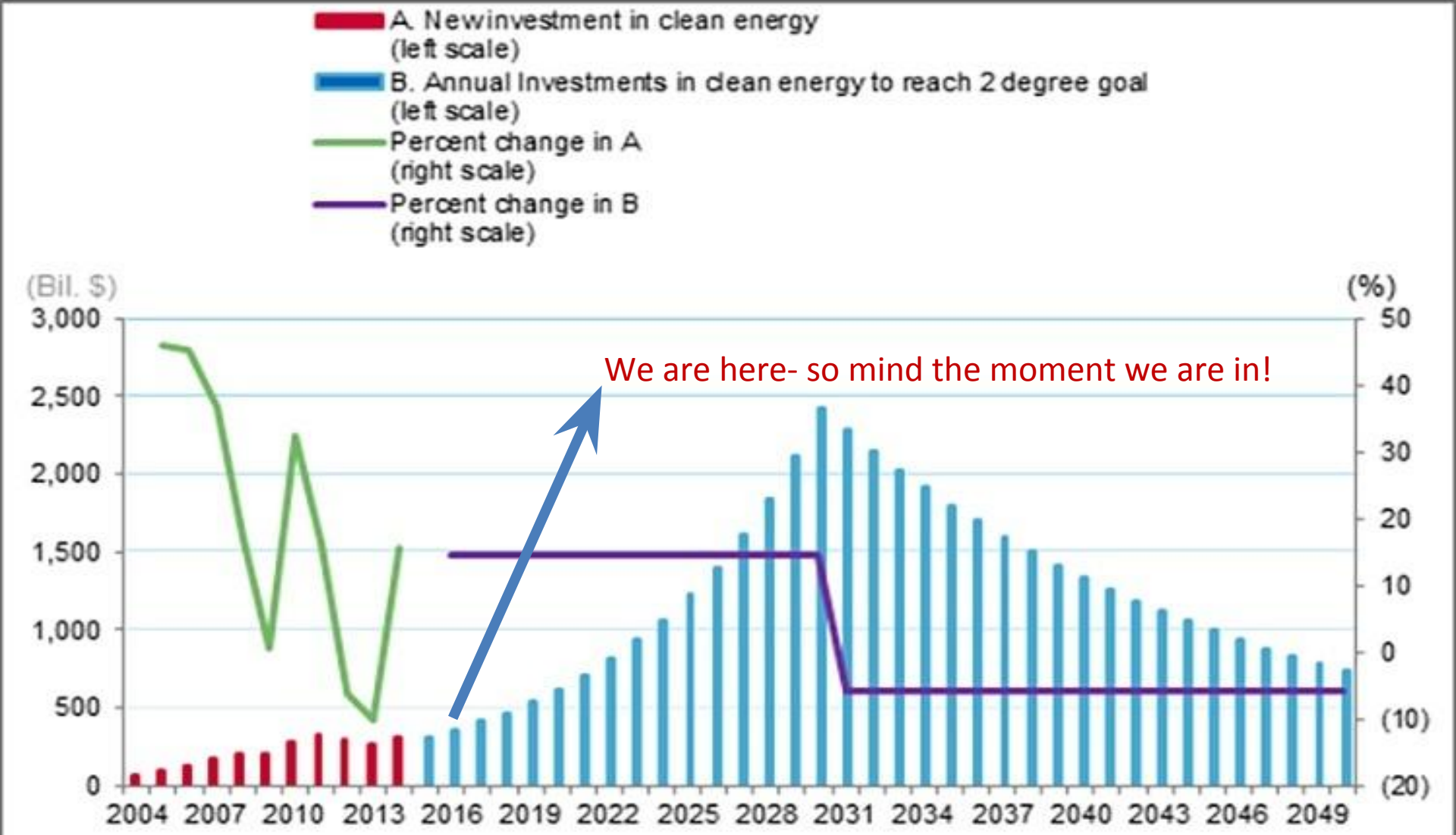
What is the Carbon Bubble?

Carbon Tracker's reference Carbon Budget to 2050 with 80% likelihood of staying below the 2°C threshold:



World Economic Forum – 2030 Scenario's

New Investment In Clean Energy Needed To Meet 2 Degree Goal

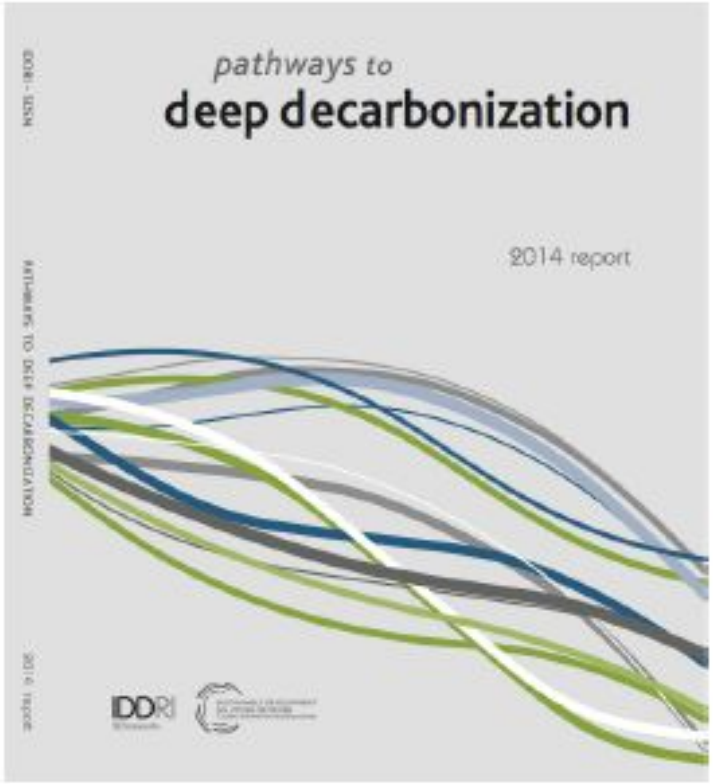


Sources: RepuTex, Bloomberg New Energy Finance, International Energy Agency.

© Standard & Poor's 2016.

2014 report: key results and messages

Clickable Access to Report



Report available at:
http://unsdsn.org/what-we-do/deep-decarbonization-pathways/

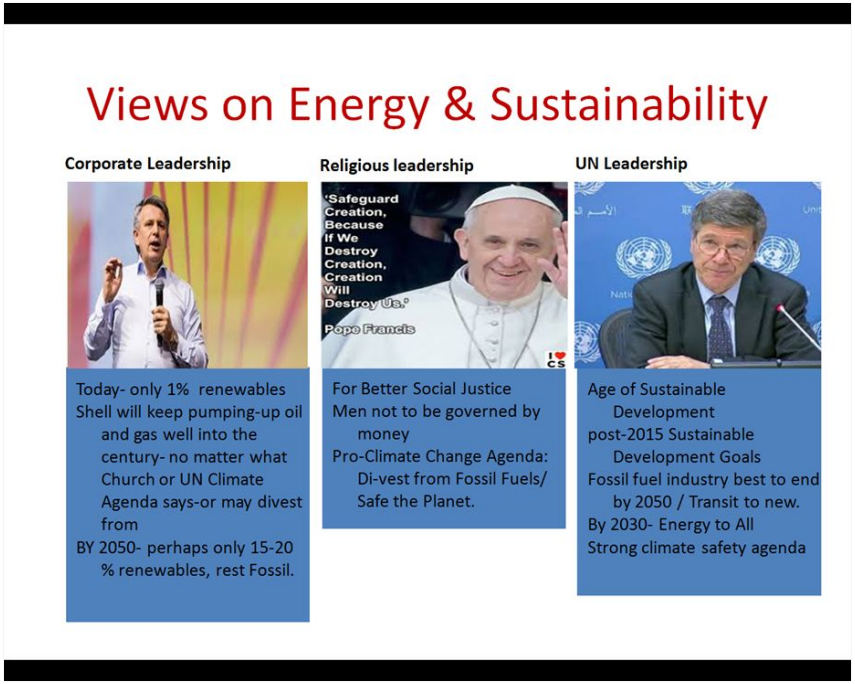
Enough Studies

- **UN SDSN- deep-decarbonization project**: http://deepdecarbonization.org/
- **Prof. Marc Jacobsen of Stanford** (100 % renewables): http://thesolutionsproject.org/
- **Bloomberg Energy Outlook**: http://www.bloomberg.com/company/new-energy-outlook/
- **GreenPeace 100% renewable**: http://www.greenpeace.org/international/en/campaigns/climate-change/energyrevolution/

Enough Energy Outlooks

Sixth IEA-IEF-OPEC Symposium on Energy Outlooks

16 February 2016 Riyadh, Saudi Arabia



……."Unfortunately, this report also shows that the current pace of action is falling short of the aim of limiting climate change to a global temperature rise of 2°C (in ETP modelling, the 2° Scenario or 2DS). Indeed, despite positive signs in many areas, for the first time since the IEA started monitoring clean energy progress, not one of the technology fields tracked is meeting its objectives. As a result, our ability to deliver a future in which temperatures rise modestly is at risk of being jeopardised, and the future that we are heading towards will be far more difficult unless we can take action now to radically change the global energy system."

Energy Architecture

From WEF/ Accenture: The energy architecture is an integrated physical system of energy sources, carriers and demand sectors shaped by government, industry and civil society.

The energy architecture on location is a reflection of the socio-political, economic, ecological and business philosophies, leadership and interests exercised on location.

The energy architecture in a country, region or global community is (ideally) to serve (the rise of, establishment of) thriving sustainable societies- making energy available, affordable and sustainable to all: balancing economic interests with that of society and nature. Here and there. Now and in the future.

Energy Architecture (2)

Governance & Geo-politics	Corporate Leadership	Society and Corporate Social Responsibility
Market Constellation, including Energy Trade and Commerce	**ENERGY ARCHITECTURE**	Sustainability & Sustainable Development
Legal, Policies and Framework	Science & Technology	Economy, Finance & Responsible Investments

Troubleshoot problems
Open Network and Sharing Center

Constructing An Integrative Framework for Steering Transition

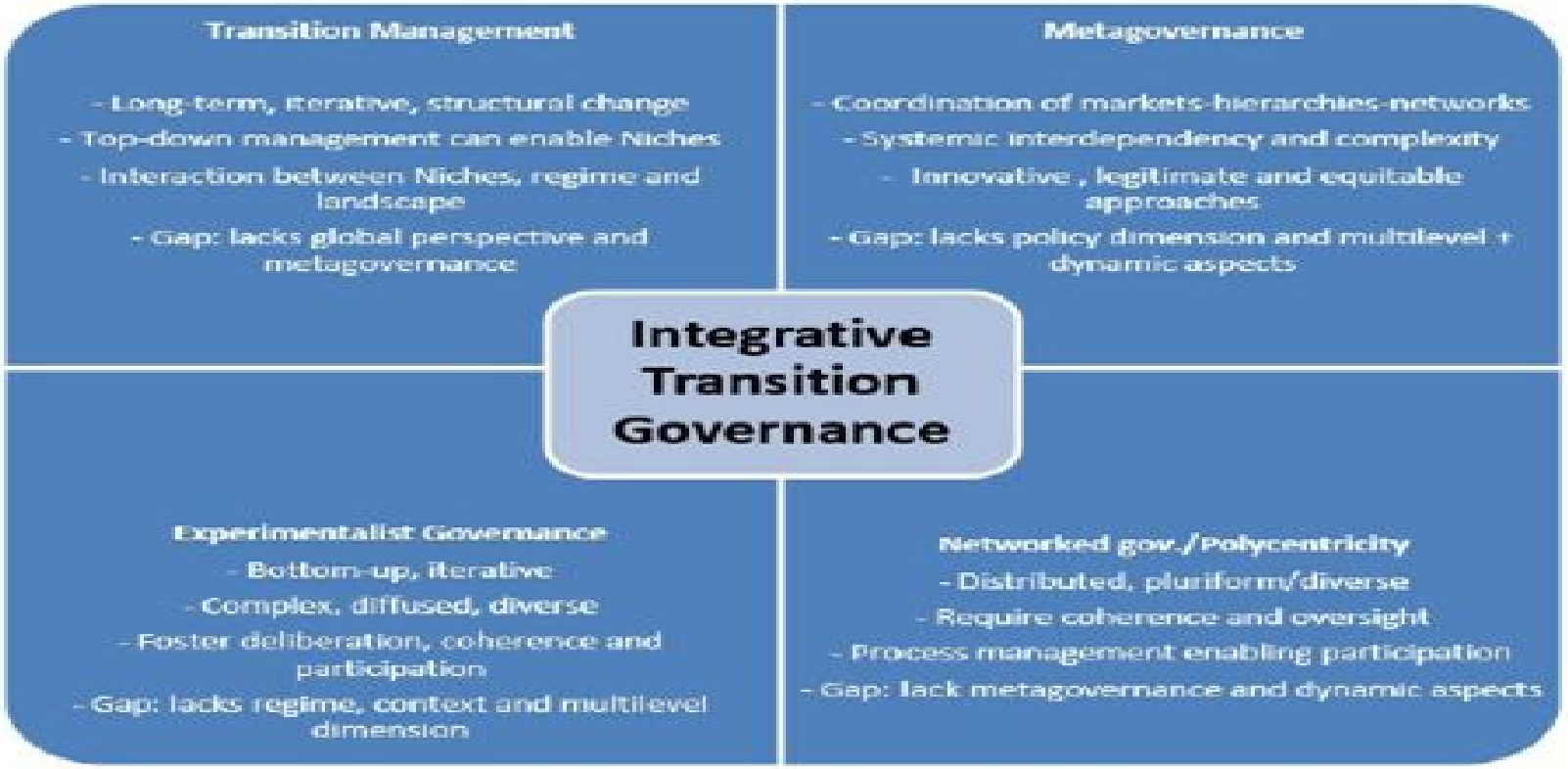


Figure 17 Key properties of the main theories that form the basis for the Integrative Sustainability Governance framework

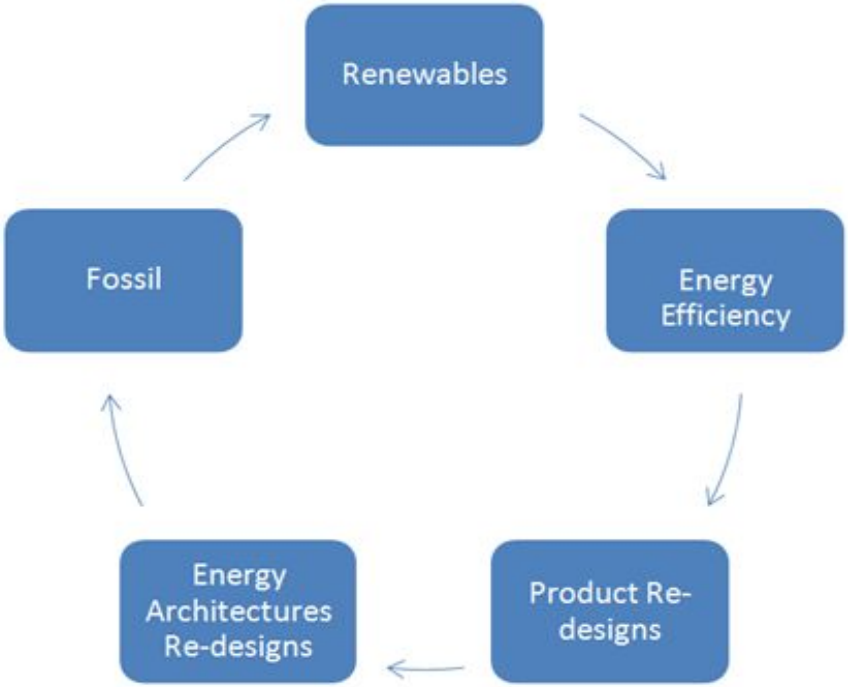
(Compiled by the author)


IHS ENERGY
CERAWEEK


SHELL NO!


Ben van Beurden

Re-inventing Strategies/Relationships:
"X-Factor of Integration"



Levels of Maturity of Change (1) Integration- Transition- Transformation

- Level 1
  - **Change and No Change. Resistance to Change. Policy, Administrative and Derivative Change (CO2 tax, ETS, Accounting). Coal vs. Gas. Continued backroom lobbying**
- Level 2
  - **Full Integration of Renewables (cleantech, energy conservations, smartness, etc.) in the Energy Architecture - but not with a system change. Retained regulations, ownership , revenue, tax and capital control structures**
- Level 3
  - **Energy Autonomy: Transition to a New Energy Architecture and Newly shared socio-economic and corporate business models- also in international trade.**
- Level 4
  - **Transformation of Economies and Societies. Eco-modernity and New human consciousness**

Levels of Maturity of Change (2)
Integration- Transition- Transformation

Electricity Markets (Homes and Cities)

NOW

- **E.g. New 100 Re % Energy Architectures: combining Sun, Wind. Geo-thermal (/ Gas?), storage and grid- regional, national and local (micro): Central and Distributed.**

Transportation

coming 5-15 years

- **E.g. Plan Obama: changing the face of personal mobility, and mass transit in cities- and between cities. Greening shipping and trucking. Cleaner and even more fuel efficient airplanes.**

Industry

Just starting

- **E.g. Circle Economy, Green Chemistry . 3D printing. Light materials/ material s for construction and manufacturing, new material science, eco-friendly etc..**

Level 4

Yet to come

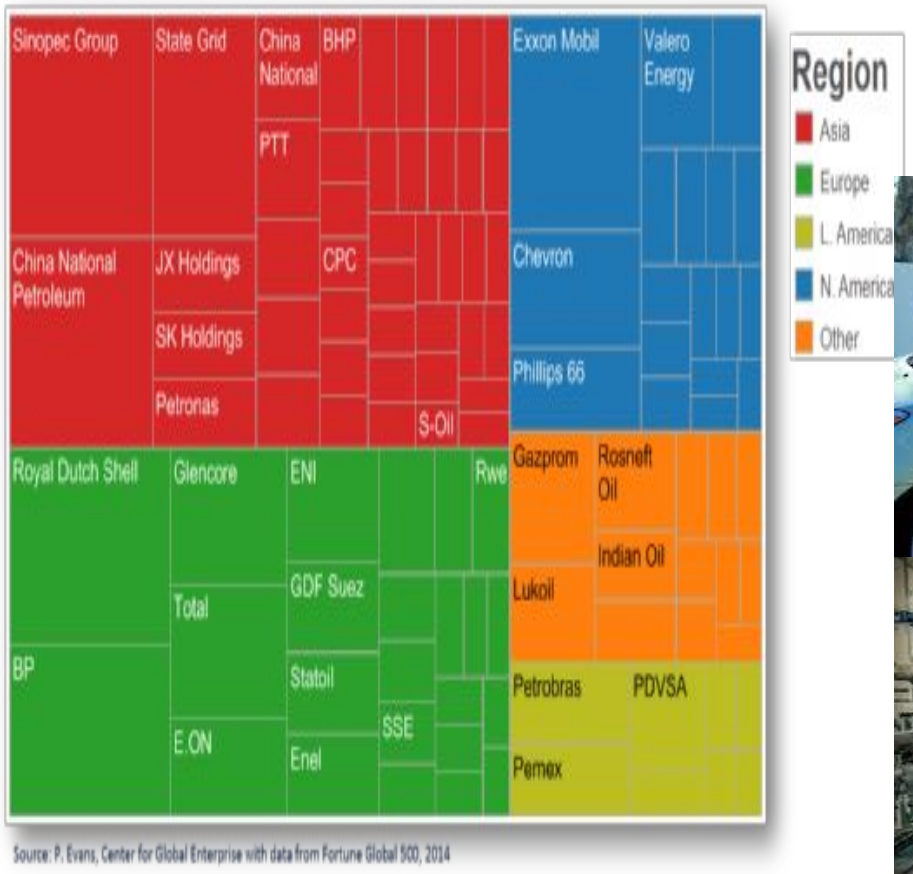
- **E.g. Transformation of Economies and Societies. Eco-modernity and New human consciousness**

*"**Every Energy Company** and **Every Energy Architecture** in this world **can be improved upon** in order to raise the **availability, affordability** and **sustainability** of **energy to all**".- Adriaan Kamp, 2015*


UN
Regional Blocks
Countries
Cities
Communities
Companies and Institutes
Co-alitions of the Willing

Old vs New

Clickable Presentations

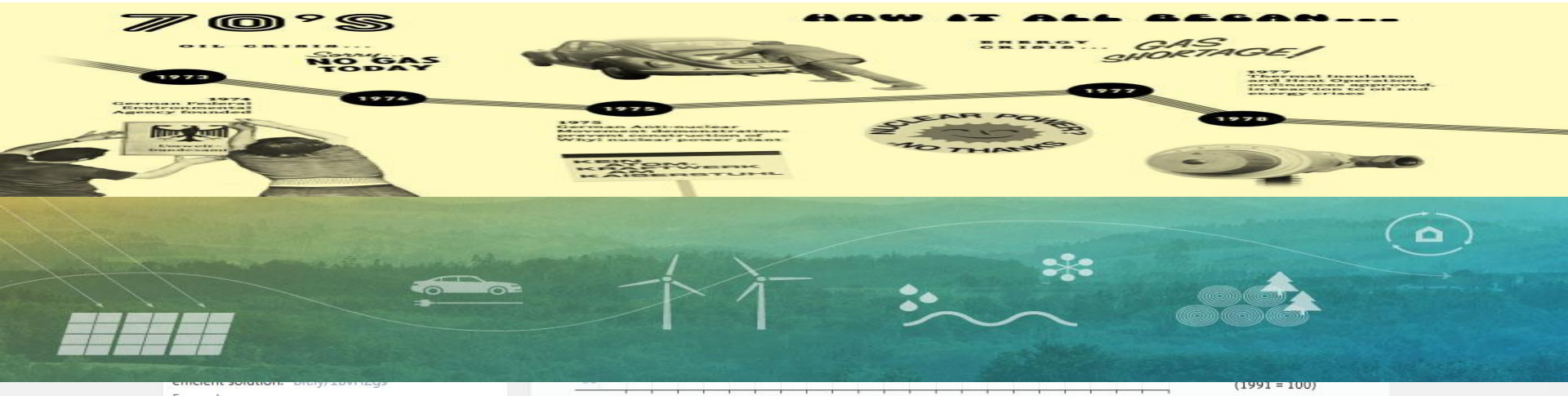


Vs 250 Bn USD investment

Dialogue and Conversation
Roles and Opportunities

- Scandinavia
- NW Europe/ Germany
- US Markets/ America's (e./g. Mexico, Argentine)
- Middle-East
- India/ SE Asia
- Africa

Germany: An example how it works- *in real*



Expand

Energiewende Germany @EnergiewendeGER 1h

Vattenfall to set up new wind business unit as part of re-jig bit.ly/1yl4PXb (PEI Renewables)

Expand

Energiewende Germany @EnergiewendeGER 2h

Silver lining to cloud over PV bit.ly/1BuUrgk (Energiewende Blog)

Expand

Energiewende Germany @EnergiewendeGER 2h

SolarWorld partners with DZ-4 for solar-plus-storage leasing in Germany bit.ly/1BuUkBB (PV-

Tweet to @EnergiewendeGER

1991 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12

(1991 = 100)

There are reasons to switch to renewable energy and to increase energy conservation, and there are reasons to do so now.

- A – Fighting climate change +
- B – Reducing energy imports +
- C – Stimulating technology innovation and the green economy +
- D – Reducing and eliminating the risks of nuclear power +
- E – Energy security +
- F – Strengthening local economies and providing social justice +

2 Technology as a key issue +

3 Policies for clean energy +

4 History of the Energiewende +

5 International perspectives +

6 Questions & Answers +

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https://www.whitehouse.gov/the-press-office/2016/02/04/fact-sheet-president-obamas
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The White House
Office of the Press Secretary

For Immediate Release February 04, 2016

FACT SHEET: President Obama's 21st Century Clean Transportation System

Smart, strategic integrated investments to help reduce carbon pollution, strengthen economy

As President Obama has repeatedly said, "no challenge poses a greater threat to future generations than climate change." At the same time, the President has made clear that taking steps to reduce carbon pollution presents an enormous opportunity to strengthen the economy, drive innovation, and create new jobs.

A key step in that effort is making smart and strategic investments to create a cleaner, more sustainable transportation system. Today, our transportation sector accounts for 30 percent of U.S. greenhouse gas emissions. A new approach to our transportation system can help to speed goods to market, expand transportation options, and integrate new technologies like autonomous – or self-driving – vehicles while at the same time reducing our reliance on

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America's New Grid

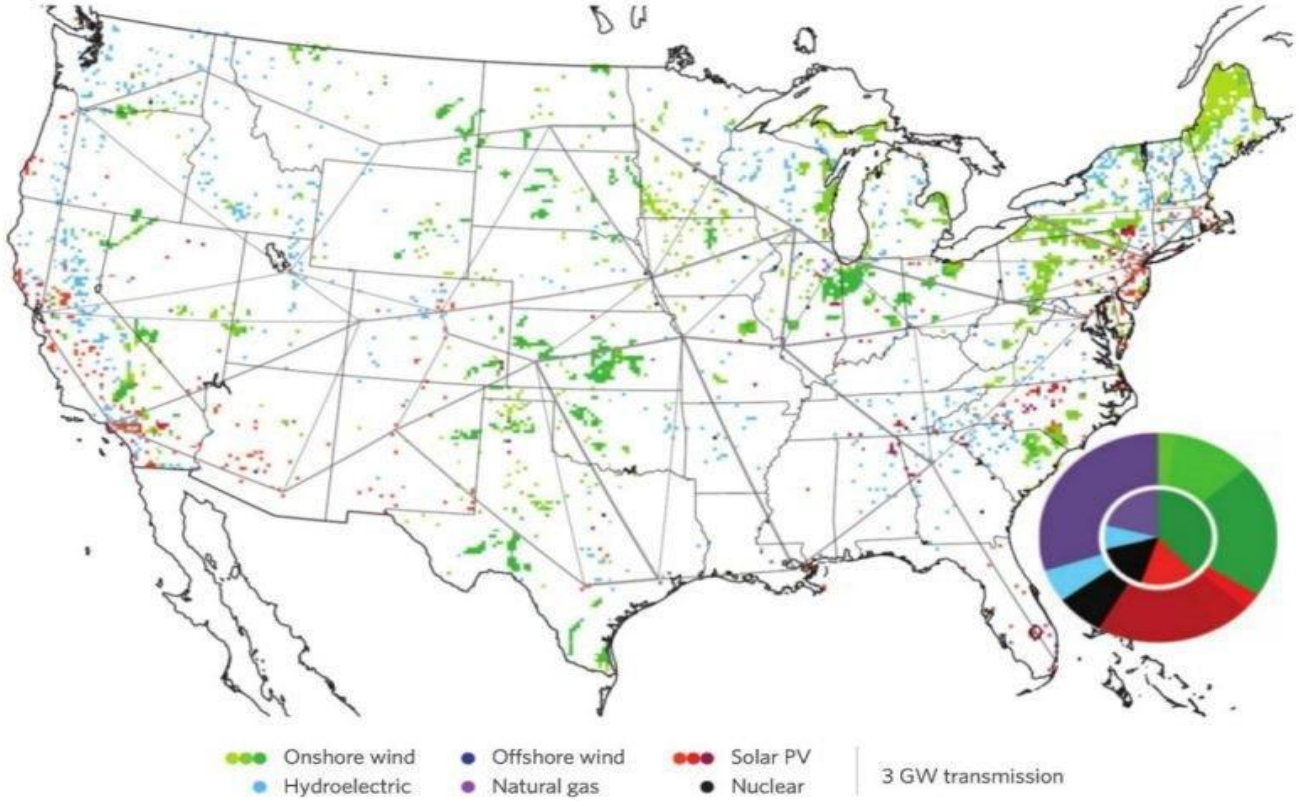

Figure 3 | Cost-optimized single electrical power system for the contiguous US, using data year 2007. The colours indicate that a model grid cell has a technology sited within it. Onshore wind and solar PV are split into three bins to designate the density of installations. For wind the bins are: less than 0.5 W m^{-2}; between 0.5 W m^{-2} and 1.5 W m^{-2}; above 1.5 W m^{-2}. For solar the bins are: less than 5 W m^{-2}; between 5 W m^{-2} and 10 W m^{-2}; above 10 W m^{-2}. The grey lines show the HVDC transmission network. The outer pie chart represents the installed capacity, whereas the inner pie chart shows the electricity demand met by each technology.

Autonomous Driving Cars-On-Demand:
A new paradigm shift
A Happy Marriage of Google with Uber

100% Renewables (Cities and Communities)- The movement

Sweden- Vaxjo

http://www.theguardian.com/cities/2015/nov/25/what-can-the-world-learn-from-vaxjo-eu

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Cities
Resilient cities

What can the world learn from Växjö, Europe's self-styled greenest city?

In 1991, the southern Swedish city became the first in the world to declare its intention to become fossil-fuel free. So how much progress has been made, and does Växjö offer a blueprint for bigger cities too?

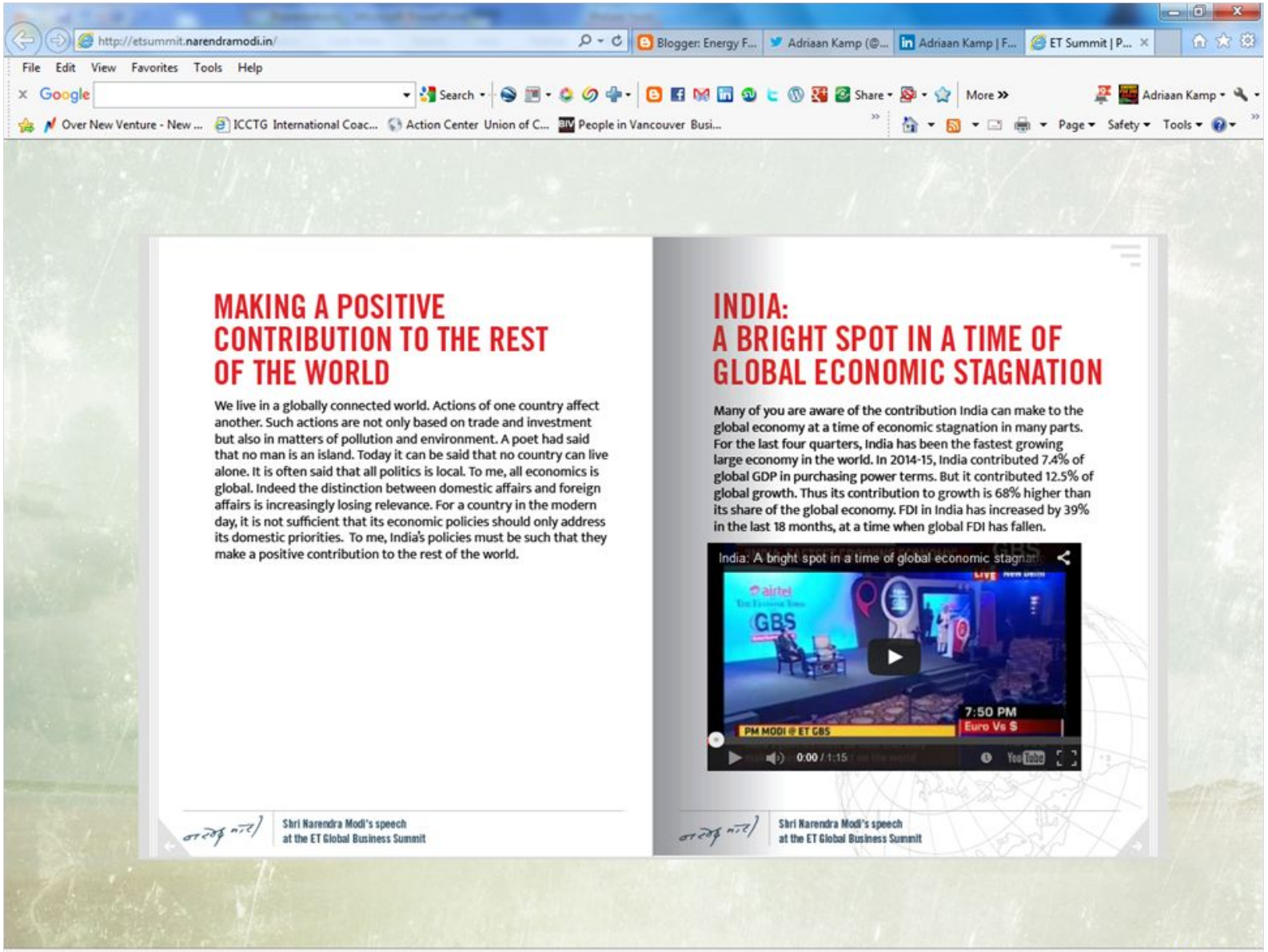
Read this article in Swedish

Växjö is focusing on increasing the uptake of cycling as part of its mission to be fossil-fuel free by 2030. Photograph: T Hedley/Alamy

http://www.theguardian.com/cities/2015/nov/25/what-can-the-world-learn-from-vaxjo-europes-self-styled-greenest-city#img-1

100%

India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Adriaan Kamp
Over New Venture - New ...
ICCTG International Coac...
Action Center Union of C...
People in Vancouver Busi...
Page
Safety
Tools
MAKING A POSITIVE CONTRIBUTION TO THE REST OF THE WORLD
We live in a globally connected world. Actions of one country affect another. Such actions are not only based on trade and investment but also in matters of pollution and environment. A poet had said that no man is an island. Today it can be said that no country can live alone. It is often said that all politics is local. To me, all economics is global. Indeed the distinction between domestic affairs and foreign affairs is increasingly losing relevance. For a country in the modern day, it is not sufficient that its economic policies should only address its domestic priorities. To me, India's policies must be such that they make a positive contribution to the rest of the world.
Shri Narendra Modi's speech at the ET Global Business Summit
INDIA: A BRIGHT SPOT IN A TIME OF GLOBAL ECONOMIC STAGNATION
Many of you are aware of the contribution India can make to the global economy at a time of economic stagnation in many parts. For the last four quarters, India has been the fastest growing large economy in the world. In 2014-15, India contributed 7.4% of global GDP in purchasing power terms. But it contributed 12.5% of global growth. Thus its contribution to growth is 68% higher than its share of the global economy. FDI in India has increased by 39% in the last 18 months, at a time when global FDI has fallen.
India: A bright spot in a time of global economic stagnat
airtel
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PM MODI @ ET GBS
Euro Vs $
0:00 / 1:15
Shri Narendra Modi's speech at the ET Global Business Summit

197 countries need to change

Annex 1. Country categories

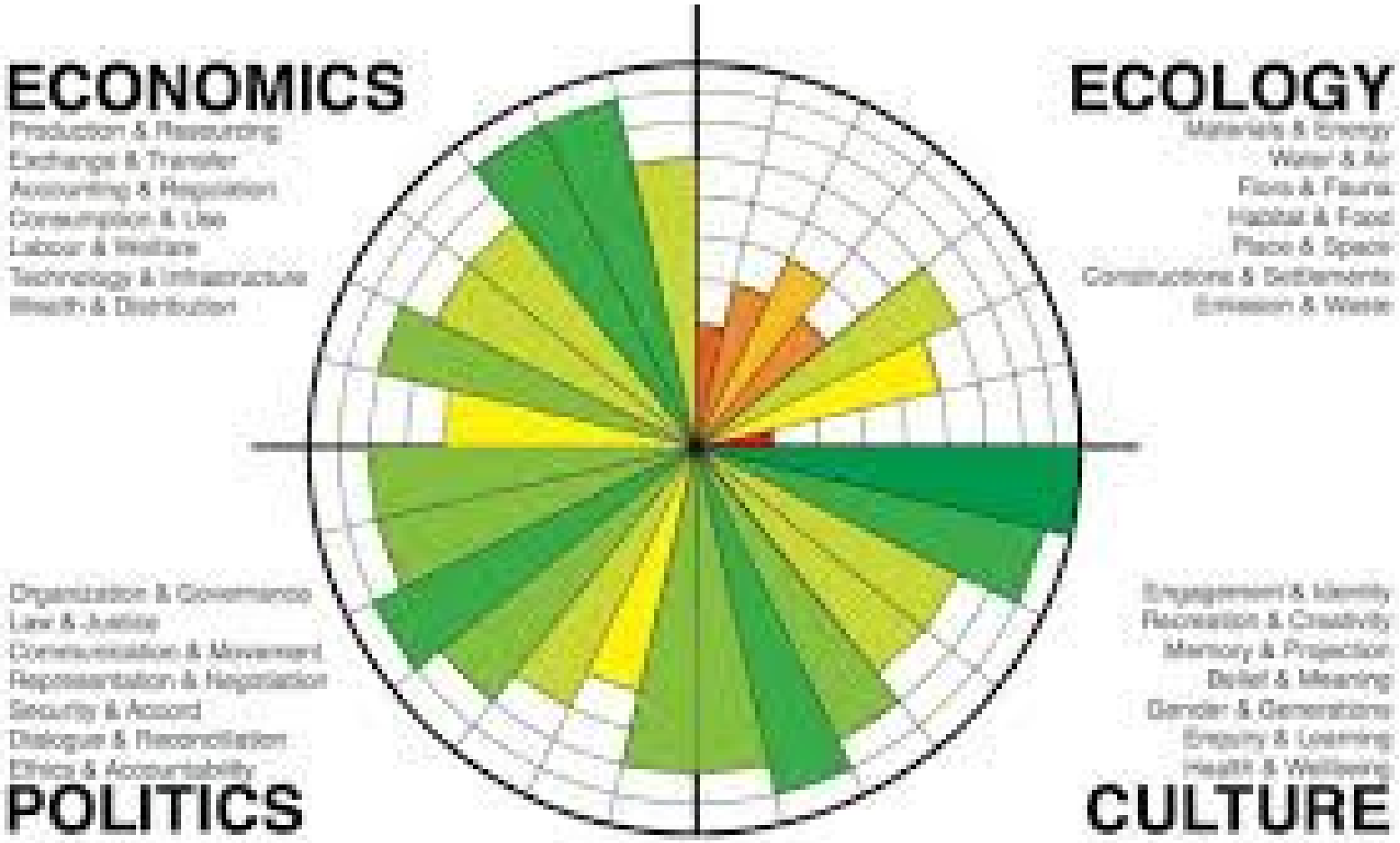
High income		Upper-middle income		Lower-middle income		Low income	
				Non-IDA eligible	IDA eligible		Non-IDA eligible
Andorra	Kuwait	Angola[a]	Palau	Armenia	Bhutan[a]	Afghanistan[a]	Korea, Dem Rep.
Antigua and Barbuda	Latvia	Albania	Panama	Egypt, Arab Rep.	Bolivia	Bangladesh[a]	
Aruba	Liechtenstein	Algeria	Peru	El Salvador	Cabo Verde	Benin[a]	
Australia[a]	Lithuania	American Samoa	Romania	Georgia	Cameroon	Burkina Faso[a]	
Austria[a]	Luxembourg[a,b]	Argentina	Serbia	Guatemala	Congo, Rep.	Burundi[a]	
Bahamas, The	Macao SAR, China	Azerbaijan	Seychelles	India	Côte d'Ivoire	Cambodia[a]	
Bahrain	Malta	Belarus	South Africa	Indonesia	Djibouti[a]	Central African Republic[a]	
Barbados	Monaco	Belize	St. Lucia[i]	Morocco	Ghana	Chad[a]	
Belgium[a]	Netherlands[a]	Bosnia and Herzegovina	St. Vincent and the Grenadines[i]	Paraguay	Guyana	Comoros[a]	
Bermuda	New Caledonia	Botswana	Suriname	Philippines	Honduras	Congo, Dem. Rep[a]	
Brunei Darussalam	New Zealand[a]	Brazil	Thailand	Swaziland	Kiribati[a]	Eritrea[a]	
Canada[a]	Northern Mariana Islands	Bulgaria	Tonga[i]	Syrian Arab Republic	Kosovo	Ethiopia[a]	
Cayman Islands	Norway[a,b]	China	Tunisia	Ukraine	Kyrgyz Republic	Gambia, The[a]	
Channel Islands	Oman	Colombia	Turkey	West Bank and Gaza	Lao PDR[a]	Guinea[a]	
Chile	Poland[a]	Costa Rica	Turkmenistan		Lesotho[a]	Guinea-Bisau[a]	
Croatia	Portugal[a]	Cuba	Tuvalu[a,i]		Mauritania[a]	Haiti[a]	
Curaçao	Puerto Rico	Dominica[i]	Venezuela, RB		Micronesia, Fed. Sts.	Kenya	
Cyprus	Qatar	Dominican Republic			Moldova	Liberia[a]	
Czech Republic[a]	Russian Federation	Ecuador			Mongolia	Madagascar[a]	
Denmark[a,b]	San Marino	Fiji			Nicaragua	Malawi[a]	
Estonia	Saudi Arabia	Gabon			Nigeria	Mali[a]	
Equatorial Guinea	Singapore	Grenada[i]			Pakistan	Mozambique[a]	
Faeroe Islands	Sint Maarten	Hungary			Papua New Guinea	Myanmar[a]	
Finland[a]	Slovak Republic[a]	Iran, Islamic Rep.			Samoa	Nepal[a]	
France[a]	Slovenia[a]	Iraq			São Tomé and Principe[a]	Niger[a]	
French Polynesia	Spain[a]	Jamaica			Senegal[a]	Rwanda[a]	
Germany[a]	St. Kitts and Nevis	Jordan			Solomon Islands[a]	Sierra Leone[a]	
Greece[a]	St. Martin	Kazakhstan			South Sudan[a]	Somalia [a]	
Greenland	Sweden[a,b]	Lebanon			Sri Lanka	Tajikistan	
Guam	Switzerland[a,b]	Libya			Sudan[a]	Tanzania[a]	
Hong Kong SAR, China	Trinidad and Tobago	Macedonia, FYR			Timor-Leste[a]	Togo[a]	
Iceland[a]	Turks and Caicos Islands	Malaysia			Uzbekistan	Uganda[a]	
Ireland[a]	United Arab Emirates	Maldives[i]			Vanuatu	Zimbabwe	
Isle of Man	United Kingdom[a,b]	Marshall Islands[i]			Vietnam		
Israel	United States[a]	Mauritius			Yemen, Rep.[a]		
Italy[a]	Uruguay	Mexico			Zambia[a]		
Japan[a]	Virgin Islands (U.S.)	Montenegro					
Korea, Rep.[a]		Namibia					

[a] Denotes OECD DAC member, [b] Denotes OECD DAC member providing at least 0.7 percent of GNI in ODA, [a]denotes Least Developed Country [i] Denotes country benefiting from the small island economy exception: small islands (with less than 15 million people, significant vulnerability due to size and geography, and very limited credit-worthiness and financing options) have been granted exceptions in maintaining their IDA eligibility. Sources: OECD, World Bank, United Nations

Building New Bridges on Energy & Sustainability

Focus – Impact- Meaning- Results

Circles of Change



Can We Change?

ENERGY FOR ONE WORLD