Appendices F: Conference Handbook

APEC 綠能融資能力建構研討會

Conference on APEC Green Energy Finance Capacity Building

會場：集思交通部國際會議中心 3F 國際會議廳

Venue: 3F, International Conference Room, GIS MOTC Convention Center

時間：2017 年 9 月 28 至 29 日

Time:28-29 September, 2017

第一日（9/28） Day One, 28 September	
時間 **Time**	**議程** **Agenda**
08:30~09:00	**報到** **Registration**
09:00~09:10	**開幕致詞** **Opening Remarks** 主講者：經濟部主任秘書陳怡鈴女士 Speaker: Ms. Yi-Ling Chen, Chief Secretary, Ministry of Economic Affairs
09:10~09:25	**團體合照** **Group Photos**
專題演講：全球氣候變遷行動與克服融資挑戰 **Keynote Speech: Global Climate Change Actions and Overcoming Financing Barriers**	
09:25~09:45	主講者：經濟合作暨發展組織環境局綠色金融及投資部門資深政策分析師 Hideki Takada 先生 Speaker: Mr. Hideki Takada, Senior Policy Analyst, Green Finance and Investment, Environment Directorate, Organisation for Economic Co-operation and Development
專題演講：2017 世界能源投資報告 **Keynote Speech: World Energy Investment 2017**	
09:45~10:05	主講者：國際能源總署經濟與投資辦公室能源投資分析師 Michael Waldron Speaker: Mr. Michael Waldron, Energy Investment Analyst, Economics and Investment Office, International Energy Agency
場次一：全球綠能市場發展及融資趨勢 **Session I : Global Trends in Green Energy Market Development and Financing**	

10:05~10:10	主持人：經濟合作暨發展組織環境局綠色金融及投資部門資深政策分析師 Hideki Takada 先生 Moderator: Mr. Hideki Takada, Senior Policy Analyst, Green Finance and Investment, Environment Directorate, Organisation for Economic Co-operation and Development
10:10~10:30	**I-1.G20 集團能源效率投資工具** **1-1.G20 Energy Efficiency Investment Toolkit** 主講者：國際能效合作夥伴關係組織計畫主任 Ailin Huang 女士 Speaker: Ms. Ailin Huang, Programme Officer, International Partnership for Energy Efficiency Cooperation
10:30~10:50	**茶敘** **Coffee Break**
10:50~11:10	**I-2.清潔能源轉型** **I-2.The Clean Energy Transition** 主講者：彭博新能源金融亞太區主管 Justin Wu 先生 Speaker: Mr. Justin Wu, Head, Asia-Pacific, Bloomberg New Energy Finance
11:10~11:30	**I-3.亞太地區能源趨勢** **I-3.Energy Trends in APEC** 主講者：亞太能源研究中心研究員 Kirsten Smith 女士 Speaker: Ms. Kirsten Smith, Researcher, Asia Pacific Energy Research Centre
11:30~12:00	**綜合討論** **Panel Discussion**
12:00~13:00	**午餐** **Lunch**
場次二：促進綠能融資發展 **Session II: Facilitating Green Energy Finance**	
13:00~13:05	主持人：國際能源總署資深能源投資分析師 Michael Waldron 先生 Moderator: Mr. Michael Waldron, Energy Investment Analyst, Economics and Investment Office, International Energy Agency
13:05~13:25	**II-1.擴展能源效率投資** **II-1.Scaling up Investments in Energy Efficiency** 主講者：亞洲開發銀行東亞部門東亞能源處資深金融專家(能源) Jennifer Romero- Torres 女士 Speaker: Ms. Jennifer Romero- Torres, Senior Finance Specialist (Energy), East Asia Energy Division, East Asia Regional Department, Asian Development Bank
13:25~13:45	**II-2.加速綠能融資—風險管理及財務模型**

	II-2.Facilitating Green Energy Finance – Risk Management and Financial Modelling 主講者：麥格里銀行綠色投資群董事總經理Peter Knott先生 Speaker: Mr. Peter Knott, Managing Director, Green Investment Group, Macquarie Capital
13:45~14:15	**綜合討論** **Panel Discussion**
14: 15~14:35	**茶敘** **Coffee Break**
場次三：能源效率融資專案最佳作業分享 **Session III: Best Practices in Energy Efficiency Financing**	
14:35~14:40	主持人：國際能效合作夥伴關係組織計畫主任 Ailin Huang 女士 Moderator: Ms. Ailin Huang, Programme Officer, International Partnership for Energy Efficiency Cooperation
14:40~15:00	**III-1.韓國優惠貸款(能源使用合理化基金)** **III-1.Korea Soft Loan (Energy Use Rationalization Funds)** 主講者：韓國能源局財政支持部門副理 Seulgi Cho 女士 Speaker: Ms. Seulgi Cho, Assistant Manager, Finance Support Division, Korea Energy Agency, Korea
15:00~15:20	**III-2.韓國的能源服務業** **III-2.ESCO Program in Korea** 主講者：韓國能源局財政支持部門能源服務業組長 Dongwook Cho 先生 Speaker: Mr. Dongwook Cho, ESCO Team Manager, Finance Support Division, Korea Energy Agency, Korea
15:20~15:40	**III-3.美國聯邦與州政府的能源效率相關政策及技術** **III-3.US Federal and State-Based Energy Policy and Technology in Regards to Energy Efficiency** 主講者：美國加州大學柏克萊分校加州能源及環境學院資深顧問 Terry Surles 博士 Speaker: Dr. Terry Surles, Senior Advisor, California Institute of Energy and Environment, University of California/Berkeley, The United States
15:40~16:10	**綜合討論** **Panel Discussion** 與談人 Panelists: • 主講會員體代表 Presenting APEC Economies Delegates

第二日（9/29） Day Two, 29 September	
時間 Time	**議程 Agenda**
09:00~09:30	**報到 Registration**
專題演講：東協綠能源發展目標與合作概況 Keynote Speech: Green Energy Target and Cooperation in ASEAN	
09:30~09:50	主講者：東協與東亞經濟研究院能源單位資深經濟學家 Venkatachalam Anbumozhi 博士 Speakers: Dr. Venkatachalam Anbumozhi, Senior Economist, Energy Unit, Economic Research Institute for ASEAN and East Asia
場次四：再生能源融資專案最佳作業分享 Session IV: Best Practices in Renewable Energy Financing	
09:50~09:55	主持人：東協與東亞經濟研究院能源單位資深經濟學家 Venkatachalam Anbumozhi 博士 Moderator: Dr. Venkatachalam Anbumozhi, Senior Economist, Energy Unit, Economic Research Institute for ASEAN and East Asia
09:55~10:15	**IV-1.再生能源融資專案最佳作業分享：智利案例 IV-1.Best Practices in Renewable Energy Financing: The Chilean Case** 主講者：智利能源部能源基礎建設部門主任 Diego Valenzuela 先生 Speaker: Mr. Diego Valenzuela, Head of Unit, Energy Infrastructure Division, Ministry of Energy, Chile
10:15~10:35	**IV-2.基礎建設基金市場 IV-2.Listed Infrastructure Fund Market** 主講者：日本東京證券交易所新上市證券推廣部門副總裁 Takumi Hayase 先生 Speaker: Mr. Takumi Hayase, Vice President, New Listing Promotion Dept., Tokyo Stock Exchange, Inc., Japan
10:35~10:55	**IV-3.再生能源融資專案最佳作業分享 IV-3.Best Practices in Renewable Energy Financing** 主講者：馬來西亞生物質公會聯合會主席拿督梁健文先生 Speaker: Dato' Leong Kin Mun, President, Malaysia Biomass Industries Confederation, Malaysia
10:55~11:15	**茶敘 Coffee Break**
11:15~11:35	**IV-4.再生能源融資專案最佳作業－新加坡之觀點**

	IV-4.Best Practices in Renewable Energy Financing–A Singaporean Perspective 主講者：新加坡國立大學新加坡太陽能研究所研究員 Monika Bieri 女士 Speaker: Ms. Monika Bieri, Research Associate, Solar Energy Research Institute of Singapore, National University of Singapore, Singapore
11:35~11:55	**IV-5.再生能源目標及推動方案** **IV-5.Renewable Energy Target and Promotion Program** 主講者：中華台北台灣金融研訓院彭勝本副研究員 Speaker: Mr. Peng, Sheng-Pen, Associate Research Fellow, Taiwan Academy of Banking and Finance, Chinese Taipei
11:55~13:00	**午餐** **Lunch**
13:00~13:20	**IV-6.泰國再生能源融資專案最佳作業** **IV-6.Best Practices in Renewable Energy Financing in Thailand** 主講者：泰國能源部替代能源發展與效率部門資深科學家 Sutthasini Glawgitigul 女士 Speaker: Ms. Sutthasini Glawgitigul, Senior Professional Scientist, Department of Alternative Energy and Efficiency, Ministry of Energy, Thailand
13:20~13:40	**IV-7.美國聯邦與州政府的再生能源相關政策及技術** **IV-7.US Federal and State-Based Energy Policy and Technology in Regards to Renewable Energy** 主講者：美國加州大學柏克萊分校加州能源與環境學院資深顧問 Terry Surles 博士 Speaker: Dr. Terry Surles, Senior Advisor, California Institute of Energy and Environment, University of California/Berkeley, The United States
13:40~14:40	**綜合討論** **Panel Discussion** 與談人 Panelists: • 主講會員體代表 Presenting APEC Economies Delegates
14:40~15:00	**茶敘** **Coffee Break**
場次五：透過 APEC 區域合作促進綠能融資發展 **Session V: Accelerating Green Energy Finance through Regional Cooperation in APEC**	
15:00~15:05	主持人：APEC 能源工作組主席陳炯曉博士

	Moderator: Dr. Jyuung-Shiauu Chern, Lead Shepherd, APEC Energy Working Group
15:05~16:05	**圓桌論壇** **Round Table** 與談人： Panelists: • 東協與東亞經濟研究院能源單位資深經濟學家Venkatachalam Anbumozhi博士 Dr. Venkatachalam Anbumozhi, Senior Economist, Energy Unit, Economic Research Institute for ASEAN and East Asia • 國際能源總署經濟與投資辦公室能源投資分析師Michael Waldron先生 Mr. Michael Waldron, Energy Investment Analyst, Economics and Investment Office, International Energy Agency • 麥格里銀行綠色投資群董事總經理Peter Knott先生 Mr. Peter Knott, Managing Director, Green Investment Group, Macquarie Capital • 經濟合作暨發展組織環境局綠色金融及投資部門資深政策分析師 Hideki Takada 先生 Mr. Hideki Takada, Senior Policy Analyst, Green Finance and Investment, Environment Directorate, Organisation for Economic Co-operation and Development • 智利能源部能源基礎建設部門主任 Diego Valenzuela 先生 Mr. Diego Valenzuela, Unit Chief, Energy Infrastructure Division, Ministry of Energy, Chile • 美國加州大學柏克萊分校加州能源及環境學院資深顧問 Terry Surles 博士 Dr. Terry Surles, Senior Advisor, California Institute of Energy and Environment, University of California/Berkeley, The United States
16:05~16:10	**閉幕致詞** **Closing Remarks** 主講者：經濟部能源局主任秘書蘇金勝先生 Speaker: Mr. Jin-Sheng Su, Chief Secretary, Bureau of Energy, Ministry of Economic Affairs

Keynote Speech：

Global Climate Change Actions and Overcoming Financing Barriers

Biography

Hideki TAKADA (Mr.)

Mr. Hideki Takada works as a Senior Policy Analyst on green finance in the Environment Directorate at OECD since July 2015.

Mr. Takada is seconded from Japanese Ministry of Finance which he joined in 1995. He has had a wide range of experience in policy-making at the heart of the government including public finance, tax, trade policies and financial services. During over 20 years of his career he spent 5 years in the UK: study at Cambridge and LSE (1997-99), and secondment to HM Treasury (the UK finance ministry, 2003-06) where he worked on financial regulation, investment market policies and public spending.

In 2009, he became the first staff of the newly created National Policy Unit and worked in the Prime Minister's Office and the Cabinet Secretariat as an architect of the new public finance framework and as a private advisor to the Prime Minister. His latest position in Tokyo which he held until 2015 was the Director of Public Relations, in charge of management of external communications of the Ministry of Finance.

Mr. Takada received a Bachelor degree in Law (University of Tokyo), a Master degree in Law (Cambridge University) and an MBA (Imperial College London).

Global Climate Change Actions and Overcoming Financing Barriers

28 September 2017

Hideki Takada
Senior Policy Analyst
Green Finance
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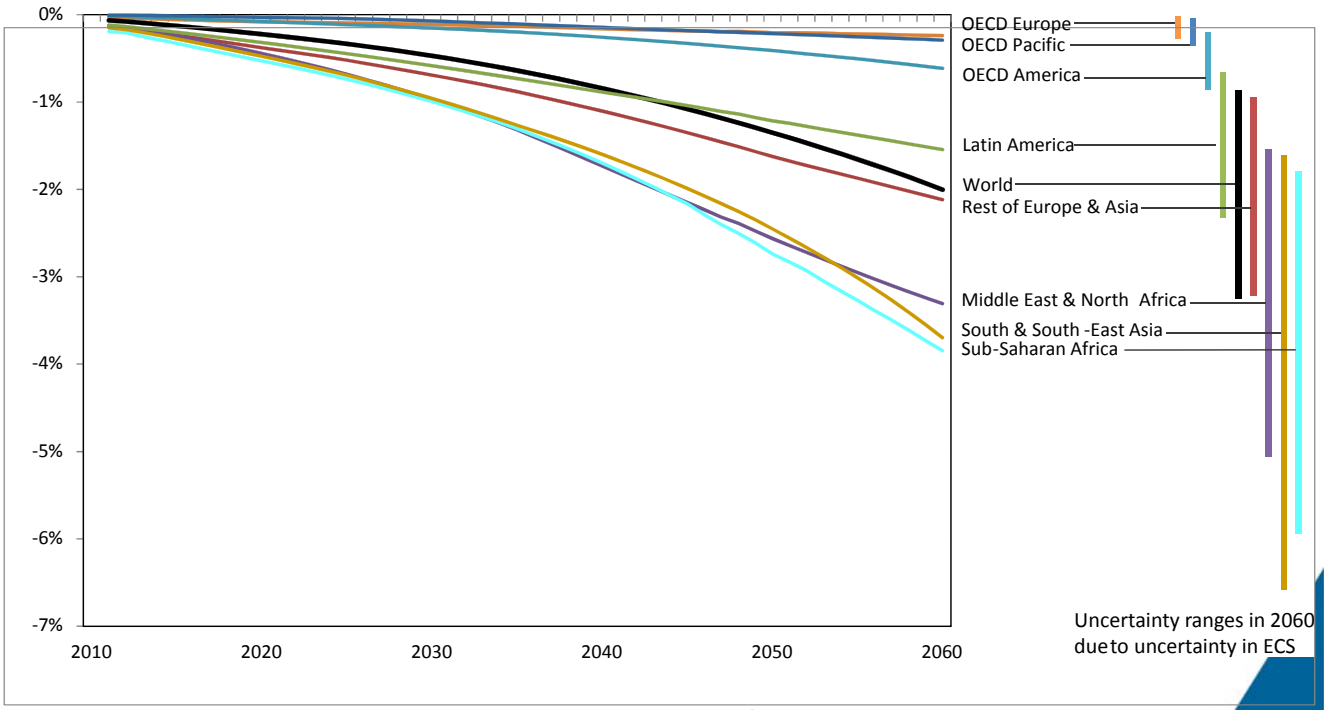
This presentation represents the views of the author alone and does not necessarily represent views of the OECD or its member countries.

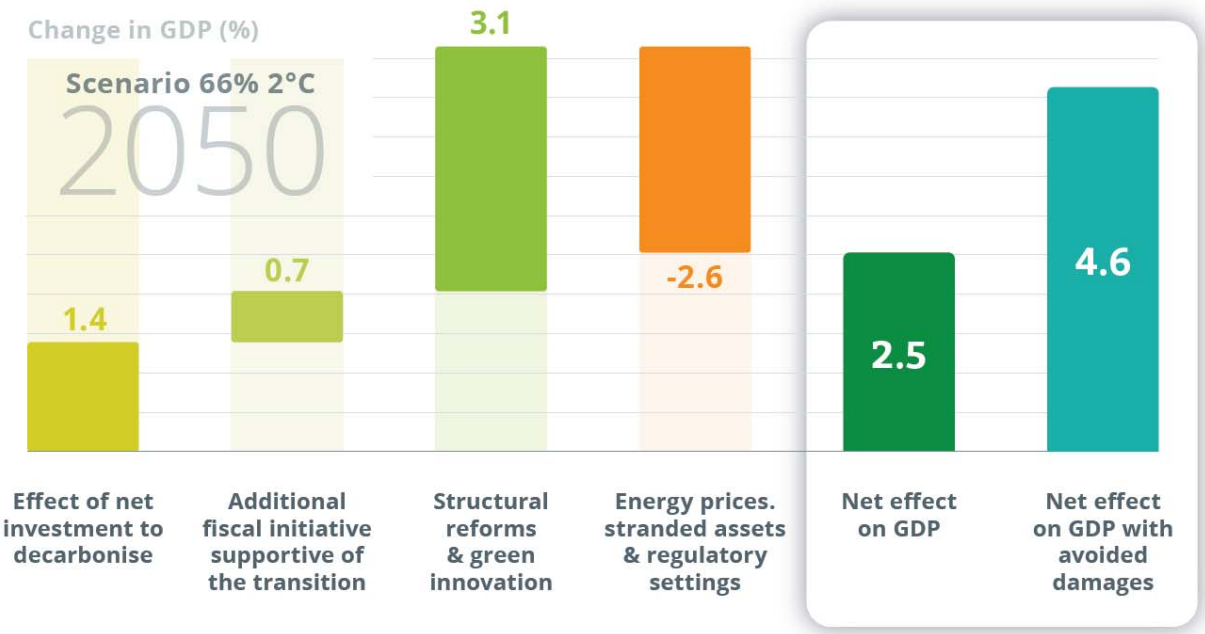
OECD
BETTER POLICIES FOR BETTER LIVES

Climate change – a global challenge, but uneven consequences



Source: OECD (2015) *The Economic Consequences of Climate Change*

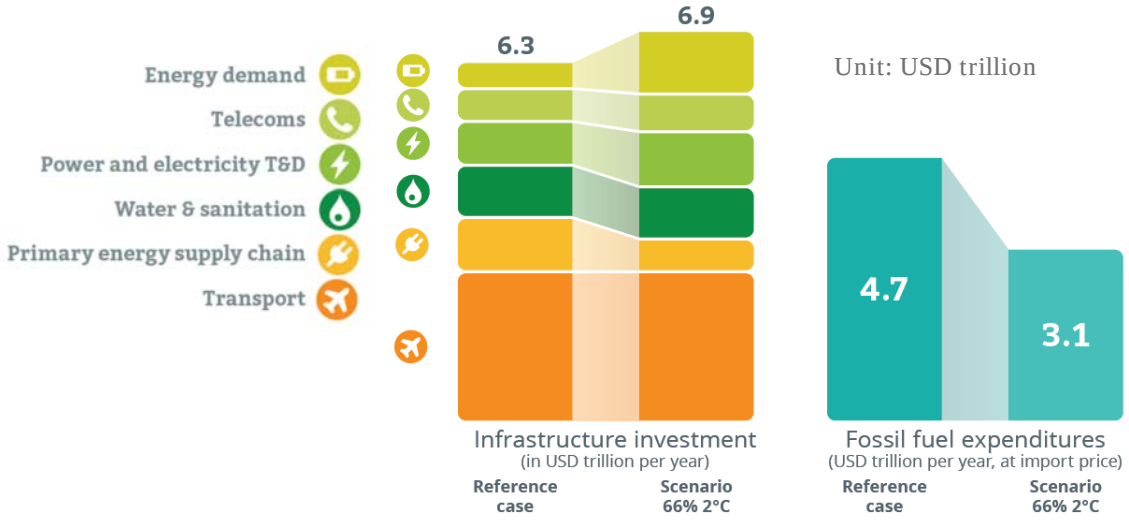
Green investment enhances growth



Source: OECD (2017) *Investing in Climate, Investing in Growth*

Significant redirection of investment is needed for a low-carbon transition

- ✓ **To make infrastructure climate-compatible, $6.9tn/year investment is needed 2016-30 on average**
- ✓ **Incremental costs are not very high vis-à-vis reference case**
- ✓ **However, significant upfront capital is needed**



Source: OECD (2017) *Investing in Climate, Investing in Growth*

COP21: The Paris Agreement

Article 2

1. This Agreement…aims to strengthen the global response to the threat of climate change…including by:

(a) Holding the increase in the global average temperature to **well below 2 °C** above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;

(c) **Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development**.

How to change finance flows?

What are the drivers of green investment and innovation?

The empirics of enabling investment and innovation in renewable energy (OECD, May 2017)


Please cite this paper as:

Ang, G., D. Röttgers and P. Burli (2017), "The empirics of enabling investment and innovation in renewable energy", *OECD Environment Working Papers*, No. 123, OECD Publishing, Paris.
http://dx.doi.org/10.1787/67d221b8-en

OECD Environment Working Papers No. 123

The empirics of enabling investment and innovation in renewable energy

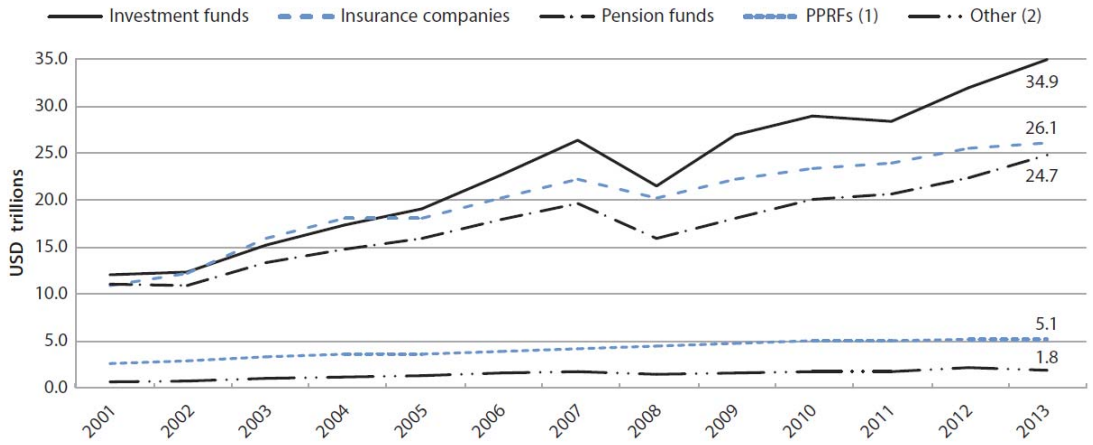
Geraldine Ang, Dirk Röttgers, Pralhad Burli

JEL Classification: F30, H23, L94, O3, Q42, Q48, Q54, Q55, Q58

- Provide insights on **policy drivers for and barriers to investment and innovation** in renewable power in OECD and G20 countries.
- **Based on new econometric study,** assess the impacts of climate policies and investment conditions on investment and patenting in renewable power since 2000.
- Also assess how the investment environment influences the effect of climate mitigation policies.

Institutional investment in green infrastructure: opportunities ahead

OECD institutional investors alone manage more than $90 tn assets but…



Only 1% of large OECD pension fund assets invested directly in infrastructure
And only a fraction of that 1% invested in green infrastructure

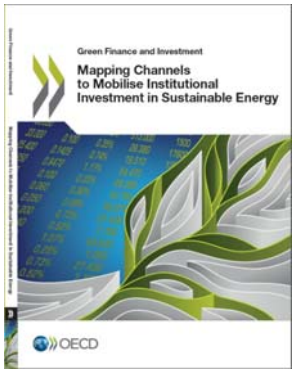
Source: OECD Global Pension Statistics, Global Insurance Statistics and Institutional Investors databases, and OECD staff estimates. (1) Public Pension Reserve Funds, (2) Other forms of institutional savings
** Direct unlisted equity investment by large OECD pension funds, covering $10+tn*
** * BNEF estimates*

Mapping Channels to Mobilise Institutional Investment in Sustainable Energy: *an OECD report*

(annexed to G20 Communique in 2015; Progress Report submitted to G20 GFSG in 2016)

Barriers to investment

- Lack of investment environment
- Weak or uncertain energy and climate policies
- Regulatory policies with unintended consequences
- Lack of suitable financial vehicles
- Shortage of information on bankable projects



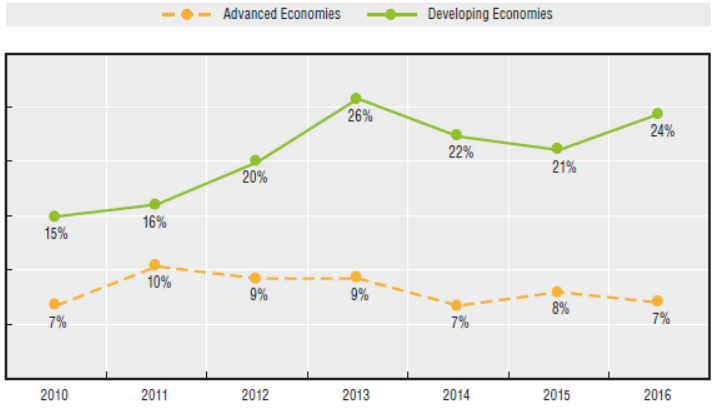
Key policy recommendations

- ✓ Establish **pre-conditions** for institutional investment
- ✓ Ensure a stable "investment grade" policy environment - evaluate and fix **unintended regulatory impacts**
- ✓ Address market failures (incl. lack of **carbon pricing** & **remove fossil fuel subsidies**)
- ✓ Provide a national **infrastructure road map & pipeline**
- ✓ Facilitate the development of liquid financing instruments (e.g. **green bonds**)
- ✓ Facilitate the development of **risk mitigants**
- ✓ Reduce the **transaction costs** of green investment (e.g. aggregation and "warehousing")
- ✓ Promote market transparency, **disclosure**, standardisation and improve **data availability**
- ✓ Establish a "**green investment bank**" or refocus existing public financial institutions

Source: OECD, 2015: http://dx.doi.org/10.1787/9789264224582-en

Role of public financial institutions for "mobilising" private capital

Share of development banks and state-owned banks in privately financed infrastructure, power and transport sectors



Source: OECD (2017) *Investing in Climate, Investing in Growth*

Public financial institutions

- Multilateral Development Banks (MDBs)
- Bilateral Development Finance Institutions (DFIs)
- National Development Banks (NDBs)
- Green Investment Banks

Tools to mobilise private capital

- ✓ Guarantees
- ✓ Debt subordination
- ✓ Co-finance/Co-investment
- ✓ Technical assistance

Development of the green bond market

Rationale for green bonds

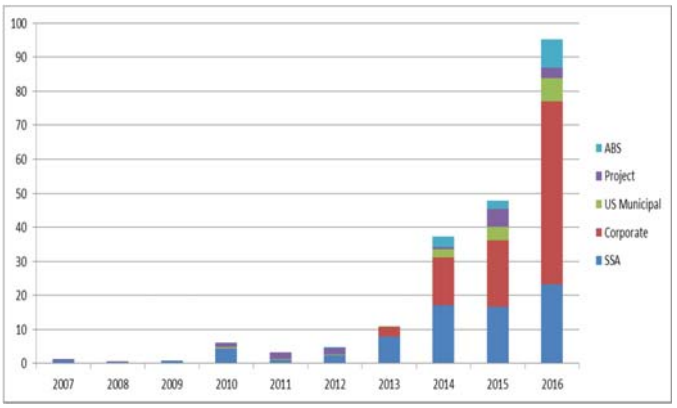
Issuers:

- ✓ Investor base diversification (more funding source, lower volatility
- ✓ Enhanced credibility of environmental strategy
- ✓ Lower cost of capital?

Investors:

- ✓ Satisfies SRI/ESG demand without sacrificing return
- ✓ Enhanced information about issuer
- ✓ Hedging climate risk in low carbon scenario

Annual issuance of green bonds (USD billion)



Source: SEB analysis provided to OECD, based on Bloomberg data

Some recent developments

- *Diversification of players / countries*
- *International and country-specific guidelines*
- *Emergence of "sovereign" green bonds*

International actions:
Financial Stability Board established Task Force on Climate-related Financial Disclosures (TCFD)

Dec 2015: **FSB established TCFD**
Mar 2016: **Phase I Report**
Dec 2016: **Recommendation Report**
Jun 2017: **Final Report**

Key features of recommendations
- Adoptable by **all organisations**
- Disclosure in **mainstream financial filings**
- Designed to solicit **decision-useful, forward-looking information** on financial impacts
- Strong focus on **risks and opportunities** related to transition to lower-carbon economy

Governance
The organization's governance around climate-related risks and opportunities

Strategy
The actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning

Risk Management
The processes used by the organization to identify, assess, and manage climate-related risks

Metrics and Targets
The metrics and targets used to assess and manage relevant climate-related risks and opportunities

Source: TCFD "*Overview of Recommendations*" (June 2017)

International actions:
G20 Green Finance Study Group

- Green Finance Study Group (GFSG) was created for the G20 finance track under the Chinese Presidency in 2016
- Gathered G20 finance ministries and central banks
- Synthesis Report welcomed by the G20 Leaders' Communique at Hangzhou Summit in Sept 2016
- GFSG continued under the German Presidency in 2017

✓ OECD actively contributed to GFSG providing 4 papers on green bonds and institutional investment

Available on the G20 GFSG Web Repository:
http://unepinquiry.org/g20greenfinancerepositoryeng/

OECD launched the new Centre on Green Finance and Investment

More information

http://www.oecd.org/cgfi

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OECD Green Investment Financing Forum

The 4th GIFF: 24-25 October 2017, Paris

- The main annual global event for the OECD Centre on Green Finance and Investment
- Gathers senior policy makers and key actors in green finance and investment from around the world
- Expecting 300+ participants and 50+ high profile speakers

GIFF
GREEN INVESTMENT FINANCING FORUM
OECD

More information and registration:
http://www.oecd.org/cgfi/2017-green-investment-financing-forum.htm

Keynote Speech：
World Energy Investment 2017

Mr Michael Waldron is an energy investment analyst in the Economics and Investment Office of the International Energy Agency. He is currently the project co-manager and one of the lead authors of the IEA World Energy Investment report, which assesses investment trends across the energy sector. He was previously the project leader and lead author of the IEA's Medium-Term Renewable Energy Market Report, which analyzes market trends of renewables in the electricity, transport and heat sectors. At the IEA he has also worked as an oil demand and biofuels analyst. Prior to joining the IEA, Mr Waldron worked as a senior energy markets analyst at Lehman Brothers in New York and London. Mr Waldron obtained his Masters in International Energy Policy & International Economics at Johns Hopkins University, School of Advanced International Studies (SAIS) and his Bachelors degree in Economics & Government at Cornell University.

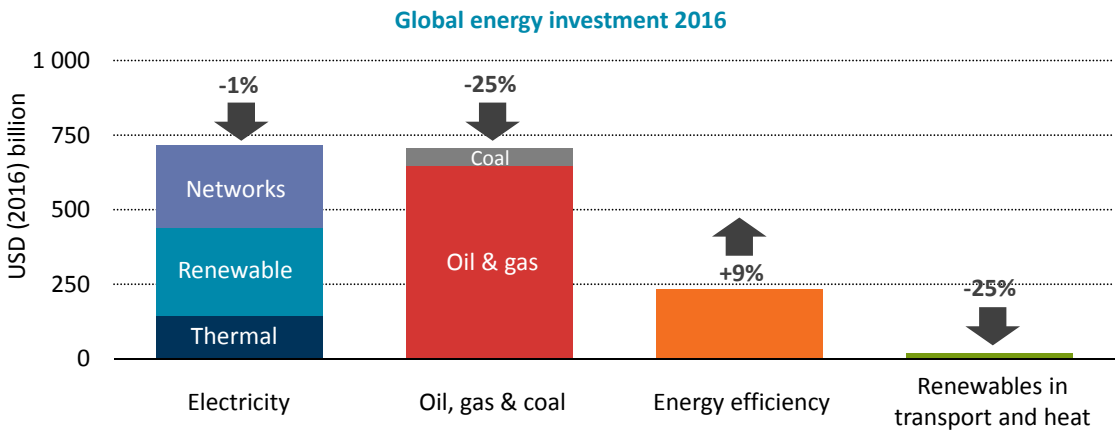
World Energy Investment 2017

APEC Conference on Green Energy Finance Capacity Building, September 2017

Michael Waldron, Economics and Investment Office

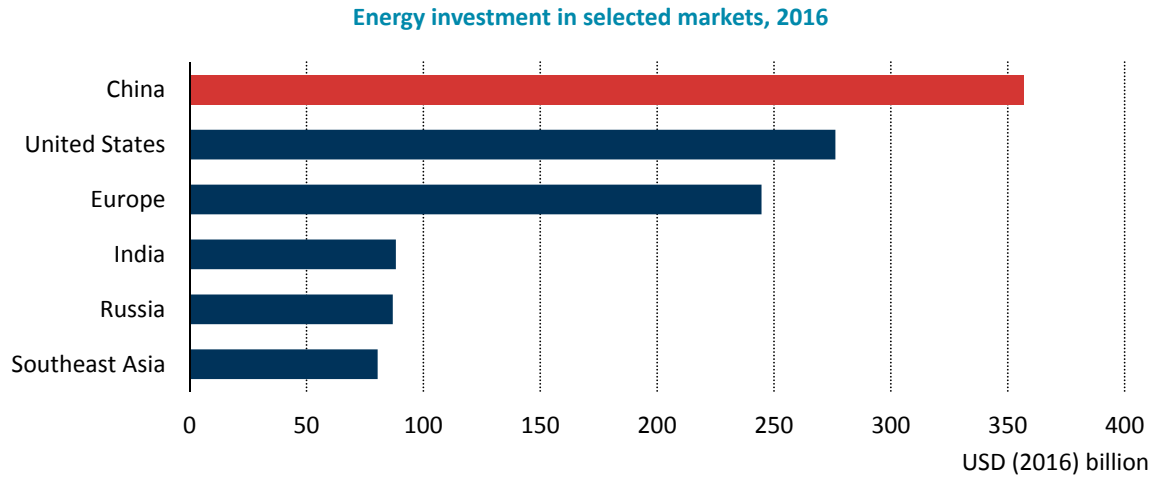
IEA

Global energy investment fell 12% in 2016, a second consecutive year of decline



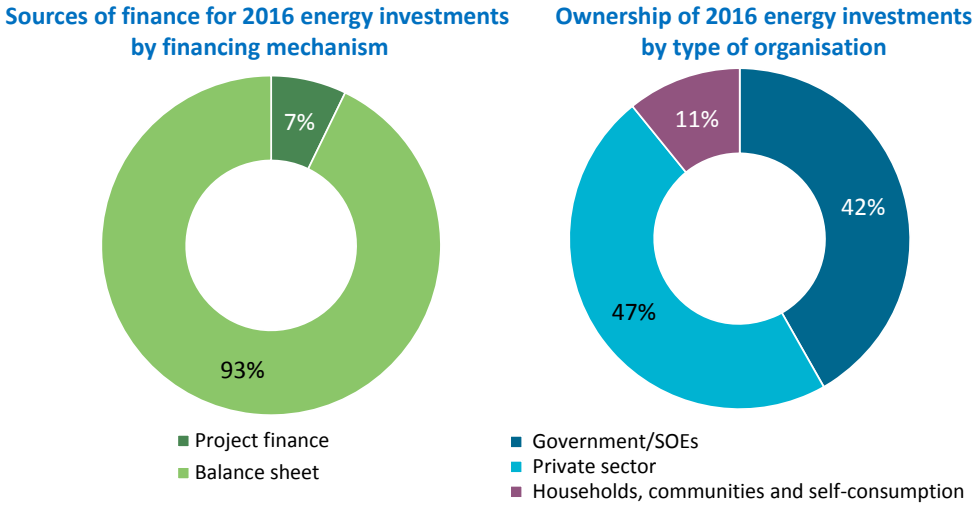
Total energy investment was $1.7 trillion in 2016. Electricity sector investment overtook oil and gas for the first time, while energy efficiency was the biggest growth sector.

China remains the first destination of energy investment in 2016



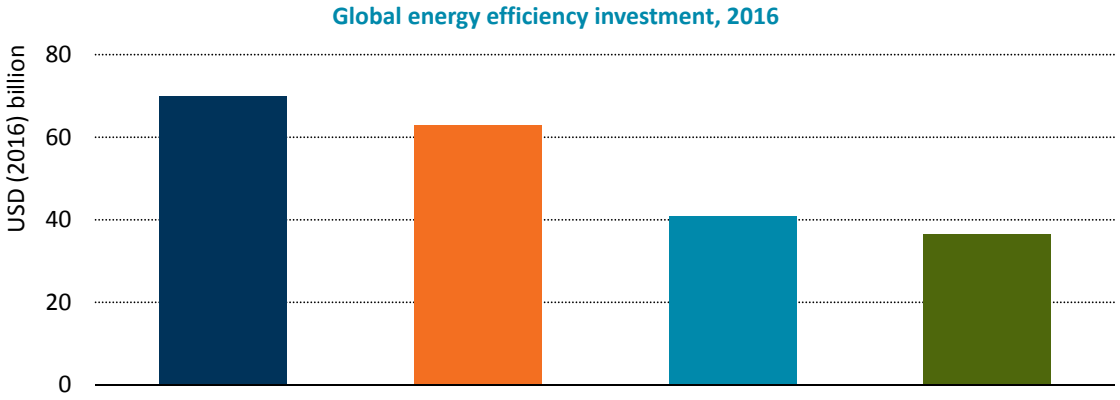
China represented 21% of global energy investment, supported by electricity supply and networks; despite a sharp decline in oil and gas, the US total share rose significantly.

The role of state actors in energy investments has increased



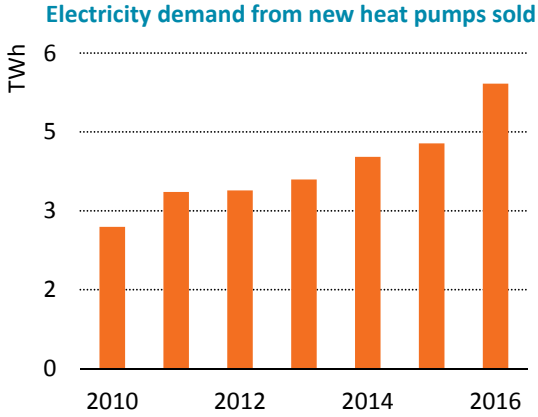
The share of state actors in total energy investment reached 42% in 2016, largely thanks to state-owned enterprises in electricity sector investment, notably in China, and NOCs in upstream oil & gas

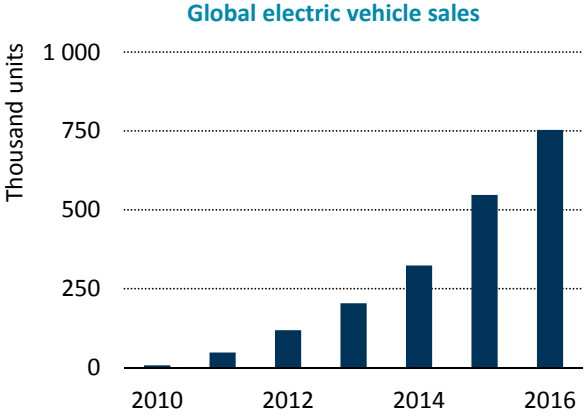
Europe leads efficiency spending but China is set to overtake it by 2018



Policy continues to underpin efficiency spending, especially in buildings insulation, heating systems and home appliances. Much of the growth in transport efficiency spending is in electric vehicles.

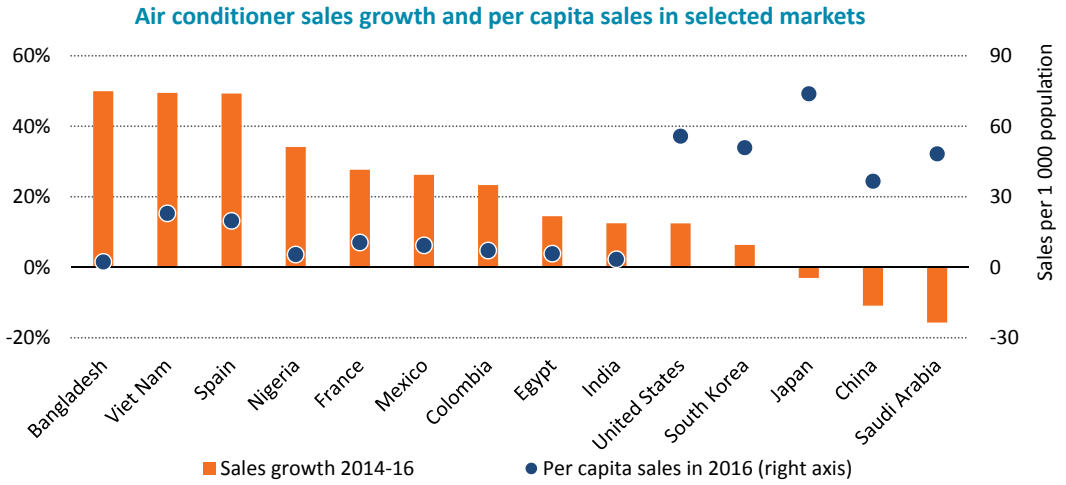
Electrification of transport and heat is progressing





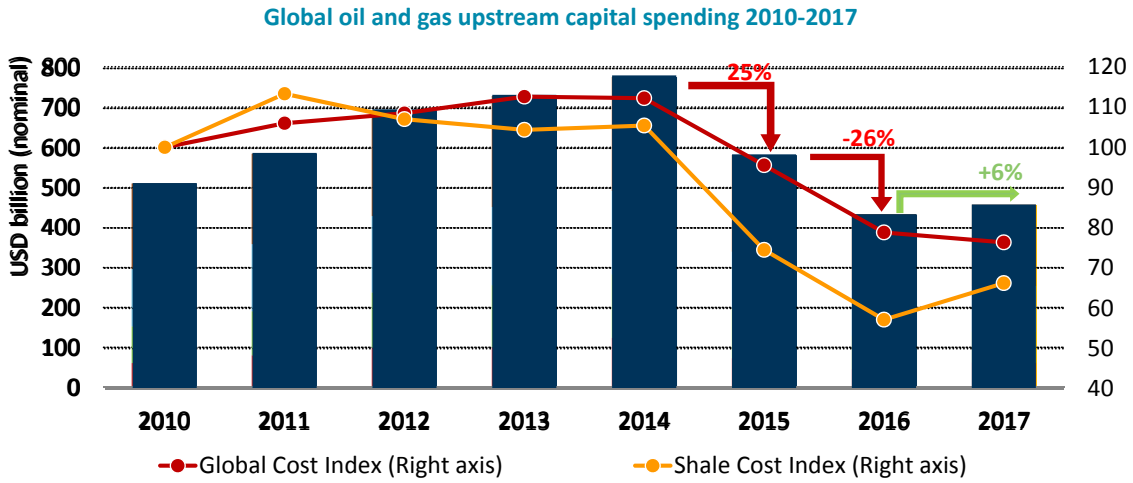
Electric vehicle (EV) sales grew 38% in 2016, bring and, at $6 billion, now represent 10% of all transport efficiency spending. Another $6 billion was spent globally on EV charging stations.

Growing electricity demand for space cooling



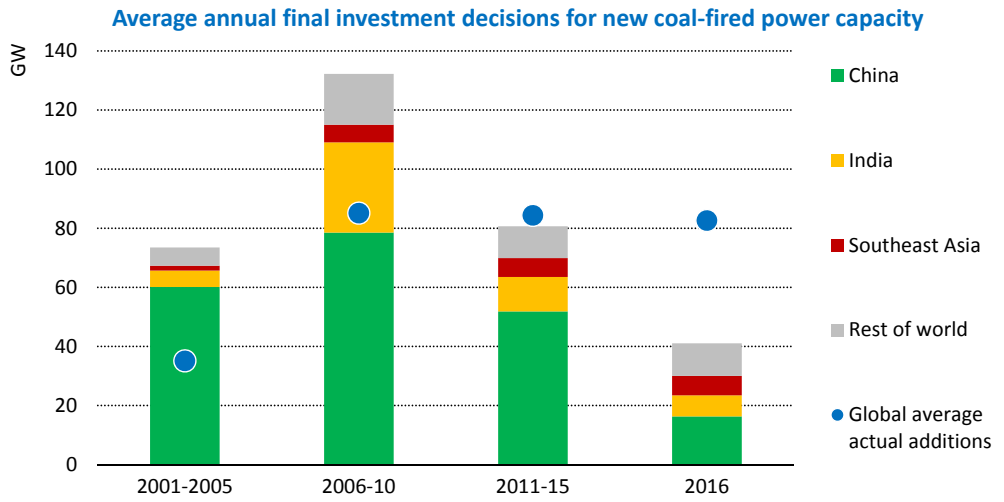
Sales of air conditioners are growing strongly in countries with low rates of market penetration, while sales are falling in the major markets China and Saudi Arabia, due to market saturation.

Global upstream oil and gas investment rebounds modestly in 2017



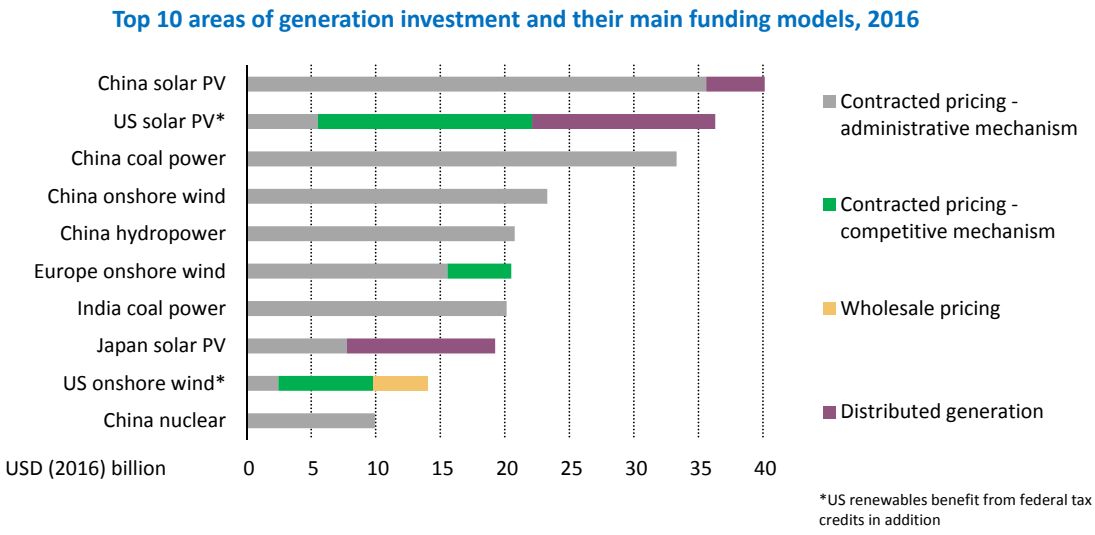
Ramp up of activities leads to cost inflation in US tight oil but elsewhere upstream costs decline further. NOC' share in total investment reaches another record high.

A wave of coal power investment is coming to a pause



In 2016, sanctioning of new coal power fell to the lowest level in nearly 15 years, hampered by competition from renewables and environmental challenges. Gas power FIDs exceeded those for coal by over 1.5 times.

Policies play an important role in electricity sector business models

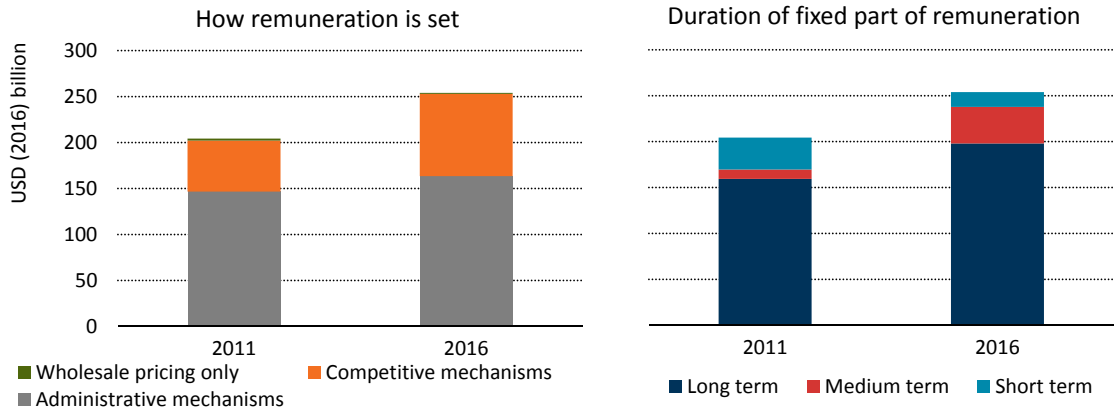


*US renewables benefit from federal tax credits in addition

Nearly 95% of global power generation investment was made by companies operating under fully regulated revenues or mechanisms to manage revenue risk associated with wholesale market pricing.

Renewables policies place more emphasis on competition and system value

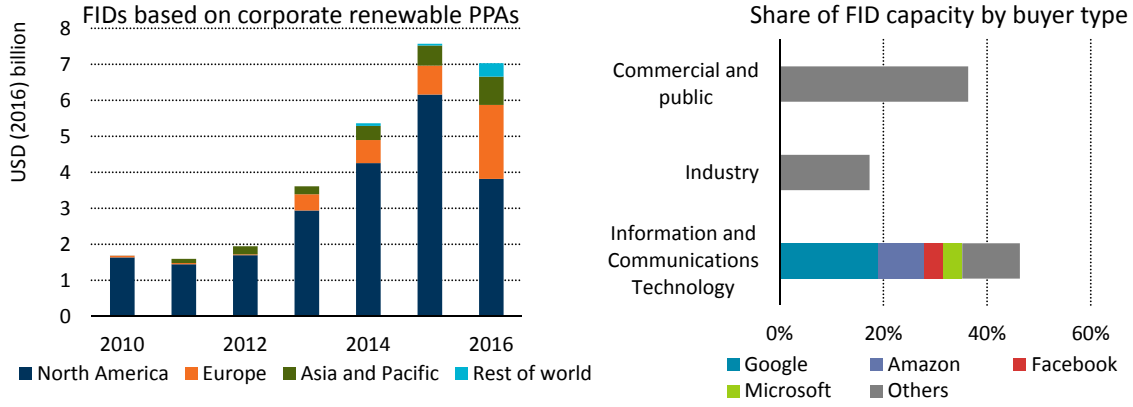
Utility-scale renewables investment by business model



Competitive price setting mechanisms drive 35% of utility-scale renewable investment. Projects largely have long-term fixed pricing, but in some cases are exposed to market prices to incentivise system-friendly capacity.

Corporations playing a growing role in renewables investment

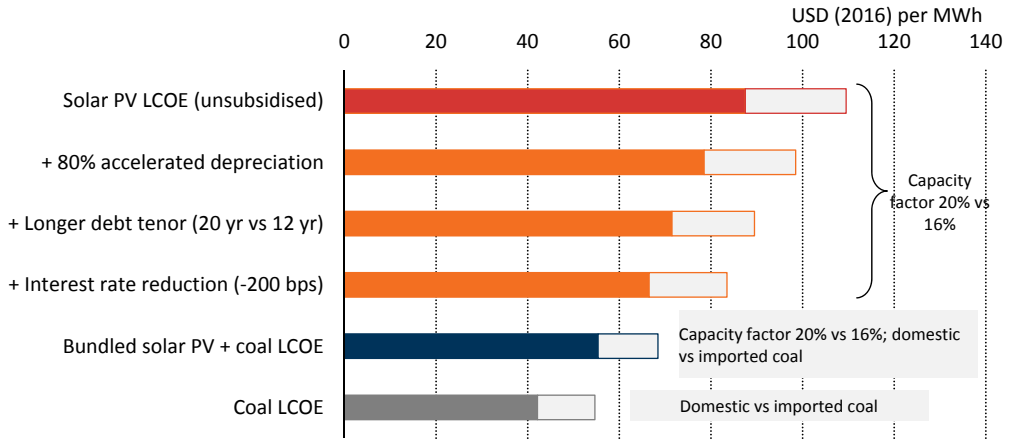
Final investment decisions based on corporate renewable PPAs by region and type of buyer



Corporate PPAs have accounted for the sanctioning of over USD 30 billion of new utility-scale renewables over the past decade, led by technology firms looking to hedge power price volatility, diversify supply and meet sustainability goals.

Improving the financial attractiveness of renewables in India

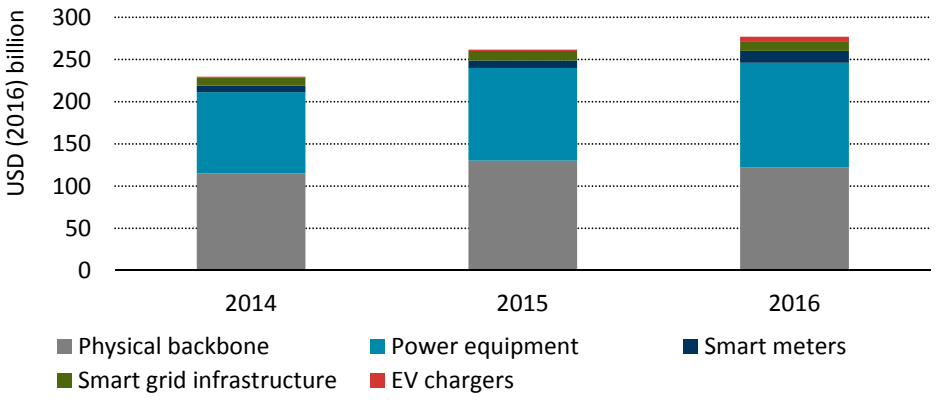
India levelised cost of generation of new solar PV and coal power, 2016



Financing with lower cost, long-term debt and attractive depreciation can reduce solar PV generation costs by a quarter and bundling with coal-fired power by half.

Smarter networks may be key enablers to address flexibility gaps

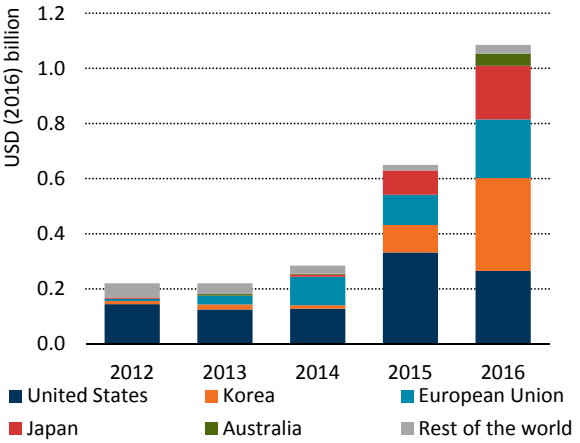
Investment in digital grid infrastructure and total electricity networks spending



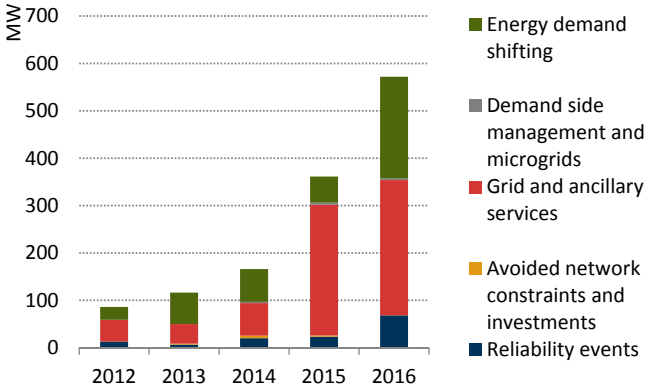
Networks spending is dominated by lines and power equipment, but digital grid infrastructure now accounts for over 10% of networks investment.

Electricity storage investment depends on regulation and market design

Grid-scale battery storage investment by region



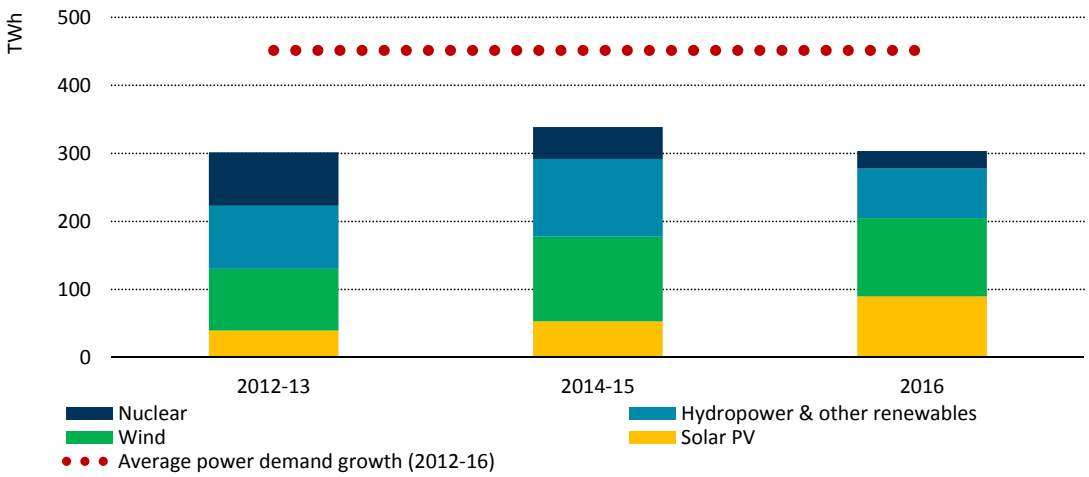
Main applications of world battery storage investment



The expansion of grid-scale batteries, which are used mainly for frequency regulation and demand shifting, will hinge on policies to reward additional capacity, flexibility and avoided grid cost services.

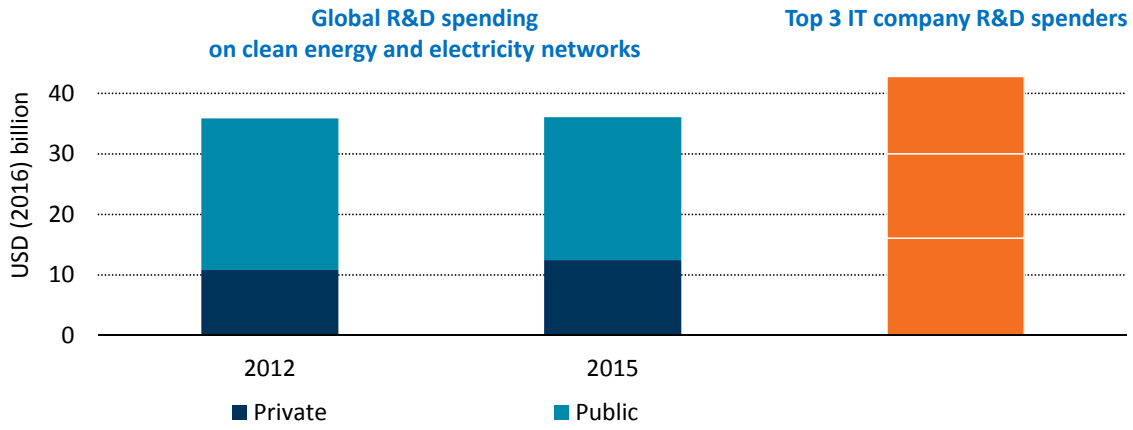
Globally, investment in clean power is not keeping pace with demand

Global expected annual power generation from final investment decisions



While the contribution of new solar PV and wind has grown nearly three-quarters in the past five years, FIDs for nuclear and hydropower have slowed. Clean power FIDs in 2016 generate at only two-thirds the level of power demand growth.

Global clean energy R&D funding needs a strong boost



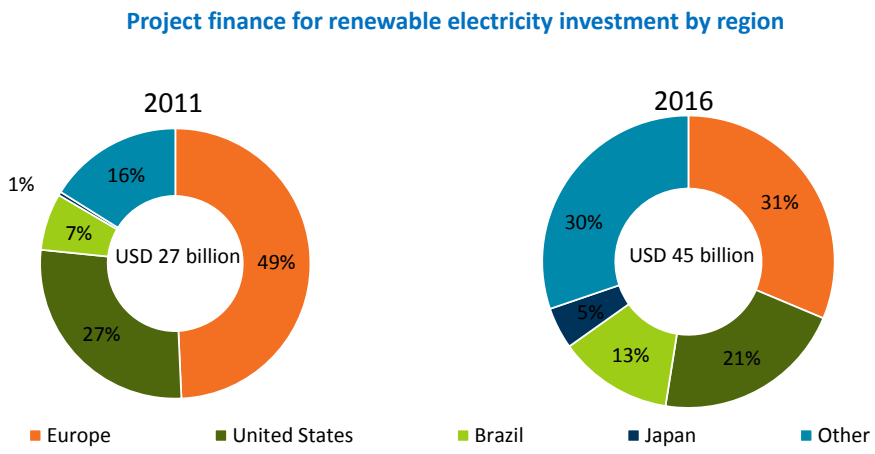
We've tracked a steady $37 billion/year of clean energy and electricity networks R&D spending, with room for growth from the private sector. As a share of GDP, China now spends most on energy R&D

Conclusions

- **Investment fell by 12% in 2016, a second consecutive year of decline, and electricity sector investment overtook oil, gas and coal investments combined**
- **An upswing of US shale investment is creating a two-speed oil market and triggering a rapid transformation of the oil and gas industry**
- **Although electricity investment remains robust, policies need to focus on maintaining supply adequacy, stimulating an acceleration of clean power and strengthening market signals for investment in flexibility**
- **The clean energy transition needs more R&D but energy R&D expenditures are stable; there is a lot of scope for increased spending on energy innovation by governments and, in particular, the private sector**
- **Investment decisions today will leave their mark on energy on energy infrastructure for decades to come; the IEA will continue to focus on investment as a cornerstone of a secure and sustainable energy system**

Backup slides

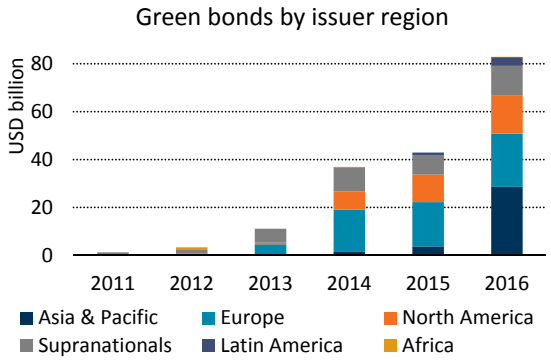
Project finance is growing, but mostly in the power sector

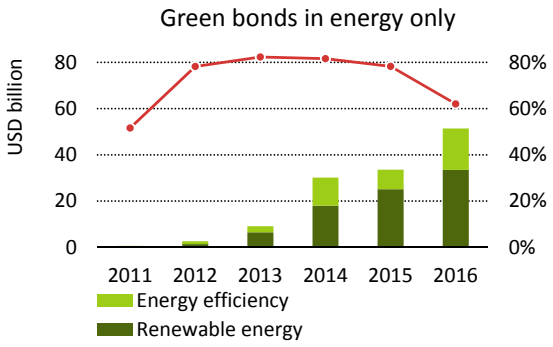


While project finance's share in energy investment is small, its use in renewable power has grown 60% in five years, reflecting lower project risk in some emerging economies and technology maturation.

Clean energy investments tapping into capital markets

Value of new green bonds by region and use of proceeds by energy sector





Growth in green bond issuance in China underpins rapid growth. At USD 50 billion in 2016, clean energy – renewables and energy efficiency – accounts for almost two-thirds of the use of proceeds.

Session I ：

Global Trends in Green Energy Market Development and Financing

G20 Energy Efficiency Investment Toolkit

Bio

As a Programme Officer at International Partnership for Energy Efficiency Cooperation (IPEEC), Ailin manages the coordination of IPEEC Task Groups and facilitates collaboration on energy efficiency between IPEEC's members and with the G20. She is part of the Secretariat of the Energy Efficiency Finance Task Group (EEFTG) and has been a co-author of its landmark project, the G20 Energy Efficiency Investment Toolkit, which launched at the G20 Energy Efficiency Forum in May 2017.

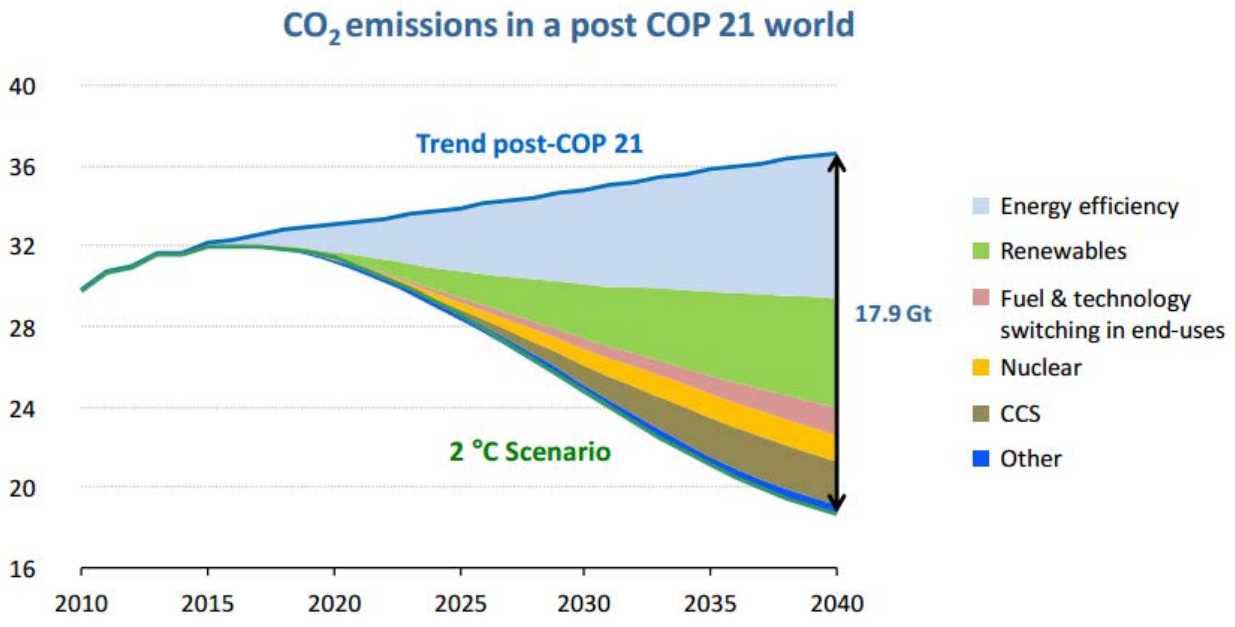
A Chinese German, Ailin has engaged closely with the Chinese and German G20 Presidencies. She previously worked on environmental policy at UNEP and also at environmental consulting firm EPEA on circular economy projects. She holds BSc and MSc degrees in Environmental Policy and Economics from the London School of Economics and the University of Oxford.

G20 Energy Efficiency Investment Toolkit

APEC Conference on Green Energy Finance Capacity Building
28-29th September, 2017, Taipei

Ailin Huang, IPEEC

Energy Efficiency First!



*Source: IEA (2016)

Key messages

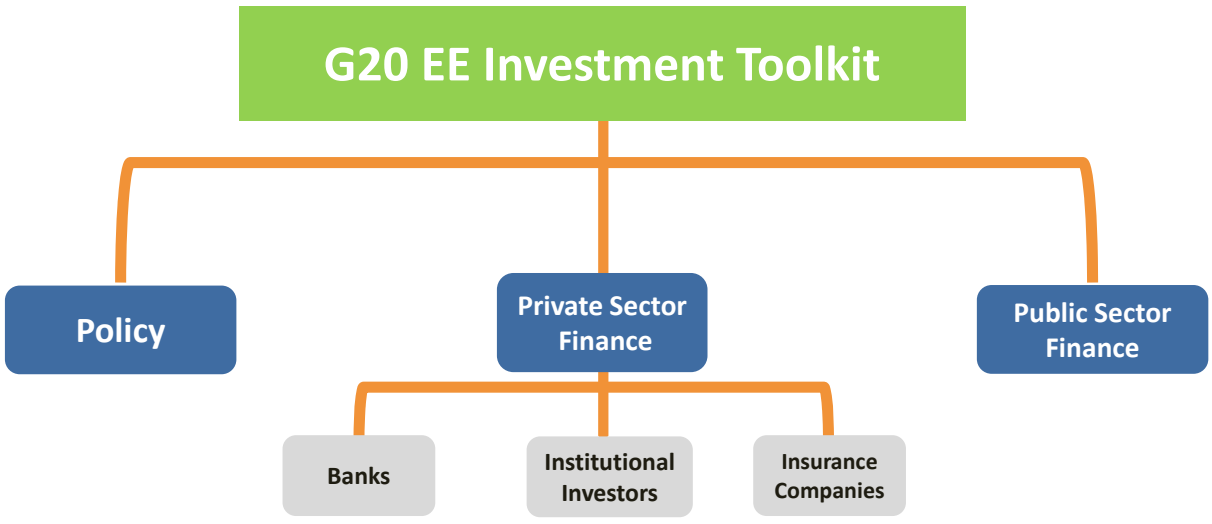
G20 Energy Efficiency policies, financing tools and best practices developed through the flexible and **collaborative architecture of this Toolkit** provide an **integrated approach** to enhancing capital flows towards EE.

Embedding EE in the investment processes through an **enabling policy framework** is key to accelerating **G20 energy intensity improvement.**

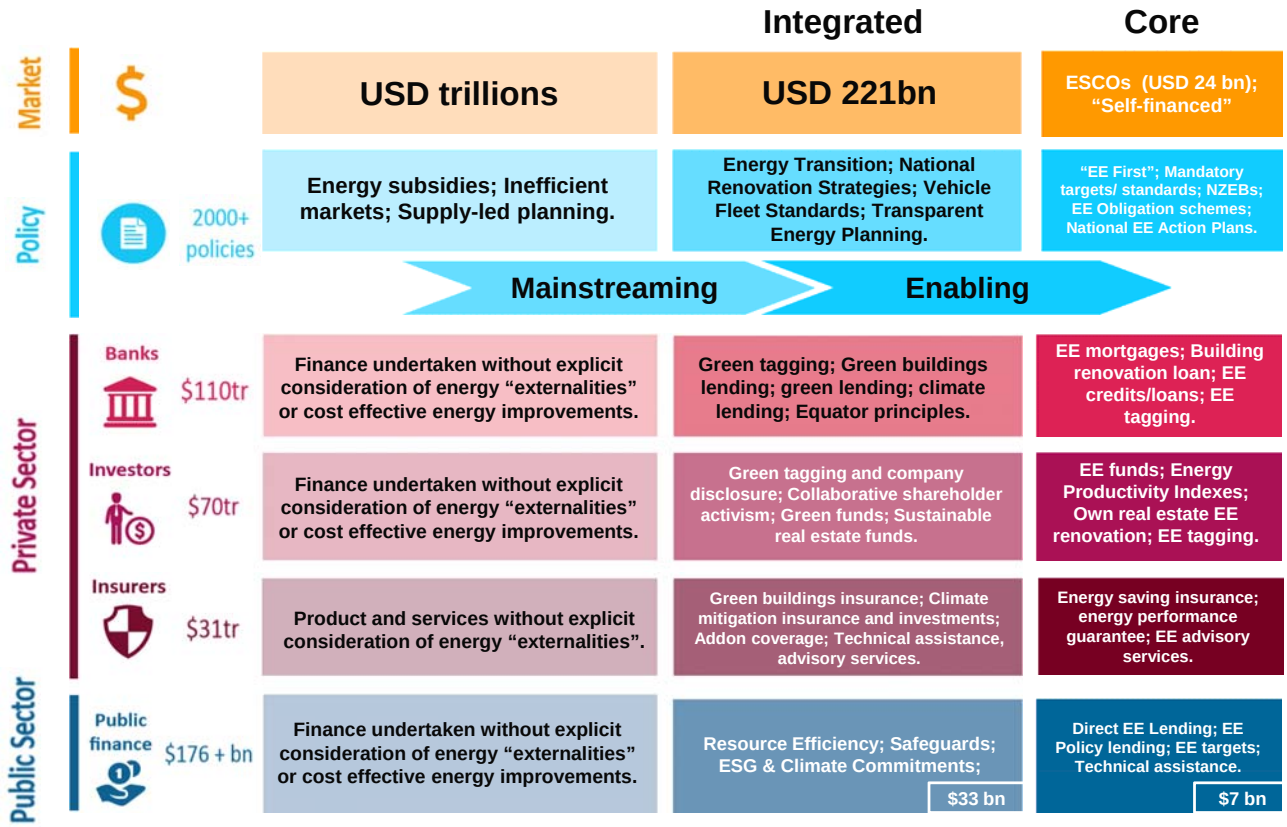
Improving the **visibility and tracking of asset energy performance** and integrating the multiple economic benefits of EE into regular finance products is key to unlocking allocation of capital from private financial institutions to EE.

Leveraging the experience and resources of **public financial institutions** to ensure **energy efficiency's central role** in the future of mobility, smart cities, energy grids, industry and infrastructure.

A Toolkit to scale-up Energy Efficiency Investments

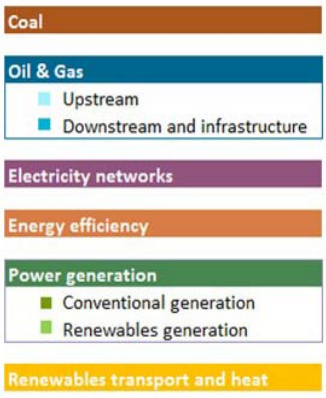


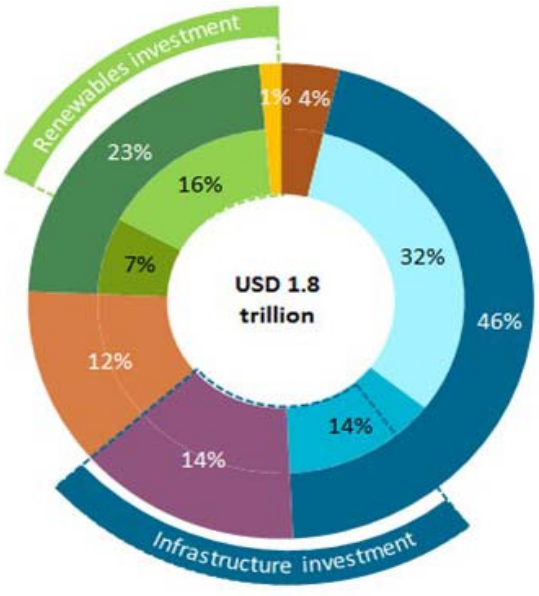
Moving towards an "Energy Efficient World" for the G20…



I. Market Tool: Assessment and Definition

Global Energy Investment 2015:



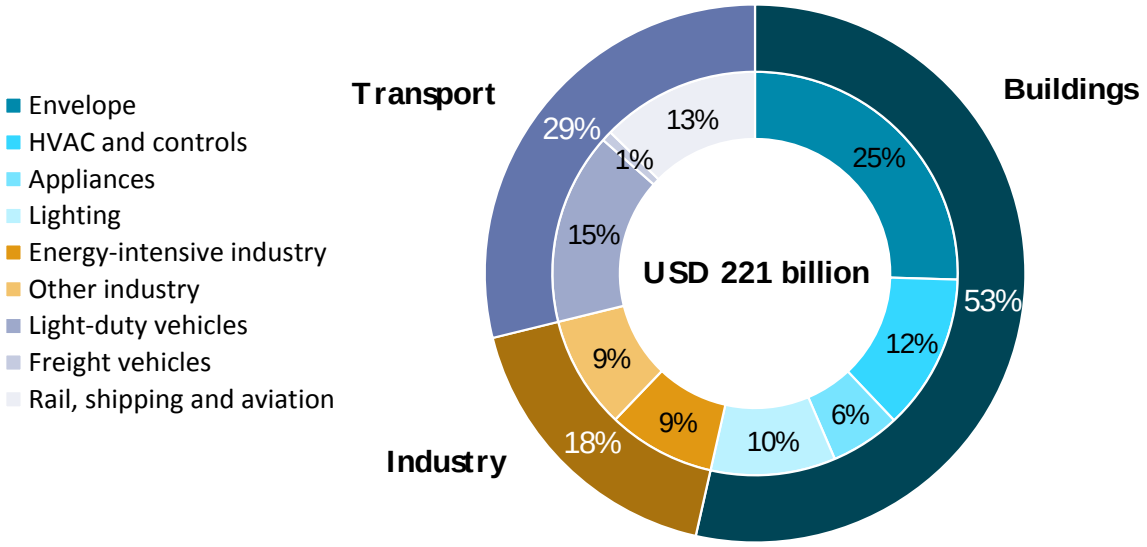


Investment in Energy Efficiency, Concepts:

- **Method 1, total spend:** Market size for energy efficient goods and technologies.
- **Method 2, incremental investment:** Additional investment needs that would lead to energy efficiency improvements above BAU levels.

I. Market Assessment

EE Investments by Sector 2015:



I. Defining the Energy Efficiency Premium

Consumer or business

To invest in:

Energy Efficient Equipment

Full cost can be divided into

1. Cost of a new but very standard and less efficient piece of equipment **(Base Cost)**

2. Cost of the added increments of energy efficiency

Energy Efficiency "Premium"

[or "discount"]

II. Policy Tools: Framework, Analysis and Progress

Policy Framework

- **G20 Energy Efficiency Investment Principles**

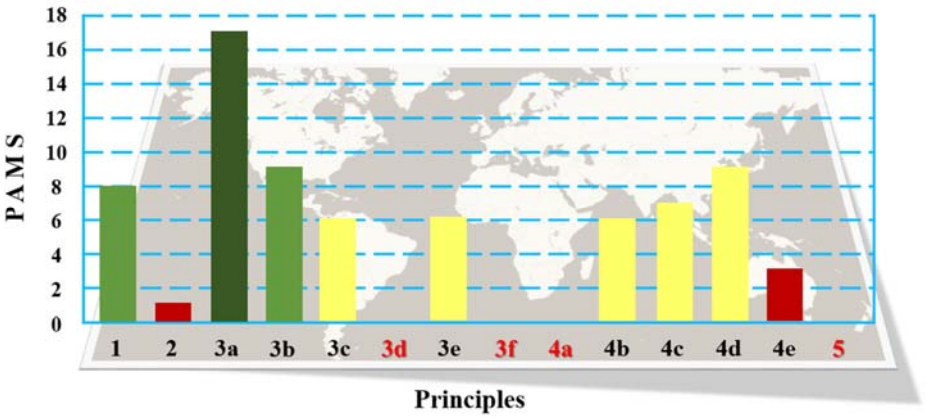
Analysis

- **Energy Efficiency Policy Databases and EEFTG Survey 2016**

Best practice

- **Case studies**

Monitoring Progress



II. Engagement

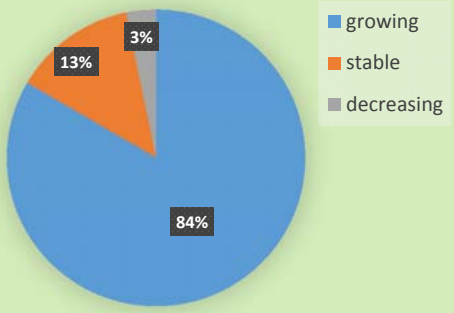
1. Supporting the development of an enabling national policy framework	2. Providing an engagement platform through its Technical Engagement Workshops	3. Exchanging knowledge of good practices
• Review of current policy framework again the voluntary Energy Efficiency Investment Principles; • Development of recommendations for improvement based on international good practices.	• Convening policymakers, financial institutions, project developers, and ESCOs; • Facilitating better understanding and improvement of domestic framework for energy efficiency finance.	• Sharing extensive international expertise with partners; • Gaining deeper country insights through exchange.

III. Private Sector Tools: Framework, Analysis, and Tools

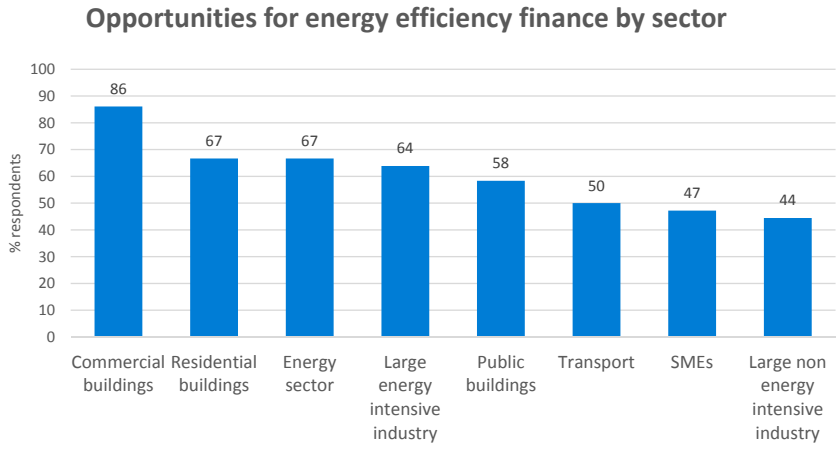
Framework	• **Declaration of Banks; Investor Statement**
Analysis	• **EEFTG/UNEP FI survey of banks; investor progress**
Best practice	• **Disclosure mechanisms, case studies, EE product and service portfolio**

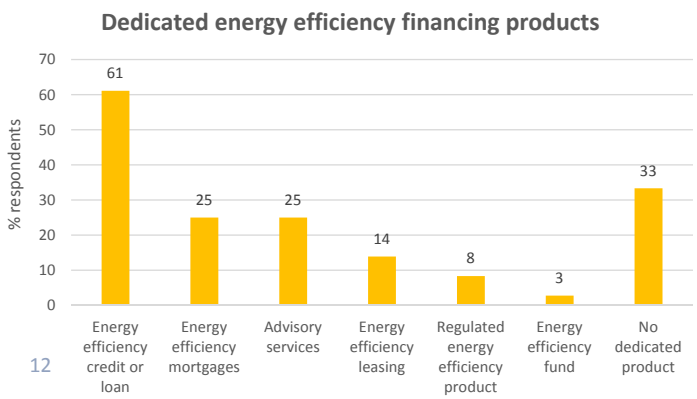
Key insights from financial institutions…

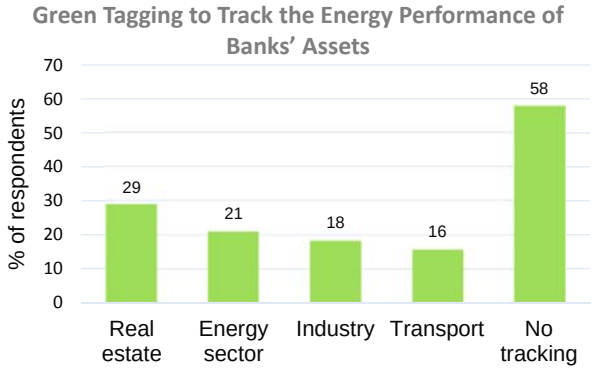
- Well-recognized opportunity
- Needs awareness raising and supportive policies
- Requires better tracking of energy efficiency finance



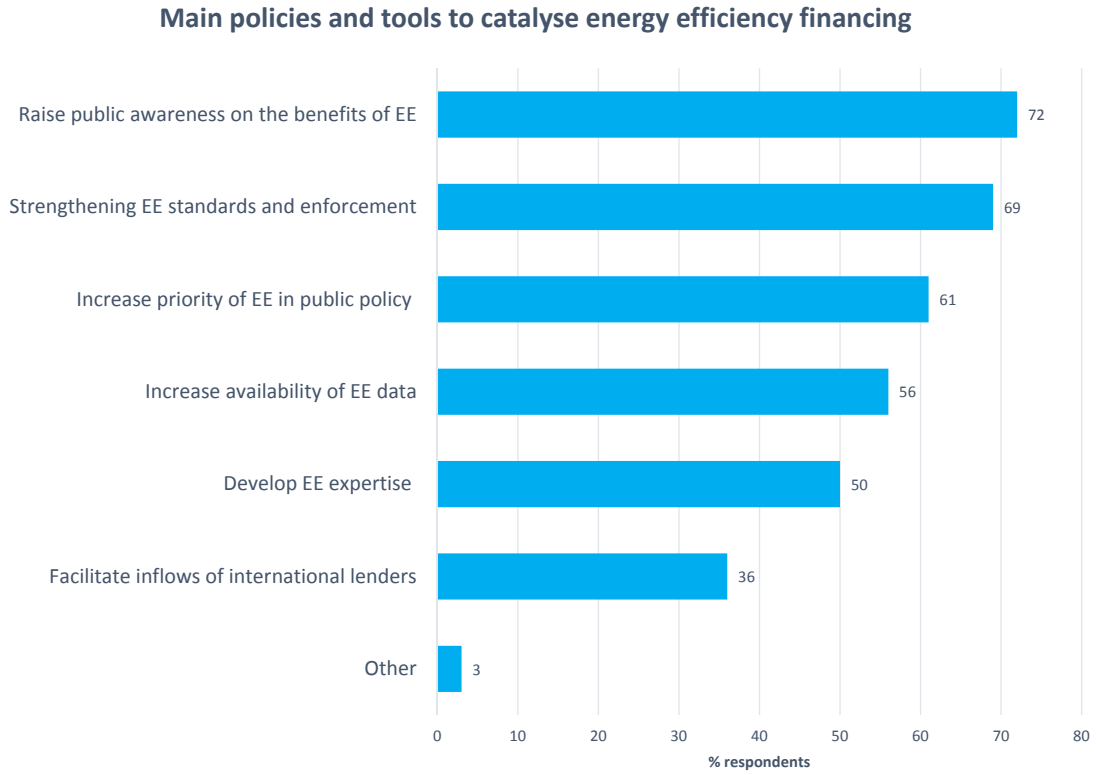
III. Zooming in on banks…







III. What banks need to scale up EE financing…



IV. Public Finance Tools: Joint Statement & Action Framework

Joint G20 Energy Efficiency Statement

1. **Increase policy-based lending** to support investment grade p**olicy frameworks** that require and **promote EE** and to drive **"life-cycle cost optimal**" procurement of public infrastructure and buildings
2. **Increasing** the amount, availability, simplicity and connectedness of **technical assistance/ project development assistance facilities**
3. **Lever multiple retail distribution mechanisms**
4. Encouraging **implementation of integrated planning** by **recognising energy efficiency's central role** in the future of mobility, smart grids and infrastructure

Framework of Action for Public Financial Institutions and Country Partners

No single stakeholder group can deliver the scale up of energy efficiency investment required on its own

The G20 EEI Toolkit provides:

Collaborative Architecture → **Value through network effect** → **Scale up of EE investments**

Thank You

G20 Energy Efficiency Finance Task Group
Contact: ailin.huang@ipeec.org
Information: ipeec.org/EEFTG

The Clean Energy Transition

Justin Wu, Head of Asia-Pacific, Bloomberg New Energy Finance

Justin has more than a decade of experience analyzing the development of renewable energy in Asia. He is a specialist in Chinese energy and environmental policy, clean energy trade and investment and electricity markets. From 2007 to 2011, he was based in Beijing as a senior analyst covering China's renewable energy industry. After moving to Hong Kong in 2011, he ran BNEF's Global Wind Insight service, where he helped developed a number of research products and analysis tools to serve the global wind industry. Since 2015, he became the Head of Asia-Pacific for BNEF, acting as the managing director for the company and responsible for all business development and research activities across the region.

Justin has been quoted extensively in international media and testified before the US Senate Committee on Energy and Natural Resources on competitiveness and collaboration between the US and China on clean energy in 2013. He is also a frequent contributor on Asian energy issues for Bloomberg radio and television.

A native of the Washington DC area, Justin holds a MS in Politics from the School of Oriental and African Studies at the University of London and a BS in International Politics and Economics from Georgetown University's Edmund A. Walsh School of Foreign Service.

Energy Trends in APEC

Kirsten Smith

Kirsten Smith is a visiting researcher at the Asia Pacific Energy Research Centre (APERC) based in Tokyo, Japan. The primary objective of APERC is to foster understanding amongst APEC economies of global, regional and domestic energy demand and supply trends, energy infrastructure development, energy regulatory reform, and related policy issues in view of the regional prosperity. APERC advocates rational energy policy formulation and enhances capacity building in energy research in the region.

She is responsible for Canadian energy policy and researches supply, investment and carbon pricing policy for the APEC 7th Edition Energy Demand and Supply Outlook. She is also involved in research and cooperative projects related to natural gas and LNG markets.

Prior to joining APERC, she worked on carbon pricing policy and the royalty regime review as part of the Economics and Markets team at the Alberta Department of Energy. She holds two bachelor's degrees from the University of Alberta in economics, political science and finance, and has previously worked on federal oil and gas carbon policy at Environment and Climate Change Canada.

APEC Energy Demand and Supply Outlook (4th-6th Editions)

Energy Trends in APEC

Kirsten Smith

September 2017

APEC Green Energy Finance Capacity Building, Chinese Taipei

APERC
Asia Pacific Energy Research Centre

APEC Asia-Pacific Economic Cooperation

1. Key Trends

APERC
Asia Pacific Energy Research Centre

Key trends in APEC

4th Edition (2009)

- Oil security is a major threat exacerbated by highly volatile oil prices and "peak oil"
- The long-term impacts of the 2008 economic crisis on capital-intensive production
- APEC intensity goals (-25% by 2030) will be met under business-as-usual (BAU)
- APEC region CO_2 emissions are expected to rise by about 40% between 2005 and 2030

5th Edition (2013)

- Oil security remains a major threat to the economies of the APEC region
- APEC's energy intensity goals will be met under the BAU (-45% by 2035)
- Business-as-usual is still environmentally unsustainable for UNFCCC targets
- Nuclear development slows down, but not by much

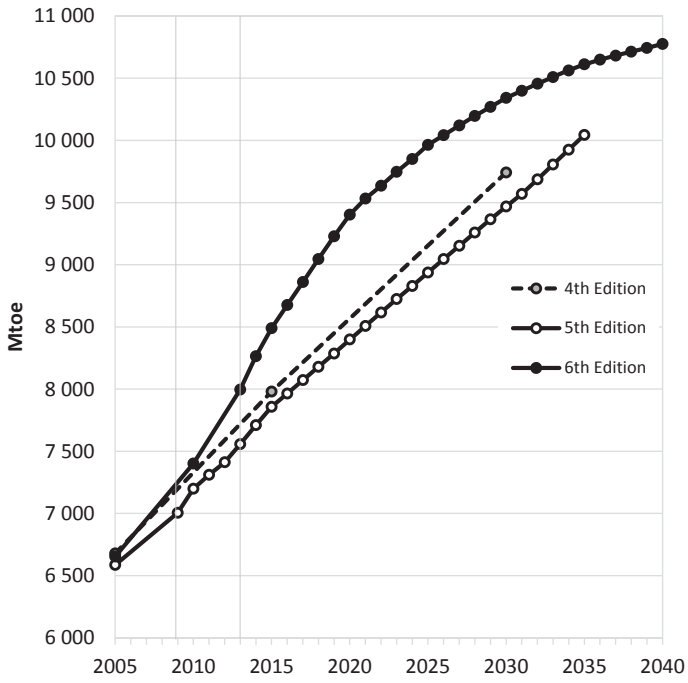
6th Edition (2016)

- China and South-East Asia drive APEC energy demand
- Renewables is the fastest growing energy source, but fossil fuels remain dominant
- APEC region energy supply gap widens
- CO_2 emissions continue rising as coal remains the largest power source

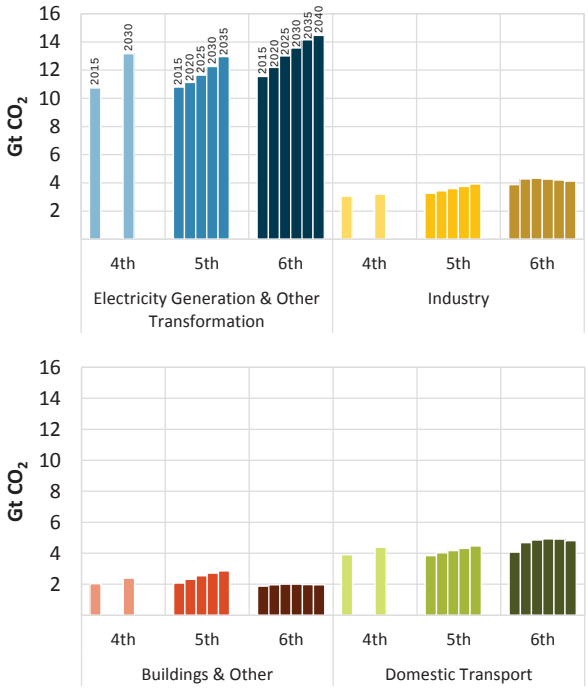
Note: All forecasts are from the APEC Energy Demand and Supply Outlooks, based on IEA data

Key trends in APEC

Total primary energy supply

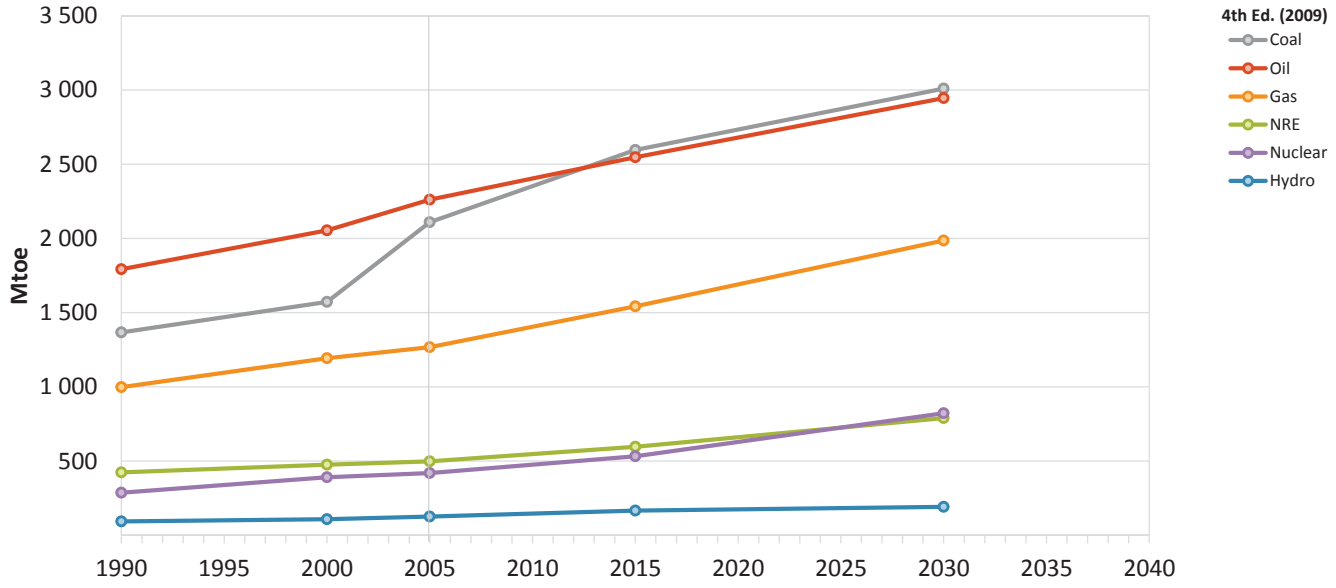


CO_2 emissions by sector



4th Edition (2009)

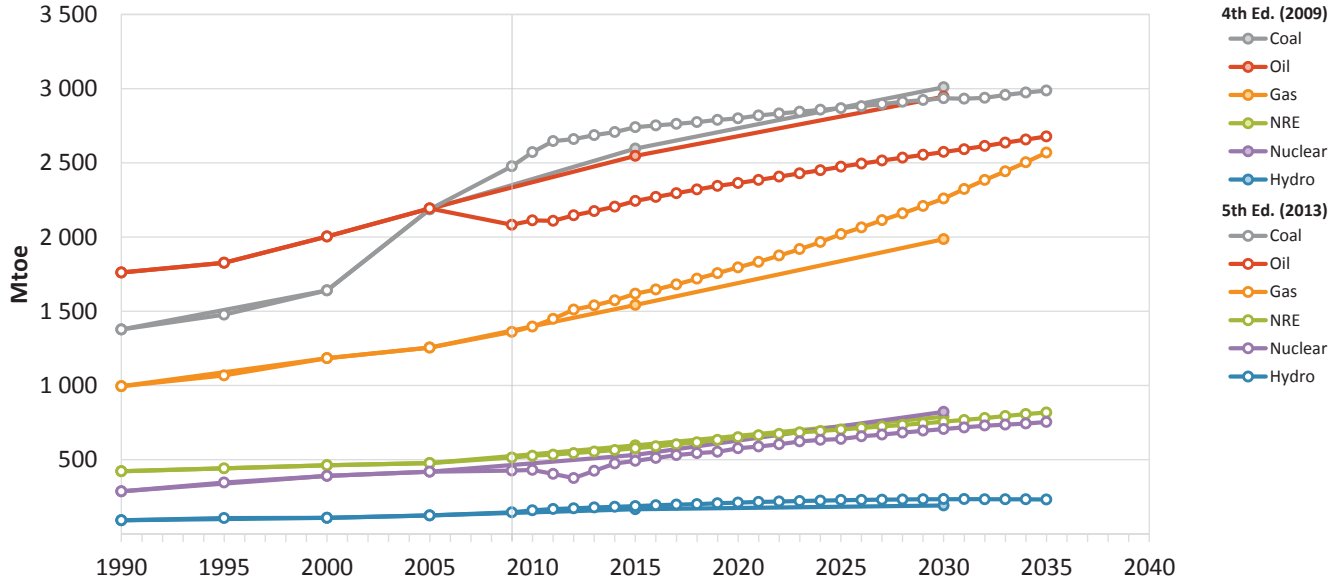
Total primary energy supply



- *Growth in coal-fired electricity demand*
- *Volatility from oil price shocks*
- *New technology for natural gas production*
- *Increased renewables potential in electricity and transport*
- *Limited growth in renewables for buildings*

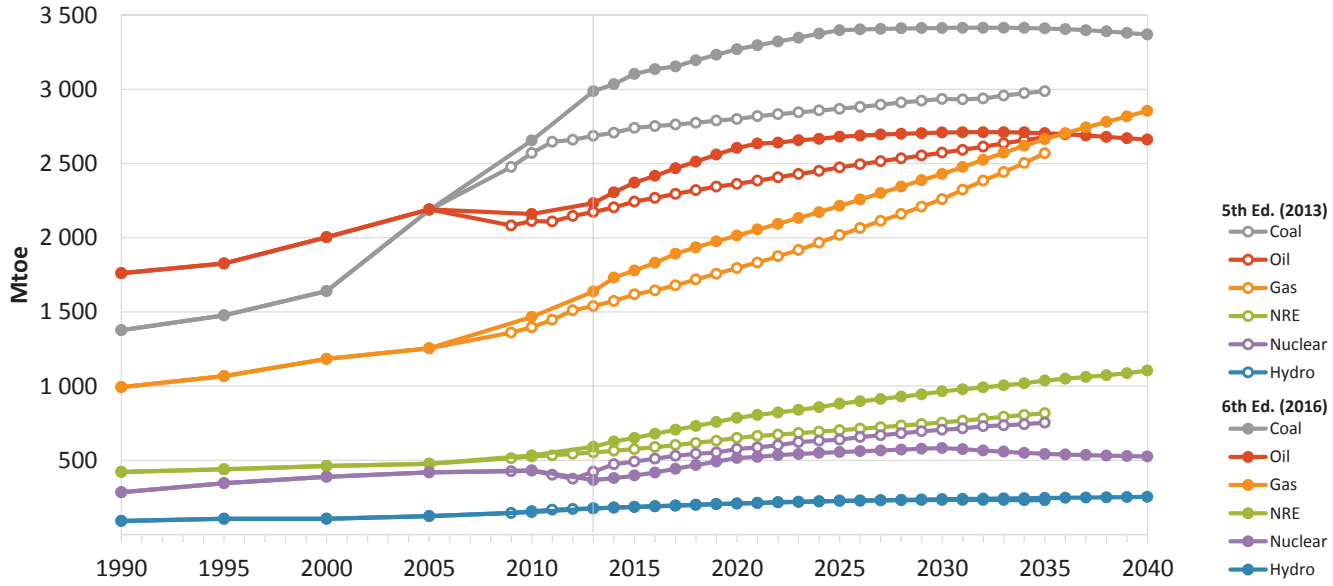
5th Edition (2013)

Total primary energy supply



- *Coal could be challenged by gas*
- *Threat to oil supply from underinvestment*
- *Gas potential has exceeded expectations*
- *Policy is driving growth in renewables*
- *Fukushima Nuclear Accident in 2011 dampens nuclear projections marginally*

Total primary energy supply



- *Coal growth driven by growing power demand*
- *Oil demand expected to peak*
- *Low gas prices spur fuel-switching*
- *Wind and solar dominate renewables growth with dramatically declining cost curves*
- *Further nuclear phase-out and retirements*

2. Renewables Trends

Renewables trends

4th Edition (2009)

- A new technology whose potential may be underestimated is solar photovoltaics (PV)
- New renewable energy (NRE) will see the largest percentage growth, 428 percent, from 2005-30
- Renewables grows quickly in the electricity and transport sectors, but fails to take off in the buildings and others sector

5th Edition (2013)

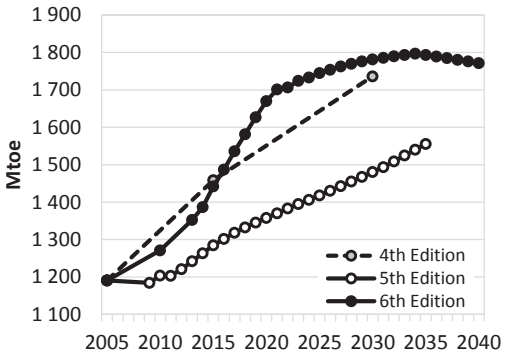
- Renewable energy policy and technological improvement that continue to reduce the cost and improve performance are promoting deployment
- Overall role of NRE remains modest under BAU assumptions, even in 2035

6th Edition (2016)

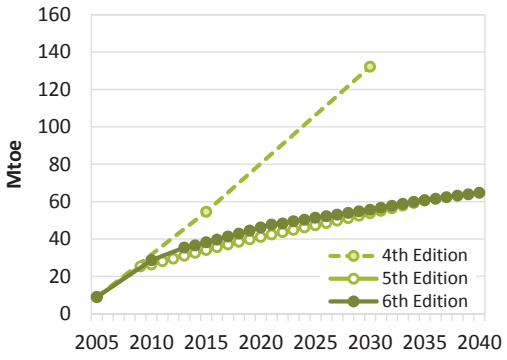
- From 1990 to 2013, for every 1 Mtoe of renewable energy added to TPES, 11 Mtoe of fossil fuels were added. By 2040, this falls to just 3 Mtoe for each toe of renewables
- Renewable energy demand under the BAU almost doubles. While all APEC economies expect to expand renewables, more than two-thirds of the increase occurs in China
- Total capacity of VREs increases to 30% of peak load in APEC

Transport sector

Total demand



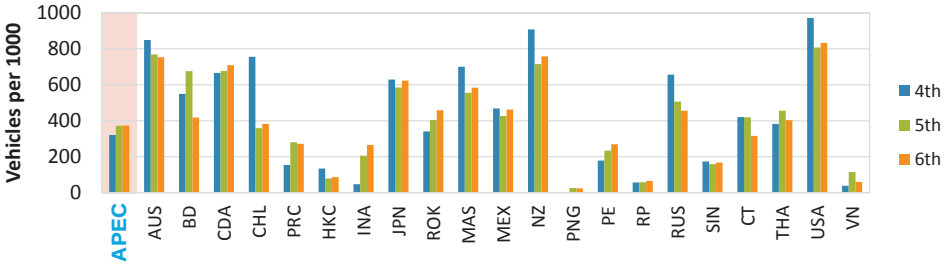
Renewables demand (biofuels)



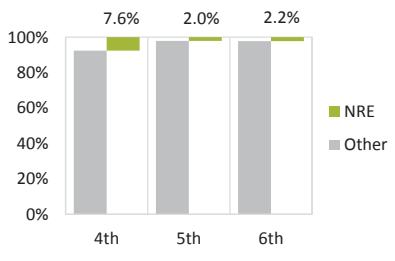
Growth is driven by increasing vehicle ownership and living standards in developing economies

Renewables assumptions based on current biofuels blend mandates and policy

Vehicle ownership per 1000 people, 2030

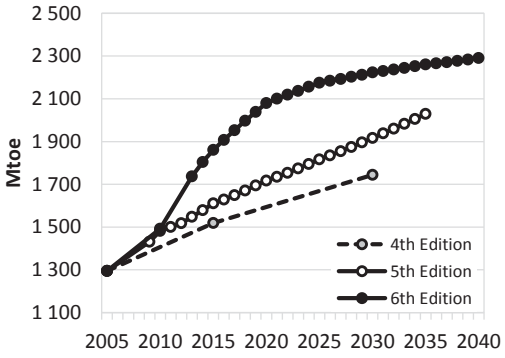


Renewables share, 2030

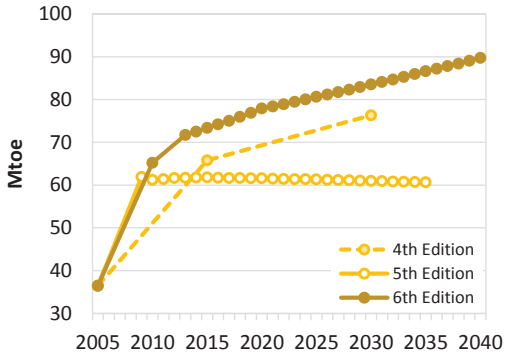


Industry sector

Total demand



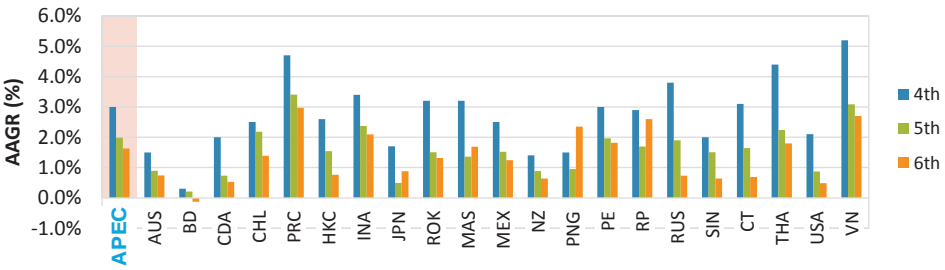
Renewables demand



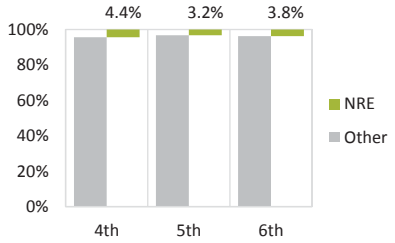
Typically the most difficult sector to decarbonize

Driven by economic activity assumptions

AAGR of GDP per capita, 2015-30

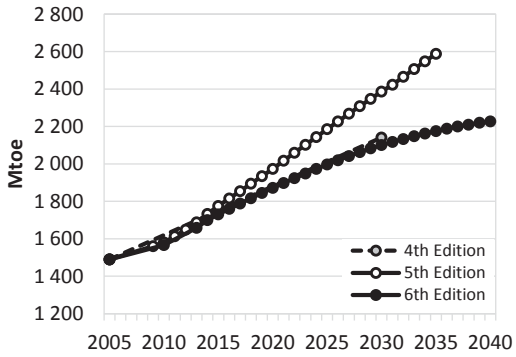


Renewables share, 2030

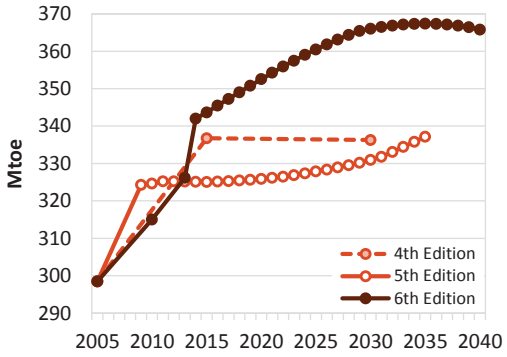


Buildings and others sector

Total demand



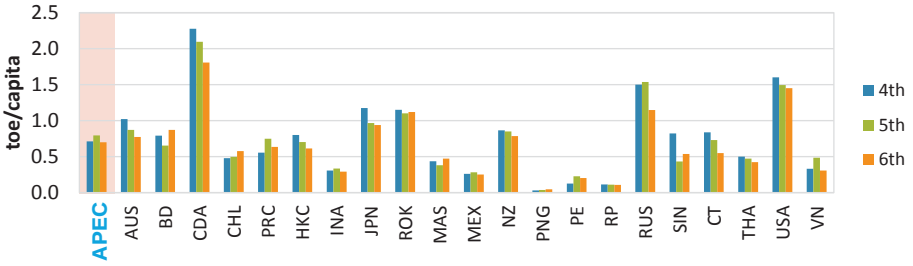
Renewables demand



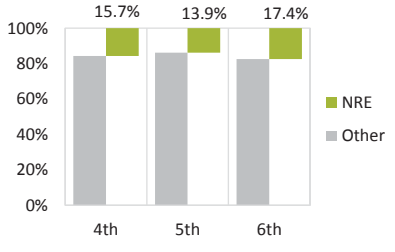
Cold, developed economies have the highest per capita energy demand

Renewables share persists with lack of access to modern fuels in some economies

Total demand per capita, 2030

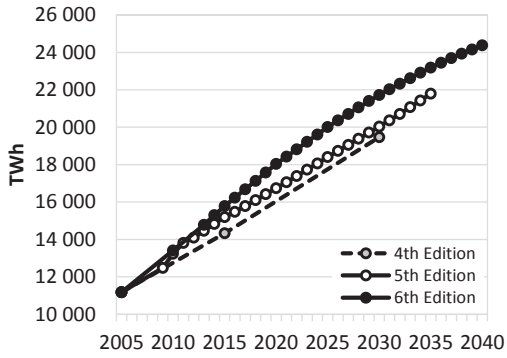


Renewables share, 2030

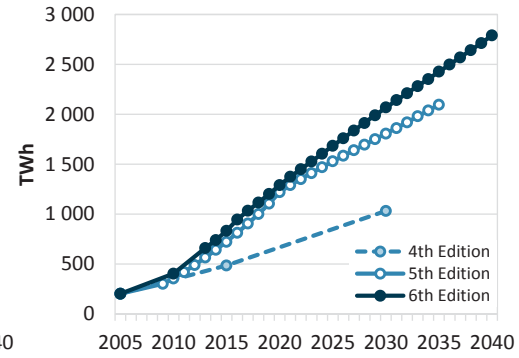


Electricity sector

Total generation



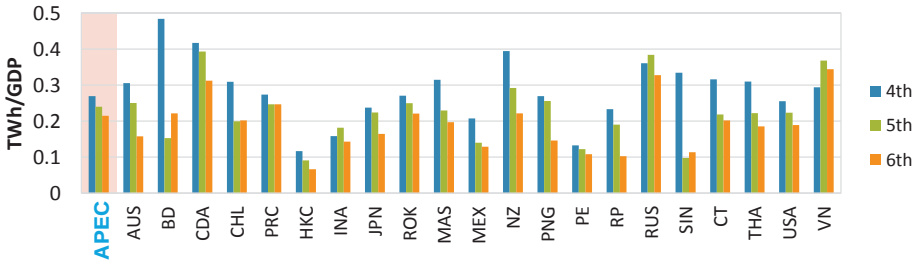
Non-hydro renewables generation



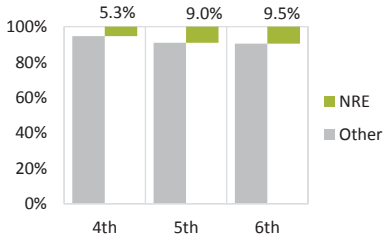
Declining costs for renewable generation and preferential policy treatment

Peaking of electricity demand in some economies

Total generation per GDP, 2030



Non-hydro renewables share, 2030



3. Investment Trends

APERC
Asia Pacific Energy Research Centre

Investment trends

4th Edition (2009)

- According to the IEA, energy investment is expected to drop sharply in 2009 compared with 2008: by 21% for upstream oil and gas, 40% for coal, and 38% for renewables
- Given the long lead times required by energy projects, these cutbacks pose a risk that energy supplies could be inadequate as the global economy recovers
- APEC governments will need to tread wisely to insure that an adequate flow of energy investment is maintained, while avoiding unnecessary expenditure





6th Edition (2016)

- Renewables account ~50% of the investment in power generation capacity
- The current low oil price could have a significant effect on upstream investment, particularly for oil and gas as many companies are reacting to the low oil price by reducing capital expenditure
- The costs of onshore wind have dropped by 18% since 2009, while cost of wind turbines has decreased by nearly 30% since 2008
- Solar PV modules costs have declined by 80% since 2008 and are projected to keep falling

3. Policy Implications

APERC Asia Pacific Energy Research Centre

Policy implications

- When organizations forecast energy supply and demand futures, especially over long (50-100 year) time horizons, there tends to be an extrapolation of current trends forward
- Understanding where current trends have diverged from previous forecasts is necessary to understanding where new trends might take us
- Very long-term forecasting is essential in evaluating current policy direction trajectories and assessing adequate levels of ambition for decarbonisation
- The 7th Edition APEC Energy Demand and Supply Outlook will be released in 2019 and will assist economies in addressing their future UNFCCC NDCs

Thank you for your kind attention

http://aperc.ieej.or.jp/

APERC Asia Pacific Energy Research Centre

Session II：
Facilitating Green Energy Finance

Scaling up Investments in Energy Efficiency

Brief Curriculum Vitae

Jennifer Romero-Torres is a Senior Finance Specialist (Energy) in the Asian Development Bank's East Asia Regional Department. She has worked on major investment projects, technical assistance and knowledge management related to infrastructure financing, financial and capital markets development in South Asia, and more recently in East Asia. Prior to ADB, she has also worked on corporate and structured finance, institutional banking, credit, and management consultancy for major international investment banks and global advisory firms. Ms. Romero-Torres is a national of Australia. She holds postgraduate degrees, including a Master of Applied Finance from the University of Melbourne, Australia.

PROFESSIONAL EXPERIENCE

ASIAN DEVELOPMENT BANK – Current

Senior Finance Specialist

East Asia Energy Division

Led several investment loans, grants, technical assistance, and knowledge management involving infrastructure financing, public private partnership, financial sector and capital markets development, local currency financing and SMEs in India, Bangladesh, Nepal, Bhutan, Maldives and Sri Lanka.

Has recently moved to East Asia Regional Department and is involved in financing and regional cooperation related to energy projects in China and Mongolia.

BOS INTERNATIONAL (AUSTRALIA) LIMITED (HBOS GROUP), SYDNEY AUSTRALIA (2004 –2007)

Senior Manager, Corporate & Structured Finance

Responsible for origination, execution and syndication of acquisition finance / leveraged transactions tailored for private equity clients in the LBO/MBO market in addition to other complex corporate financing transactions. Worked on several major leveraged finance transactions, refinancing and IPO transactions in Australia and New Zealand.

AUSTRALIA AND NEW ZEALAND BANKING GROUP (SYDNEY, AUSTRALIA) (2003-2004)

Manager, Corporate and Institutional Banking

Responsible for credit and risk management, including the preparation of credit memorandum, portfolio review and monitoring of various corporate and institutional investments.

ERNST & YOUNG TRANSACTION ADVISORY SERVICES (SYDNEY, AUSTRALIA) (2001–2002)

Senior Consultant, Corporate Finance

Worked on major transaction advisory engagements relating to public float, vendor and acquisition due diligence, and public private partnership.

EDUCATION

Master of Applied Finance, The University of Melbourne

Master of Business Administration (with Distinction) and

Bachelor of Science in Commerce (US Institute of International Education Starr Foundation Scholar), De La Salle University

Facilitating Green Energy Finance – Risk Management and Financial Modelling

Peter Knott is a Managing Director in the Green Investment Group at Macquarie Capital based in the United Kingdom. Prior to the acquisition of UK Green Investment Bank plc by the Macquarie Group in August 2017, Peter was the Chief Financial Officer and Executive Director, having originally joined on the launch in 2012 as the Chief Risk Officer. Prior to that, Peter had held a number of senior roles at Standard Chartered, including Group Treasurer, Consumer Banking Group Chief Risk Officer and Group Head of Operational Risk. He qualified as a Chartered Accountant with Deloitte in London and spent the early part of his career with Jardine Fleming in Hong Kong and Tokyo before moving to New York with JPMorgan Chase as CFO for the Global M&A and Investment Banking Coverage groups.

He is an Advisory Board member at the Centre for Climate Finance and Investment at Imperial College Business School.

Facilitating Green Energy Finance – Risk Management and Financial Modelling

APEC Conference on Green Energy Finance Capacity Building

28-29 September 2017

Peter Knott
Managing Director
Green Investment Group

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UK Green Investment Bank ("GIB") - Introduction

GIB is a case study of how private capital has been mobilised alongside public capital to invest in renewable energy

- Established to meet public policy objectives and accelerate the UK's transition to a green economy
- Double bottom line – green and profitable
- Strong risk management has enabled a well-diversified portfolio
- A team of Green Infrastructure investment specialists has been built
- An innovative investment strategy has been adopted
- Active project and portfolio management has enhanced value
- The cost of capital for renewable energy projects has reduced

Established to meet public policy objectives

We were established to accelerate the UK's transition to a green economy

UK objectives:

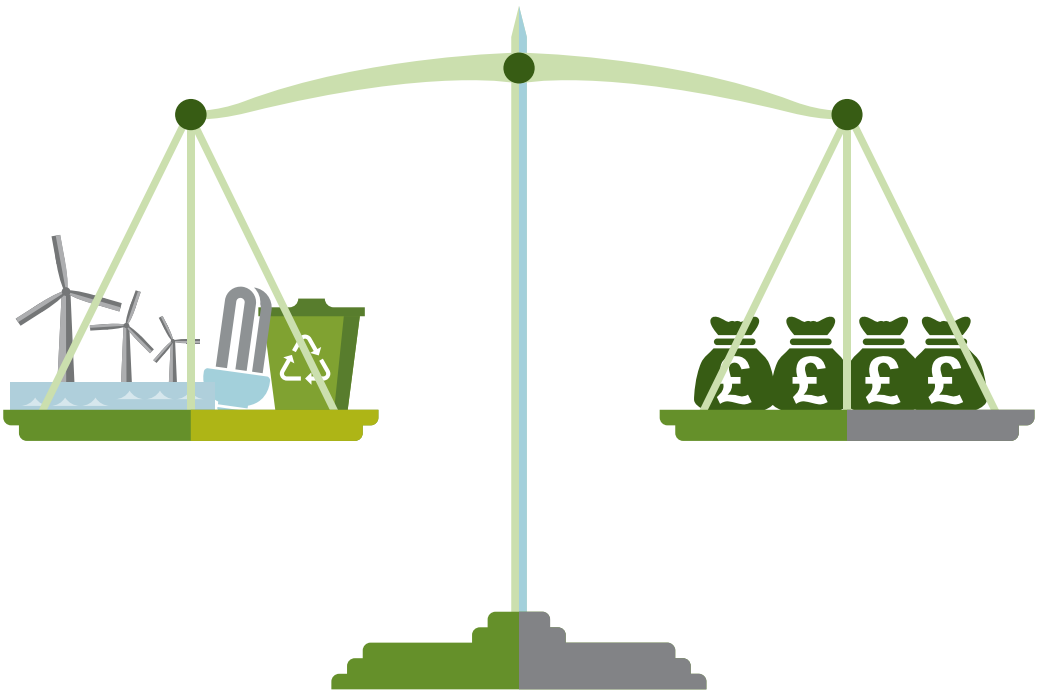
Reduction in **Greenhouse Gas Emissions**

Increase in proportion of **renewable energy**

Reduction in **biodegradable waste to landfill**

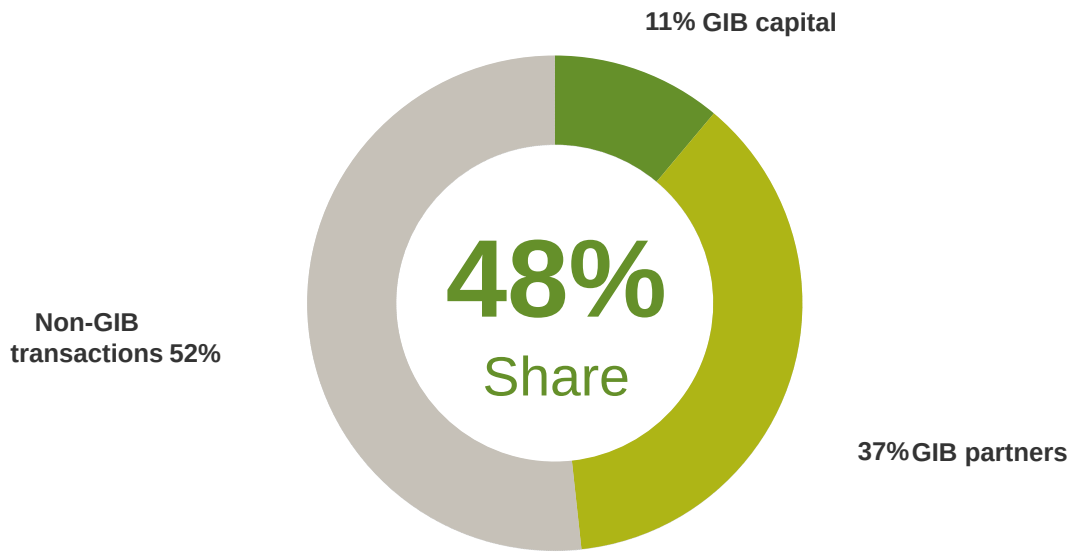
Notes: 1) vs 1990 levels; 2) from 3% in 2010; 3) vs 1995 levels;

Double bottom line – green and profitable



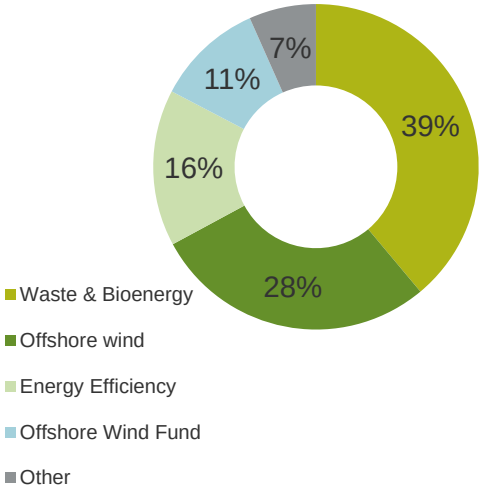
We are an important part of the UK's green economy

Market share (FY13-FY16)

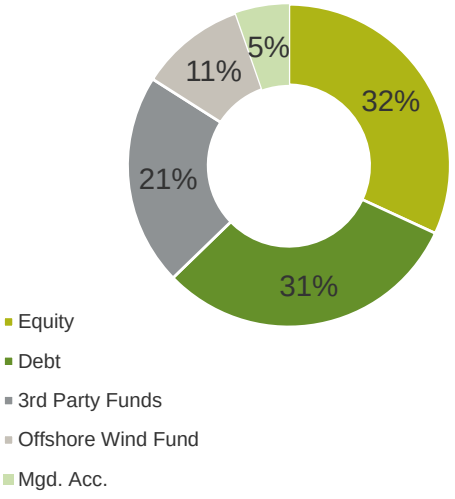


Built a diversified portfolio

Across renewable energy sectors…



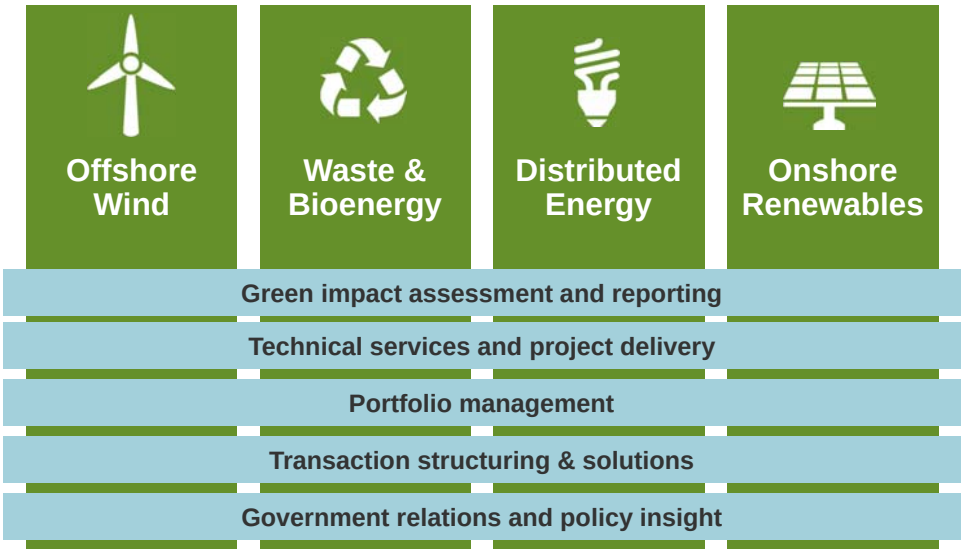
… and across the capital structure.



… we were involved in **64%** of the transactions in our markets in 15/16

A centre of excellence in green energy

Europe's largest team of green infrastructure investment specialists



A leader in UK offshore wind

Over £2.2bn of capital committed over 4 years through innovative transaction structures and products

Completed Transactions	Product	Phase	GIB Investment	Partners		Innovation
Lincs	Equity	Operational	£681m	DONG energy		
Lynn and Inner Dowsing	Equity	Operational	£242m	EIG, BlackRock, centrica	1st	✓ 100% owned by non-utility investors
Galloper	Equity	Construction	£119m	RWE, SIEMENS	1st	✓ Construction-ready offshore wind project finance deal
Rampion	Equity	Construction	£306m	E.ON, ENBRIDGE	1st	✓ Construction financing at FID
Offshore Wind Fund	Fund	Operational	N/A		1st	✓ Offshore wind fund raising £1bn
Sheringham Shoal	Equity	Operational	£240m	Statoil, Statkraft		
Westermost Rough	Equity	Construction	£241m	Marubeni, DONG energy	1st	✓ Holdco financing in construction
Gwynt y Môr	Equity	Construction	£220m	RWE		
London Array	Debt	Operational	£59m	SMBC, kfw, SIEMENS, Bank of Tokyo-Mitsubishi UFJ		
Greencoat[1]	Fund	Operational	£50m	London Stock Exchange, SSE	1st	✓ Listing of OSW asset on the LSE
Rhyl Flats	Equity	Operational	£57m	GREENCOAT UK WIND		
Walney	Debt	Operational	£46m	Lloyds Banking Group, Santander, RBS, SIEMENS	1st	✓ Holdco re-financing minority stake
Total			**£2,261m**			

Notes: 1) Greencoat deal was committed by BIS and comprised a mix of onshore and offshore assets. The transaction was supported by GIB.

Oversight of more turbines than any other UK investor

More than 880 WTGs equating to over 3.3 GW of gross capacity

A. Walney
- Senior debt, operational financing
- 102 X 3.6 MW Siemens WTGs, 367.2 MW

B. Rhyl Flats
- 24.95% equity stake, operational investment
- 25 X 3.6 MW Siemens WTGs, 90 MW

C. Gwynt y Mor
- 10% equity stake, pre-CoD investment
- 160 X 3.6 MW Siemens WTGs, 576 MW

D. Westermost Rough
- 25% equity stake, construction investment
- 35 X 6 MW Siemens WTGs, 210 MW

E. Lynn and Inner Dowsing
- 61% equity stake, operational investment
- 54 X 3.6 MW Siemens WTGs, 194.4 MW

F. Lincs
- 75% equity stake, operational investment
- 75 X 3.6 MW Siemens WTGs, 270 MW

G. Sheringham Shoal
- 20% equity stake, operational investment
- 88 X 3.6 MW Siemens WTGs, 316.8 MW

H. Galloper
- 25% equity stake, FID construction investment
- 56 X 6 MW Siemens WTGs, 336 MW

I. London Array
- Senior debt, operational financing
- 175 X 3.6 MW Siemens WTGs, 630 MW

J. Rampion
- 25% equity stake, FID construction investment
- 116 X 3.45 MW MHI-Vestas WTGs, 400.2 MW

Innovative investment strategy

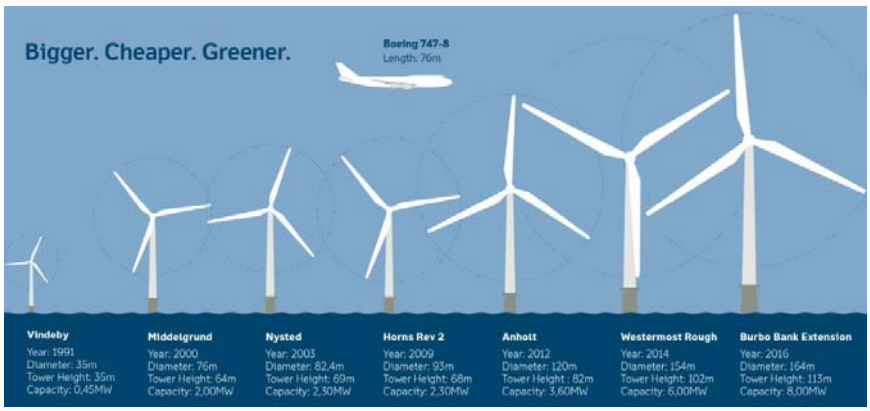
The largest dedicated regulated renewable energy fund in Europe

c. £1.1bn assets under management with investment in six assets

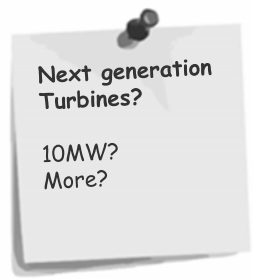
Fund Size	• £1bn target • GIB commitments of £200m • Total fund capital of £1.12bn, together with co-invest commitments
Investors	• Insurance company • UK Pension Funds • Sovereign Wealth Fund
Assets	• Six assets totalling 1.45 GW • Equity stakes in UK OSW unlevered operating assets
Fund Team	• Dedicated team of professionals with extensive experience in renewable energy investing • Access to GIB's team of experts and investment platform

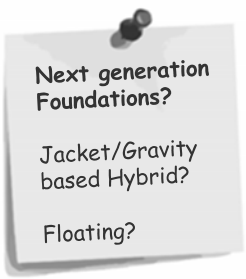
Innovation in offshore wind

Turbines to step up to 10MW or more…



Source: Dong Energy

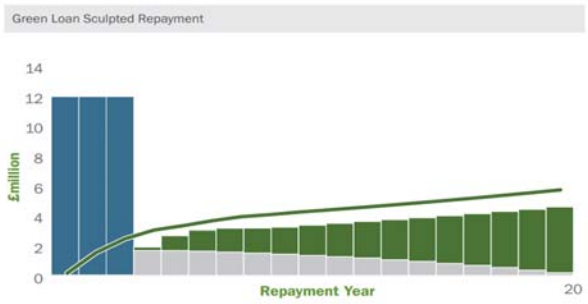




Innovations in investment approach

Green Loan continues a success story in street lighting projects

- The Green Loan is a flexible financing product, designed for public sector energy efficiency projects
- Debt repayments are profiled to match the forecasts of savings



Green Loans issued

Glasgow City Council; southend on sea Borough Council; Stirling Council; Kent County Council; London Borough of Barking & Dagenham lbbd.gov.uk

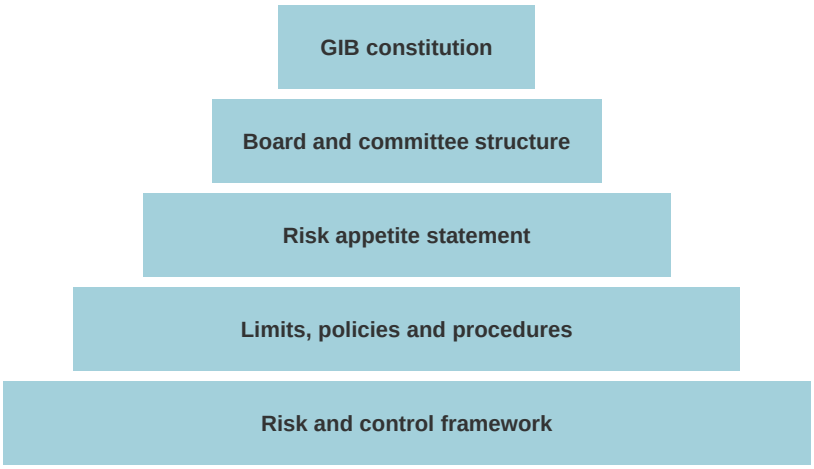
Established a robust framework for risk management

Risk Management Framework – key principles:

- Strong and transparent governance
- Sound risk management with clear identification of risk vs reward
- Risk appetite clearly stated
- Three lines of defence with clear accountabilities
- Meeting world-class standards

Risk management framework

The starting point was to establish strong foundations for an effective framework



GIB constitution (Aug 2012 - July 2017)

UK statute
- GIB is "designated" by Enterprise and Regulatory Reform Act 2013
- 5 Green Purposes

GIB constitution
- Articles of Association
- Shareholder Relationship Framework Document
  - Sectors
  - Responsible Investor
  - Sound Finance
  - Enduring institution
  - Additionality (mobilisation)
  - Portfolio rate of return (3.5%)
  - No borrowing

GIB

State aid
- Sectors
- Products
- MEIP
- Additionality (no "crowding out" of competitors)

GIB policies
- Green
- Risk Policies
- Compliance Policies

Other legal requirements
- Financial Services & Markets Act
- Data Protection
- Freedom of Information
- Public Procurement

Board and committee structure

Executive Committees

Investment
Portfolio
Management
Risk & Compliance

PLC Board

Board Committees

Audit & Risk
Remuneration
Nomination
Valuation
Chair's

Chair
2 Executives Directors – CEO and CFO
8 Non-Executive Directors

Risk appetite statement

Defined for each major risk type

- Investment
- Operational
- Green
- Liquidity
- Reputational

Defines limit-setting and clear escalation process

Risk management framework

GIB Policies

Risk	Compliance	Operations	Finance	Green	HR
Risk Rating	Business Partner Suitability & Financial Crime	Business Continuity Planning	Travel and Expense	Corporate Environment	HR
Operational Risk	Conflicts of Interest	External Communications	Taxation Matters	Green Investment	Remuneration
Credit Risk	Market Abuse and Personal Account Dealing	Freedom of Information	Accounting	Responsible Investment	Code of Conduct
Market Risk	Anti-Bribery and Corruption (incl Gifts & Hospitality)	Information Security Management			Health and Safety
Reputational Risk		Record Keeping and Data Protection			
Models					
Enhanced Monitoring					
Stress Testing					

All employees are responsible for understanding and complying with GIB policies

Risk and control framework

Are we operating within risk appetite?

- Identification
- Assessment
- Acceptance
- Monitoring
- Reporting

Credit / investment risk

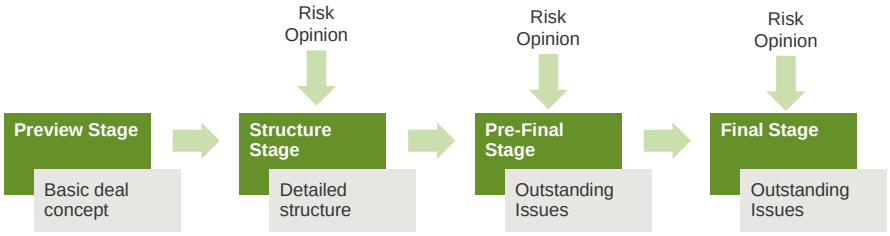
Starting point

- Idiosyncratic assets
- Small portfolio and no history
- Financial models to understand value drivers and sensitivities
- Complex technical, operating and contractual risks:
  - Challenging offshore operating environment
  - Evolving technology
  - Dependency on many partners
  - Complex legal contracts

Credit / investment risk

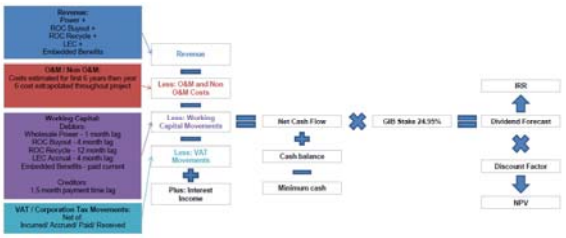
Current framework

- Portfolio concentration / diversification – limit setting and exposure monitoring
- Embedding of Risk Oversight in Transaction / Investment Committee Process:



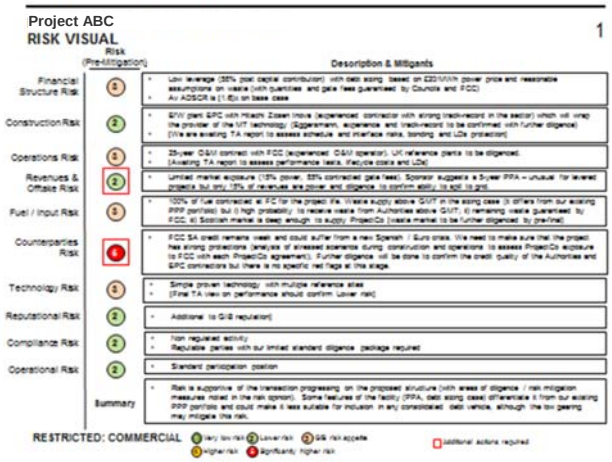
- Monthly Monitoring of Project / Valuation Status:

- Supported by Deal Models and Models Governance:



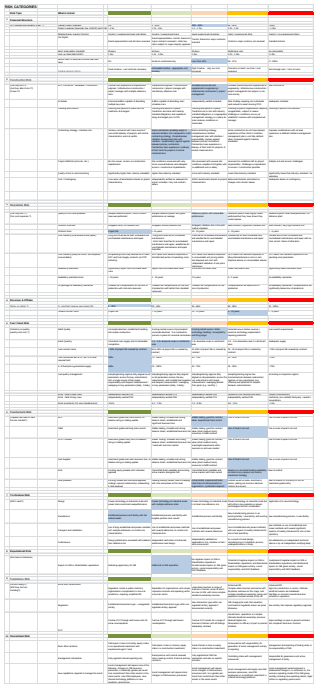
Risk assessment summary

Risk utilise different tools to assess and report investment/credit risk across the different product types; **equity, debt and funds**


Project ABC
RISK VISUAL
1

	Risk (Pre-Mitigation)	Description & Mitigants
Financial Structure Risk	1	• Low leverage (35% post capital contribution) with debt sizing based on £20/MWh power price and reasonable assumptions on opex (with quantities and gas fees guaranteed by Councils and FCC) • Av. ADSCR is [1.4]x on base case
Construction Risk	2	• EPW plant EPC with Hitachi Zosen Inova (experienced contractor with strong track-record in the sector) which will wrap the provider of the WT technology (Siggenerator, experience and track-record to be confirmed with further diligence) • [We are awaiting TA report to assess schedule and interface risks, bonding and LDs protection]
Operations Risk	1	• 25-year O&M contract with FCC (experienced, O&M operator), UK reference plants to be diligenced. • [Awaiting TA report to assess performance tests, lifecycle costs and LDs]
Revenues & Offtake Risk	2	• Limited market exposure (15% power, 33% contracted gate fees). Sponsor suggests a 5-year PPA – unusual for levered projects but only 15% of revenues are power and diligence to confirm ability to get one.
Fuel / Input Risk	1	• 100% of fuel contracted at FC for the project life. Waste supply above GMT in the sizing case (it differs from our existing PPP portfolio) but i) high probability to receive waste from Authorities above GMT, ii) remaining waste guaranteed by FCC, iii) Scottish market is deep enough to supply ProjectCo [waste market to be further diligenced by pre-final]
Counterparties Risk	4	• FCC SA credit remains weak and could suffer from a new Spanish / Euro crisis. We need to make sure that the project has strong protections (analysis of stressed scenarios during construction and operations to assess ProjectCo exposure to FCC with each ProjectCo agreement). Further diligence will be done to confirm the credit quality of the Authorities and EPC contractors but there is no specific red flags at this stage.
Technology Risk	1	• Simple proven technology, with multiple reference sites • [Final TA view on performance should confirm Lower risk]
Reputational Risk	2	• Additional to GIB reputation]
Compliance Risk	2	• Non regulated activity • Regulable parties with our limited standard diligence package required
Operational Risk	2	• Standard participation position
Summary		• Risk is supportive of the transaction progressing on the proposed structure (with areas of diligence / risk mitigation measures noted in the risk opinion). Some features of the facility (PPA, debt sizing case) differentiate it from our existing PPP portfolio and could make it less suitable for inclusion in any consolidated debt vehicle, although the low gearing may mitigate this risk.

RESTRICTED: COMMERCIAL 1 Very low risk 2 Lower risk 3 GIB risk appetite 4 Higher risk 5 Significantly higher risk ☐ Additional actions required



Green risk

Current framework

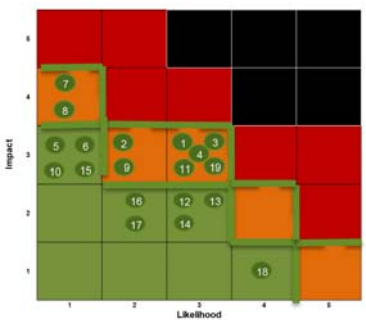
Green handbook and associated tools:

Quantification of CO_2 savings:

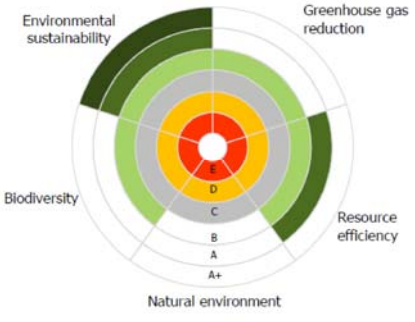
Year	Long-run marginal				Grid average			
	Consumption-based			Generation-based	Consumption-based			Generation-based
	Domestic	Commercial/ Public sector	Industrial		Domestic	Commercial/ Public sector	Industrial	
2010	0.381	0.374	0.367	0.349	0.504	0.495	0.486	0.462
2011	0.374	0.367	0.360	0.342	0.486	0.477	0.468	0.445
2012	0.366	0.359	0.353	0.335	0.539	0.530	0.520	0.494
2013	0.358	0.352	0.345	0.328	0.503	0.494	0.484	0.460
2014	0.350	0.343	0.337	0.320	0.504	0.494	0.485	0.461
2015	0.341	0.335	0.328	0.312	0.473	0.465	0.456	0.433
2016	0.331	0.325	0.319	0.303	0.370	0.363	0.356	0.339

Source: Department of Energy and Climate Change

Same risk reporting framework as other risk types:



Dashboard for green assessment of investments:



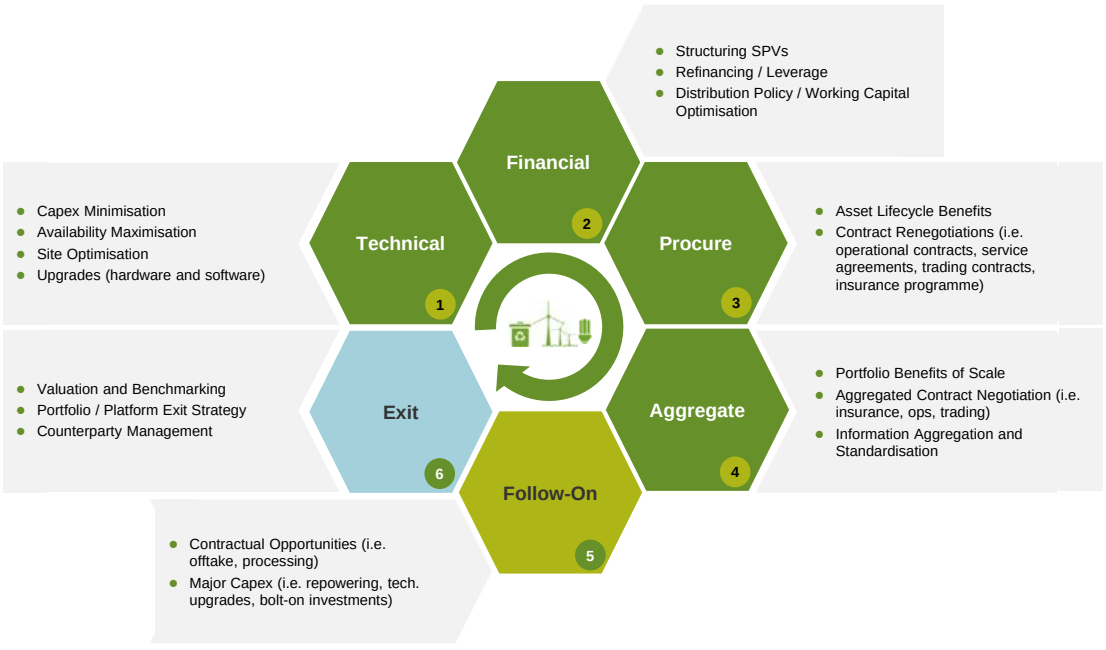
Active project and portfolio management

The Portfolio Management Team is unique in comprising all the necessary skills required for in-depth management and value enhancement of GIB's investments, underpinned by strong operational asset management expertise

Operational Expertise	Market-leading expertise in managing both operational and construction-phase energy infrastructure projects, with a combined experience of over 80 years in the field
Equity Asset Management	Our equity asset management experience across the renewables and broader infrastructure sectors drives value via hands-on participation in project governance
Third-Party Fund Management	The team includes fund management specialists who are experienced in both managing funds on behalf of investors as well as investments into third-party managed vehicles
Debt Management & Administration	Our debt management and administration specialists maintain strong relationships with borrowers and other lenders, protecting value via proactive analysis and rigorous procedures

Value enhancement framework

Portfolio Management drives value by identifying value enhancement opportunities across the portfolio and using sector expertise to optimise assets, identify further investment opportunities and achieve successful exit



Reducing the Cost of Capital

- GIB has observed a continuing decline in market cost of capital required to invest in construction and operational OSW projects. This reduction in cost of capital can be attributable to a number of factors including, inter alia:
  - Reductions in the risk free rate
  - Greater competition for assets, in part due to reductions in returns from other asset classes
  - A broader investor universe with greater familiarity with OSW projects and associated risks
  - Improving OSW construction and operating methodologies, reducing costs and risks across the sector
- GIB has calculated likely minimum market cost of capital levels for each transaction type using a bottom up methodology.

Summary

- GIB achieved UK Government policy objective to accelerate transition to a green economy
- Achieved a double bottom line of being green and profitable
- Strong risk management enabled an innovative investment strategy
- Active asset management enhanced value
- Demonstration effect raised confidence in renewable energy investment and lowered the cost of capital
- What's next?

MACQUARIE
Green Investment Group

Q&A

Session III：

Best Practices in Energy Efficiency Financing

Korea Soft Loan
(Energy Use Rationalization Funds)

Seulgi Cho

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PERSONAL

Date of Birth: November 29, 1986
Citizenship: Republic of Korea

EMPLOYMENT

Korea Energy Agency, Yongin city, Gyeonggi-do
May 19,2014 - present

Assistant Manager

- Finance Support Division

Korea Western Power Co.,Ltd, Yongin city, Gyeonggi-do
November 1,2013 – March 31,2014

Intern

- Power Generation Department (Climate Change & Environment Team)

EDUCATION

Ajou University, Suwon city, Gyeonggi-do
MA in Energy Economics
February 2013

Ajou University, Suwon city, Gyeonggi-do
BEng in Chemical Engineering
February 2011

Korea Soft Loan

(Energy Use Rationalization Funds)

September 28, 2017

한국에너지공단
KOREA ENERGY AGENCY
http://www.energy.or.kr

Contents

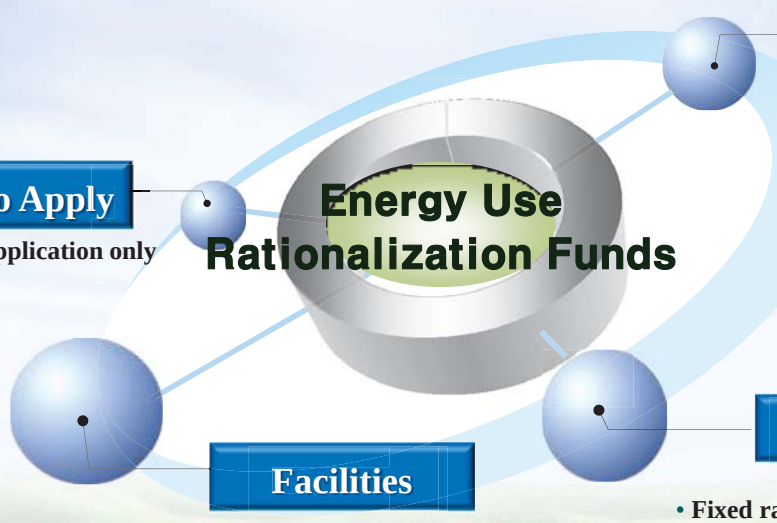
1. Background

- As Korea imports 97% of its energy from overseas, energy efficiency improvement is of utmost importance
- After the oil shock in the 80s, the government took energy saving measures and had problems with promoting energy-efficient facility investment
  ※ Rational Energy Utilization Act was passed in the 80s for energy conservation in industrial /residential /building sector
- In the 80s, government offered 200 billion wons of long-term loans with low interest rates for energy-efficient facility investment
- In the 90s, fresh means of financial support was required due to technical and financial incapacity of investors
- In 1991, third party financing was suggested as a solution and ESCO program was introduced
  ※ In 1991, Rational Energy Utilization Act was revised to initiate ESCO program

- started in USA in 1970's → started in KOREA in 1992
- 310 ESCOs in KOREA, Registration System (2017.8)
- ESCOs can use Energy Conservation Fund (Government budget)

2. What is an Energy Use Rationalization Funds?

☞ Policy funds to support the investment of the energy saving facilities in long-term low-interest loans for energy use rationalization and GHG reduction



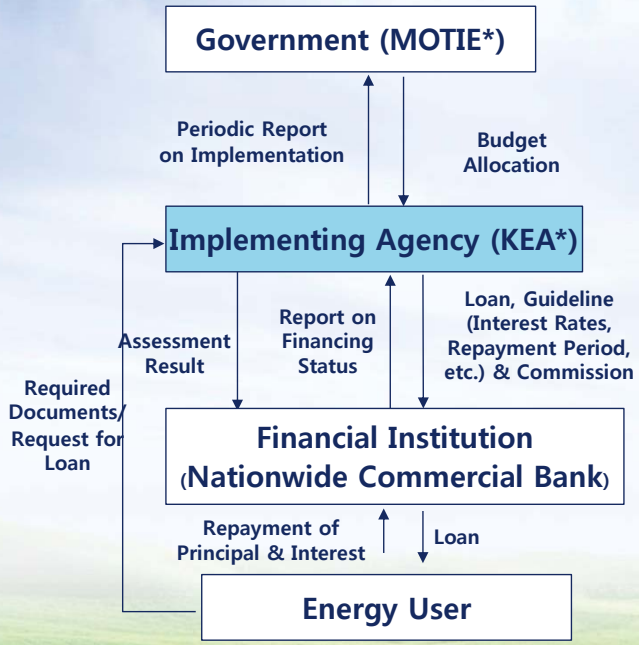
Criteria
- Loan according to regulation of bank (Indirect loan system)
- Operating on Reviewing Committe

How to Apply
- Online application only

Facilities
- 80 items including High Efficiency Energy Equipment etc.
- Adjusting existing facilities and Finding new facilities every year

Interest rate
- Fixed rate : 2.75%(only ESCO)
- Floating rate : 1.5% for small sized
  1.75% for medium sized
  ('17 3/4Q, Quarterly Change)

3-1. Financing Mechanism of Funding Program



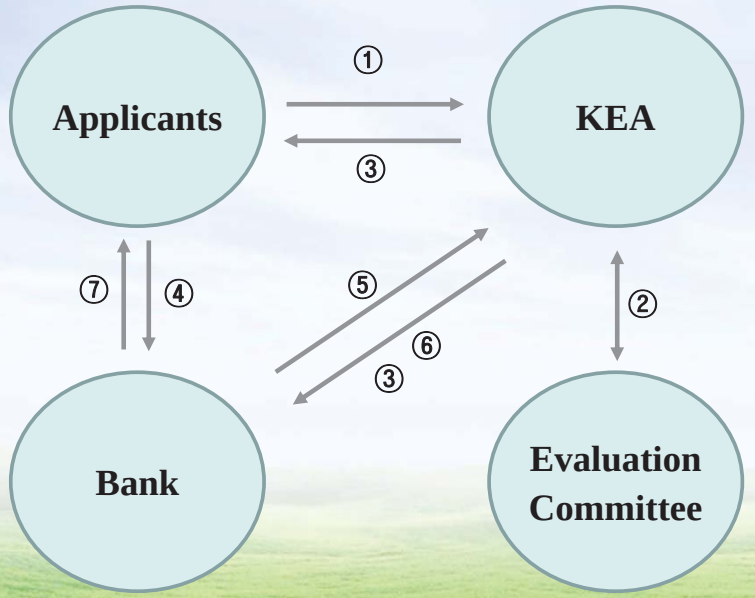
- The applicant files an application online for funding.
  KEA reviews the application and conducts an expert review of the proposed project.
- Depending on the conclusion of the expert's review, KEA may issue the loan recommendation for the applicant.
- The applicant, now with the loan recommendation from KEA, visits a financial institution and takes the required loan.

✓ MOTIE : Ministry of Trade, Industry and Energy, KEA : Korea Energy Agency

3-2. Financing Mechanism of Funding Program

Support Procedure

☞ Indirect loan system, KEA issues recommendation, banks lend money



① Loan Application
② Evaluation
③ Issue Recommendation
④ Loan Requisition
⑤ Apply for Loan
⑥ Loan
⑦ Run Loan

* Banks require security(collateral) and credit

4. Funding Beneficiares & Criteria

☞ **Beneficiaries : SME, Public institution, Non-profit Corporation**

Business Division	Beneficiaries
ESCO* projects	ESCO Contractor Between ESCO & Energy User
Energy Saving Facilities projects	Those who want to install energy-saving equipment* specified by the government funding guideline

* 80 Items : CHP, Old Boiler exchange, Waste Heat Recovery Boiler & Heat Pump, Energy Saving Furnace, VVVF, High-Efficiency energy Equipment etc

☞ **2017 Budget and Criteria**

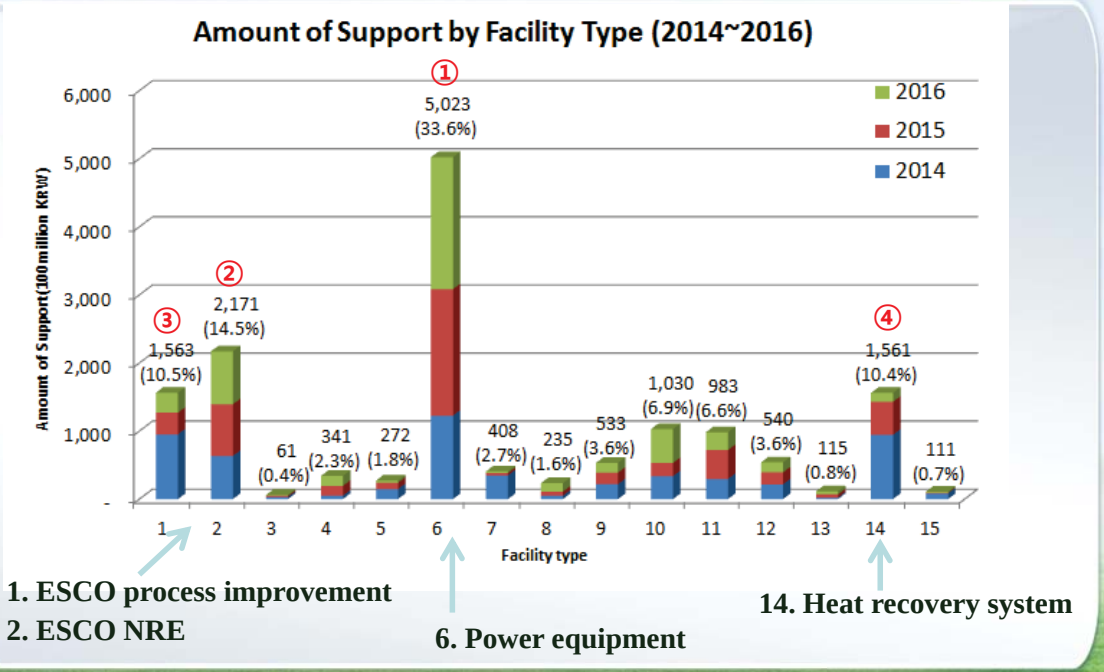
Business Division	Budget (100 million ₩)	Limits (per a business establishment)	Loan Period	Interest
ESCO projects	1,500	200	7 years with 3-year grace repayment	Now -floating1.5% (Quarterly Change) -fixed 2.75% (only ESCO)
Energy Saving Facilities projects	2,000	200	5 years with 3-year grace repayment	

✓ **ESCO : Energy Service Company**

5-1. Financial Support for Facilities

☞ **Since 1980, KEA has provided 12,173 billion KRW**

☞ **KEA has provided 1494.9billion KRW from 2014 to 2016(3years)**



5-2. Facilities for Energy Funding

1. ESCO Process improvement / 2. ESCO NRE	
3. Building Energy Conservation and AHU facility	Energy-saving air conditioning system, Dehumidifier , Building automation control unit etc.
4. Drying equipment	Infrared heating paint booth, Drying for printing press etc.
5. High-efficiency energy equipment	
6. Power equipment	VSD compressor, Servo motor controlled injection molding machine, Inverter, Fluid coupling etc.
7. Boiler system	Decrepit boiler replacement, CHP etc.
8. Demand management facility	Ice(water) thermal storage system by using midnight electricity, Gas heat pump, Energy storage system etc.
9. Dyeing & Paper equipment	Low-liquor ratio dyeing facility, Tenter etc.
10. Investment projects for GHG & energy management companies	
11. Furnace	Heating Furnace, High Energy Efficiency Glass Melting Furnace, Waste heat recovery boiler etc.
12. Lighting system	LED
13. Evaporation & Enrichment facility	Steam re-pressure evaporator facility, Steam condensate condensing tube etc.
14. Heat recovery system	Almost all of Waste heat recovery facilities except boiler etc.
15. Other system	EMS by application ICT, Improvement projects of Energy Audit result

5-3. Facilities for Energy Funding

☞ **KEA provides loans for energy-saving projects that are especially known to have proven effects**

☞ **KEA conducts an inspection on Funding Program and its target facilities twice every year, and based on the results, decides to add new facilities or remove several existing ones**

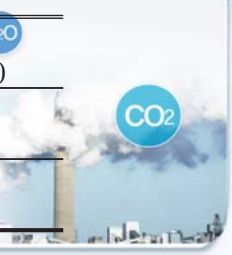
6-1. Performance Review

Performance Review

- To ensure that the intended energy-saving effects actually take place

- Analyzing the documents of completed projects as well as conducting on-site investigation
- Over the last three years shows a reduction in greenhouse gas emissions equivalent to 1,191 kilo TOE or 2,645 kilo tCO2 in total

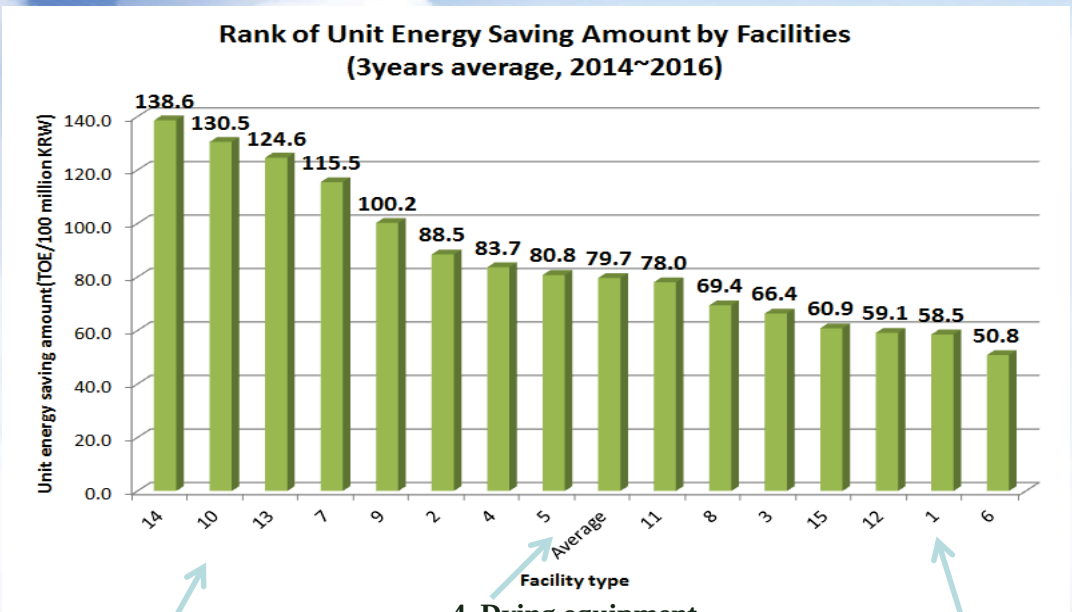
	2014	2015	2016
Funding provided (100 million KRW)	5,551 ($482M)	4,808 ($418M)	4,590 ($399M)
Energy saved (in kilo TOE)	438	375	378
Greenhouse gases reduced (in kilo tCO_2).	940	763	942



Postloan Management

- reviewing ALL funded projects in terms of whether the loans have been used according to the stated purposes in the applications
- Each and every single facility in use is confirmed in order to determine whether the provided loans have been used for the right purpose

6-2. Performance Review



4. Dying equipment
5. high-efficiency equipment
11. Furnace

14. Heat recovery system
10. Investment projects for GHG & Energy management
13. Evaporation & Enrichment facilities

12. Lighting system
1. ESCO Process improvement
6. Power equipment

7. Tax Incentives

☞ **Over view : Provide tax exemption benefit to the investment costs of the energy saving facilities to enhance the competitiveness of companies saving Energy.**

☞ **Benefit Supported : If energy saving facilities are installed by 31 Dec, 2018, government provides tax credits from income tax or corporate tax**

※ big business 1%, mid-sized businesses 3%, smaller businesses 6%

☞ **Legal Basis : Restriction of special taxation act article 25-2 (Tax Credits for Investment in Energy-Saving Facilities)**

Thank you

Cho, Seulgi

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ESCO Program in Korea

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PERSONAL

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Citizenship: Republic of Korea

EMPLOYMENT

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January 1,2001 - present

Team Manager

- Finance Support Division

Manager / Deputy General Manager

- Energy Consulting Division
- New & Renewable Energy Center
- Inspection on Thermal Equipments

EDUCATION

Dongguk University in korea
MS in New & Renewable Energy
February 2011 ~ present

Sung kyun kwan University in korea
BEng in Electrical, Electronics & Computer Engineering
August 2000

ESCO Program In Korea

September 28, 2017

한국에너지공단
KOREA ENERGY AGENCY
http://www.energy.or.kr

ESCO Program

What is an ESCO(Energy Service Company) ?

☐ ESCO means Company or Business Model

☞ Company concept : Registered Company in MOTIE with the requirements of Assets, Technical Manpower and Equipment by the Energy Use Rationalization Act

☞ Business Model concept : Business to perform Energy Saving Projects, in place of the Energy User(Recovering the investment costs by Savings)

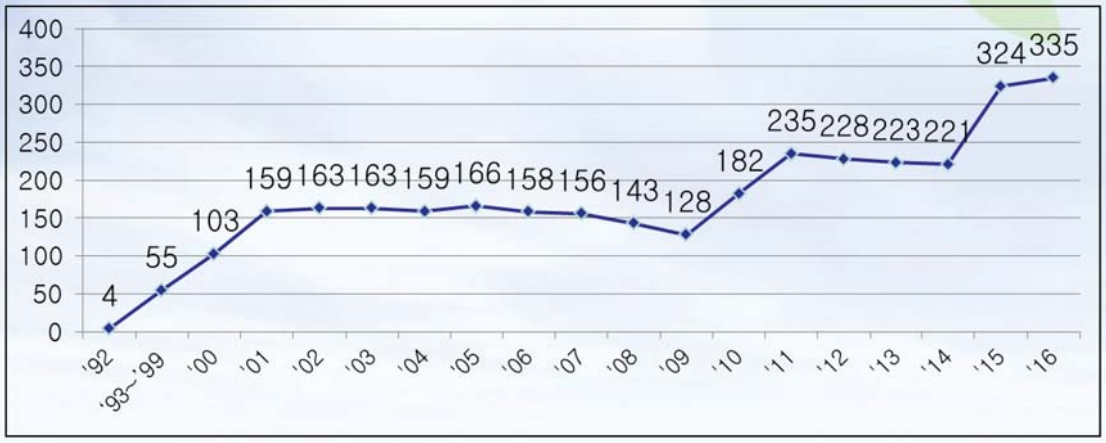
☐ ESCO generally perform such as
Energy Audit, Project Proposal, EPC, MRV, Maintenance etc

* EPC : Engineering, Procurement, Construction, MRV : Measuring, Reporting, Verification

ESCO Registration Requirements

	Contents		Requirement
Assets	Corporation	Capital	KRW 200 million or greater.
	Private operators	Asset appraisal	KRW 400 million or greater.
Technical Manpower	More than qualified articles according to the "National Technical Qualifications Act", in field of Machine, Material, Chemical, Electric, Electronic, Telecommunications, Energy or Gas		Three workers or more
Equipment	1. Infrared Thermometer 2. Data recorder 3. Temperature & humidity measurement devices		Each one or more

Registered ESCOs



- In 1992, 4 Companies were registered
- Huge Increase between 1997 and 2001
- Steady Increase since 2009
- 310 Companies are registered (31 Aug, 2017)

Kinds of ESCO Contracts

☞ **Confirmed Savings contract(Limited to high-efficiency certified products)**

☞ **Guaranteed Savings and ESCO Financing contract**

☞ **Guaranteed Savings and User Financing contract**

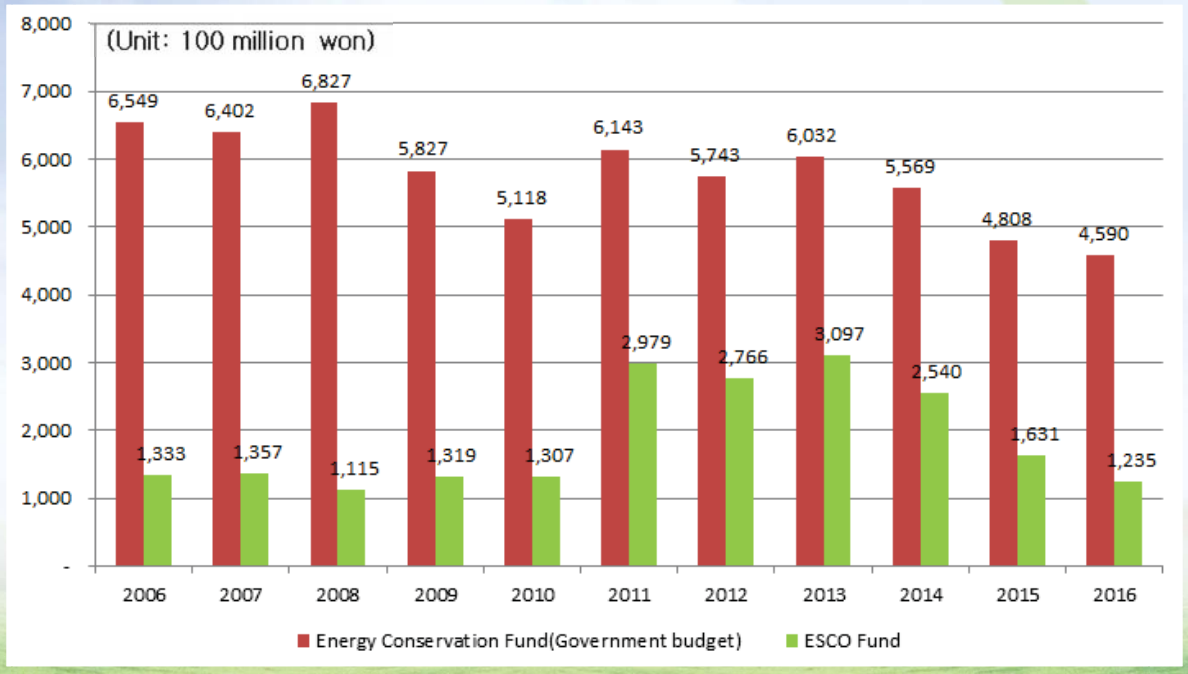
ESCO Business Area

☞ **4 Projects that supported by Energy Use Rationalization Funds**

Division Business	Criteria for Support
① Replacing Energy Saving Facility	76 Facilities specified in funding guideline
② Renovation Building Insulation	Insulation or window replacement of the buildings last for more than 10 years
③ GHG Reducing PJTs	Projects to reduce GHG emissions(more than 5%)
④ Other Energy Efficiency Improvement PJTs	More than 5% energy savings Facilities or Process

ESCO Program

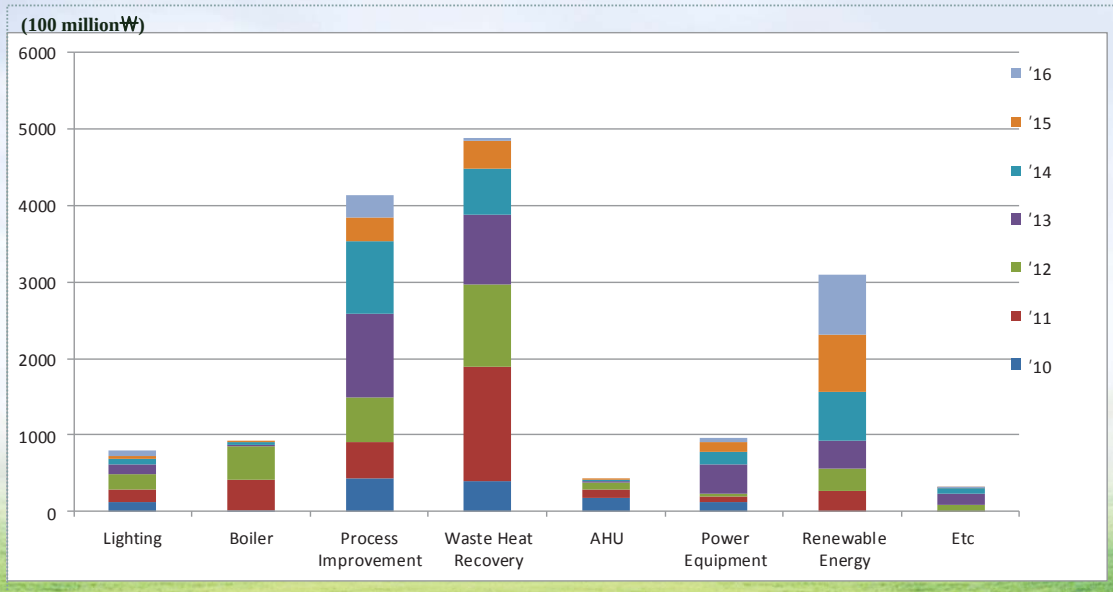
Financial Support for ESCO Program by Year('06~'16)



ESCO Program

ESCO Main Investment Area

☞ **ESCO Policy Loan(Energy Use Rationalization Funds) Support Area('10~'16 year)**



ESCO Program

ESCO Business Flow

- **Contract** — Energy User vs ESCO
- **Financing** — Who loan? Both ESCO or Energy User can loan
- **EPC** — ESCO do EPC
  * EPC : Engineering, Procurement, Construction
- **Guarantee** — ESCO guarantee the Energy Savings
- **MRV** — ESCO do MRV
  * MRV : Measuring, Reporting, Verification
- **Amortize Investment** — Energy User Amortize Investment costs
  * By Guaranteed Savings or Shared Savings

ESCO Program

ESCO Data in 2016

☞ Policy Loans 124 Billion₩ supported → Saving 104 Ktoe(86 Billion₩)

※ Only Policy Loan Data, Excluded Private Funds

KEA

Thank you
for your kind attention

Dong-Wook Cho

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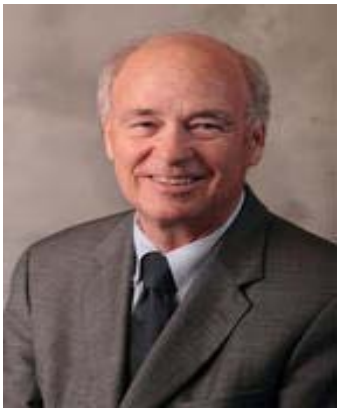
US Federal and State-Based Energy Policy and Technology in Regards to Energy Efficiency



Terry Surles, Ph.D.

Dr. Surles just finished being an emergency hire as the Interim Administrator for the Hawaii State Energy Office. He has a distinguished career in energy and environmental management and consulting positions. Since 2012, he has been at the University of Hawaii and the California Institute for Energy and Environment. During this time, he has also served as an expert for APEC and IEA in Indonesia, China, Vietnam, Peru, and Korea. In 2015, he led an analysis of DOE's Grid Modernization Initiative for Booz, Allen, Hamilton. From 2010 to 2012, as Desert Research Institute Vice President, he led program development and management for three research divisions and four research centers in environmental and energy sciences. From 2006 to 2010, he was the Technology Integration and Policy Analysis Program Manager at the Hawaii Natural Energy Institute focusing on grid integration of variable renewable resources and energy storage technologies. From 2004 to 2006, he was Vice President at EPRI focusing on air quality, health, energy/water nexus, and climate change issues. From 2000 to 2004, he was on loan to the California Energy Commission as the PIER Program Director where the emphasis was on energy efficiency, renewable energy, grid modernization, and regional climate assessment. For this position, he took leave from Lawrence Livermore National Laboratory where he was Associate Laboratory Director for Energy Programs from 1998 to 2000, focusing on energy efficiency, energy storage, and climate change science and analysis. In 1997, he was appointed by Gov. Wilson to

be Deputy Secretary for Science and Technology at California EPA. From 1978 to 1997, he was at Argonne National Laboratory (ANL) with his final position being General Manager for Environmental Programs. Major program areas included energy systems assessment, climate change science, risk analysis and assessment, emergency planning and response, and energy and environmental modeling. From 1974 to 1978, he was at Camp, Dresser, & McKee, with his final position as Vice President.

Dr. Surles received his Ph.D. in Chemistry from Michigan State and has more than 330 publications, technical reports, and presentations. He has served on a number of committees, including seven appointments with the National Research Council as well as advisory groups for DOE and its laboratories. In addition to those listed above, he consulted or is currently consulting with NELHA, the Northeast Asia Economic Forum, East-West Center, the United Kingdom Energy Research Centre, the California Public Utility Commission, and the State of Victoria.

US Federal and State-Based Energy Policy and Technology in Regards to Energy Efficiency

Terry Surles, surles@hawaii.edu

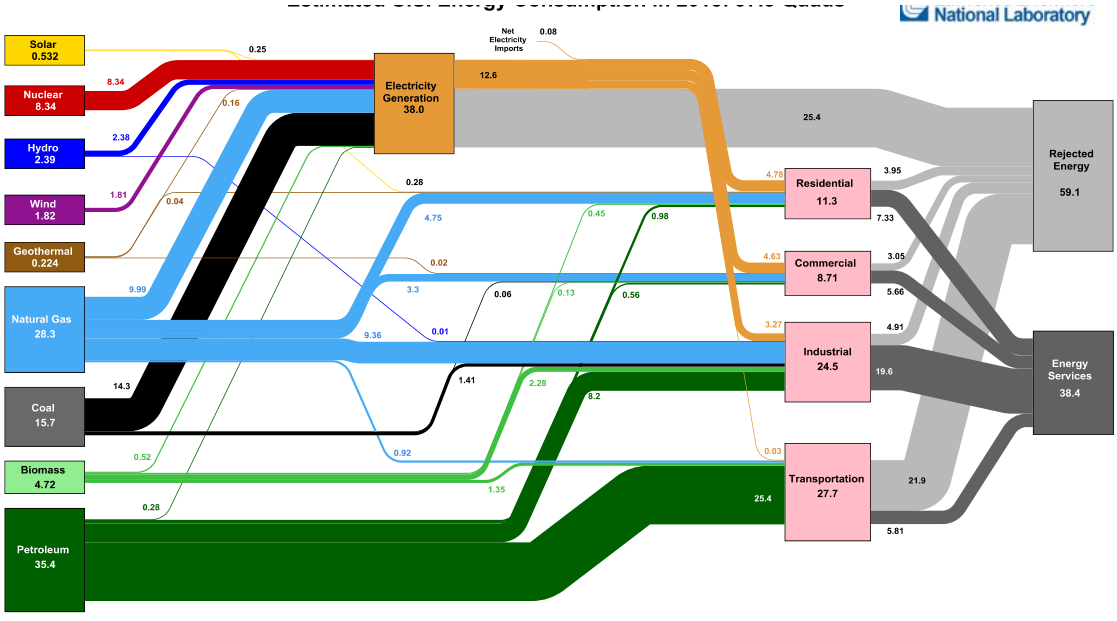
APEC Conference

Taipei

September 28, 2017

College of Social Sciences
University of Hawaii at Manoa

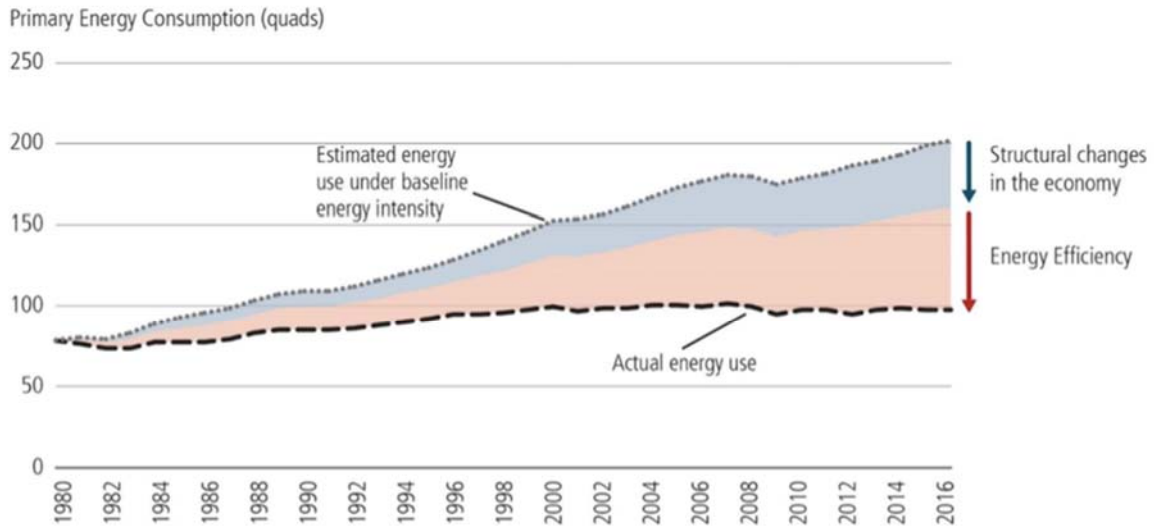
US Consumption at 97.3 Quads – No Substantive Increase in Twenty Years



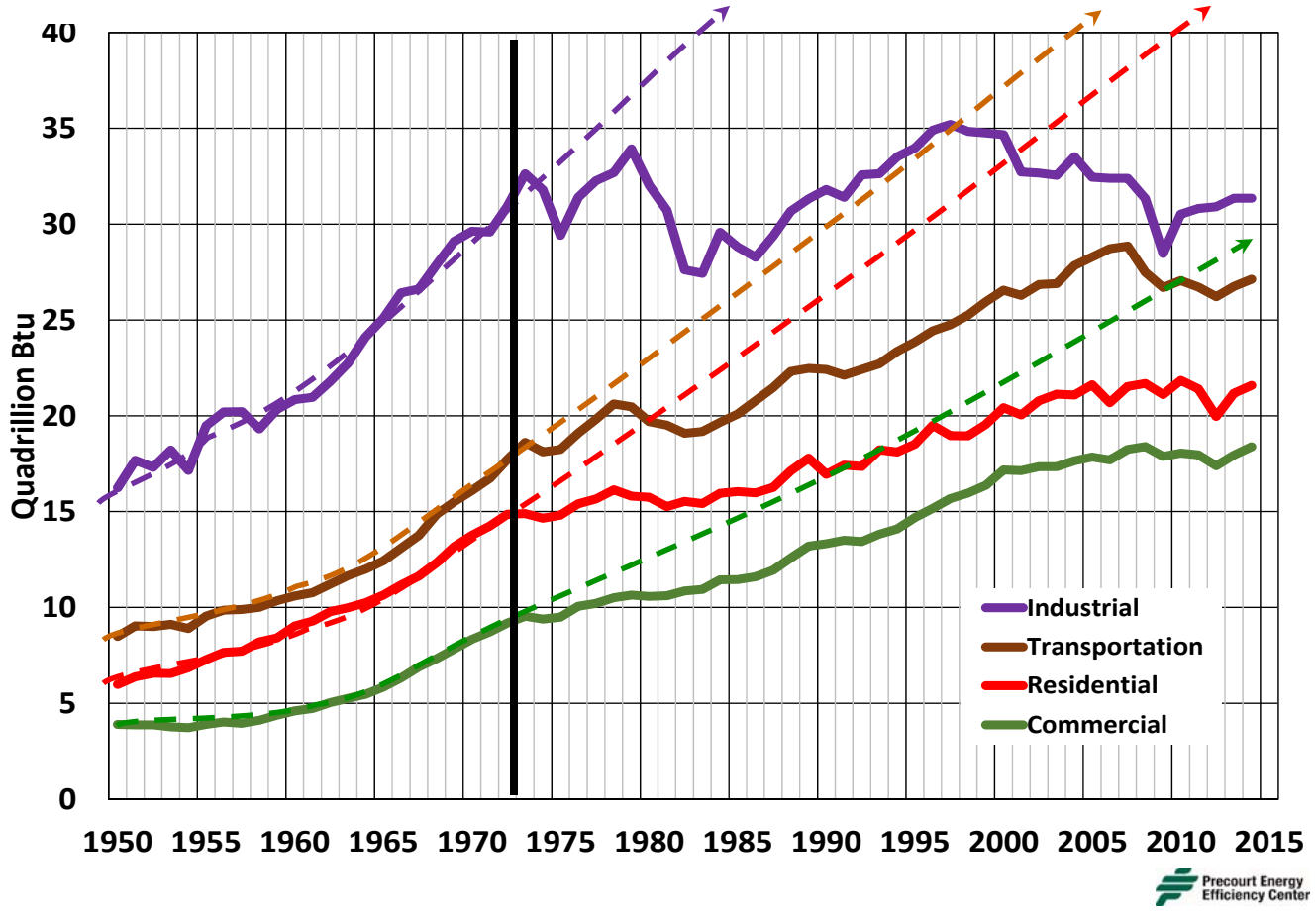
Source: LLNL March, 2016. Data is based on DOE/EIA MER (2015). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant heat rate. The efficiency of electricity production

Recent Findings in DOE Electricity Report – August 2017

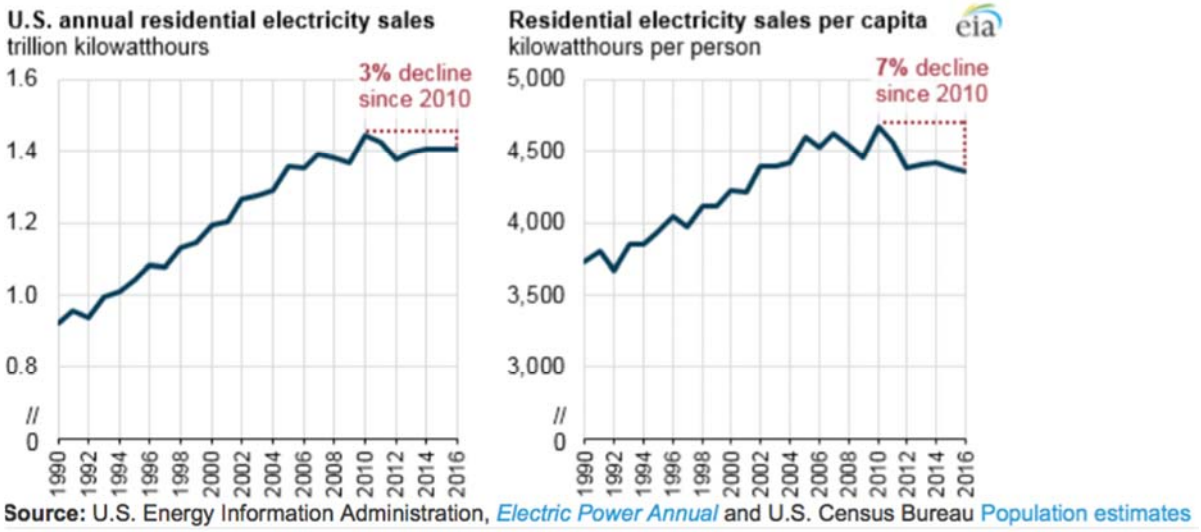
Figure 3.30. Estimated U.S. Energy Savings from Structural Changes in the Economy and Energy Efficiency, 1980–2016[189] [190]



Consumption Trends Changed In All Sectors of the US Economy

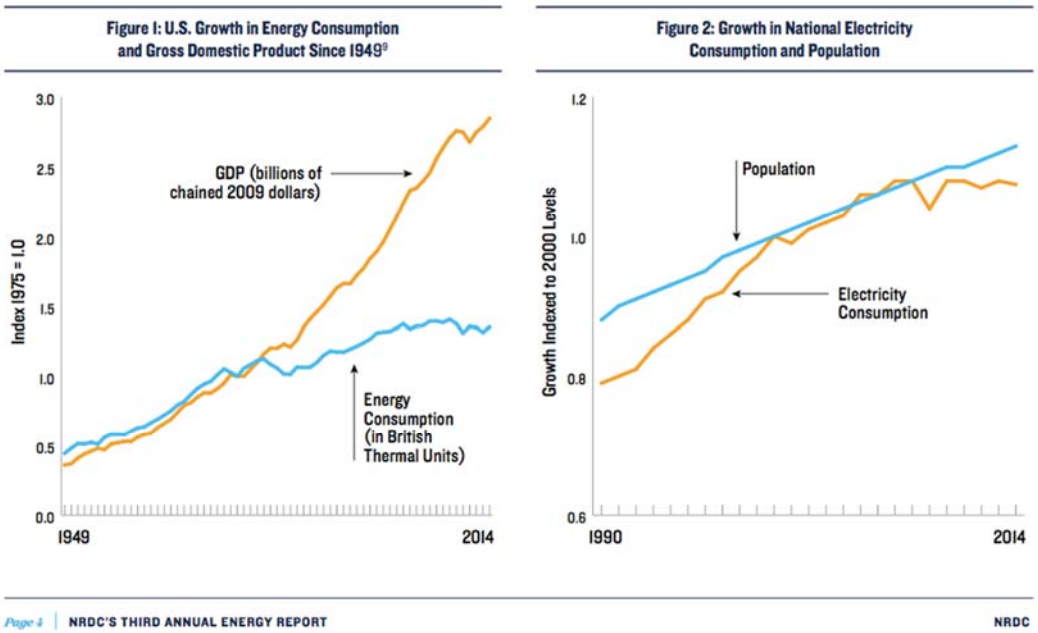


Efficiency and BTM Generation Drive Electricity Sales Down – Can Negatively Impact Funding for New "Smart Grid" Systems



Source: U.S. Energy Information Administration, *Electric Power Annual* and U.S. Census Bureau Population estimates

Efficiency Is the Most Cost-Effective Approach to Energy Use

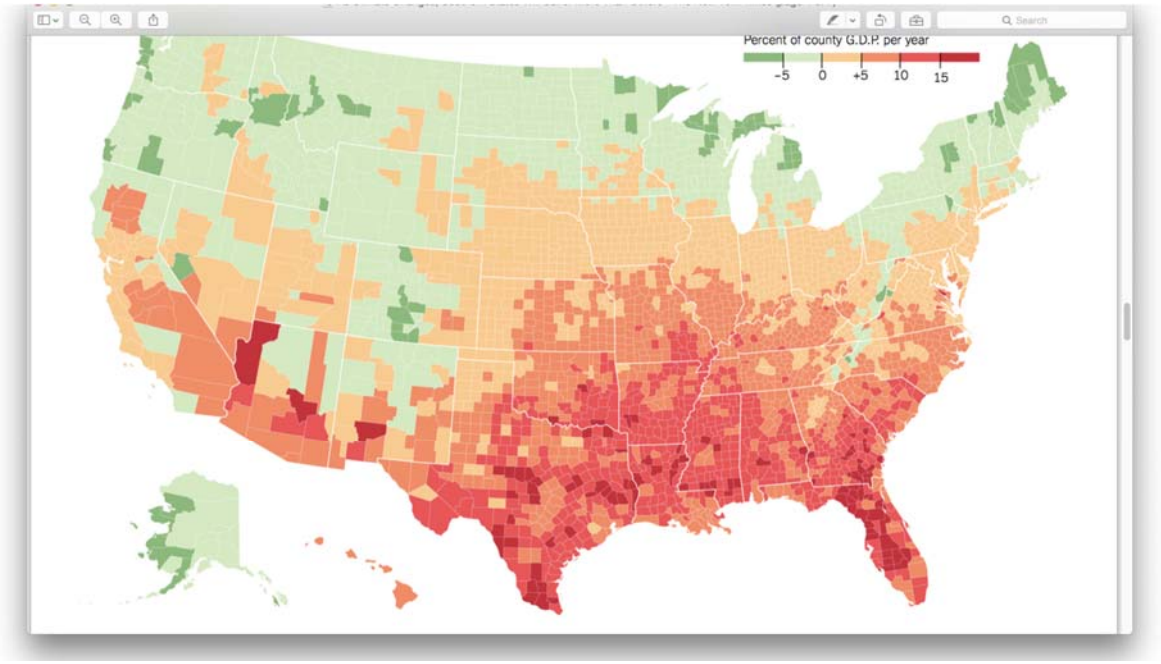


Unfortunately, This Fact Is Now Not Recognized on a National Level

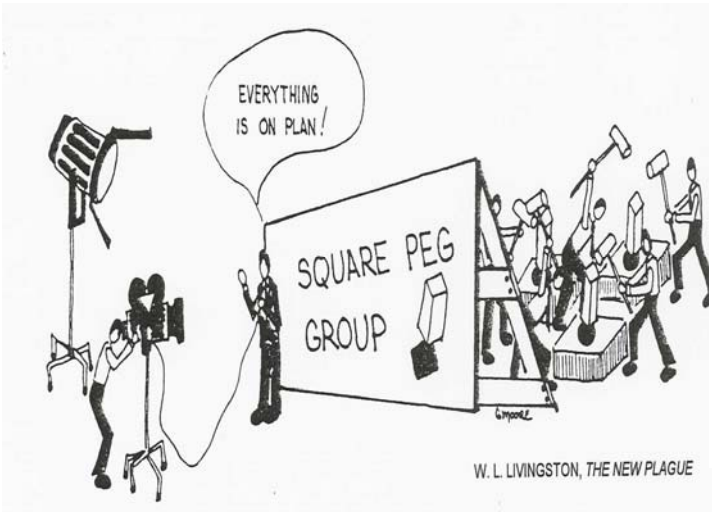
A President "so untethered to reality" – LA Times, 4/2/17 – or "Absent at the Creation" today in NYT

Bannon at the 2017 CPAC

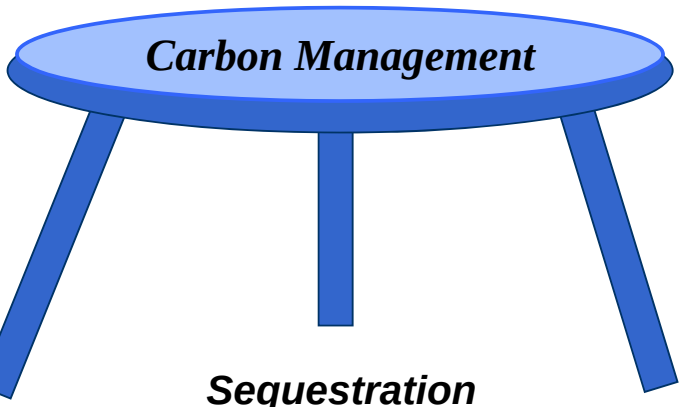
Parts of US That Don't Believe in Climate Change Will Be Most Economically Impacted – Harvey and Irma



US Energy Policy Is to Not Have an Energy Policy - There Is Currently Little Support for Energy Efficiency on a National Level



Carbon Management and Energy Security – However, a Number of National Standards Are in Place



Decarbonization

$$< \frac{CO_2}{Btu}$$

- Nuclear
- Renewables

Sequestration

$$< \frac{CO_2\ atm}{CO_2\ emitted}$$

- Capture/storage

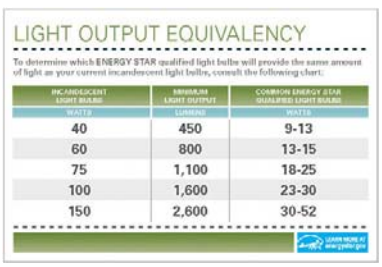
Efficiency

$$< \frac{Btu}{GDP}$$

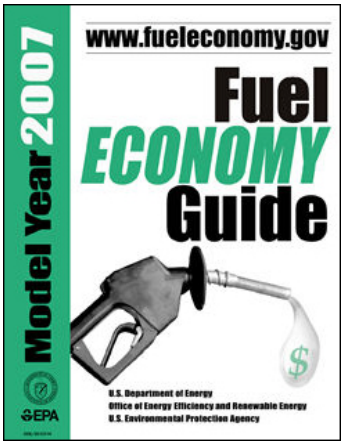
- End-use Technologies
- Demand response

Energy Efficiency – Most Cost Effective Approach

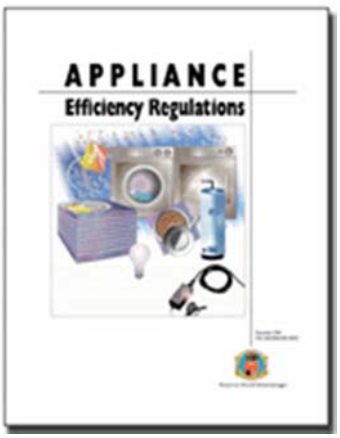
(Hawaii kwh is 34 – 44 cents, "negawatt/hour" is 2.3 cents)



Lighting



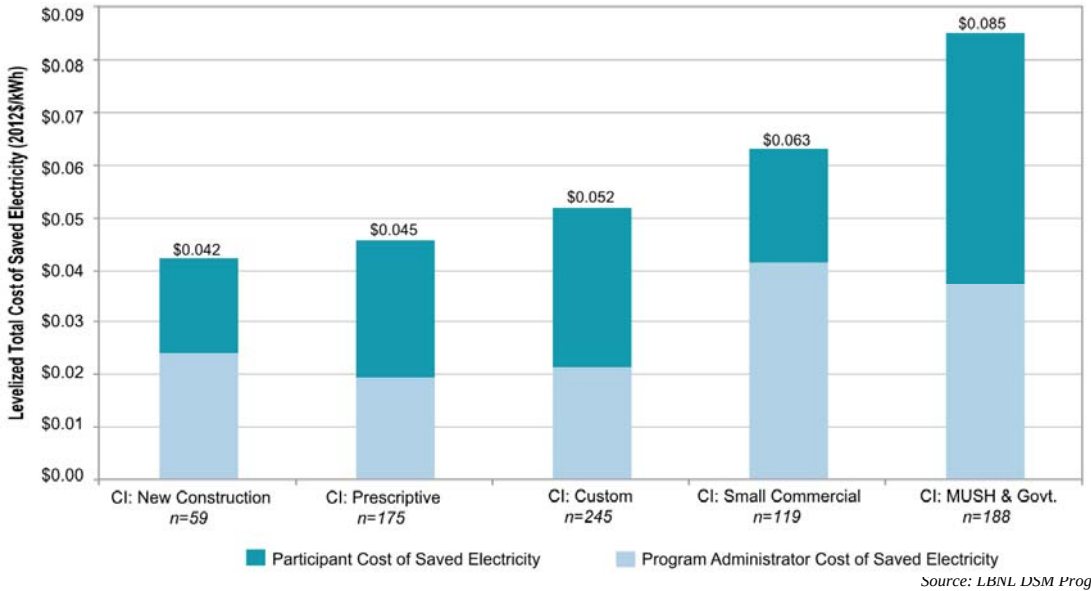
Transportation



Appliances

Total Cost of Saved Electricity: Commercial/Industrial Programs

- Savings-weighted COSE values for **most C&I sector programs are $0.04-$0.06/kWh**
- C&I programs garner **more participant investment** than residential programs, particularly in **custom and prescriptive programs**

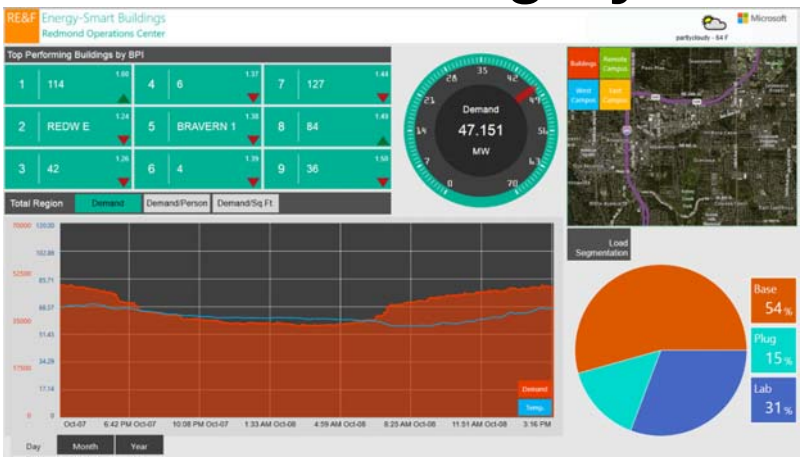


Source: LBNL DSM Program Database

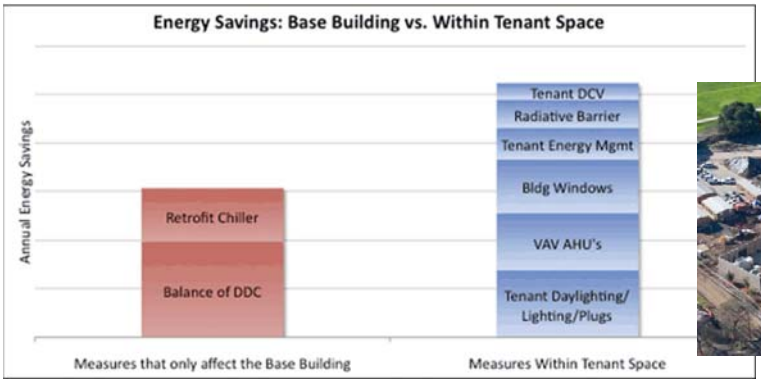
Buildings Account for Almost 50% of Total US Carbon Emissions.

Title 24/CA

Commercial/Industrial Building Systems



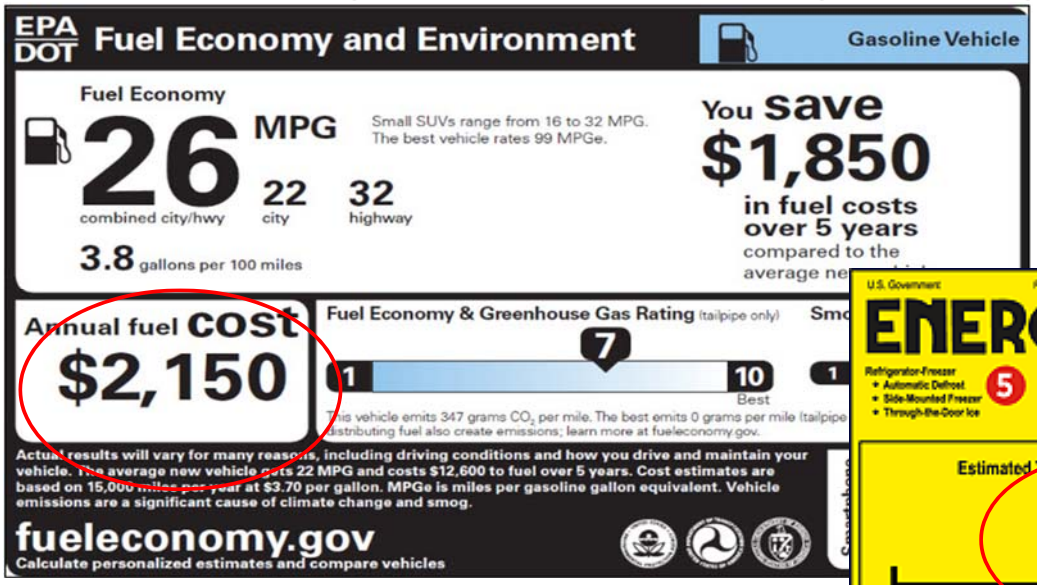
Microsoft Dashboard

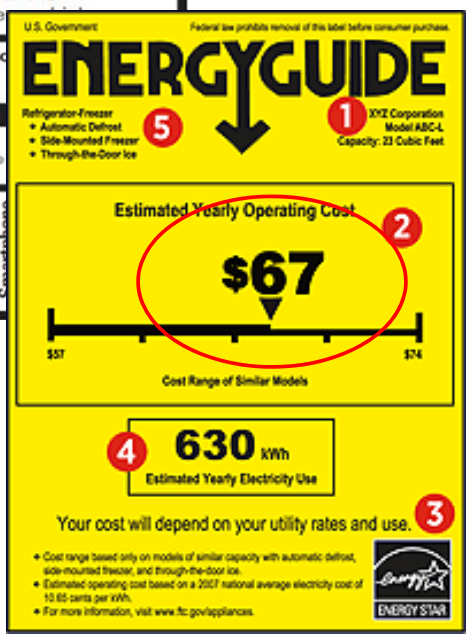


Empire State Building Retrofit

Stanford ESI

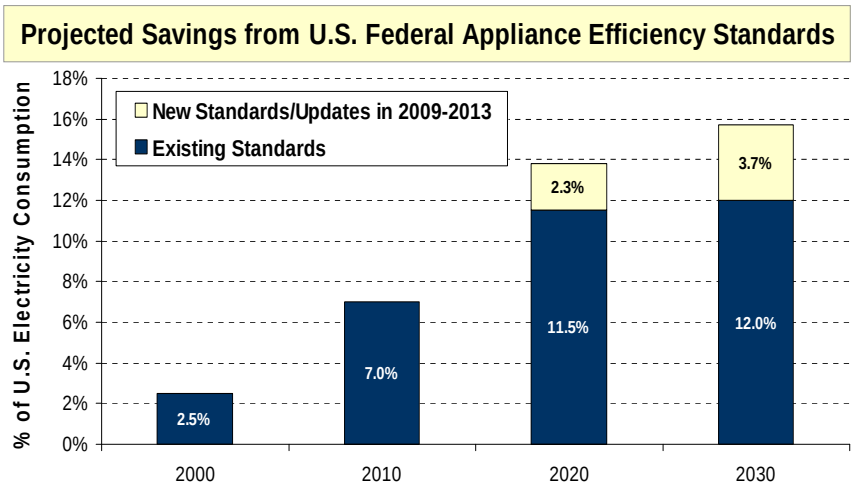
Energy Use Labeling/ Nudges





Appliance Efficiency Standards

- Federal standards currently cover over 70 products
  - Conventional incandescent lighting phased out in 2012
- Since 2001, 13 states have adopted more aggressive standards for products not covered by Federal standards



Adapted from: "KaBOOM! Savings from Existing and New U.S. Appliance Standards," American Council for an Energy Efficient Economy, July 2009.

Changing Light Efficacy: Lumens per Watt (LPW) 2015 vs 1973 Source: Finelite, Inc.

Application	1973		2015		
	Light Source	Efficacy (Lumens Per Watt)	Light Source	Efficacy (Lumens Per Watt)	Watts/Lumen Reduction
Light Bulb	Typical 60 Watt Incandescent (A-19)	14	LED bulb equivalent (A-19)	84	83%
Cobrahead Street Light	High-Pressure Sodium	48	LED	93	48%
High Bay Industrial	400 watt Metal Halide (14K lumens)	31	213 watt LED (18K lumens)	85	64%
Office Recessed 2x4 Luminaire	40 Watt, T12 Fluorescent	60	2x4 Recessed LED Luminaire	115	48%
Kitchen Down Light	5-inch diameter, 65 watt, incandescent (BR40)	10	5-inch diameter, 12 watt, LED (BR40)	67	85%
Track Lighting	2.5-inch dia., 45 watt spot, incandescent (R20)	9	2.5-inch dia., 5 watt, LED (R20)	65	87%

Improvement Trends for Household Appliance Energy Efficiency

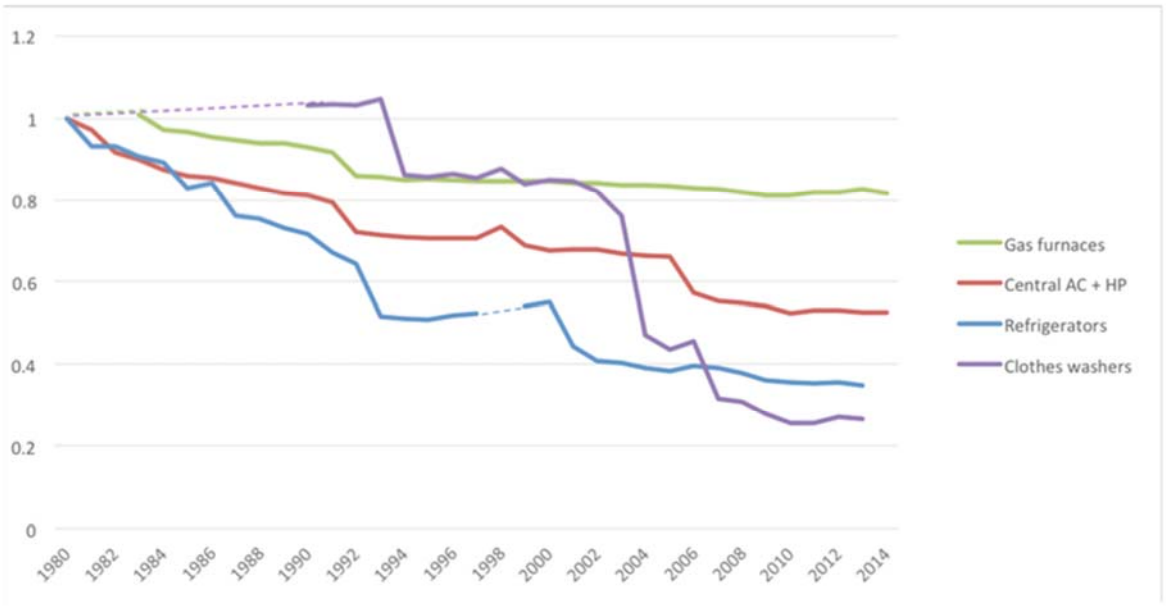
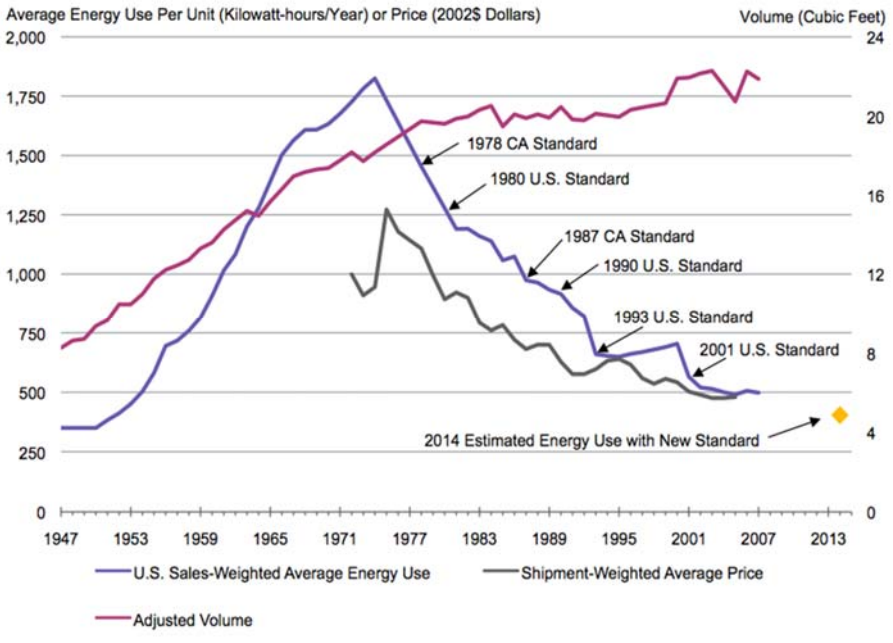


Figure 5. Relative average energy consumption of new appliances sold over the 1980–2014 period (2014 refrigerator and clothes washer

US Setting Standards: Refrigeration Efficiency Has Improved by 70% - National Savings ~50GW



States Remain More Effective in Developing New Policies, Programs, and Addressing (or Forcing) Changing Utility Business Models

- **Energy Efficiency and DSM Standards and Goals**
  - **Standards developed for building codes and appliances**
  - **Emerging demand response program in California – latest PUC rulings**
- **Renewable Portfolio Standards (RPS)**
  - **Feed-in tariffs and net metering laws and regulations**
- **Power Purchase Agreements - Growth of IPP generation (as an example, only 20% of SCE electricity is from their generators)**
  - **New PPAs now take into account ancillary services - grid stability, reliability, Var support**
  - **Push for grid stability and power quality is leading to new mandates for the use of energy storage, two-way meters, other Smart Grid devices**
- **T&D investments, access and renewable interconnection - "Dueling laws"**
  - **Various public (ISOs, state EPA) and private intervenors can drag out interconnection time and increase costs for IPPs**

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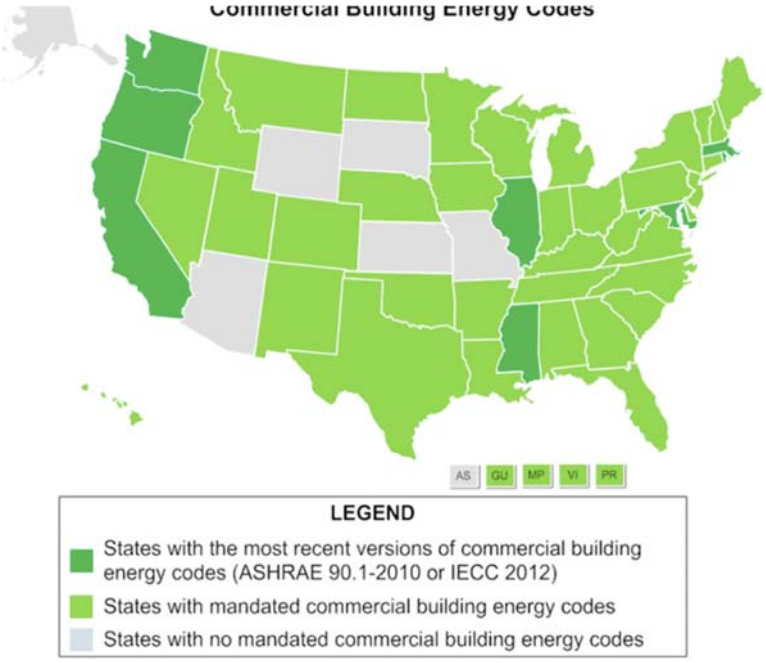
There Are 1.9 Million Energy Efficiency Jobs in the US

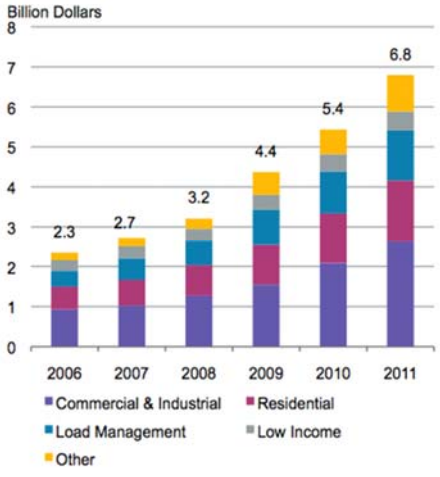
Building Energy Code Status – 2017

set by regulators, policy offices, legislatures



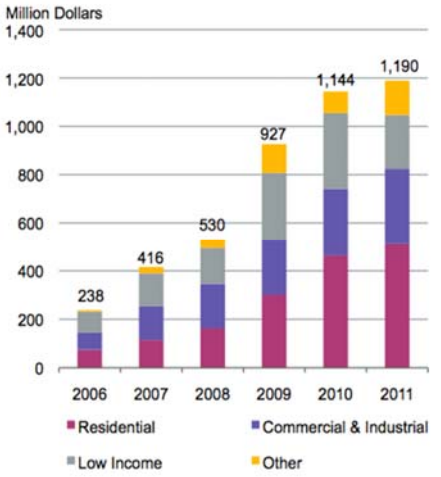
State Public Utility Commissions Approve Energy Efficiency Budgets

Figure 3-5: Energy Efficiency Program Budgets for U.S. Electric Utilities, 2006-2011



Note: Actual expenditures could vary from the budget numbers.
Source: Patrick Wallace and Hilary Jane Forster, Consortium for Energy Efficiency, *State of the Efficiency Program Industry: Budgets, Expenditures, and Impacts 2011*, March 14, 2012, http://library.cee1.org/sites/default/files/library/8000/2011_CEE_Annual_

Figure 3-6: Energy Efficiency Program Budgets for Gas Utilities, 2006-2011



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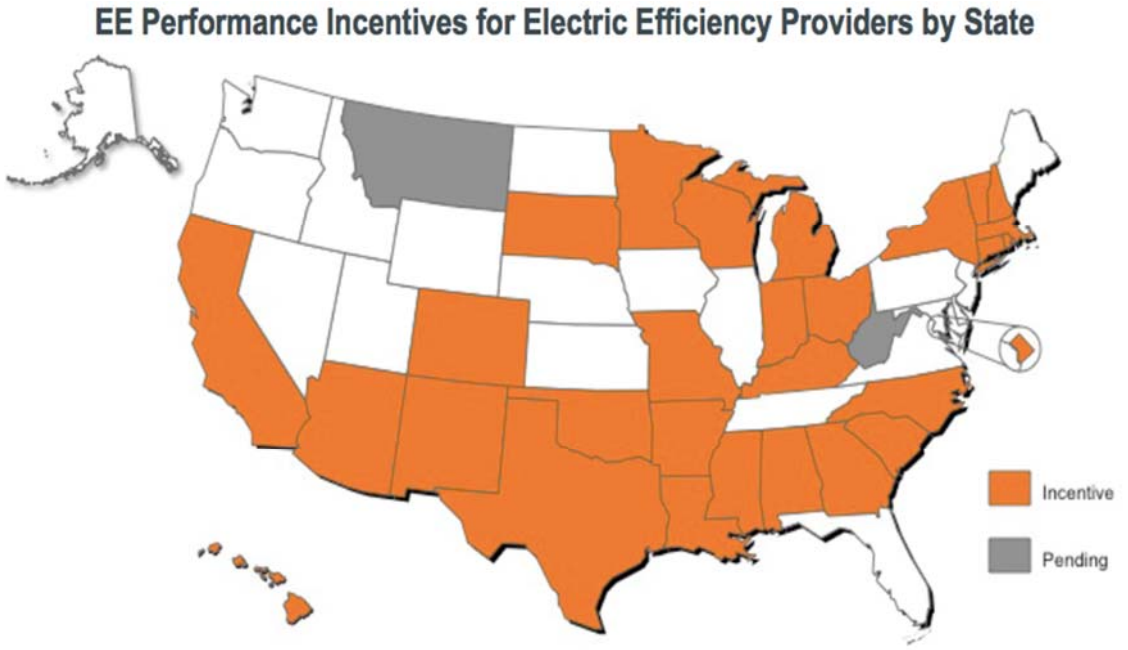
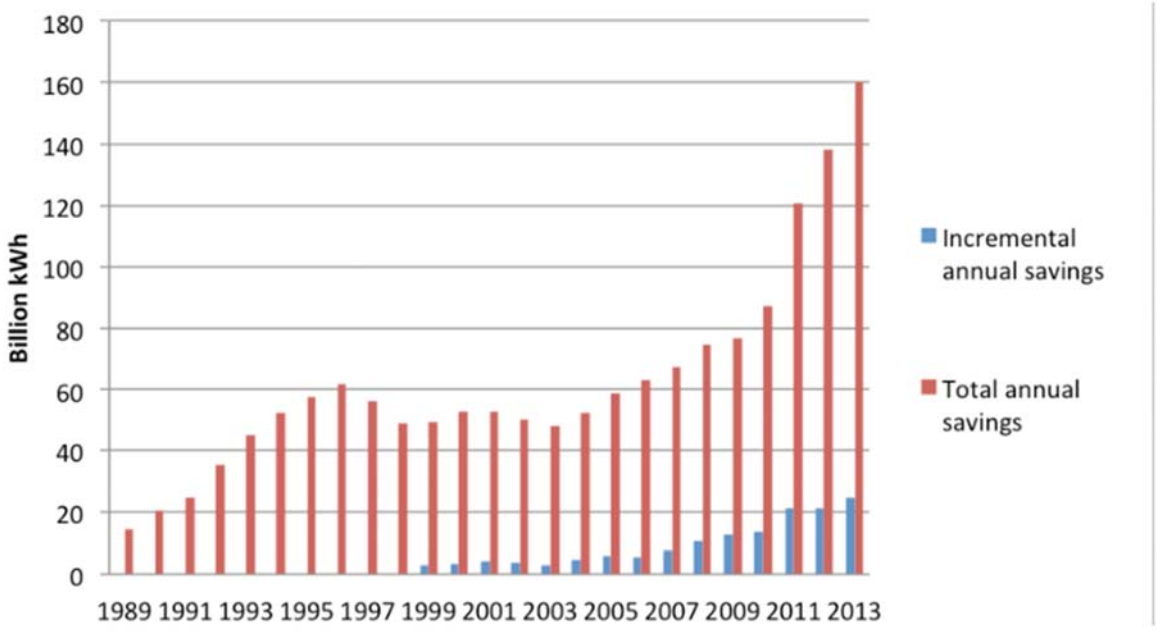
Energy Efficiency Performance Incentives and by State



Utility Energy Efficiency Savings Are Cumulative



Percentage of Utility Energy Savings on a State by State Basis

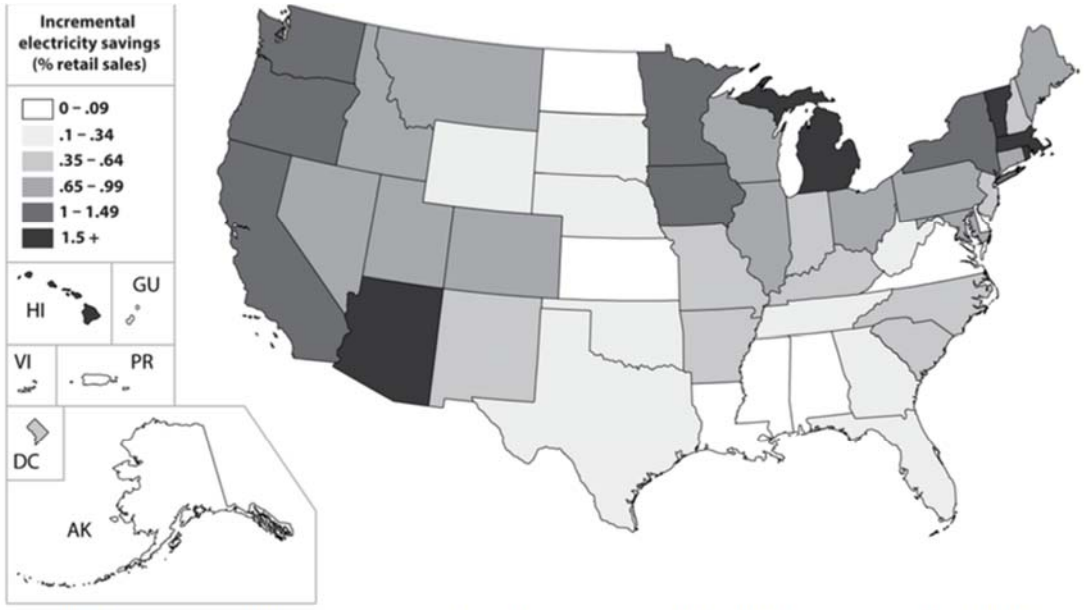
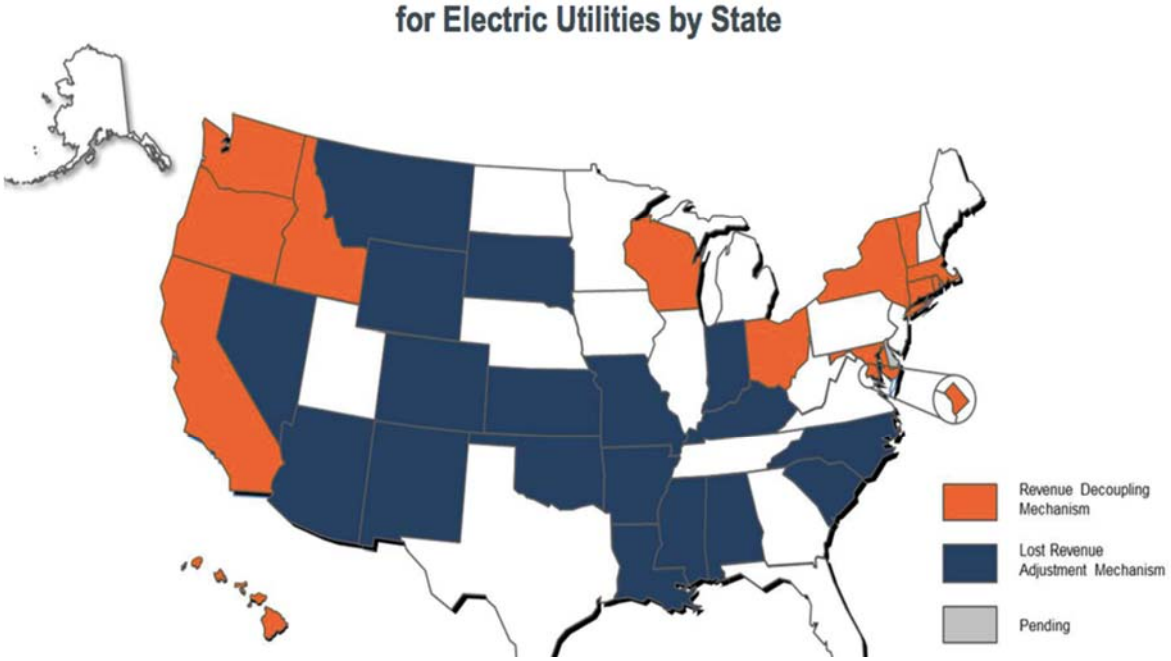


Figure 20. Utility sector energy efficiency program savings by state from measures installed in 2013 as a percentage of state 2013 electricity sales. *Source:* Gilleo et al. 2014.

Revenue Decoupling Mechanisms as a Policy



• Hawaii Clean Energy Initiative - HCEI

- 100% Renewable (electricity sector) by 2045
- **Reduce 4,300 Gwh by 2030 - Since 2008, Hawaii has reduced energy consumption by 8%**



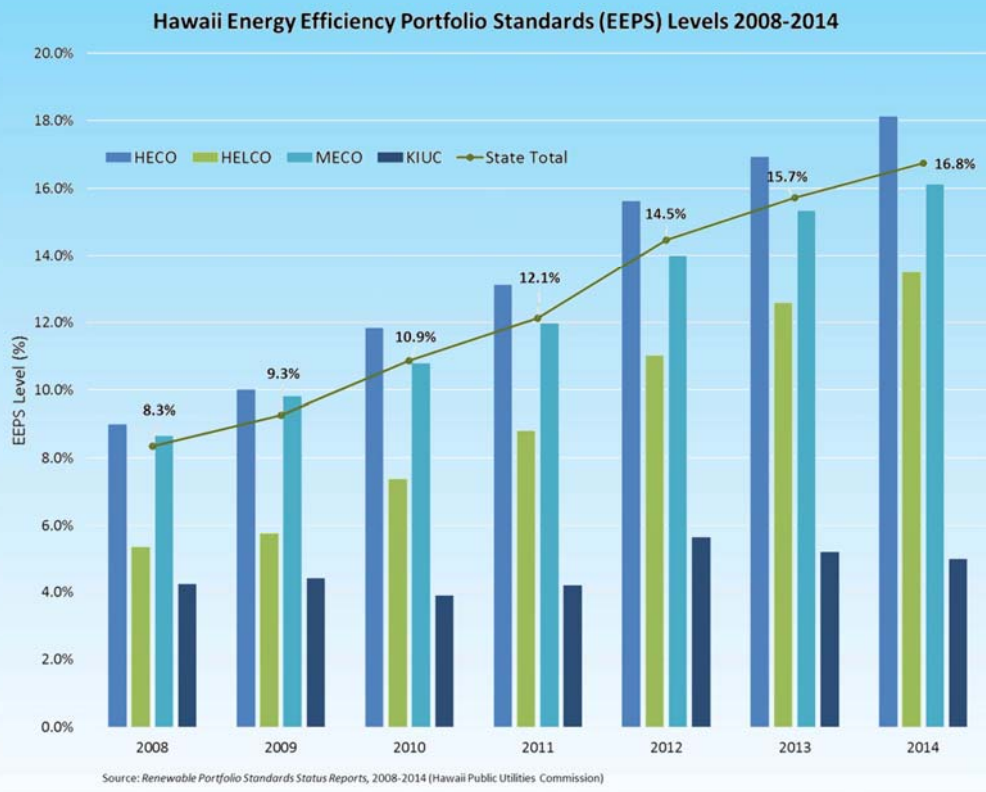
• Performance Contracting, Hawaii First in US –
• Promoting Energy Efficiency Retrofits

Energy Services Coalition Ranking – *Race to the Top*						
State	**Population**	**Performance Contracting**	**Dollars per Capita**	**Job Years Created**	**Source Energy Saved**	**Tons Carbon Avoided**
Hawaii	1,360,301	$442,432,189.00	$325.25	4,809	3,671,302	63,062
Kentucky	4,339,367	$750,000,000.00	$172.84	8,152	6,223,500	106,901
Delaware	897,934	$138,707,463.00	$154.47	1,508	1,150,994	19,771
Massachusetts	6,547,629	$865,349,091.00	$132.16	9,406	7,180,666	123,342
Ohio	11,536,504	$1,252,683,627.00	$108.58	13,616	10,394,769	178,551

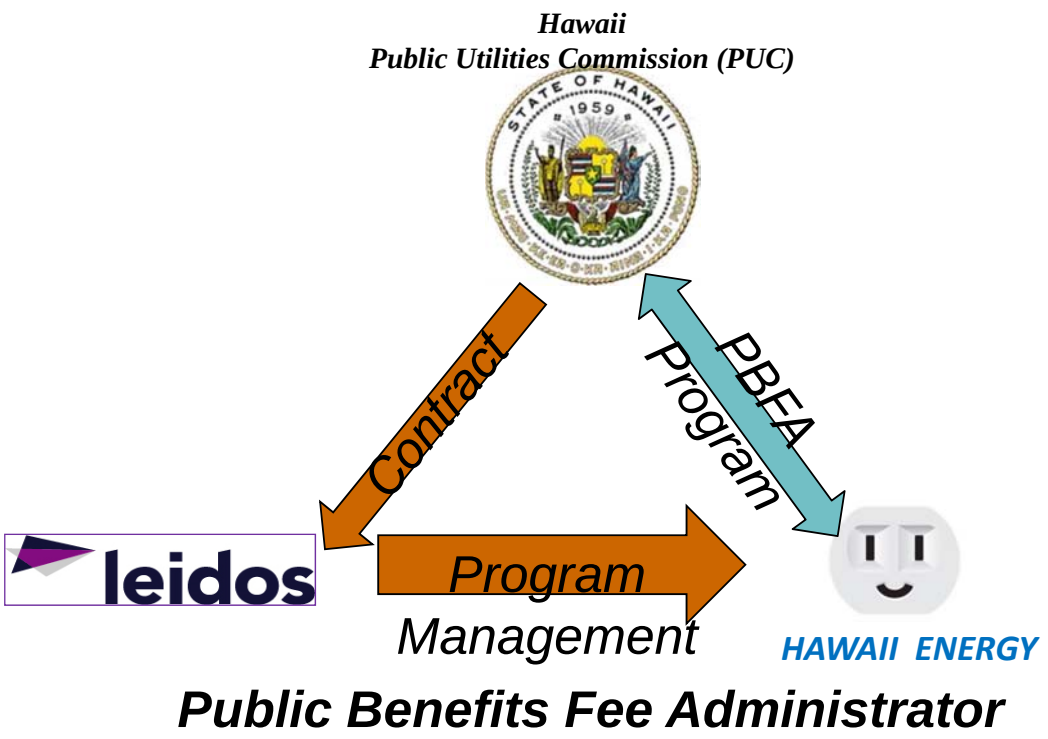
State Agencies Lead by Example in Reducing Energy Use – Hawaii Is #1 in US for Performance Contracting

- ***Energy use by state agencies has fallen 13 percent over the past 10 years***

• Hawaii Is One of a Number of States with Energy Efficiency Portfolio Standards



Hawaii Energy as 3rd Party Administrator



Public Benefits Fee Administrator

Hawaii Energy Mission and Accomplishments

- Provide outreach, education and incentives to promote electricity conservation and efficiency and reduce imported fuel consumption in Hawaii
  - **262 school teachers trained to educate on energy efficiency**
  - **2600 community participants in 91 energy literacy workshops**
- Enable customers to effectively participate in Hawaii's clean energy transformation as directed by the PUC
  - **"in-need" households provided free solar water heaters**

PY12 Key Accomplishments Verified by Audit

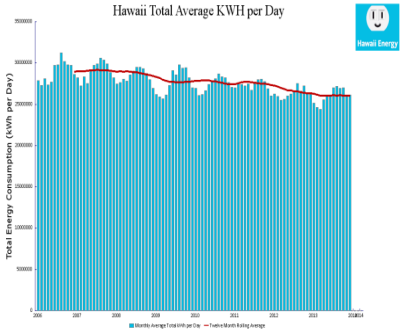
1.4 ***billion kWh savings delivered to grid***
over lifetime of efficiency measures

$404.9 ***million back into customer pocketbooks***
over lifetime of efficiency measures

$30.9 ***million expended*** *(71%incentive / 29%non-incentive)*
out of $37.7 million budget (including $2.8 million PY11 rollover)

2.3 ***cents per kWh***
over lifetime of efficiency measures

1.5% ***reduction***
vs. 2012 electricity sales



California Energy Efficient Incentive Programs Driven by Legislation and Regulation

- **In 2014, over $1.7 billion was budgeted for energy efficiency programs in the state**
  - **Primarily through CPUC decisions**
  - **Income derived from additional charges to users**
- **Savings by design - $150K per project**
- **Customized offering for business**
- **Prescriptive rebates for upgrades**
- **Numerous other programs available through individual communities**
  - **emergence of Community Choice Aggregation**

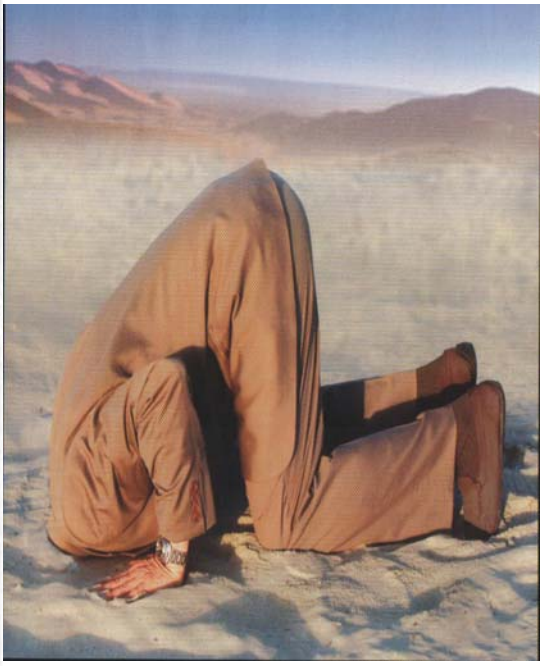
California Public Utility Commission Develops Regulations for Investor-Owned Utilities

- Electricity savings from 2010 to 2012 equaled powering over 800,000 homes, $317M budget
  - In 2013, over $300M leading to savings of almost 500Gwh
- Over $110M/yr in On-Bill financing for efficiency upgrades
- Lighting - $70M with 63MW saved, 414Gwh
- HVAC - $120M, 186 Gwh saved, 61MW
- Emerging tech - $38M funded by utilities
- Addressing water/energy nexus

California Energy Commission Develops Codes and Standards for all Utilities

- Statewide Codes and Standards Program saved ~1100Gwh in 2014:
  - 1) CPUC influences standards and code-setting at CEC to strengthen energy efficiency regulations
  - 2) Improving compliance with existing codes and standards(both agencies)
  - 3) Assisting local governments to develop ordinances that exceed statewide minimum requirements
  - 4) coordinating with other programs and entities to support the state's ambitious policy goals

Climate Change:
Water/Energy Sustainability



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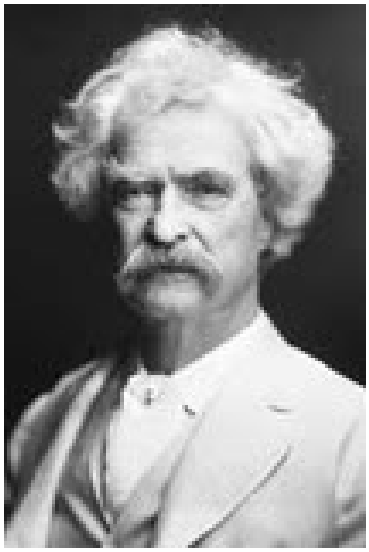
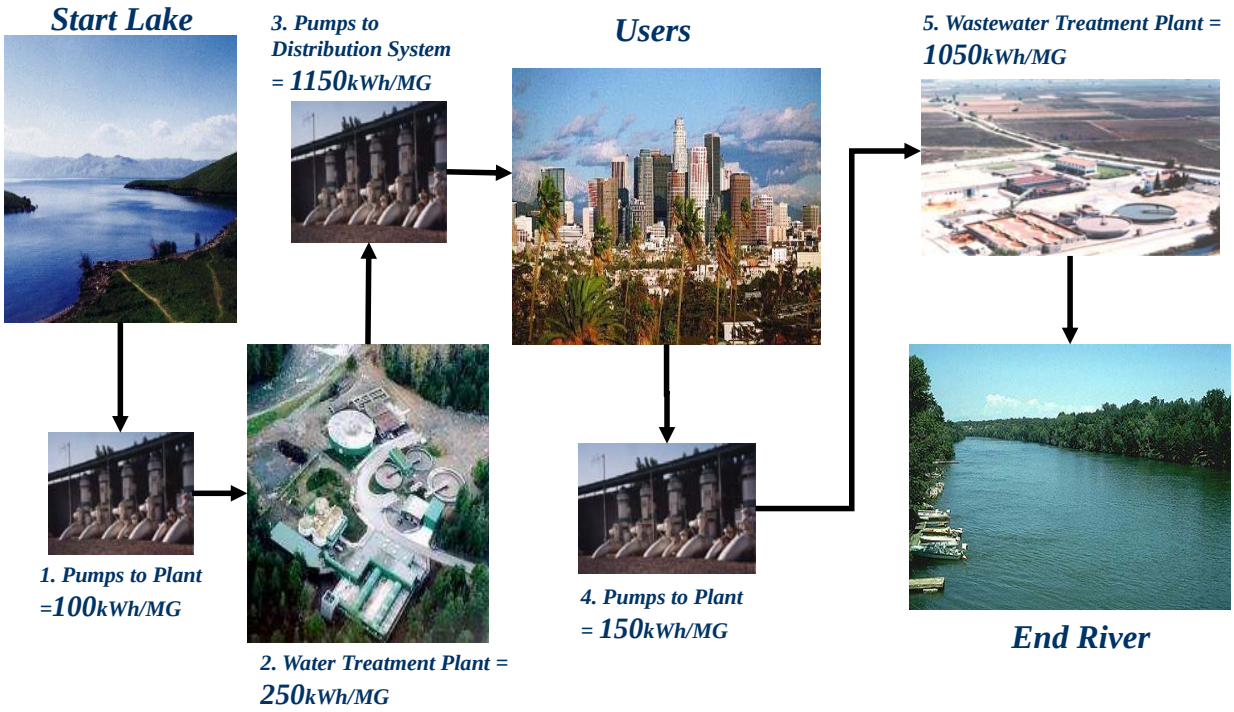
"Whiskey's for drinking, water's for fighting over."

– *Mark Twain*

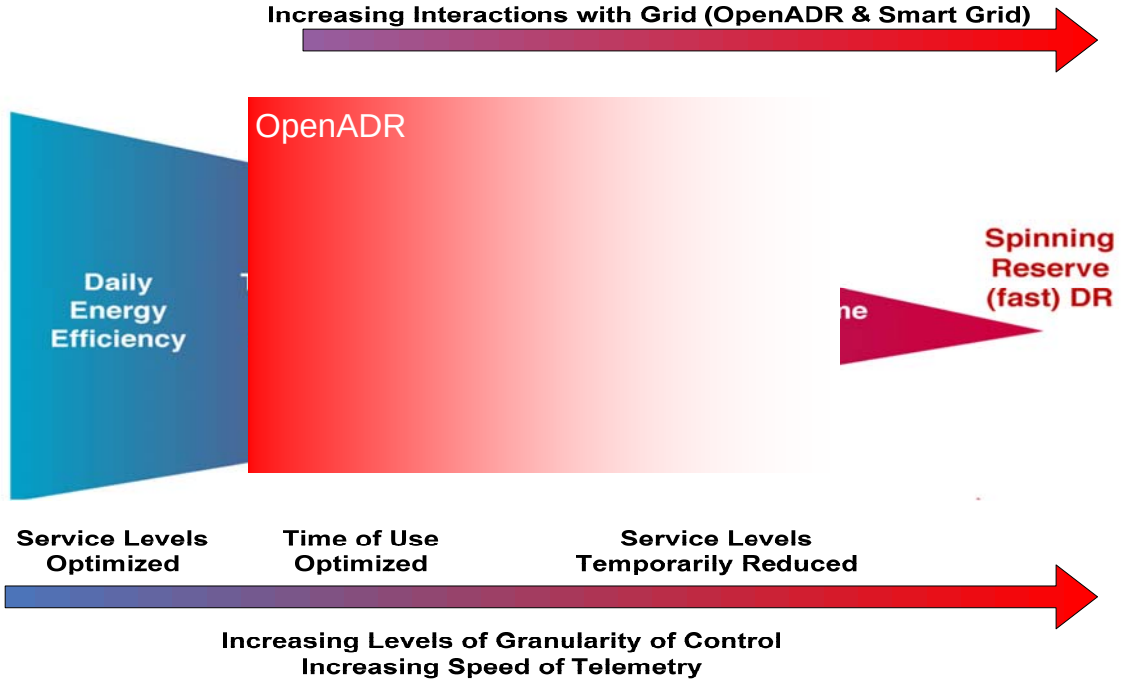


System-Wide Energy Use In Water and Wastewater Treatment – 2.7Mwh/MG, 2nd Largest User of Electricity in CA



	Step 1	Step 2	Step 3	Step 4	Step 5
Accumulating Total	100kWh/MG	350kWh/MG	1500kWh/MG	1650kWh/MG	2700kWh/MG

Demand-side Activities with Smart Grid Systems – Link EE and DR



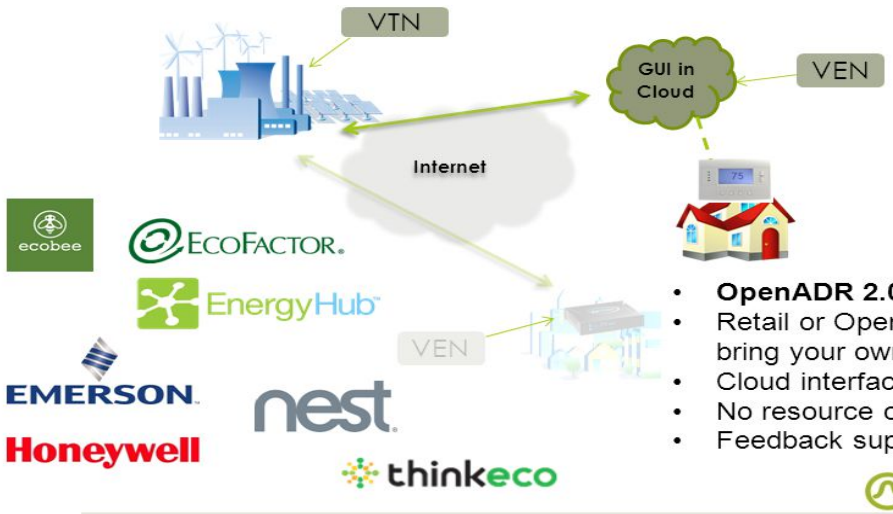
Current Status OpenADR in California

Utility	Enabled Load Shed kilowatts (kW)[a]	Cost of Enablement ($M)	Enrolled Service Accounts	Enrolled Load Shed (kW)[b]
Pacific Gas and Electric	81,330	13.9	347	70,577
Southern California Edison	157,748	37.0	747	155,329
San Diego Gas & Electric	10,740	3.2[c]	126	8,130
TOTAL	**249,818**	**54.1**	**1,220**	**234,036**

- 234 MW, 1,220 accounts currently enrolled in at least 1 program
- ~$215/kW Statewide average enablement cost
- Additional sites in Sacramento, Palo Alto, coming to LADWP
- Additional sites with WIFI Communicating Thermostats
- New requirements in Title 24 bringing new awareness of DR and DR automation
  - Need to link the DR installation with EE programs
  - For tomorrow's talk, need to think about ADR in terms of moving loads INTO generation peaks

Open ADR with Cloud Communications – Now Deal with Moving Load into Peak Generation

Cloud Interface



Government Remains Critical Part of Equation

- Financial instruments (loan guarantees, etc.) must be available to overcome "Valley of Death"
- Regulatory and institutional approaches must remain flexible
- Public/private partnerships for technology development
- Laws should promote the insertion of new, environmentally-acceptable technology, but not "pick winners"
- Should lead public education and information dissemination
- Must link public policies with technology development and scientific findings

Better Direction Is Needed for Regulatory and Institutional Changes

- Major energy technology initiatives require that institutional and regulatory barriers be addressed in addition to technical and financial aspects of the technology
- Example: Clear direction articulated by AB1925/AB32 was needed versus dog's breakfast in the California regulatory and policy environment


LIFE IS GOOD! HOME PRICES ARE ON THE REBOUND, AND SOON WE'LL ALL HAVE OCEANFRONT PROPERTY!
GLOBAL WARMING WORSE THAN WE THOUGHT

Hawaii

Keynote Speech：

Green Energy Target and Cooperation in ASEAN

Venkatachalam Anbumozhi is a Senior Economist at the Economic Research Institute for ASEAN and East Asia (ERIA), Indonesia. His previous positions include Senior Capacity Building Specialist at Asian Development Bank Institute, Assistant Professor at the University of Tokyo, and Senior Policy Researcher at the Institute for Global Environmental Strategies and Assistant Manager in Pacific Consultants International, Tokyo. He has published several books, authored numerous research articles and produced many project reports on energy policies, sustainable infrastructure design, and private sector participation in Green Growth. Anbumozhi was invited as a member of the APEC Expert Panel on Green Climate Finance and the ASEAN Panel for promoting climate-resilient growth. He has taught Resource management, International cooperation and Development Finance at the University of Tokyo and has speaking engagements at some of the leading international organizations. He obtained his PhD from the University of Tokyo.

Green Energy Target and Cooperation in ASEAN

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Economic Research Institute for ASEAN and East Asia

Paris Agreement and INDC Targets

	High Income	Upper-Middle	Lower-Middle
Reductions below BAU	Korea: 37% Brunei: 63%	Thailand: 20% (25%)	Vietnam: 8% (25%) Indonesia: 29% (41%) Cambodia: (27%)
Absolute Reductions	Australia: 26-28% below 2005. Japan: 26% below 2013. NZ: 30% below 2005.	-	-
Emissions Intensity	Singapore: 36% below 2005.	China: 60-65% below 2005. Malaysia: 35% (45%) below 2005.	India: 33-35% below 2005

Source: ERIA, 2016

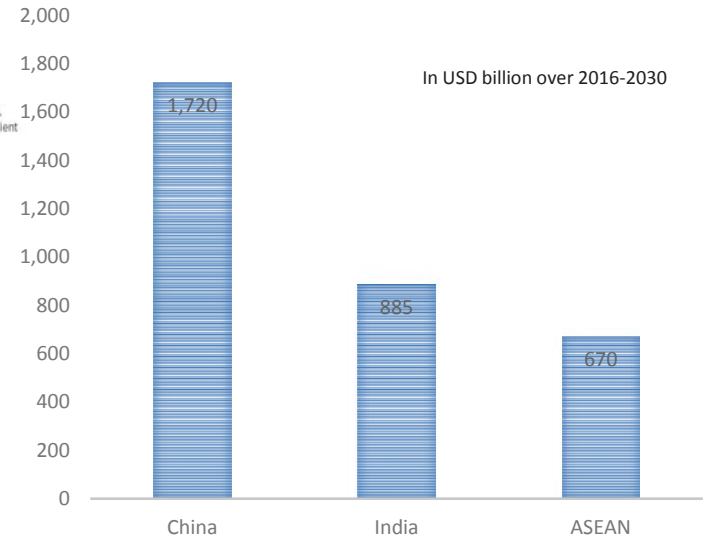
INDC = Δ Emissions intensity = Decomposition of Energy Use

$$\Delta CO_2 = \Delta GDP \times \Delta CO_2/GDP$$
$$= \Delta GDP \times \Delta Energy/GDP \times \Delta CO_2/Energy$$

- Energy intensity (Energy/GDP)
  - technological improvements within each industry/product
  - structural change within the economy
- Carbon intensity (CO_2/Energy)
  - fossil fuels replaced by renewable or nuclear power or CCS
  - end use energy efficiency
  - Annual changes usually much smaller than Δ Energy/GDP
  - But decisive in the longer term

Total Infrastructure Spending Needed for the Transition

Source: IEA, 2015



Source: ERIA, 2015

Opportunity Knocks: What INDC means for ASEAN Energy Investments

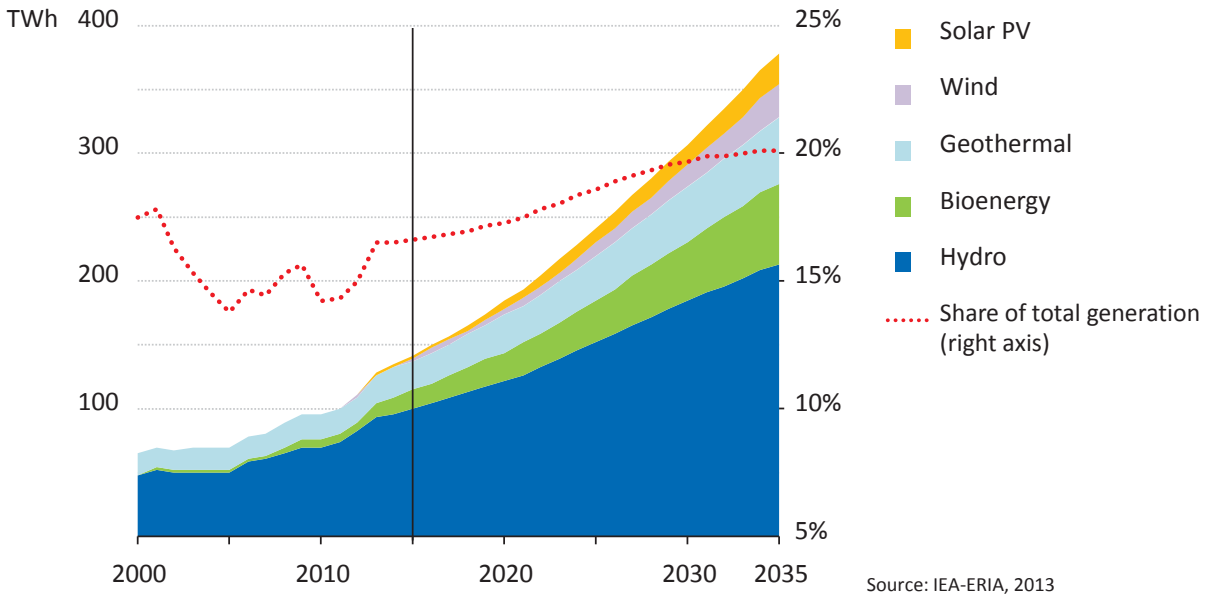
USD Billion

	Wind	Solar	Biomass	Small Hydro	Geothermal	All Renewables	Electric Transmission & Distribution	Industrial Energy Efficiency	Buildings	Transport	Waste	Subtotal
East Asia Pacific	231	537	48	34	16	866	392	143	13,235	1,357	53	16,046
Latin America and Caribbean	118	44	45	11	14	232	0	21	901	1,460	26	2,640
South Asia	111	211	16	0	0	338	0	85	1,543	255	13	2,234
Europe and Central Asia	51	39	6	7	6	109	0	57	410	78	11	665
Sub-Saharan Africa	27	63	3	3	27	123	0	0	153	499	8	783
Middle East and North Africa	50	46	0	1	0	97	21	1	92	50	4	265
Total Climate-Smart Investment Potential by Sector ($ billion)	588	940	118	56	63	1,765	413	307	16,334	3,699	115	22,633

From 2016 – 2030, based on INDCs

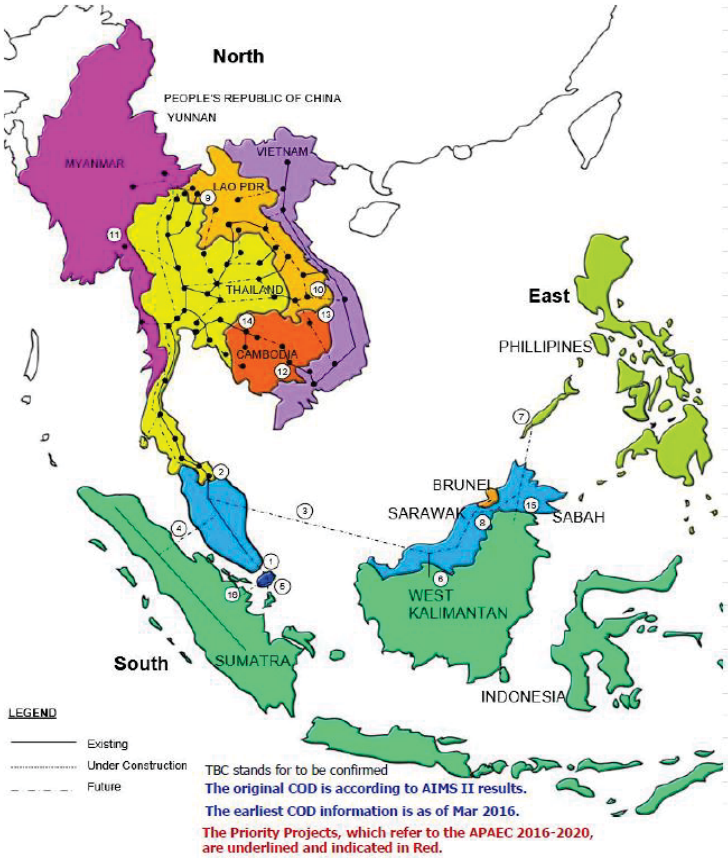
Source: World Bank, 2017

ASEAN Renewable Energy Targets



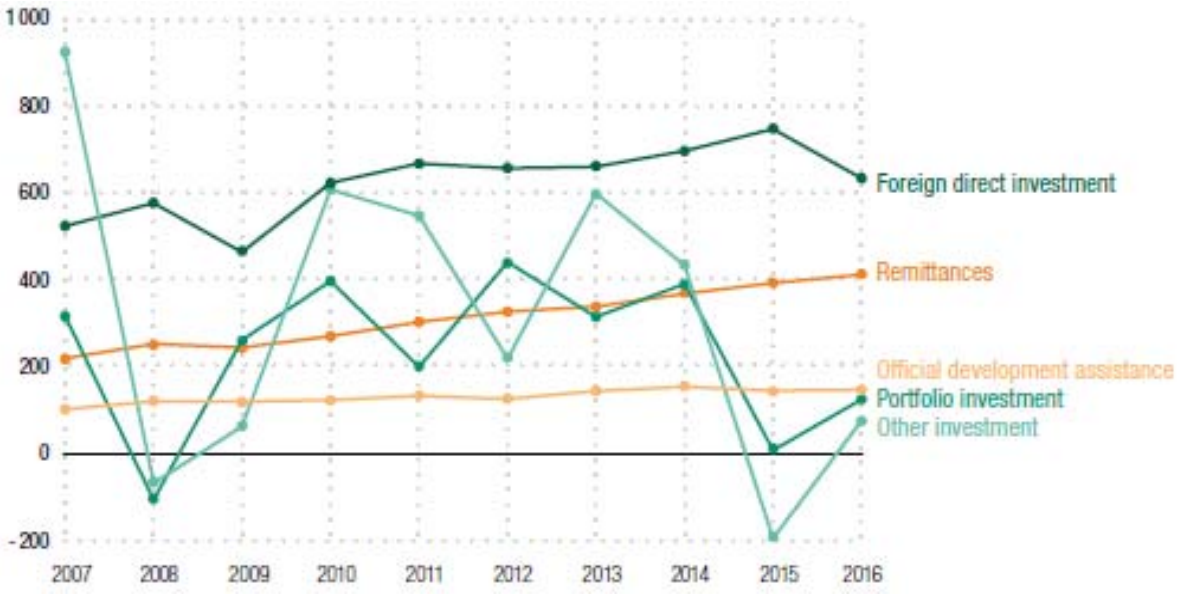
Source: IEA-ERIA, 2013

Meeting the Targets through ASEAN *Power Grid* (APG)



		Earliest COD
1)	**P.Malaysia – Singapore**	
	• Plentong – Woodlands	Existing
	• P.Malaysia – Singapore (2nd link Plentong – Woodlands)	post 2020
2)	**Thailand – P.Malaysia**	
	• Sadao – Bukit Keteri	Existing
	• Khlong Ngae – Gurun	Existing
	• Su Ngai Kolok – Rantau Panjang	TBC
	• Khlong Ngae – Gurun (2nd Phase, 300MW)	TBC
3)	**Sarawak – P. Malaysia**	**2025**
4)	**P.Malaysia – Sumatra**	**2021**
5)	**Batam – Singapore**	**post 2020**
6)	**Sarawak – West Kalimantan**	**Existing**
7)	**Philippines – Sabah**	**TBC**
8)	**Sarawak – Sabah – Brunei**	**2020**
	• Sarawak – Sabah	2020
	• Sarawak – Brunei	2019
9)	**Thailand – Lao PDR**	
	• Nakhon Phanom 2 - Thakhek - Theun Hinboun	Existing
	• Ubon Ratchathani 2 - Houay Ho	Existing
	• Roi Et 2 – Nam Theun 2	Existing
	• Udon Thani 3 - Na Bong - Nam Ngum 2	Existing
	• Nakhon Phanom 2 – Thakhek – Then Hinboun (Exp.)	Existing
	• Mae Moh 3 – Nan – Hong Sa	Existing
	• Udon Thani 3 – Nabong (converted to 500KV)	2019
	• Ubon Ratchathani 3 – Pakse – Xe Pian Xe Namnoy	2019
	• Khon Kaen 4 – Loei 2 – Xayaburi	2019
	• Nakhon Phanom – Thakhek	2015
	• Thailand – Lao PDR (New)	2019-2023
10)	**Lao PDR – Vietnam**	**2016 - 2020**
	• Xekaman 3 – Tranhmy	Existing
	• Xekaman 1 – Pleiku 2	2016
11)	**Thailand – Myanmar**	**2018-2026**
12)	**Vietnam – Cambodia (New)**	
	• Chau Doc – Takeo – Phnom Penh	Existing
	• Tay Ninh – Stung Treng	TBC
13)	**Lao PDR – Cambodia**	
	• Ban Hat - Kampong Sralao	Existing
	• Ban Hat - Stung Treng	post 2018
14)	**Thailand – Cambodia (New)**	**post 2020**
	• Aranyaprathet – Banteay Meanchey	Existing
	• Thailand – Cambodia	post 2020
15)	**East Sabah – East Kalimantan**	**TBC**
16)	**Singapore – Sumatra**	**post 2020**

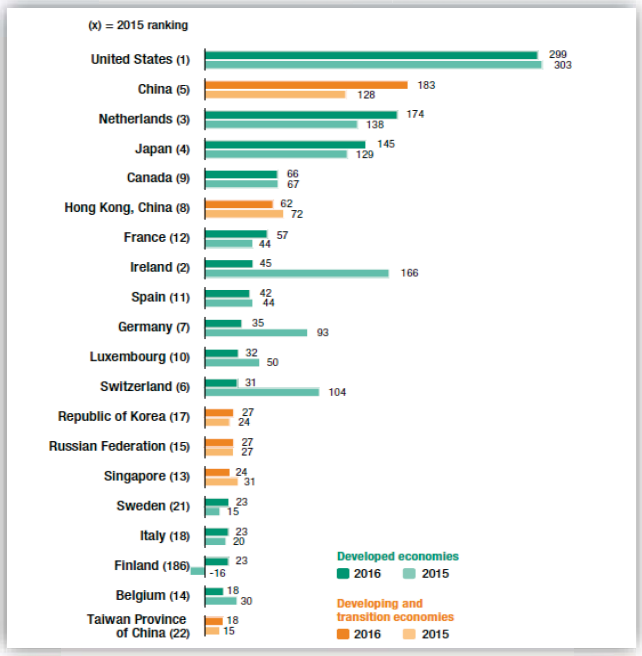
Patterns of Financial Inflow into Emerging Economies



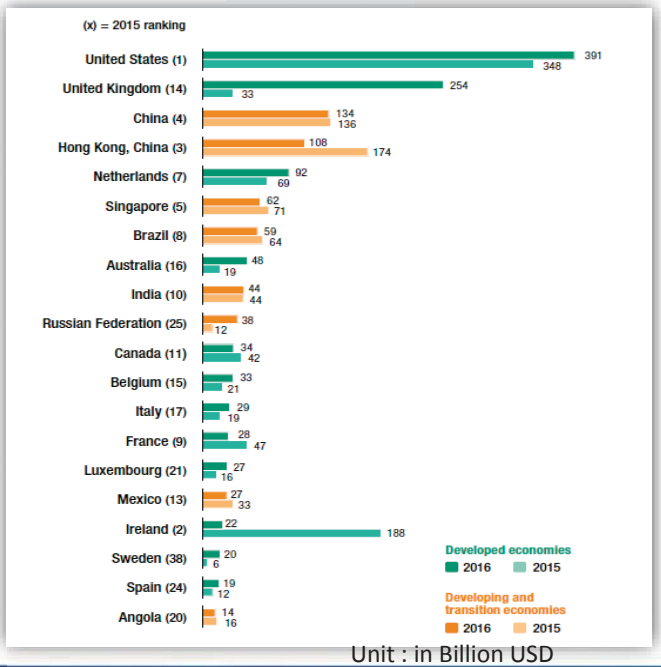
Source: UNCTAD - database for FDI flows, OECD - for ODA, World Bank - for remittances

FDI – Outflows Inflows

Top 20 home countries



Top 20 host countries



Unit : in Billion USD

ERIA

Source: WIR, 2017

What determinants private low-carbon Energy Investment Flows?

1.Policy Frameworks (renewable energy policy, climate change policy, environmental) (Creamer , 2011; Govindarajulu, 2012; Giz, 2016)

2.Economic Determinants (by motive)

- Market seeking motive (eg, low carbon products and energy)
- Resource seeking motive (access to natural and precious metal)
- Efficiency seeking motive (technology upgrade of motives)

-Strategic asset seeking motive (access to technology)

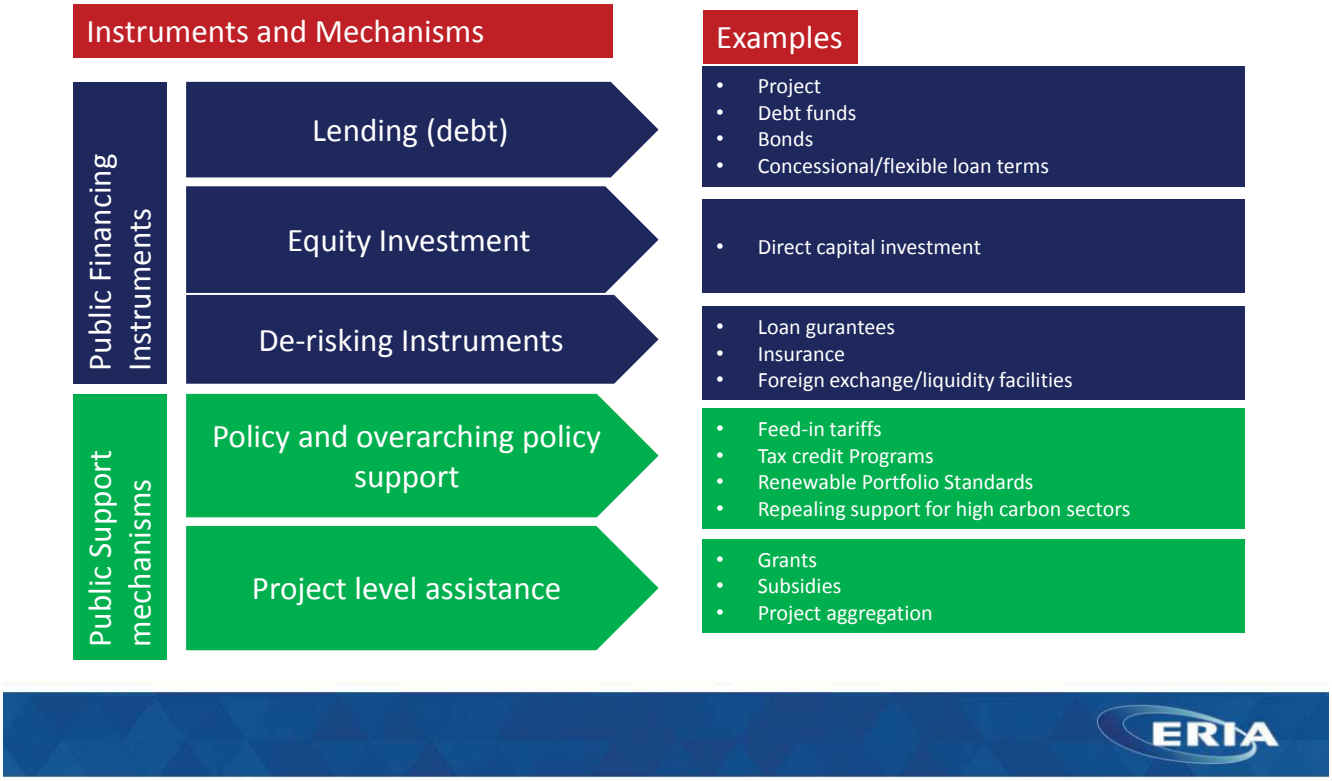
(Sarochawikasit, 2013; El salmawy, 2014; Sachs, 2015; Hamilton, 2010)

3. Business Facilitation measures (investment promotion, after care, tax incentives) (Popil, 2011. Yoshino, 2015; Kawai, 2011; Kurowski, 2013)

Choice of countries, sectors and private investment flows

ERIA

A taxonomy of Public Policy Instruments and mechanisms practiced in Asia



Source: ERIA Background papers (2017)

Hypothesis: Capital Allocation costs can be minimized by maximizing Regional Cooperation

- By their nature, low carbon energy transition takes longer to receive attention from investors
- Incumbent industries and investors are always considered as intervenors. Low-carbon investors and inventors usually do not intervene
- Resulting lack of certainty and incentives and regulation dampen investment on clean energy transition
- Paradoxically, continued focus on INDC targets rather through trade and investment liberalization increases the likelihood of regional public good from private investment.

Risks to Spillover benefits of investment in low carbon energy system

or

Rationale for regional cooperation for maximizing capital allocation

Low Carbon Investors are compensated for low capital stocks region-wide

Low capital stocks in emerging low carbon energy value chain result in capital intensive business models for progressive investors

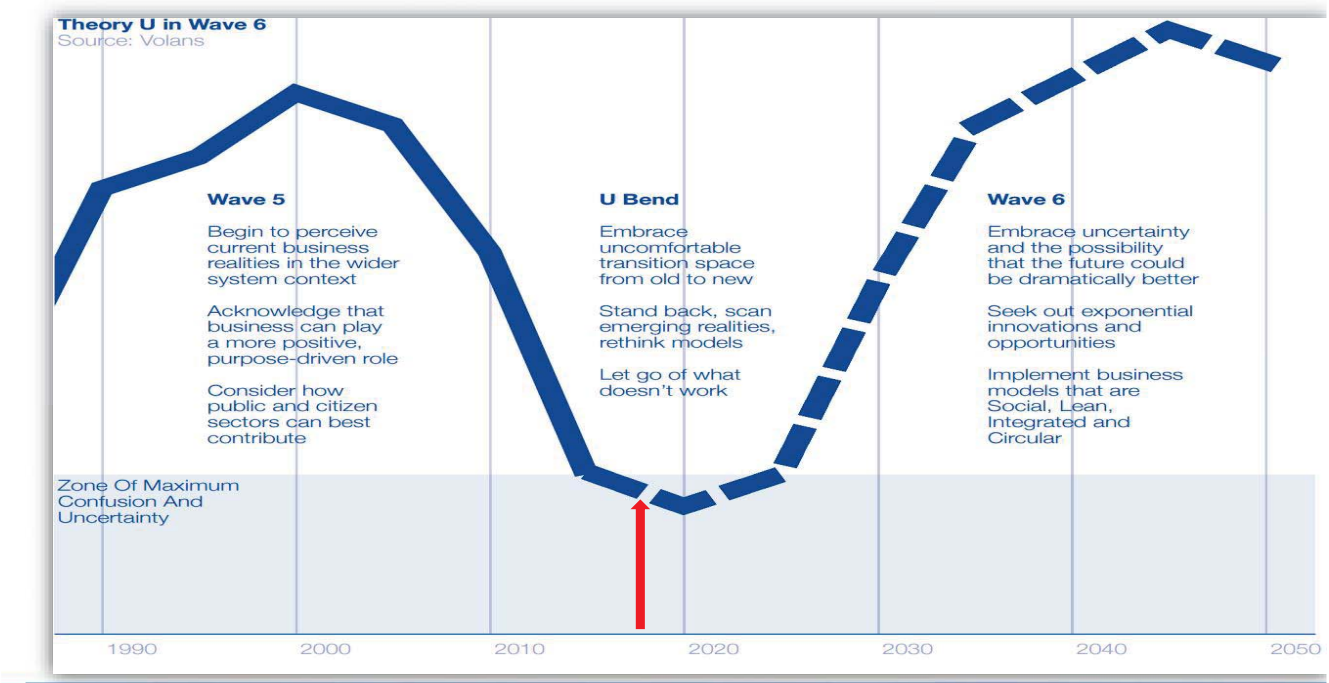
- region/global distribution
- Technology research and development
- System integration

Customers with long lived Assets Protecting shareholder value

- In order to maximize shareholder return, customers may require investors to bear greater risk when they adopt low carbon energy
- Investors may therefore need to deliver turnkey systems rather than work with shareholders
- Lack of regulatory certainty makes capital difficult to obtain

ERIA

Paris Agreement and INDC targets gives a moment of great opportunity for Transition to Low carbon Economy



ERIA

Four Propositions

- Regional Low-Carbon Transition Fund
- Financial Performance Warranty Program
- Regional Best Regulations for the Green Economy Program
- Hi-tech Low Carbon Infrastructure Program

ERIA

1. Regional Low-Carbon Transition Fund

Problem Set: Broadening and deepening risk bearing capacity of investors to support the low-carbon transition

Market Challenges:

- Existing capital markets for low-carbon technology projects are thin, making raising project finance slow and costly
- Thin capital markets are slowing deployment of low carbon energy solutions that can contribute to INDC targets
- Regulators do not have market signal to provide evidence of the scale and nature of potential low carbon innovation solutions to address Paris commitments and other regional public goods

1.Regional Low-Carbon Energy Transition Fund

- Regional Low-carbon transition Fund would enable the investors in low carbon assets, which will underpin the INDC targets to monetize the carbon credits and thus to increase their financial resilience.
- The value of the fund would be proportional to existing fissile fuel subsidies in the region and would be established to operate during the period in advance of substantial prices on carbon.
- Investors would be entitled to implement the projects across the borders. These projects would be considered for eligibility under bilateral offset trading mechanisms. This regionally subscribe fund would serve to deepen capital stocks.

2. Regional Finance Warranty Program

Problem Set: Broadening and deepening financial markets to reduce the cost of financing low carbon energy investments/new innovative solutions

Market challenges:

- Public sector actors seeking low carbon technology absorption or other projects cannot bear the full risks for technical and business performance.
- As a result, contractual agreement with low-carbon projects proponents may result in risk down loading whose balance sheet are still forming, or the exclusion of such investments together
- Financial markets have not received sufficiently concentrated market signal to build or acquire lending and underwriting experience for low carbon investment
- Performance insurance underwriting capacity exists for risky sectors such as mining, oil and gas – but market signals have not triggered a spill over of this capacity to low carbon energy sectors.

2. Regional Finance Warranty Program

- Low-carbon finance performance warranty program would target sellers of low carbon technology whose customers, require insurance to warranty technology availability and performance.
- This regional wide program would target the formation of a critical mass of risk underwriting opportunities to attract private sector underwriters to warranty the performance and availability of innovations and investments being procured by the public and private sector.
- The program goal would be to enable the formation of a low carbon risk underwriting market. The market signals to kick-start such performance warranty or insurance market would come from the accreditation of low carbon projects under the regional low carbon energy transition fund.

3. Best Regional Regulations for Green Energy Investment

Problem Set: Broadening and deepening demand for low carbon investment to gain the eco- productivity benefits

Market Challenge:

- Many regulators at regional and national level are not now structured to accommodate low carbon innovative solution.
- Energy sector investors have low-regulatory engagement, but they are knowledgeable of regulations and policies that enable the deployment of their investments in international/regional markets.
- Provision in articles in AEC and Paris Agreement will lead to increasing regional cooperation and a greater need for regulatory harmonization

3. Best Regional Regulations for Green Energy Investment

- The best regional regulation program would enable countries request a third party assessment o the potential within their country of international policies and regulations that have enabled commercial deployment of low carbon technology investment.
- The intent of the programs would be to recruit academia and non-profits to assesse the effectiveness of current policy barriers and regulations internationally to determine and prioritize the reforms.
- This program could be established for a period of five years to coincide with INDC implementation review. The review could also consider structural impediments such as costs, delays and current investment status.

4. High Tech Low-Carbon Energy Infrastructure Program

Problem Set: Broadening and deepening demand for low carbon energy investment to gain economic productivity benefits

Market Challenges:

- Infrastructure procurement criteria generally assesse one time capital expenditure only, with no requirement to consider the cost of future carbon targets and other operating costs or cost effective alternatives
- With very few exceptions, low carbon high technology firms and investments have been unsuccessful in integrating their innovations into public infrastructure projects.
- Taking up innovative solutions within public procurement and or demand stimulus program would be a vehicle to ensure that spill over benefits of the last three propositions are realized

4. High tech low -carbon Energy Infrastructure Program

- Under the regionally coordinated or agreed programs, a procurement approach with three stages would be taken to elauria new energy infrastructure investments proposal.
- Full economic life-cycle cost assessment, including taking into account operating costs, social benefits and the impact on INDC targets.
- Full emission cost assessment, accounting for embodied, operational and end of life costs
- Best available technology solutions – assessment that requires investors to undertake analysis of whether the need associate with the energy infrastructure project can be met through high tech or natural means.

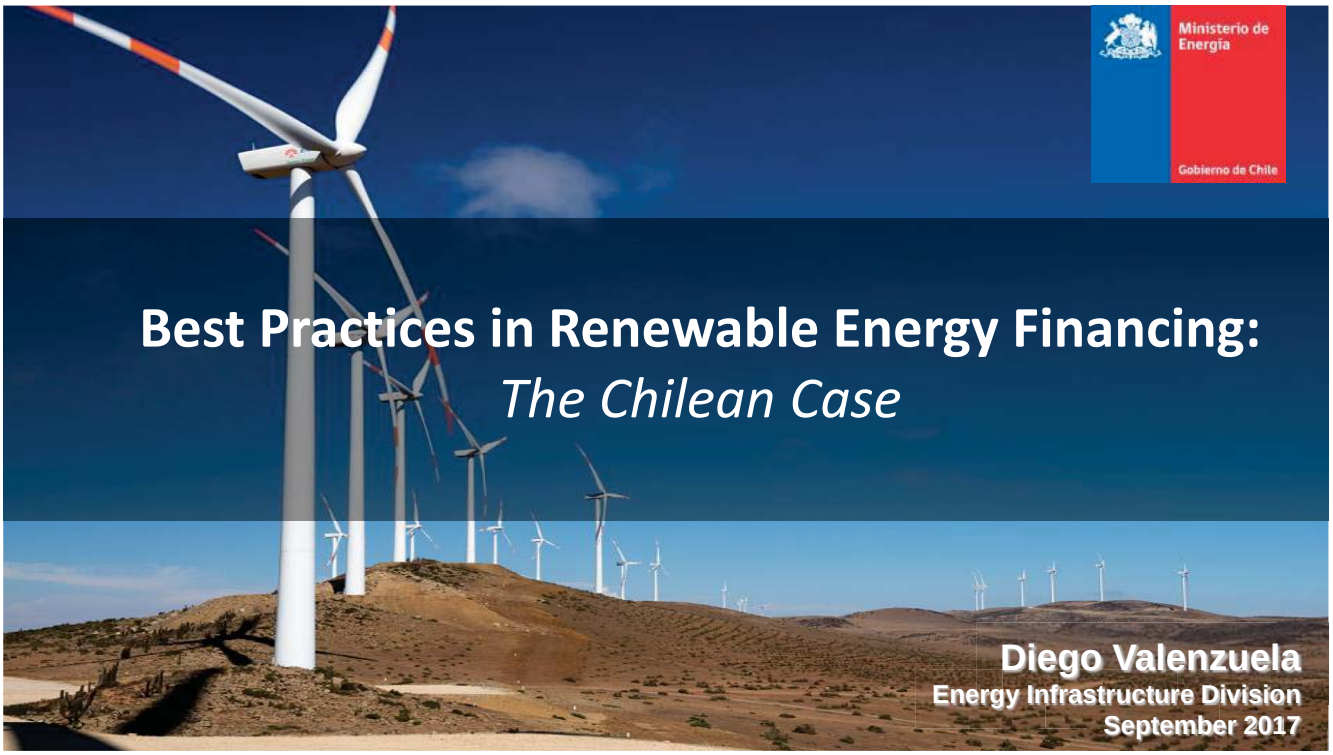
Session IV：

Best Practices in Renewable Energy Financing

Best Practices in Renewable Energy Financing: The Chilean Case

Short Bio

Diego Valenzuela has a law degree from Universidad de Chile and a Master's degree in International Energy Policy from Columbia University, NY. He joined the Energy Ministry in 2014 as an advisor to the Minister´s Cabinet. In 2016 he was appointed Unit Head of the Energy Infrastructure Division. Previous to joining the Ministry, Mr Valenzuela worked for the Inter-American Development Bank in Washington, DC and in several law firms in Santiago, Chile.



Best Practices in Renewable Energy Financing:
The Chilean Case

Diego Valenzuela
Energy Infrastructure Division
September 2017

Let's look back at 2013…

Energy spot price	US$150 MWh
Public Power tender price	US$128 MWh
Bids received	2
N° of Power Plants under construction	28
% Renewables in Matrix*	5%

*excludes large hydro

Where are we now… *(as of Dec. 2016)*

		Δ from 2013
Energy spot price	US$60 MWh	(60%)
Public Power tender price	US$47 MWh	(63%)
Bids received	84	x40 times
N° of Power Plants under construction	54	+93%
% Renewables* in Matrix	17%	x3,4 times

*excludes large hydro

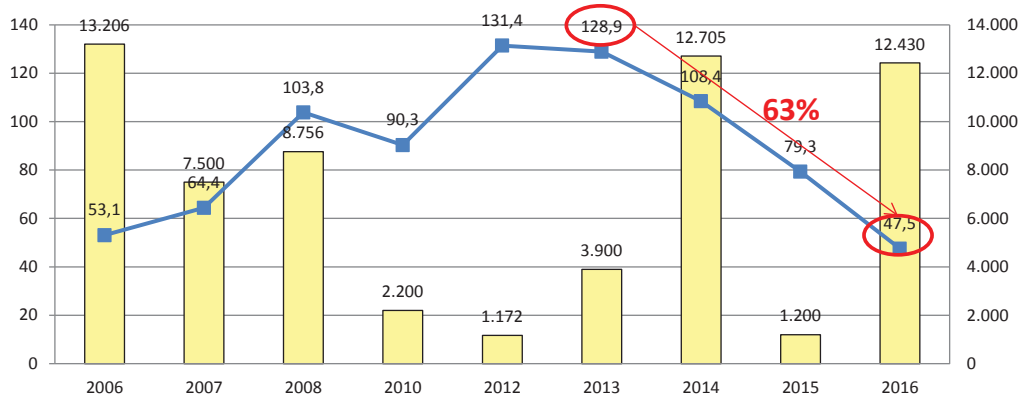

What happened?


Policies implemented:
• Short Term Energy Policy (Energy Agenda)
• Long Term Energy Policy (Energy 2050)
• 6 new laws enacted:
- Institutional strengthening
- Power Tender Processes
- National Oil Company
- Residential Gas
- Electric Transmission
- Residential Electricity Tariff

Tender Design: introducing competition & making easier to finance projects…

- **With Time Blocks**
  - Día
  - Peak
  - Night
  - 24 hours
- **With Energy Blocks of different sizes**
- **Increase in the supply period from 15 to 20 years**
- **Longer period before beginning supply, from 3 to 5 years**
- **Longer notice of the call for bids, from 90 days to one year**

Tender Results:



On June 27th, 2016

84

offers

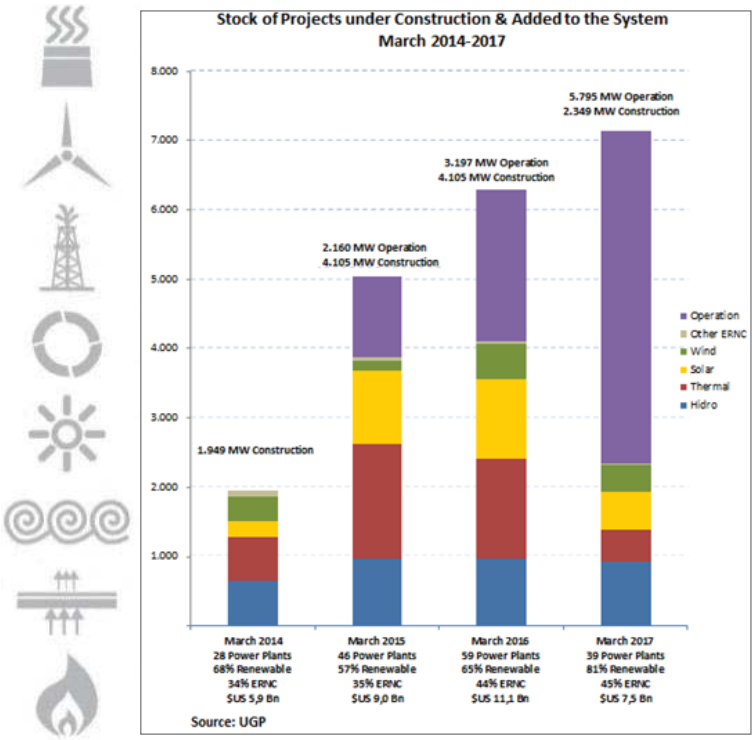
were presented for the electricity auction

Auction Results 2016

- Offers were received from 84 bidders
- 12,430 GWh/year of energy was auctioned, equivalent to one-third of the consumption of the regulated clients of the SIC and SING Grids
- The average price was 63% lower than the auction held in 2013

Current State of Investment in the Energy Sector in Chile

N°1 Investment ranking: Energy Sector

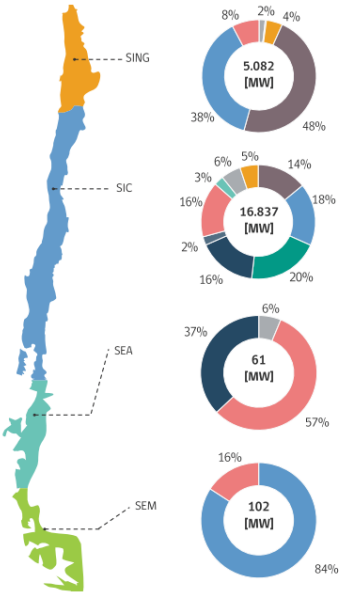


In 3 years:

- Almost 4,800 MW have been added to the matrix
- That's a 25% growth compared to 2014
- Most of this increase has been in renewable energies

NCRE are 17% today... Three years ago it was 5%

Capacidad Instalada por Tecnología



Capacidad Instalada por Sistema

Sistema	Capacidad [MW]	Capacidad [%]
SING	5.082	23,0%
SIC	16.837	76,2%
SEA	61	0,3%
SEM	102	0,5%

Fuente: CDEC-SIC / CDEC-SING y CNE

- Others
- Wind
- Diesel
- Coal
- Biomass
- Natural Gas
- Solar photovoltaic
- Hydroelectric (run – of – river)
- Hydroelectric (reservoir)
- Mini hydroelectric

What about Transmission?

Transmission investments at Record Levels:

- Currently over 2000 kms. of lines under construction, worth approx. $2,5 billion in investment.
- Transmission Projects Pipeline: Another $2,5 billions in investment for the next 5 years.


Thank you!
Ministerio de Energía
Gobierno de Chile
13

Listed Infrastructure Fund Market

Takumi Hayase

Vice President, New Listings Promotion Department

Tokyo Stock Exchange, Inc.

Takumi Hayase is a Vice President at New Listings Promotion Department based in Tokyo, Japan. The team is responsible developing listing rules for structured financial products, such as Infrastructure Funds, REITs, and etc. as well as promoting these structured financial products.

Mr. Hayase receives his Bachelor of Economics from The University of Tokyo (Japan).

Listed Infrastructure Fund Market

Sep. 29, 2017
Tokyo Stock Exchange, Inc.

About JPX Group and Tokyo Stock Exchange

Establishment of Japan Exchange Group (JPX)

✓ The January 2013 merger combined the complementary strengths of Tokyo Stock Exchange and Osaka Exchange in the cash equity and derivatives markets.

TOKYO STOCK EXCHANGE GROUP

OSE

Merger in Jan 2013

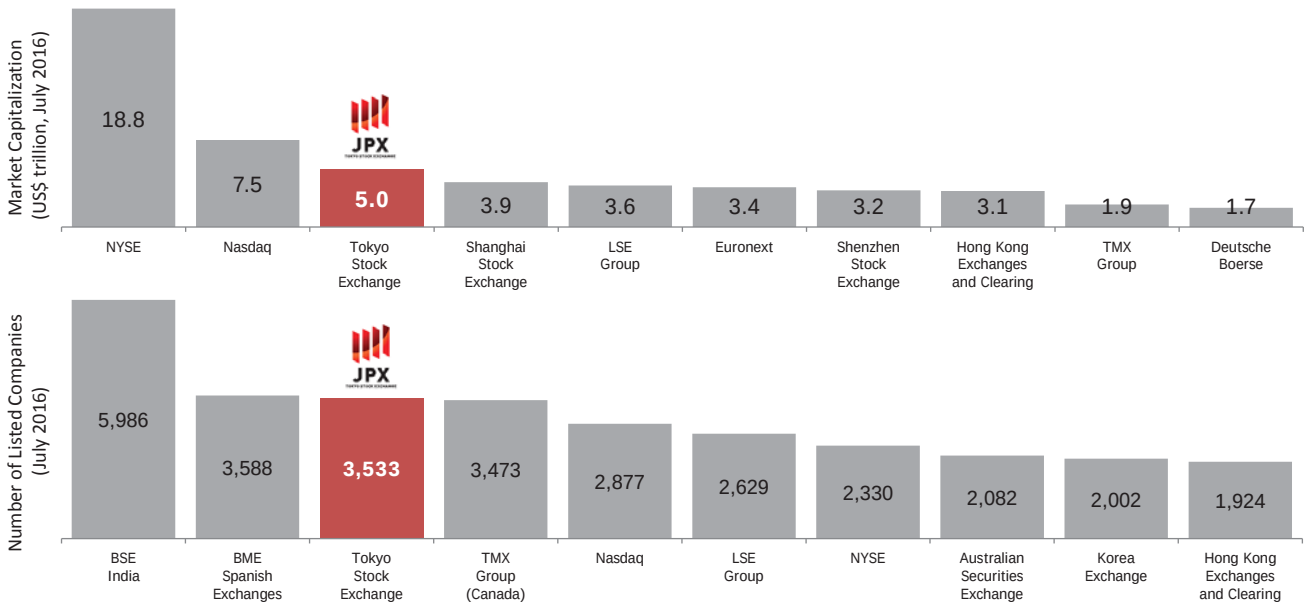
JPX JAPAN EXCHANGE GROUP

- **Tokyo Stock Exchange (TSE)** : Dominant domestic **Cash Equities Market**
- **Osaka Exchange (OSE)** : **Derivatives Market** with Nikkei 225 Futures & Options
- **Japan Exchange Regulation** : Self-Regulation
- **Japan Securities Clearing Corporation** : Clearing (Cash/Derivatives/OTC) JSCC

The Largest Exchange in Asia by Market Capitalization

✓ Tokyo Stock Exchange is the world's third largest and Asia's largest exchange by market capitalization and number of listed companies.

✓ TSE's trading value (2015): US$ 5.5 trillion (JPY 696 trillion).
(cf. NYSE US$ 17.5 trillion, LSE Group US$ 2.7 trillion, HKEx US$ 2.1 trillion)



Source: World Federation of Exchanges

Product Lineup - Asset Classes -

- ✓ Japan Exchange Group is expanding its product lineup to provide investors with more investment options.
- ✓ We are working to diversify our ETF/ETN, REIT, and derivatives lineups.
- ✓ Infrastructure Fund Market was launched in 2015 and now has 3 funds listed.

Cash Equity Market (Tokyo Stock Exchange)

Stock Market
More than 3,500 Issues

- 1st Section (blue chips)
- 2nd Section
- Markets for Emerging companies

JASDAQ Mothers

- Market for Professionals

TOKYO PRO Market
TOKYO PRO-BOND Market

Fund Market

ETF/ETNs
234 Issues

REITs
58 Issues

Infrastructure Funds
3 Issue

Derivatives Market (Osaka Exchange)

Equity Derivatives

- TOPIX Futures / mini Futures
- Ni225 Futures / mini Futures
- Nikkei/Dividend Futures
- JPX-Nikkei 400 Futures
- TOPIX Options
- Nikkei 225 Options
- Nikkei 225 Weekly Options
- Equity Options etc.
- TSE Mothers Futures
- JPX-Nikkei 400 Options
- TAIEX Futures
- FTSE China50 Futures

Fixed Income Derivatives

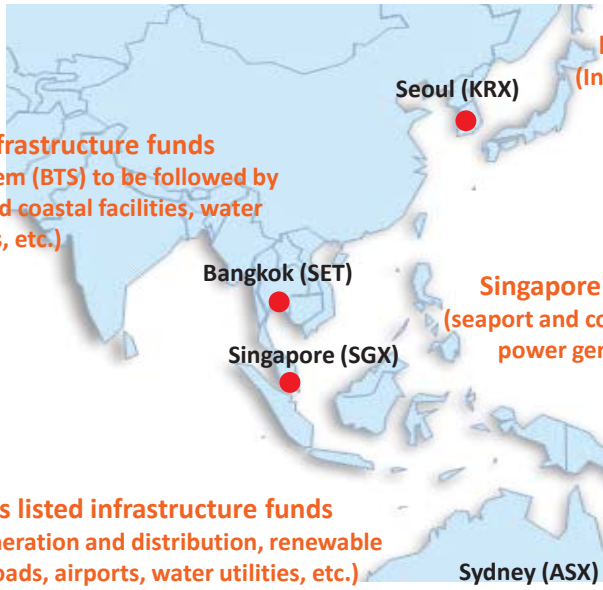
- JGB Futures (5/10/20yr)
- Mini-JGB Futures (10yr)
- Options on 10-yr. JGB Futures
  etc.

Source: Tokyo Stock Exchange
Note: As of the end of Jul 2017

Outline of Listed Infrastructure Fund Market

Listed Infrastructure Fund Markets in Asia

✓ The success of the infrastructure fund market in Asia was a driving force behind creating a similar market in Japan.



Korea's listed infrastructure funds
(Incheon airport, Pbusan seaport, toll roads, tunnels, bridges, and subways, etc.)

Thailand's listed infrastructure funds
(Bangkok Mass Transit System (BTS) to be followed by electric power, seaport and coastal facilities, water utilities, etc.)

Singapore's infrastructure and business trusts
(seaport and coastal facilities, renewable energy, fossil fuel power generation, urban transport network, and telecommunications, etc.)

Australia's listed infrastructure funds
(gas, power generation and distribution, renewable energy, toll roads, airports, water utilities, etc.)

***Besides these, listed infrastructure markets are also found in the US (NYSE), the UK (London), Canada (Toronto), and New Zealand.**

Source: Report by the Study Group on the Listed Infrastructure Market (May 2013)

Timeline of Infrastructure Fund Market

Jul. 2012	■ Japanese government introduced a feed-in tariff system
May 2013	■ **Release of the Report by the Study Group on the Listed Infrastructure Market** - Toward Establishing the Listed Infrastructure Market in Japan -
Jun. 2014	■ Cabinet approved "Japan Revitalization Strategy Revised in 2014" • Improve the environment for creating infrastructure fund market • Encourage to introduce the greatest-possible quantity of renewable energy sources
Sep. 2014	■ Revision of Order for Enforcement of the Act on Investment Trusts and Investment Corporations • Permitted for investment corporations to invest renewable energy facilities and concessions.
	■ Amendment to conduit requirement for corporate tax • Investment corporations that invest in renewable energy facilities shall be substantially exempted from corporate tax for **ten** years.
Apr. 2015	■ **TSE's Infrastructure Fund Market was launched**
Jul. 2015	■ The Japanese government published the Long-term Energy Supply and Demand Outlook (Energy Mix).
Apr. 2016	■ FY2016 Tax Reform • For listed investment corporations investing in renewable energy facilities, the period for being substantially exempted from corporate tax shall be extended from ten to **twenty** years.
Jun. 2016	■ New listing : **Takara Leben Infrastructure Fund, Inc.**
Dec. 2016	■ New listing : **Ichigo Green Infrastructure Investment Corporation**
Mar. 2017	■ New listing : **Renewable Japan Energy Infrastructure Fund, Inc.**

Outline of Infrastructure Funds

Target Assets of Infrastructure Funds

Renewable power generation facility

Solar, Wind, Geothermal, etc.

Concession of public facility

Transportation

Toll Roads, Railways, Airport, Port facilities, etc.

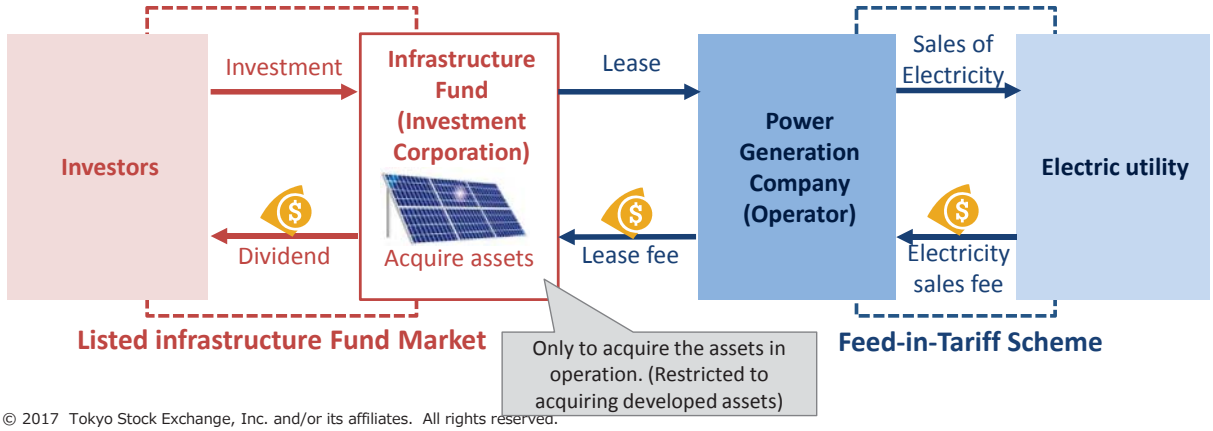
Energy

Power Plants, Gas facilities, Oil pipelines, etc.

Others

Water facilities, telecommunications facilities, etc.

Structure of Infrastructure Funds (e.g., Renewable Power Generation Facilities)



Synergy in the Listed Market and Japanese Government's Policy

Japanese Government's Policy on Renewable Energy

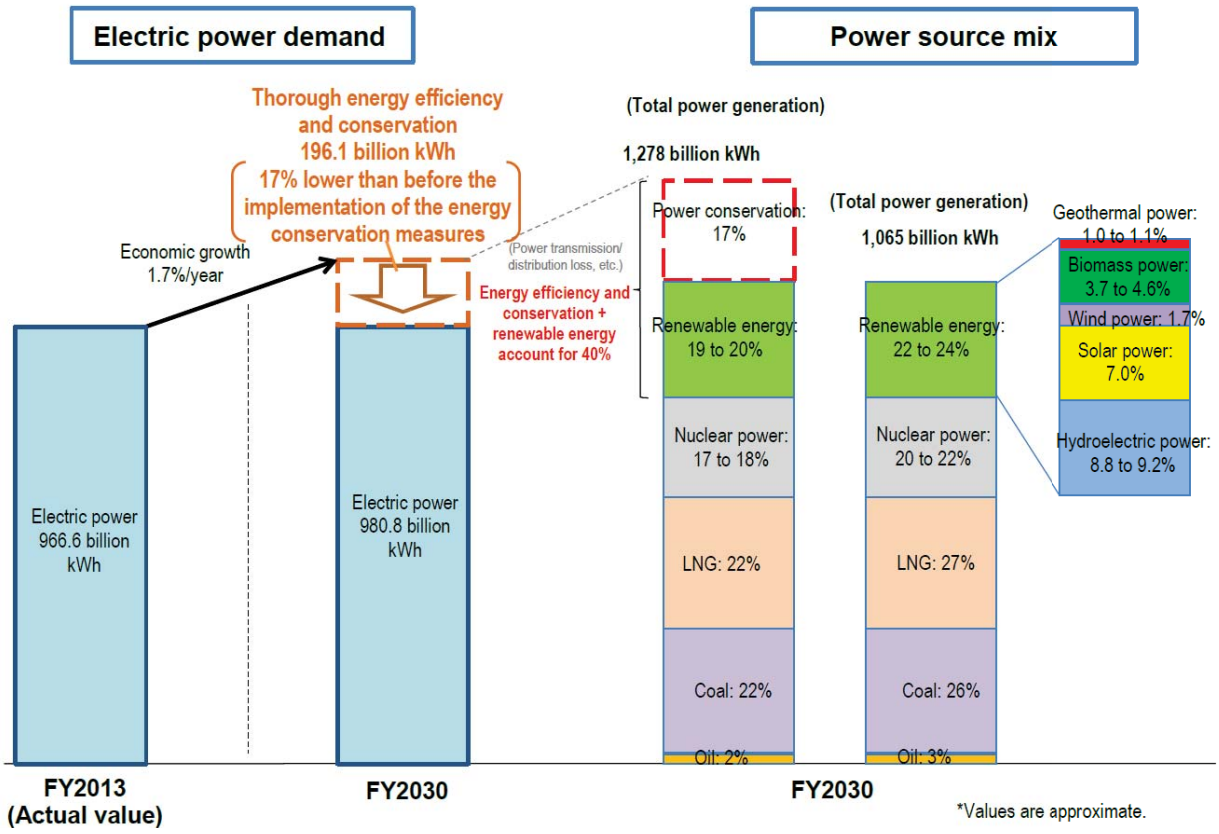
- ✓ The Japanese government announced "Best Energy Mix Plan in FY2030 (The Energy Mix)" in April 2015. This plan aims to increase the share of renewable energy in Japan's energy sources to 22-24% in FY2030.
- ✓ To accelerate the development of renewable power generation facilities and achieve the Energy Mix, the Japanese government adopted the Feed-in-Tariff (FIT) system for renewable energy in July 2012.
- ✓ In April 2017, the government reformed the FIT system, (i) **to improve the cost-effectiveness of renewable energy projects**, and (ii) **to keep power plants stable over the long term**.

Accelerating development of renewable power generation facilities → **Improving the cost-effectiveness** of renewable energy projects and keeping plants **stable over the long term**

	FY2010		FY2016	FY2030
Solar	0%	+5%	5%	7%
Wind	0%	+1%	1%	2%
Biomass	1%	+1%	2%	4-5%
Geothermal	0%	→	0%	1%
Hydropower	7%	→	7%	8-9%
	8%		15%	22-24%

Source: the Ministry of Economy, Trade and Industry(METI)

Long-term Energy Supply and Demand Outlook (Energy Mix)



Source: The Long-term Energy Supply and Demand Outlook (Jul 2015)

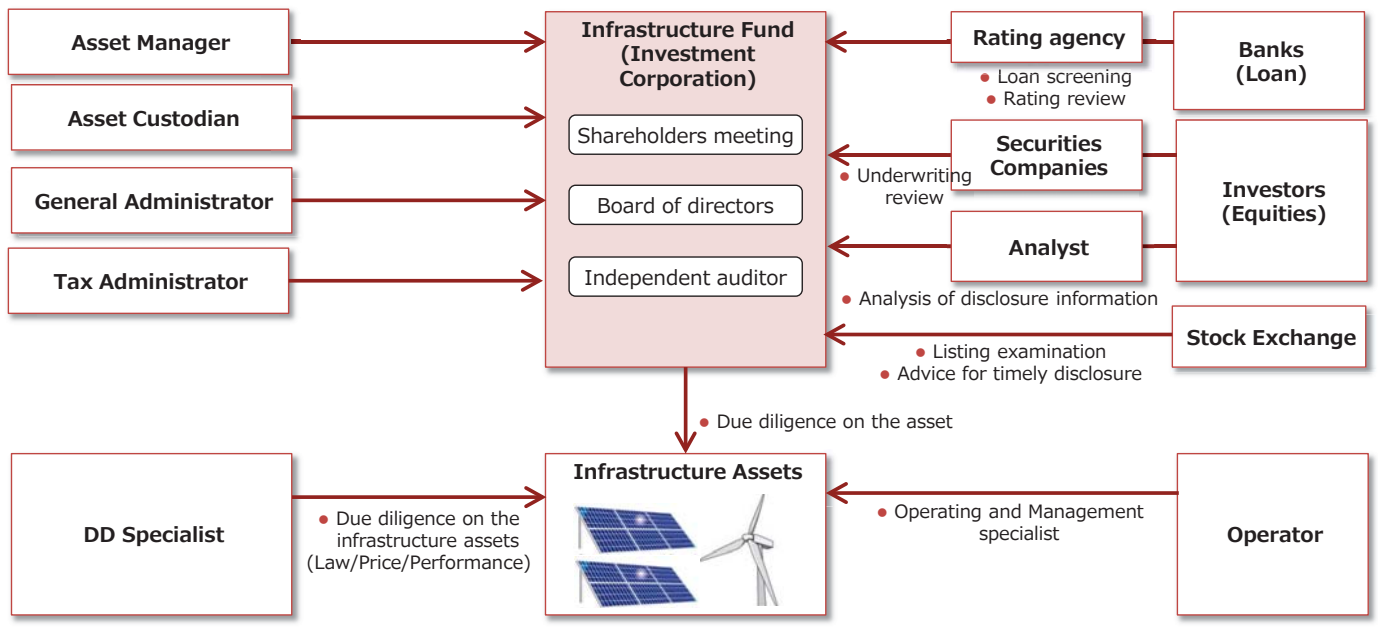
Merits of Listed Fund Market

✓ Listed Infrastructure Fund Market is expected to contribute the new energy policy that aims to (i) improve the cost-effectiveness of renewable energy projects, and (ii) stably operate renewable power plants over the long term.

Cost Reduction of Renewable Power Generation Projects	➢ Financing from the listed market is expected to reduce the cost of capital. ➢ Listed funds acquire renewable power generation facilities, and this is expected to expand the secondary market for renewable power generation facilities, and reduce the risk of development of such facilities.
Establishment the Long-term Stable Operation Systems	➢ The listed funds (including asset management company) are required to establish stable operations and to disclose operating status under the law and stock exchange rules. ➢ The listed funds are organized as closed-end funds, which restrict the refunding of units. Long-term capital from listed funds allows for the long-term, stable operation of power generation facilities.

Long-term Stable Operation Systems of Listed Fund

✓ The listed funds are monitored for their assets and operations by various independent experts.



Establishment of Listed Infrastructure Fund Market

Strong Support of the Government

- ✓ The infrastructure fund market was launched with the strong support of the government.
- ✓ In June 2014, the Abe Cabinet approved "Japan Revitalization Strategy Revised in 2014" as the basic growth strategy that included "Improve the environment for creating infrastructure fund market" and "Encourage to introduce the greatest - possible quantity of Renewable energy sources".

The Basic Growth Strategy of the Abe Cabinet (Jun. 2014)

- Improve the environment for creating infrastructure fund market
- Encourage to introduce the greatest possible quantity of renewable energy sources

Financial Services Agency (FSA)	**Revision of the Act on Investment Trusts and Investment Corporations (Sep. 2014)** • Enabled investment corporations to invest in renewable energy facilities.
Ministry of Finance (MOF)	**Amendment of the tax on investment corporations (Sep. 2014)** • Listed investment corporations that invest in renewable energy facilities shall be substantially exempted from corporate tax for **ten years**.
	Improvement of the tax environment for investment corporations (Apr. 2016) • For listed investment corporation investing in renewable energy facilities, the period for being substantially exempted from corporate tax shall be extended from ten to **twenty years**.
Ministry of Economy, Trade and Industry (METI)	**Announcement of the Long-term Energy Supply and Demand Outlook (Jul. 2015)** • Aim to increase the share of renewable energy in Japan's energy sources to 22-24% in FY2030.

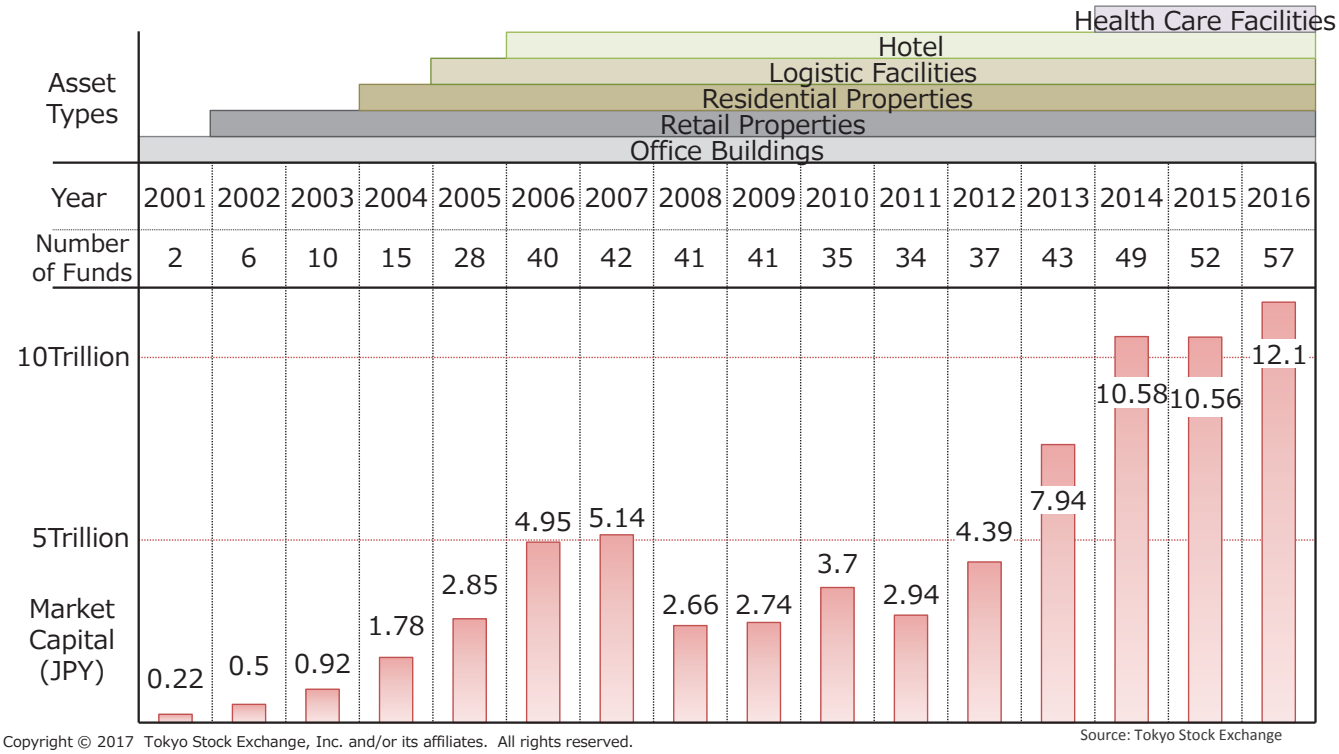
Improvement of Laws on Investment Corporations

- ✓ The infrastructure fund market is based on the Act on Investment Trusts and Investment Corporations.
- ✓ The Act was established in 1998. Investment corporations were permitted to invest in real estate in 2000.
- ✓ In order to meet the demands of investors, the law and rules for listed investment corporations were improved year by year, and that improvement contributed to the expansion of the J-REIT market.

2000	Law	■ Revision of the Act on Investment Trusts and Investment Corporations • Investment corporations were permitted to invest the real estate
2001	Market Rules	■ TSE's J-REIT Market was launched
2004	Market Rules	■ Establishment of rules for the allocation of the shares before listing on the J-REIT market.
2006	Market Rules	■ Require more disclosure on asset management system from listed funds than under the law ■ Beginning of listing examination for new listing J-REITs, similar to new listing companies
2013	Law	■ Revision of the Act on Investment Trusts and Investment Corporations, etc. • Newly allow J-REIT to repurchase its equity and finance through rights offering • Measures to facilitate the acquisition of overseas real estate by J-REIT • Newly apply insider trading regulations to J-REIT
2014	Law	■ Revision of Order for Enforcement of the Act on Investment Trusts and Investment Corporations • Investment corporations were permitted to invest in renewable energy facilities and concessions.

Overview of the J-REIT Market(Number of Funds, Market Capitalizations, Asset Types)

- ✓ The TSE J-REIT market was launched in 2001, and has now expanded to more than 50 funds.
- ✓ The total market capitalization was more than 100 billion dollars, the second largest REIT market in the world.
- ✓ With the growth of the market, invested asset types were expanded within the definition of real estate.



Source: Tokyo Stock Exchange

Outline of the Listing Rules (compared with J-REIT Market)

- ✓ Listing rules of the infrastructure fund market are based on the J-REIT Market and most of the quantitative listing criteria and basic rules of timely disclosure are same as the J-REIT market.
- ✓ In consideration of the specific risk for infrastructure, we added the criteria about “operator” for the Infrastructure Fund Market.

	J-REIT Market	Infrastructure Fund Market	
Types of funds	■ **Investment corporations** (All listed REITs are investment corporations) or investment trusts		Based on the J-REIT Market
Target assets	■ Real estate	■ Infrastructure assets	
Quantitative Listing criteria	■ Financial criteria (total assets of JPY 5 billion or more, net assets of JPY 1 billion or more) ■ Criteria for investor distribution and liquidity (no. of investors: 1,000 or more, no. of listed units: 4,000 or more) ■ Dividend payment shall be expected to continue (If unable to distribute dividends, the fund shall be delisted)		
Timely disclosure	■ Disclosure on the issuer, asset management company, and assets under management	■ Disclosure on operators	Criteria for specific risk of infrastructure
Operator		■ TSE defines operator as the entity that is responsible for deciding matters regarding the operation of infrastructure assets ■ Operators shall be selected by an appropriate method.	

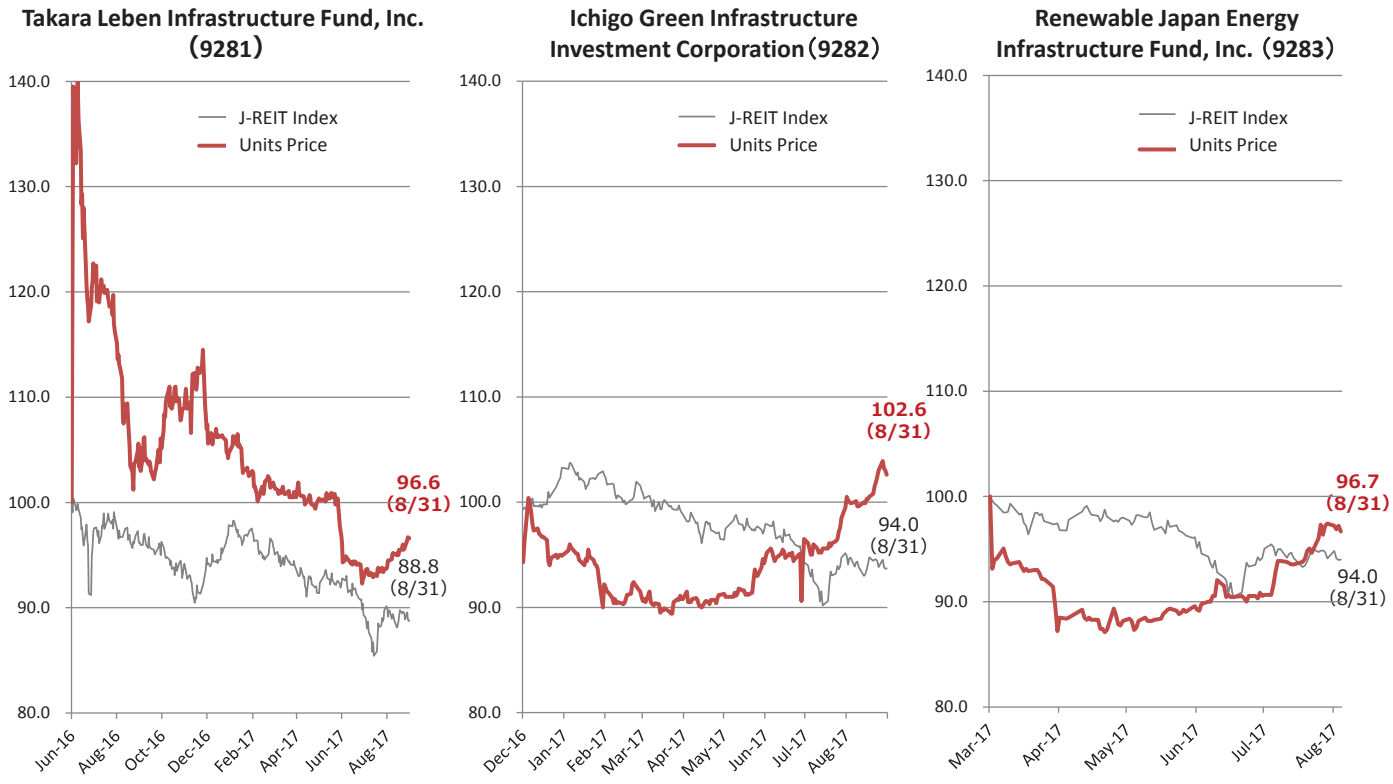
Market Data of Infrastructure Fund Market

List of Infrastructure Funds

	Takara Leben Infrastructure Fund, Inc.	Ichigo Green Infrastructure Investment Corporation	Renewable Japan Energy Infrastructure Fund, Inc.
Code	9281	9282	9283
Date of Listing	Jun. 02, 2016	Dec. 01, 2016	Mar. 29, 2017
Fund Type	Investment Corporation	Investment Corporation	Investment Corporation
Asset Management	Takara Asset management	Ichigo Investment Advisors	RJ Investment
Asset Type	Renewable energy facilities	Renewable energy facilities	Renewable energy facilities
Total asset size at the initial listing	10 assets (Only Solar PV) JPY 7.87 billion （Panel Output：18MW）	13 assets (Only Solar PV) JPY 10.02 billion （Panel Output：25MW）	8 assets (Only Solar PV) JPY 8.26 billion （Panel Output：21MW）
Total asset size （as of Aug.31,2017）	18 assets (Only Solar PV) JPY 20.9 billion （Panel Output：50MW）	15 assets (Only Solar PV) JPY 11.5 billion （Panel Output：29MW）	8 assets (Only Solar PV) JPY 8.26 billion （Panel Output：21MW）
Settlement Month (Accounting period)	May & Nov. (6 months)	Jun. (12 months)	Jan. & Jul. (6 months)

Source: Tokyo Stock Exchange

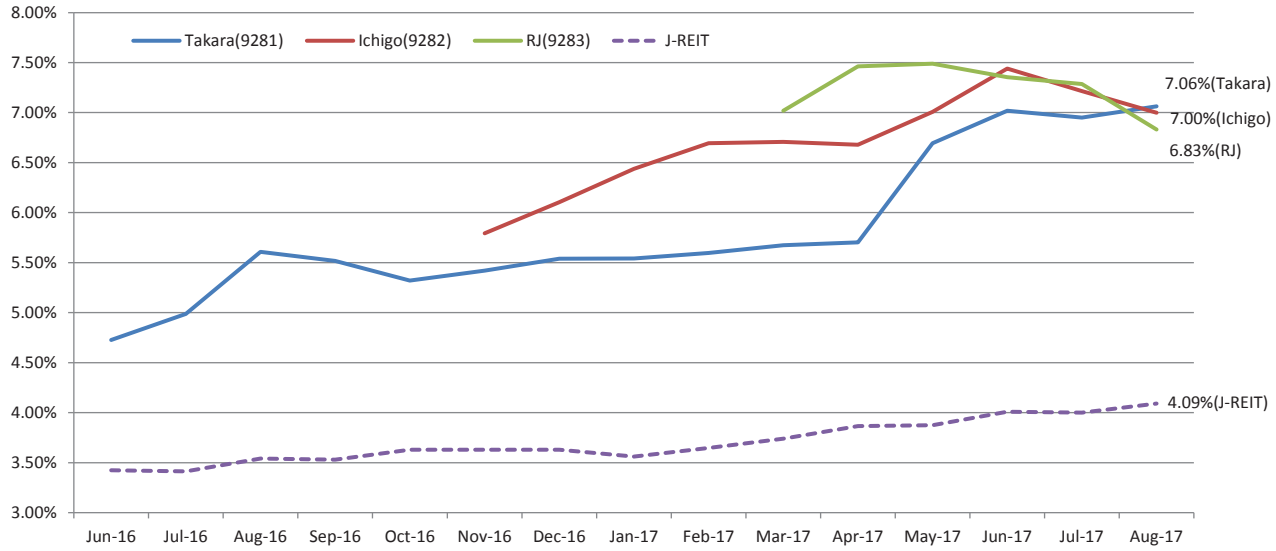
Overview of the Market Price of the Units



Note：Posted the units price and J-REIT index on the listing date as 100

Source: Tokyo Stock Exchange

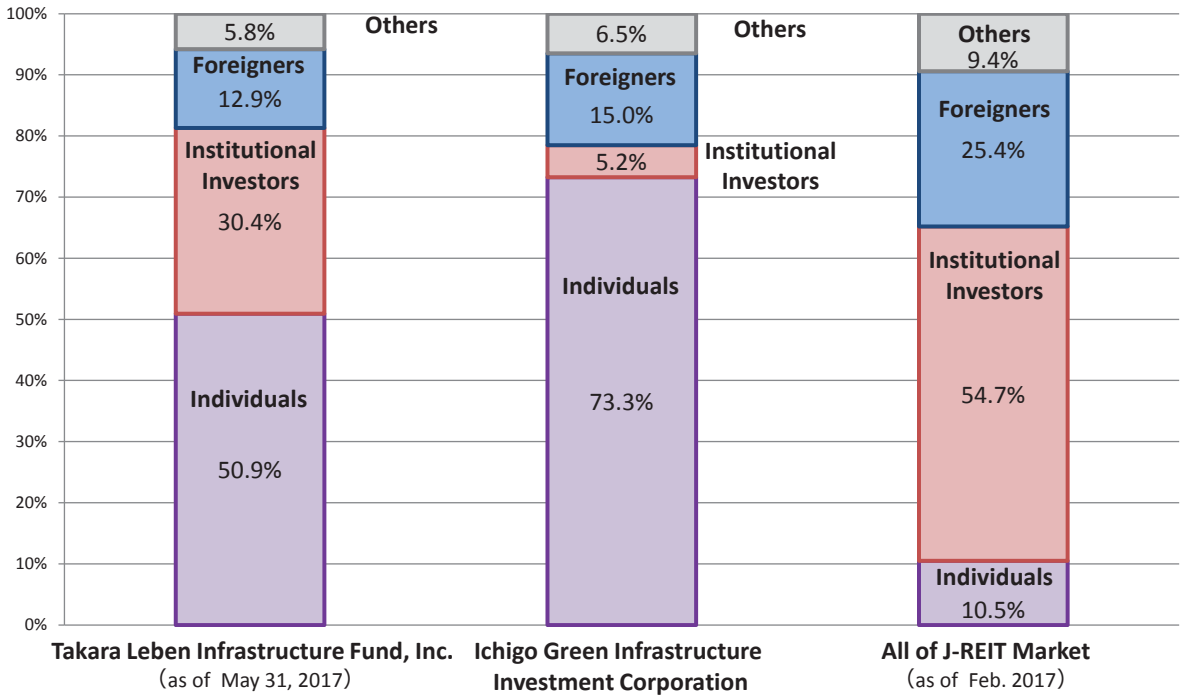
Overview of the Dividend yield



Source: Tokyo Stock Exchange

Infrastructure Funds and J-REIT Holding Ratio by Investor Category

✓ Comparing infrastructure funds with the J-REIT market, the ratio of institutional investors is low.
For most institutional investors, market capitalization and liquidity of infrastructure funds do not reach the investment criteria yet.

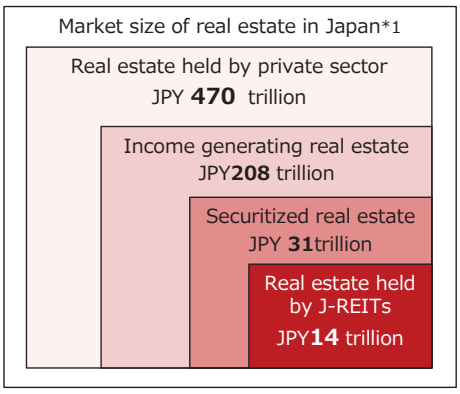


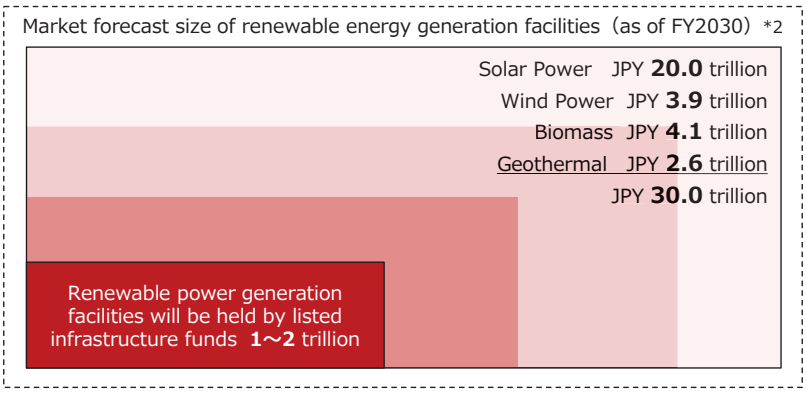
Note : Ratio of Takara and Ichigo excludes holding by their sponsors.
Source: Tokyo Stock Exchange

Challenges for the Infrastructure Fund Market

Market Potential in Japan

- ✓ Tokyo Stock Exchange hopes to expand the Infrastructure Fund Market like the J-REIT market.
- ✓ According to the Energy Mix in 2030, Infrastructure Fund Market will expand more than JPY 1 trillion.





Investors in Japan

(Individual investors・Life and non-life insurance companies・Pension funds・Mega-banks・Regional banks)

*1 Source: Ministry of Land, Infrastructure, Transport and Tourism (MLIT)
*2 Market forecast size is estimated by Tokyo Stock Exchange according to Energy Mix Plan in 2030 (METI).

Challenges for the Infrastructure Fund Market

✓ To grow the infrastructure fund market sustainably, we have to solve various tasks in cooperation with the government and market participants.

Participation of more institutional investors	✓ For most institutional investors, the market capitalization and liquidity of infrastructure funds does not yet satisfy their investment criteria.
Realizing investment other than PV facilities	➢ Infrastructure funds are permitted to invest in various types of renewable energy facilities under the law and stock exchange rules. However, listing of infrastructure funds investing in wind power and biomass power plants has not been realized.
Improving the profitability of renewable energy	➢ To minimize the financial burden for consumers, the Japanese government lowers the fixed purchase price for renewable power year by year. The realization of development at a low cost is important not only to realize the Energy Mix in 2030 but also the sustainable growth of the listed market.
Improving tax merits	➢ The tax merits for J-REIT is permanent treatment, but the tax merits for infrastructure funds (funds investing in renewable energy facilities) is limited to 20 years, which is the same as the duration of FIT.

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Best Practices in Renewable Energy Financing

Dato' Leong Kin Mun
***Managing Director*, Primer Capital Sdn Bhd**
President, Malaysia Biomass Industries Confederation (MBIC)

Dato' Leong Kin Mun, aged 45, is the Managing Director of Primer Capital Sdn. Bhd. (www.primer.my), a company with an extensive knowledge and experience in green finance solutions, biomass commercialization, green corporate deals. He is also an Accredited Angel Investor with the Malaysian Business Angel Network (MBAN).

Dato' Leong currently serves as President of the Malaysia Biomass Industries Confederation (MBIC) since 2012, a national level industry association highly engaged with various government departments in Malaysia; He formerly served as the Technical Advisor for the European Union (EU)-Malaysia Biomass Sustainable Production Initiative (Biomass-SP) between 2010 and 2013, a development co-operation initiative between the European Union (EU) and Malaysia through the Malaysia Industry-Government Group for High Technology (MIGHT), Prime Minister's Department. Dato' Leong was the key resource person for two important publications related to the Malaysian biomass economic landscape i.e. Malaysian Biomass Industry Action Plan 2020 published by MIGHT in 2013 and the Malaysia Green Financing Report for the Biomass Industries 2014 by the EU-Switch Asia Programme.

Recently, he is appointed as the Director of Environmental Preservation and Innovation Centre Sdn Bhd (EPIC), a new centre of excellence for waste management established by Malaysia Government. He sits in the SIRIM's industrial advisory panel i.e. Energy & Environment (E&E) Flagship Research Committee to promote commercialization, a government agency under the purview of Ministry of Science, Technology & Innovation (MOSTI).

In recognition of his multi-disciplinary expertise in green finance and sustainability initiatives, he has been to speak at various conferences hosted by authoritative national and international organizations such as the EU, the China-ASEAN Technology Transfer Centre (CATTC), United Nations SDG Summit, Korea Green Promotion Agency, Singapore Business Federation (SBF), the Malaysian-German Chamber of Commerce (MGCC), Sustainable Energy Development Authority (SEDA), Malaysia Investment Development Authority (MIDA), Malaysia Palm Oil Board (MPOB), Securities Industry Development Corporation (SIDC) etc.

His work has won him prestigious awards and recognition from the EU Commission, the Malaysia Canada Business Council (MCBC), Channel News Asia (Singapore), Junior Chamber International (JCI) and conferred the Dato' national recognition title from Malaysia King. He graduated from the University of Technology Malaysia (UTM) as Gold Medalist with Bachelor of Surveying (Hons) in Property Management and Valuation and subsequently won the Vice Chancellor Award – UTM Outstanding Alumni.

"Best Practices in Renewable Energy Financing"

Presented by:

DATO' LEONG KIN MUN

***President*, Malaysia Biomass Industries Confederation (MBIC)**

***Managing Director*, Primer Capital Sdn. Bhd.**

PRESENTATION OUTLINE

- Introduction of Malaysia Biomass Industries Confederation (MBIC)
- Introduction of Primer Capital Sdn Bhd
- Biomass in Malaysia
- Biomass Value Chain: 4 Major Direction
- Biomass Energy Projects Financing Criteria
- Green Energy Financing in Malaysia
- Global Trends in Green Energy Financing
- The Way Forward

Malaysia Biomass Industries Confederation

- Formed in 2012 as legacy of the **EU-Malaysia Biomass Sustainable Production Initiative**, a development cooperation programme between the European Union (EU) and Malaysian Government (2010 – 2013)
- Recognised national industry association in Malaysia
- Main objective: to promote a growing and sustainable biomass industry in Malaysia as well as the ASEAN region

- MBIC website - **www.biomass.org.my**

Primer Capital Sdn Bhd

- Providing Hybrid Green Finance Models for Renewable Energy projects in Malaysia/ASEAN through Multiple Solutions inclusive of **bank loan, grant, climate financing, venture capital, private equity, green bond, IPO** etc.
- Have undertaken numerous case studies on financing models on various green projects inclusive of **biomass, solar, mini-hydro, bioplastics, green chemicals, waste management, bio engineering products** etc.

- Website: **www.primer.my**

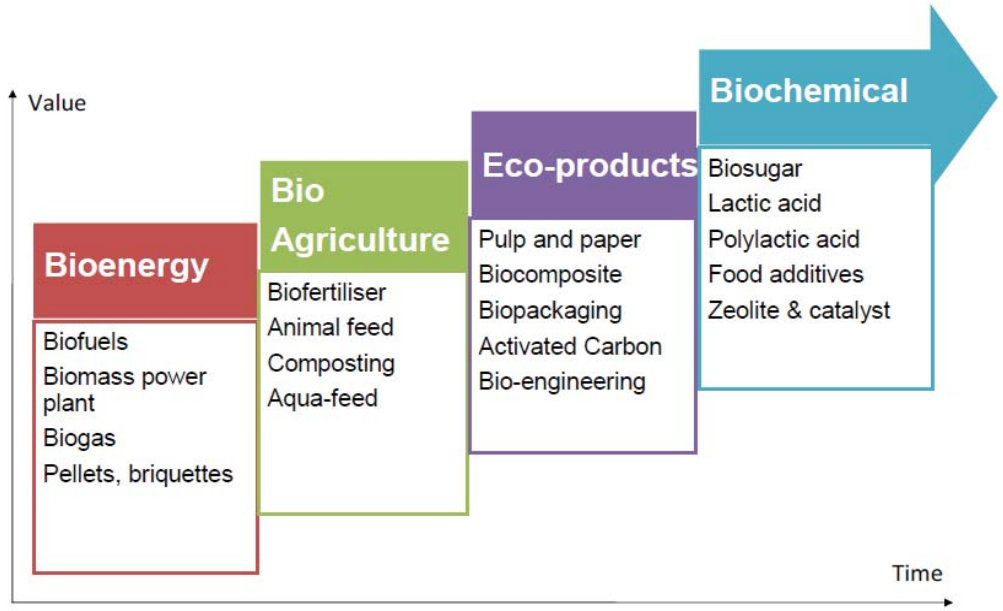
Biomass & Types of Biomass

BIOMASS – any form of biologically-derived substance that, if not utilized would be an economic, environmental and social liability that needs to be properly disposed.

Biomass Feedstock

- The oil palm industry contributed **3.5%** to the total Gross Domestic Product (GDP), with export earnings of **RM67.6 billion** and accounted for **8.6%** of total merchandise exports in 2016.
- About **82 million tonnes dry weight** of oil palm biomass is generated - From that about **57.31 million tonnes** of palm oil mill effluent (POME) were generated.
- The Government, is encouraging biogas capture from POME, through the **Palm Oil National Key Economic Area (NKEA)** initiative.
- Currently there are **93 biogas plants** in operation in the country, 8 under construction and 145 under planning. Out of 93 plants, 23 are connected to the grid under the **Feed-in Tariff initiative**.
- **National Biomass Strategy 2020 (NBS2020)** - the biomass industry is targeted to continue RM30 billion in additional Gross National Income (GNI), creating 66,000 jobs as well as expected to contribute to a saving of 12% in carbon emissions by 2020.

Biomass Value Chain: 4 Major Direction



- Bio-Energy is the best approach towards mitigating climate change i.e. creating highest environmental benefits in term of Greenhouse Gas (GHG) emission reduction, but has low economic value from business standpoint.

Financing Criteria for Biomass RE Projects

- **Security of feedstock** i.e. own plantation/mills or at least 10 years of fuel supply agreement
- **Security of technology** i.e. mature and proven technology
- **Security of management** i.e. experience in managing and operating power plants
- **Security of project** i.e. all relevant licensing/legalities requirements should be met
- **Security of systems**
  - Maintenance and servicing plan should be included
  - Warranty from equipment vendor
- **Security of market** i.e. buy-back agreement, REPPA, letter of intent, etc.
- **Debts to Equity Ratio**: Bank Financing vs. Equity Financing
- **Debts to Assets Ratio**: Critical for Bank Financing
- Impact on **Greenhouse Gas Emission Reduction** (to qualify for Preferential 2% Interest Rate Subsidized by Malaysia Government)

Green Energy Financing in Malaysia

- **Project Financing > MYR100 mil** (US$23.8 mil) for a 10 MW Biomass Power Plant by Maybank Islamic Bank with **Corporate Guarantee by a Singapore Public Listed Company**
- **Equity Crowd Funding (ECF) for Malaysian SME** – Raised **MYR1 mil** (US$0.24 mil) for biogas project from various retail investors based on fix-income approach and IPO's theme
- SPV created by Ministry of Finance i.e. **Malaysia Debt Venture Bhd** just recently launched its third fund; **MYR1 bil (USD238 mil)** to finance technology companies via project financing (non-collateral financing) for Energy Efficient Vehicle, Biomass & Biogas, Green Transport, Mini Hydro, Solar and Waste Management.

Green Technology Financing Scheme (GTFS)

- The transformation of the economy to be driven by green technology have been spelled out as the main agenda under the **National Green Technology Policy** which was launched in July 2009
- Various programmes have been implemented to promote the application and development of green technology including the establishment of the **Green Technology Financing Scheme** in 2010.
- **Green Technology Financing Scheme in Malaysia – MYR8.5 Billion (USD2 Billion)**
- Offers a 60% guarantee of the financing amount and a rebate of 2% on the interest/profit rate charged by the financial institutions
- Available until **December 2022**

GTFS Guideline

For Producers

- Projects must be located within Malaysia, utilising local and imported technology.
- Financing Size : Up to **MYR100 million** (US$23.8 mil) per company. **(effective from 15 June 2016)**
- Financing Tenure : Up to **15 years**.
- Eligibility Criteria : Legally registered Malaysian-owned companies **(at least 51%)** in all economic sectors.

For Users

- Projects must be located within Malaysia, utilising local and imported technology.
- Financing Size : Up to **MYR10 million** (US$2.4 mil) per company.
- Financing Tenure : Up to **10 years**.
- Eligibility Criteria : Legally registered Malaysian -owned companies **(at least 70%)** in all economic sectors.

Green Bond / Sukuk in Malaysia

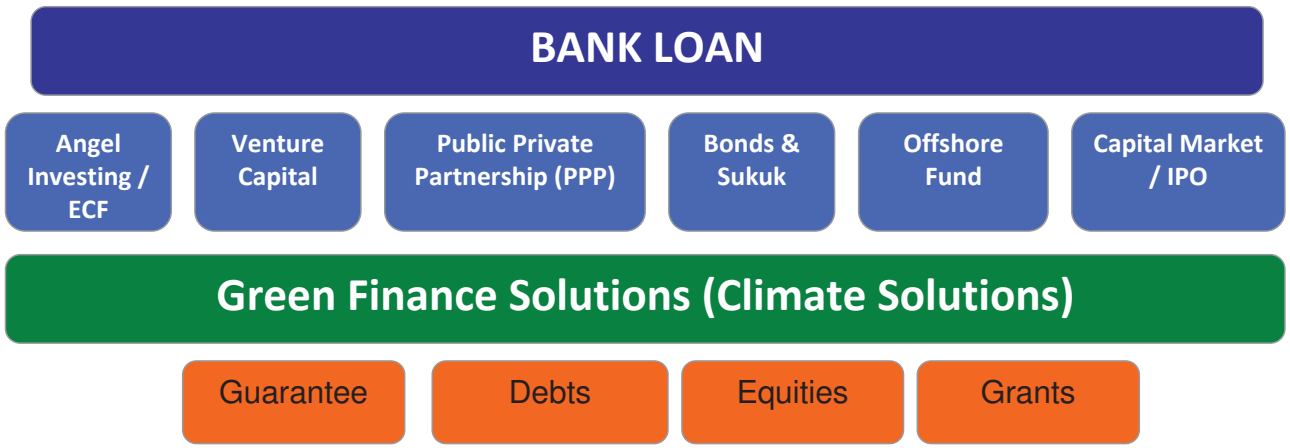
- **The Green Sukuk (Malaysia)**: an innovative green bond initiative based on Islamic Finance principle to address global funding gaps in green financing
- To complement SRI Sukuk framework and promote greater utilisation of green sukuk as a fundraising channel, several incentives are in place to attract green issuers including:
  - Tax deduction until year of assessment (YA) 2020 on issuance costs of SRI sukuk approved or authorised by or lodged with the Securities Commission
  - Tax incentives for green technology activities in energy, transportation, building, waste management and supporting services activities

Emerging Financing Instrument

Green Sukuk

- Facilitate financing of Renewable Energy & Energy Efficiency Project; **Large Scale Solar Farming**
  - Tadau Energy- Large Scale Solar Farming in Sabah with 50MW under two 21-year Power Purchase Agreements entered into with Sabah Electricity Sdn Bhd in December last year.
  - Issued RM250 million of Sustainable Responsible Investment Sukuk
  - The Green SRI Sukuk Tadau with a tenure of 2 to 16 years have been assigned a long-term rating of AA3 by RAM Rating Services Berhad
  - World Bank has recently introduced a Green Sukuk initiative to fund solar farming projects in Malaysia.

Hybrid Green Financing Models



© **Hybrid Green Finance Models for RE Projects** , *Dato' Leong Kin Mun*

Maju Intan Biomass Energy Sdn Bhd

- A subsidiary of Asiatic Group (Holdings) Limited, a public listed company from Singapore
- Obtained **MYR105 million** financing from Maybank Islamic Bank Berhad for **12.5 MW** Biomass Power Plant project with Corporate Guarantee by Asiatic
- Loan backed by Green Technology Financing Scheme (GTFS)
- Power Purchase Agreement with Electricity Utility Company of Malaysia (Tenaga Nasional Berhad) for a concession period of 21 years
- Exports 10MW to TNB, with the remainder being kept for the plant's own use

Cenergi Renewable Energy- Case Study

Havys Biogas Power Plant (Palm Oil Mill Effluent- POME)

- Operates under a **13-year Build-Own-Operate-Transfer (BOOT)** agreement with the Havys Palm Oil Mill owner
- The total project cost of this 2MW plant was 100% funded by **Cenergi (Khazanah Sovereign Fund investee)** and sufficient to power more than 700 households.
- The in-ground anaerobic digester used in Havys typically generates 1,200 ~ 1,500m3 raw biogas per hour, which is scrubbed to remove hydrogen sulphide and chilled to reduce its moisture content.
- The treated biogas is then channelled to 2 x 1,063 kWe Jenbacher engines for electricity generation from which electricity is exported to the national grid via a 3km power cable to the nearest substation.
- Holds a renewable energy power purchase agreement (REPPA) with Tenaga Nasional Bhd and qualifies as a renewable energy feed-in tariff program that is governed by the Sustainable Development Authority of Malaysia (SEDA).

Cenergi Renewable Energy- Case Study

The Sawira and Cheekah-Kemayan Biogas Power Plants

- Developed by Biopower Climate Care Holdings Sdn Bhd (BPCCH), a **joint venture project company comprising of Cenergi and Green Lagoon Technology Sdn Bhd (GLT), a biogas technology provider.**
- Sawira and Cheekah-Kemayan each have a capacity of 1MW and commenced operations in October 2015 generating roughly 585m3 of raw biogas from POME per hour.
- Both plants utilise in-ground anaerobic digesters to produce untreated biogas, which is then channeled to a single 1,063 kWe Jenbacher engine.
- hold a renewable energy power purchase agreement (REPPA) with Tenaga Nasional Bhd and qualify as renewable energy feed-in tariff programs that are governed by the Sustainable Development Authority of Malaysia (SEDA).

Green Lagoon Technology Sdn Bhd

- First green tech company in Asean to raise funds through an **equity crowdfunding (ECF)** platform
- Has raised **MYR800,000 (USD197,134) for two 1MW biogas plants** located in Pahang to 40 per cent each (60 per cent is owned by Cenergi SEA)
- Fixed dividend of **6% per annum for 3 years**, with a mandatory conversion to ordinary shares in the event of an initial public offering exercise or at the 3rd year
- With the funding, the company will have a post-money valuation of **MYR12.2 million**, based on a price-to-earnings multiple of 4.5 on the forecast net profit after tax of the financial year of 2016
- GLT turns organic waste into renewable energy, completed more than 10 biogas projects, also provides **Build-Own-Operate-Transfer (BOOT)** and turnkey solutions for palm oil millers to manage biogas emitted by palm oil mill effluents

Cenviro Sdn Bhd

- **Scheduled Waste-to-Energy (SWTE) plant**
  - Expected to be completed by the third quarter of 2017.
  - It will treat up to 33,000 MT of all types of incinerable scheduled waste annually and produce 3.4 MWe of green power which will be exported to the Grid– enough to power approximately 9,700 households.
  - The plant will be able to treat a wide variety of waste including scheduled waste in solid form, clinical waste, drummed waste and liquid waste with low operation and maintenance cost.
  - To sell renewable energy at the Feed-in Tariff (FiT) rate; Cenviro is an investee company of Khazanah, Malaysia sovereign fund.

Global Trends in Green Energy Financing

- **Hong Kong** has established a conducive framework for Green Energy companies **(wind, solar, hydropower, waste to energy)** to raise fund through **IPO**. These green energy companies are trading between 6-20 times based on their PER

- Singapore has launched a **Private Equity Fund** through subscription from high net-worth individuals or social institutional investors to fund projects with the theme of **"Environment Sustainable & Governance (ESG)"**
  - Clean Energy, Healthcare & Agriculture are the target sectors
- - More and more thematic clean energy fund has been launched such as **Bill Gates leads USD1 billion green energy fund to fight climate change.**

Global Trends in Green Energy Financing

- **Corporate Bond**: Etrion a European PLC (European RE Project Developer) – 8% Corporate Rate, raised **EURO 80 million**, solar farm projects across the globe, operates utility scale power generation projects (**139 MW installed solar capacity**)
- **International Donors** – EU Commission (Horizon 2020 addressing R&D Innovation related to green energy), United States Agency of International Development (USAID) to facilitate green energy projects in Asia etc
- **Green Climate Fund** – USD 100 billion commited by the participating countries
- **China Government's One Belt - One Road Initiative** – Renewable Energy sector is one the key beneciary for direct access funding opportunities from China.

The Way Forward

- Hybrid Green Finance (Hybrid-GF) Solutions serves an emerging green financing models for viable and "non-viable" green energy projects by SMEs, SOEs and Public Listed Companies.
- Customised Hybrid-GF solutions remain as the most practical solutions to address funding gap of various types of green energy projects.
- RE Projects especially Solar Farm has become the "Blue-eyed Boy" of Financiers vs Biomass Energy Projects which needs more intervention from the Government, Financiers and Industry to unlocks its development potential.
- Energy Efficiency Financing need further intervention for Green Finance to achieve Green Growth. At the momemt, it is still very much remains as an unpopular funding models with most of financial institutions.

Conclusions

Thank You!

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Best Practices in Renewable Energy Financing – A Singaporean Perspective

Monika BIERI

Solar Financial and Economic Specialist, Solar Energy Research Institute of Singapore (SERIS)

Ms. Monika BIERI is a solar economic specialist with the combination of her unique expertise in solar technologies, energy and economics. She is a research associate at the Solar Energy Systems Cluster of SERIS, complementing the team with her expertise in economic viability assessments of renewable energy applications and fundamental power market analysis including future power price scenario modelling. She is the "Solar Energy Economist" playing a critical role in providing comprehensive financial/economic analysis/modelling in all solar energy system related projects. She is the author of Singapore Solar Economics Handbook and provides content and continuous updates of the National Solar Repository (NSR) of Singapore website. She was a financial analyst with UBS AG, Zurich for fourteen years. She was responsible for covering the European power sector within the fixed income team at UBS Global Asset Management. This accorded her a wide breadth of experience in providing strategic investment recommendations to portfolio managers for water, gas and electricity companies. In order to further enhance her finance knowledge with renewable energies, Monika completed the executive programme 'Diploma of Advanced Studies in Renewable Energy Management (REM-HSG)' at the University of St. Gallen in 2013. She obtained her Bachelor's degree in Economics at the University of Applied Science in Business Administration in Zurich, Switzerland and successfully completed the Chartered Financial Analyst (CFA) exams in 2003.

Best practices in renewable energy financing – A Singaporean perspective

Monika BIERI
Research Associate

Solar Energy Research Institute of Singapore (SERIS)
National University of Singapore (NUS)

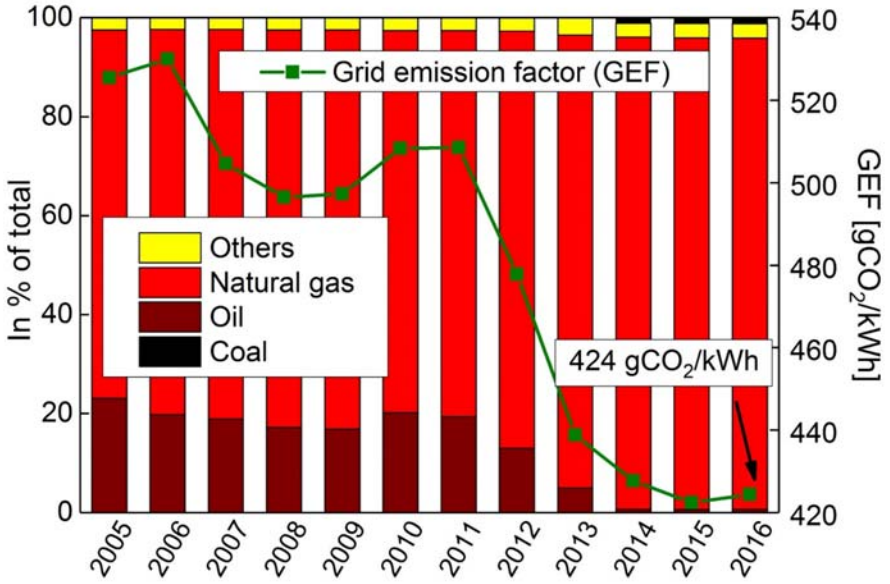
APEC Conference on Green Energy Finance Capacity Building
GIS MOTC Convention Center, Taipei, Chinese Taipei
28-29 September 2017

Outline

- ❑ Supporting policy framework in an unsubsidised market
- ❑ Economic viability assessment of distributed solar investment
- ❑ Proper quality assurance – technical risk assessment framework

Conventional generation optimised

Next step: increase renewable energy uptake

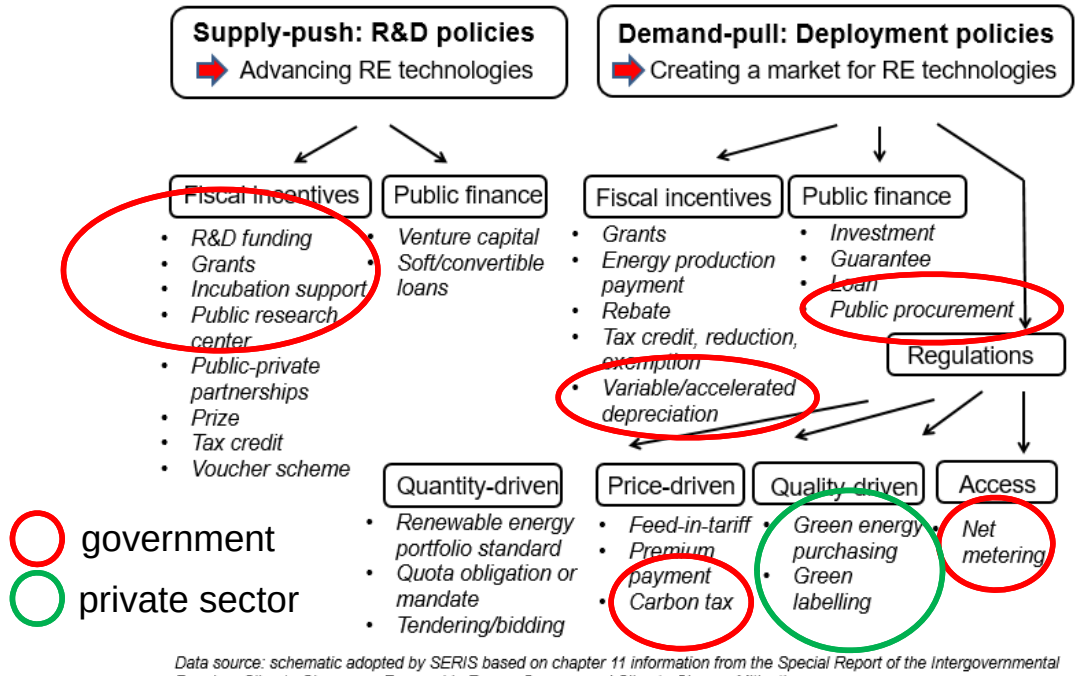


- Solar energy is the most abundant available renewable energy source for Singapore

Data source: EMA, monthly fuel mix data, GEF based on the average operating margin

Singapore's policy approach

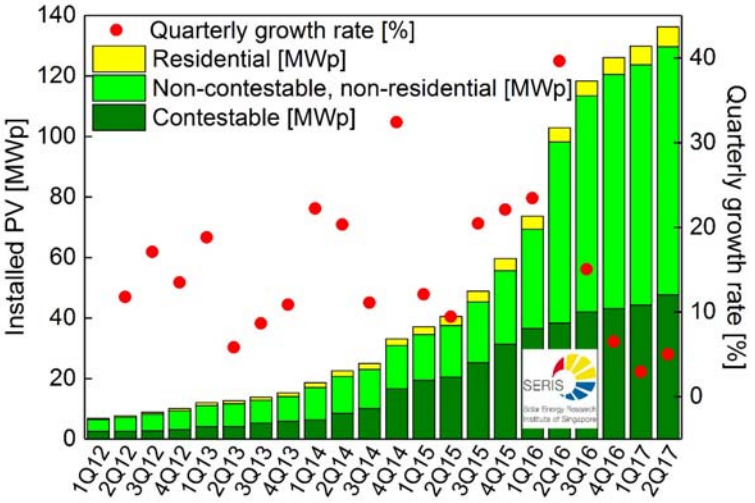
While there are no direct subsidies, there is indirect support…



Data source: schematic adopted by SERIS based on chapter 11 information from the Special Report of the Intergovernmental Panel on Climate Change on Renewable Energy Sources and Climate Change Mitigation.

Driver: government installations

Goal: > 1 GW_p beyond 2020, long-term potential: > 5 GW_p



- Early years adoption accelerated via the Solar Capabilities Scheme (SCS) which provided up to 30% capital expenditure funding
- Private sector adoption lagging behind due to challenging economic viability conditions

Data source: EMA

National Research Foundation (NRF)

- Set up in Jan 2006 as a direct department within the Prime Minister's Office
- Sets national direction for R&D by developing policies, plans and strategies
- Funds strategic initiatives and builds up R&D capabilities by nurturing research talent, examples of many:
  - Campus for Research Excellence and Technological Enterprise (CREATE): collaboration of nine international universities with focus on human, energy, environmental and urban systems
  - The energy National Innovation Challenge (Energy NIC), established in Feb 2011, S$300 million (2011-2015) allocated to increase energy efficiency, reduce carbon emissions and increase energy options
- Aim: transform Singapore into a vibrant R&D hub that contributes towards knowledge-intensive, innovative and entrepreneurial economy

RIE* 2020 Funding Initiative

One of the four domains: Urban Solutions and Sustainability (USS)

- Overall government budget: S$19 billion over FY2016-2020

- Aim: to develop a sustainable and liveable city through integrated solutions for Singapore and the world
- Focus: new urban mobility solutions, optimising liveable space, building the next generation smart grid, lower energy consumption of used water treatment, seawater desalination and NEWater production

*Research, innovation and enterprise (RIE), picture source: www.nrf.gov.sg

NTU*'s EcoCampus initiative

Goal: Greenest campus in the world

- Demonstration site to achieve 35% reduction in energy, water and waste intensity by 2020 (baseline 2011)
- Focus on research (demonstration/deployment), living labs and industry collaboration in:
  - energy efficient air-condition and lighting
  - electric vehicles
  - adoption of renewable energies
  - user behavior analysis
  - energy management concepts

Picture source: *Nanyang Technological University (NTU), 5 MWp installation on campus, produces ~3-5% of current electricity consumption and saves ~S$1.5 million of annual electricity costs

Renewable Energy Integration test-bed

Largest hybrid micro-grid in the tropics under REIDS*

- A joint-initiative by NTU, EDB* and NEA*
- Partners and adopters: Accenture, ClassNK, DLRE, Engie, GE, LSIS, REC, Schneider Electric, SEAS, Sembcorp, SONY, Trinasolar, Varta, Vestas, Bawah, Meralco.
- Test-bed the integration and interaction of renewable energy (solar, wind and tidal) with diesel, storage and power-to-gas technologies
- Enhances Singapore's knowledge in micro-grid management
- Off-grid solutions are required to enable affordable energy access-for-all in Southeast Asia

*Renewable Energy Integration Demonstrator-Singapore (REIDS), Economic Development Board (EDB), National Energy Agency (NEA), picture source: NTU

Government tender: SolarNova

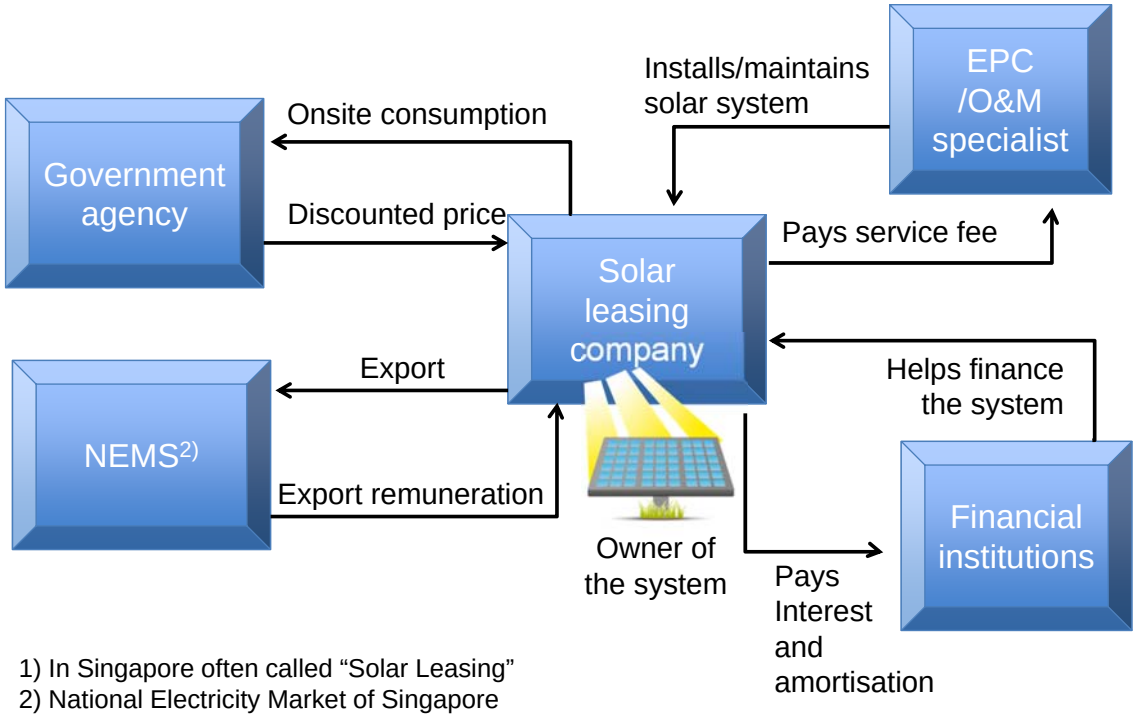
Provides economies of scale to lower cost and attract financing

- <u>Goal:</u> 350 MW_p on government buildings by 2020
- Follows successful test-bedding phase since 2006 by HDB*, in total of ~53 MW_p (last tender before SolarNova ~38 MW_p, first without the need of upfront capital help)
- Forming portfolios of ~40 MW_p by selecting suitable roofs from government agency buildings and HDB residential housing blocks
- Selection criteria: 65% discount given on benchmark tariff, 25% capability, 10% safety & performance
- Based on 20 year power purchase agreements (PPAs) with respective government agencies
- Quality conditions: guaranteed energy output at 75% performance ratio within 1st year and degradation not more than 1% per annum
- Stringent testing and commissioning requirements (SERIS)

*Housing Development Board (subsidised residential housing)

Concept based on "Solar PPAs[1)]"

Structure for SolarNova tenders



1) In Singapore often called "Solar Leasing"
2) National Electricity Market of Singapore

Tender results

- ❑ SolarNova 1: awarded in December 2015 to Sunseap Leasing
  - 9 tenderer, discount offered for HDB: 30-99.9%, discount offered to agencies: 20-65%
  - Winning bid: 99.9% and 65% for HDB/agencies respectively
  - Total capacity: > 40 MWp, ~800 HDB blocks, ~8 agencies
- ❑ SolarNova 2: awarded in June 2017 to Million Lighting
  - 9 tenderer, discount offered for HDB: 10-99.9%, discount offered to agencies: 20-90%
  - Winning bid: 99.9% and 90% for HDB/agencies respectively
  - Total capacity: > 40 MWp, ~640 HDB blocks, ~47 agencies
- ❑ Success: HDB owners/agencies are getting on-site demand for free or highly discounted
- ❑ Challenge: project cash flow bears future price risk (no fixed-price PPA) and export volume uncertainties

→ Bankable?

Successful financing news

Commercial financing is available to largest player Sunseap

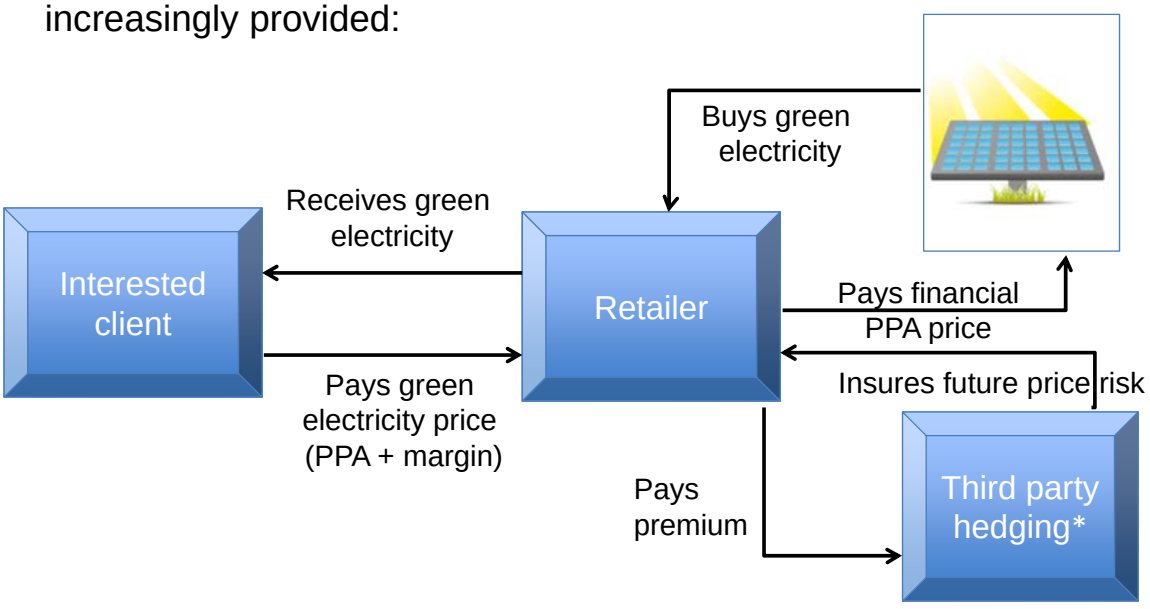
- NEW: Green bond grant scheme*: up to SGD 100k to offset cost of an independent review based on international green bond standards (minimum size: SGD 200 million, might be a barrier for distributed PV portfolios)
- Future: solar-based asset-backed securities, aim to list renewable energy business trusts in Singapore (leverage experience from real estate trust activities)

*initiative offered by the Monetary Authority of Singapore (MAS)

Open market for new products

Green electricity retailing

- Instead of owning a suitable roof, green electricity retail products are increasingly provided:

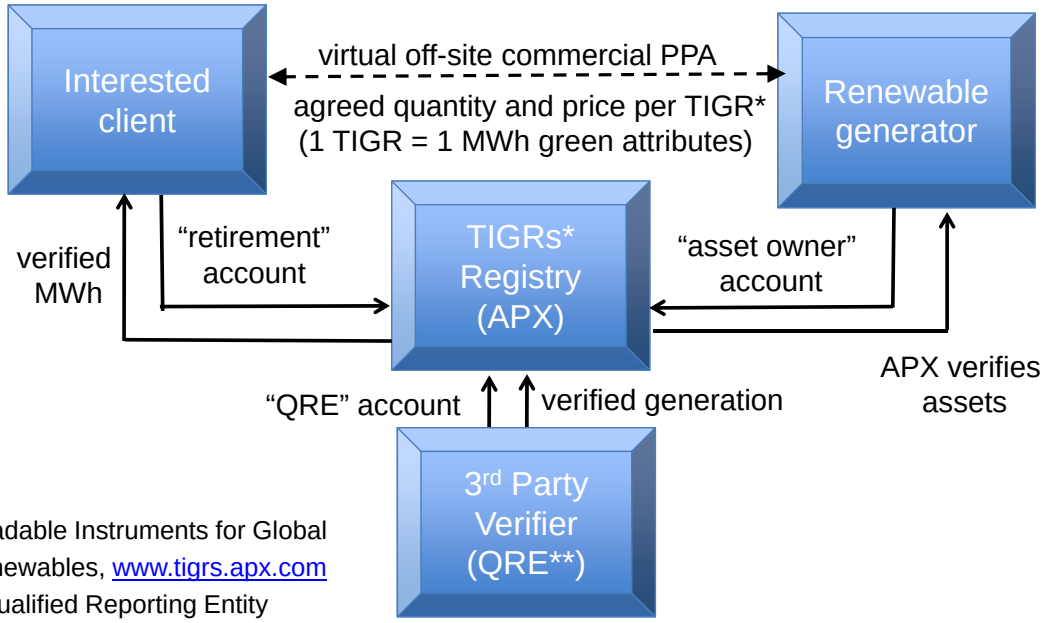


*as example through the Futures wholesale power market or with a generation company

Voluntary renewable energy certificates

Selling green attributes

- APX forms the central platform where each 1 MWh produced green attributes are tracked via individual serial numbers until retirement



*Tradable Instruments for Global Renewables, www.tigrs.apx.com

**Qualified Reporting Entity

Outline

- Supporting policy framework in an unsubsidised market
- Economic viability assessment of distributed solar investment
- Proper quality assurance – technical risk assessment framework

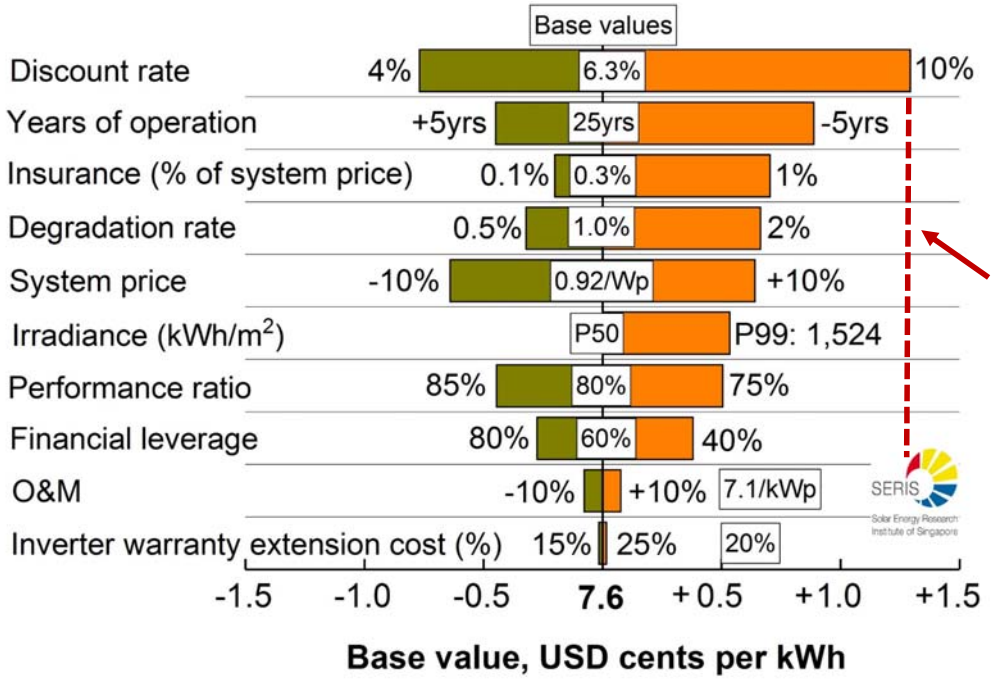
Example: 1MWp industrial roof in SGP

- System size: 1 MW_p, System price: ~920 USD/kW_p
- Total investment: USD ~920k (of which equity ~370k)
- 60% debt finance, 3% over risk-free rate, 10 years at 5.5%
- 8.9% equity cost, 17% tax rate, 6.3% discount rate
- 80% performance ratio, average irradiance of ~1,632 kWh/m^2 (P50)
- First year energy yield: ~1,306 kWh/kW_p
- 1.0% degradation rate p.a., 25 years operational life
- 0.3% insurance cost p.a. (in % of total investment cost)
- Cost inflation 2.7% p.a.
- Annual operating and maintenance expense: 7.1 USD/kW_p
- Inverter warranty extension cost at 20%, 45% and 60% of prevailing inverter price factored in every 5th year, respectively (increasing with the average age of the inverters)

LCOE = 7.6 USD cents per kWh (pre-tax)

Sensitivity analysis (individual ranges)

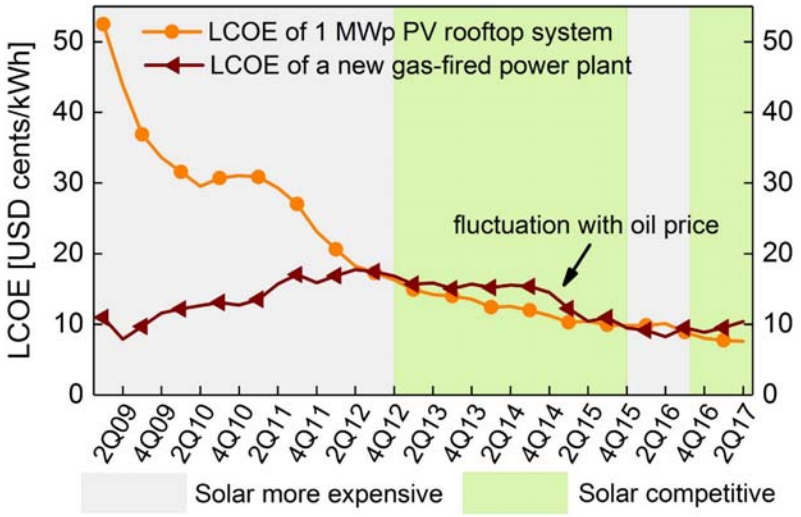
Most critical LCOE parameters are discount rate and durability



Excluding debt financing 9.1 USD cents per kWh

Solar PV competitiveness in Singapore

With latest solar module price declines, solar reached "grid" parity against new gas-fired plants again in 4Q16



- "Grid" parity not yet reached with wholesale power prices, which are lower due to overcapacity (1H17 average ~5.9 USD cents/kWh)

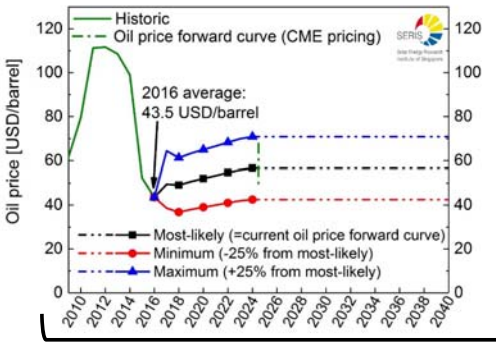
Data source: EMA for LCOE of a new gas-fired power plant (allocated vesting price), EMC

No FiT: what future electricity prices?

Scenario analysis important to understand underlying key drivers

- What is the cost of the primary fuel (gas) of the marginal power plant?
- What is the supply/demand outlook for the sector?
- Will the update of renewables change the merit order of the market?

Oil price scenarios*



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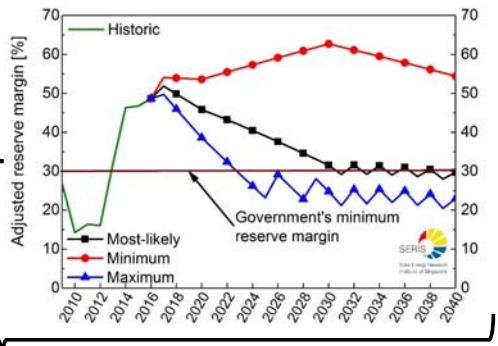
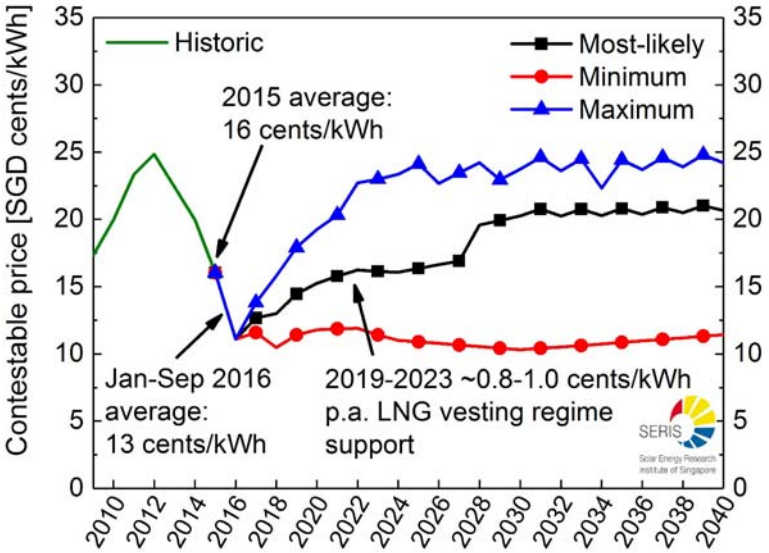
Reserve margin scenarios



wholesale electricity price scenarios → grid price scenarios

* As per Brent oil forward price curve of 27 June 2017

Contestable price scenarios*



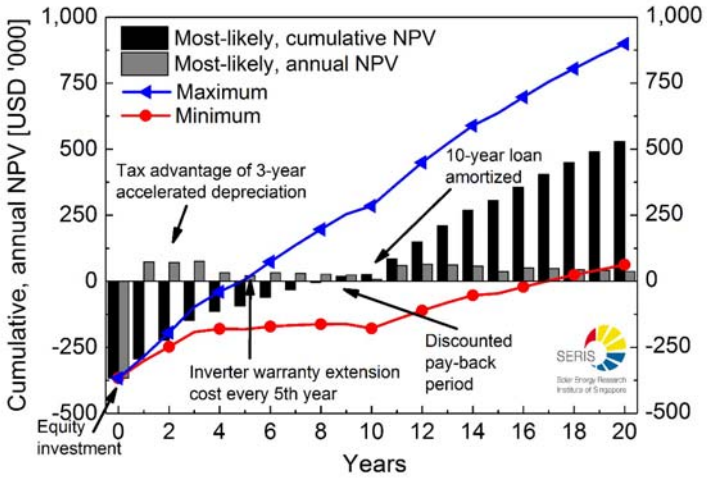
- Assumption: energy portion linked to USEP/LRMC, grid cost of 3.5 cents/kWh increased by 0.5% p.a. until 2026, other fees of 1 cents/kWh remain constant, annual LNG vesting price support added 0.8-1.0 cents/kWh on average during 2019-2023

*As per 27-Jan-2017 Brent forward price curve, Spot Brent oil price: 46.7 USD/barrel

Self-consumption is economic viable

NPV profile example of a 1 MW_p rooftop system

- Assumption: base year 0 = 2016, future prices in line with SERIS' contestable client price scenarios*



Equity IRR:
Maximum: 25.9%
Most-likely: 18.0%
Minimum: 7.8%

Project IRR:
Maximum: 16.1%
Most-likely: 12.1%
Minimum: 6.2%

- Discounted payback period can be shortened by four years in case loan maturity is extended to 20 years instead of 10 years.

*As per 27-Jun-2017 Brent forward price curve, Spot Brent oil price: 46.7 USD/barrel

Outline

- ❑ Supporting policy framework in an unsubsidised market
- ❑ Economic viability assessment of distributed solar investment
- ❑ Proper quality assurance – technical risk assessment framework

PV Quality Assurance Centre

How SERIS can help the industry to ensure quality

Areas	SERIS' activities
Feasibility	• Solar potential analysis (for urban areas) • Yield assessments • Financial and technical due diligences • Optimised system design • Grid simulation study • Impact studies of PV deployment on stability of electric power grid (central, de-central)
Testing and Commissioning	• Verify that system is structurally & electrically safe • Verify that as-built system is as designed • Test and commission according to national/international standards
Asset management (PV System Doctor)	• Real time monitoring • Advanced on-site diagnostics • Independent financial assessment
TECHNO-FINANCIAL RISK ASSESSMENTS	

Quantitative risk assessment

On PV system level, evaluating 54 different possible risk factors

Performed detailed assessment of technical risks and the system design concept, broken down in detailed categories:

- **Component level (13)**:
  Risk analysis of each single component such as modules, inverters, cables/connectors, array combiner boxes, transformers etc.)
- **System level (25)**:
  Risk analysis of system design aspects such as civil, mechanical and electrical parameters, component concepts, temperature management, grounding/lightning protection, testing & commissioning, implementation monitoring
- **O&M level (16):**
  Risk analysis of aspects such as O&M concept, spare part provision, preventive maintenance, performance monitoring, soiling and cleaning routines etc.)

Categorisation of risks

With respect to the impact on the Net Present Value (NPV)

Probability scale:

Rating	Description	% over the life of the project	Annual Frequency
5	Almost certain	90% or greater chance to occur	Up to once in 2 years or more
4	Likely	65% up to 90% chance to occur	Up to once in 3 years or more
3	Possible	35% up to 65% chance to occur	Up to once in 10 years or more
2	Unlikely	10% up to 35% chance to occur	Up to once in 20 years or more
1	Rare	< 10% chance to occur	Up to once in 30 years or more

Severity scale:

Rating	% of negative impact on base case NPV	Safety
5	>20%	significant injuries or fatalities due to a technical fault
4	>15%	risk of significant injuries or fatalities due to technical fault
3	>10%	most likely no injuries/fatalities due to technical fault
2	>5%	most likely no injuries/fatalities due to technical fault
1	> 0% < 5%	most likely no injuries/fatalities due to technical fault

Detailed risk assessment performed

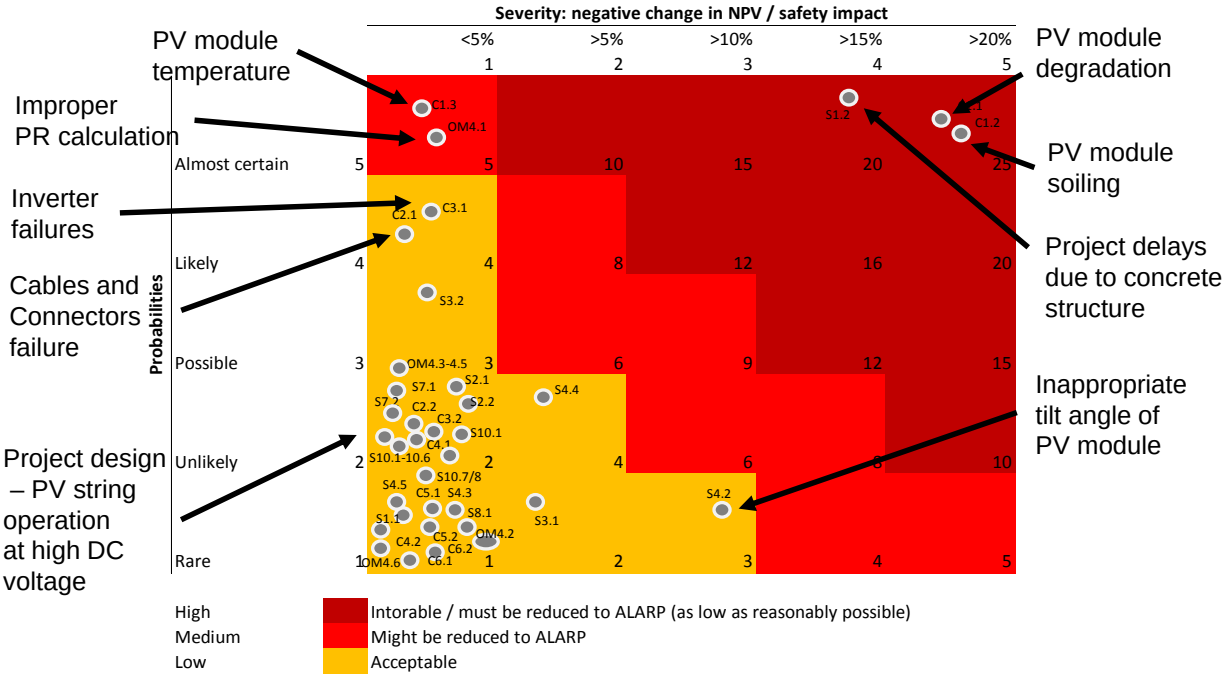
	Identifier	Description of risk	Potential failure mechanisms	Type of risks involved	Probability 1 (rare) - 5 (definitely)	Affects (PR, O&M, Capex, Degradation, Power output)	Pre-determined base level	Distribution (Triangular, Discrete, Uniform, Normal)	Absolute or Percentage
COMPONENT level									
	C.1 PV modules								
	C.1.1	PV module degradation	Due to harsh desert climate, D19 degradation is higher than expected. Possible degradations: cell cracks that would remove 10% of the whole cell area; bubbles or delamination cause a continuous path between any of the electrical circuit and the edge of the module; broken, torn, or cracked external surfaces (glass, backsheet, or	Impact on operation, decrease in output, lower expected revenues, safety issue.	5	Degradation	0.70%	uniform	Percentage (value of power loss)

IMPACT								
Minimum	Most-Likely	Maximum	NPV impact in % from base case	Severity 1 (insignificant) - 5 (catastrophic)	Risk level (High, Medium, Low)	Potential mitigation measures (cost-benefit analysis, response strategy)	Discussions / Remarks	Sources / citations
0.3% annually	0.7% annually	2% annually	-75%	5	25	PV Module Manufacturer need to provide third party certificate and "Module Performance Warranty Insurance" Document. Regular visual inspection On-site EL and IV scan to diagnose module failure and power degradation	• Degradation of 0.3% was assumed for 100 MWp pilot project, at first year 2.5 % maximum, and following years 0.7 % maximum will be allowed under the Energy Purchase Agreement. • A 0.5% increase in the degradation rate results in 0.4 cents/kWh higher LCOE, decrease of 1.3% in Equity IRR and decrease of USD 34.8 mil in NPV.	1.IEC Standards: IEC 61215, IEC 60904-9; 2.Yedidi-Faliure and degradation modes and rates of PV modules in a hot-dry climate results after 16 years of field exposure; 3 Review o f Failures of Photovoltaic M odules Report IEA - PVPS T13 - 01:2014

Source: SERIS; methodology adapted from Altran / Arthur D Little

Probability-based impact assessment

Risk mapping matrix



Source: SERIS; methodology adapted from Altran / Arthur D Little

Summary

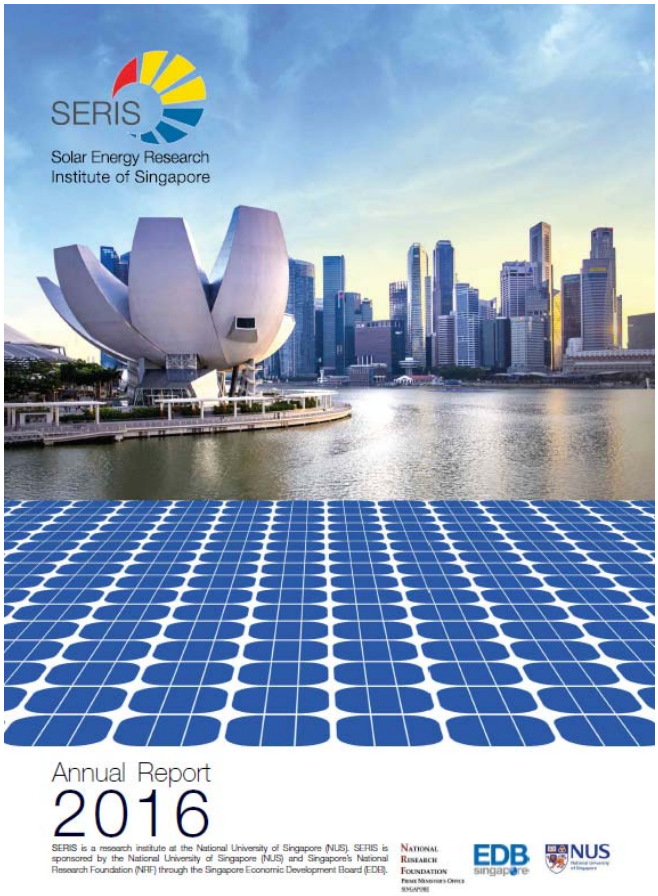
- Singapore supports solar energy indirectly with R&DD funding, test bedding opportunities and creating an open “level-playing” field
- Until now, largest driver of solar adoption came from government-induced tendering process (partially funded in earlier years)
- SolarNova tenders were successfully bid with high discounts for respective public entities, bankability not yet tested
- Thanks to the continued decline in panel prices distributed solar investments are getting increasingly economic viable
- Access to debt financing for small-scale actors could accelerate private sector adoption (so far only possible with scale = Sunseap)
- Quality assurance is important with requirements of independent owners engineering and T&C services
- A detailed review of technical risks helps to categorise financial implications linked to their probability of occurrence and ensures efficient allocation of risk mitigation strategies

Thank you for your attention!

monika.bieri@nus.edu.sg

More information at
www.seris.sg
www.solar-repository.sg

We are also on:



Renewable Energy Target and Promotion Program

Sheng-pen Peng

Associate Research Fellow, Taiwan Academy of Banking and Finance

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Ph.D. in Economics, The City University of New York, USA

B.A. in Economics, Fu-Jen Catholic University, Taiwan

Past Positions:

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Standard Chartered Bank

Assistant Research Fellow, Taiwan Academy of Banking and Finance

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People · Passion · Professionalism · Precision

Renewable Energy Target and Promotion Program

Sheng pen Peng

2017/9

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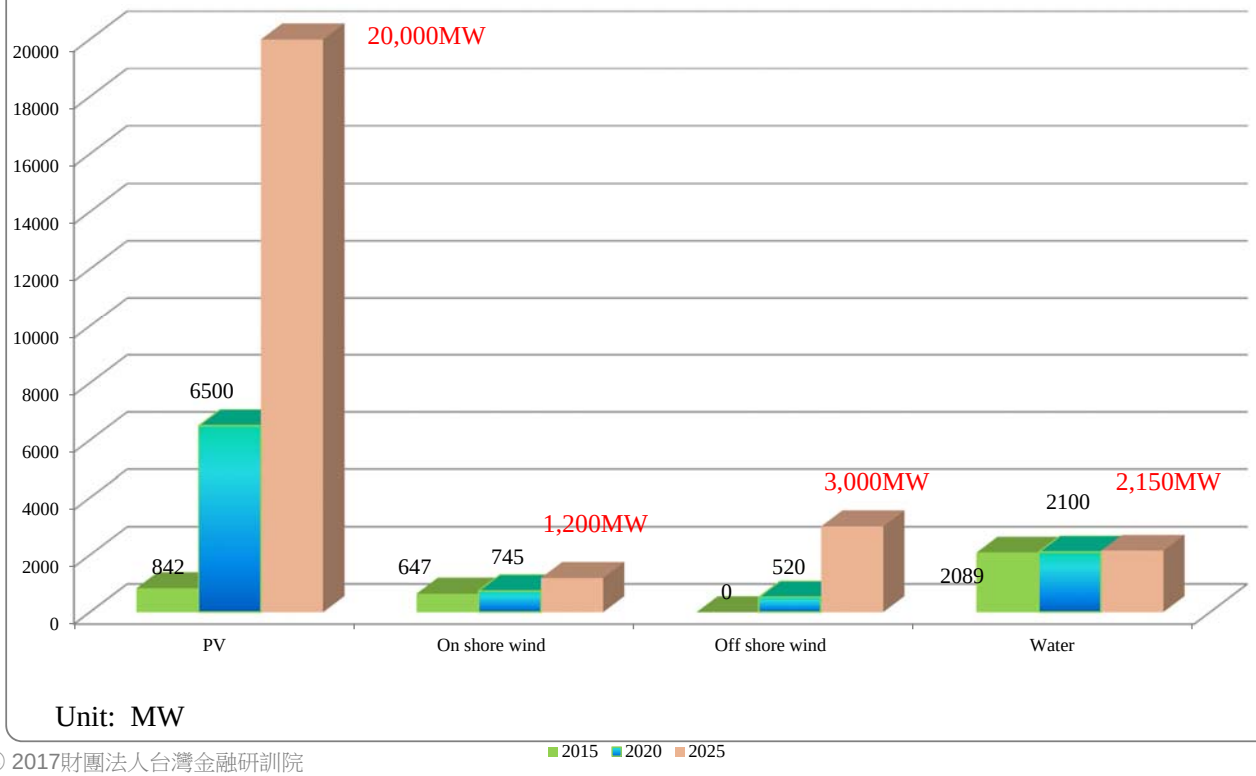
Unit1: Renewable Energy Policy Target



Unit: MW

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PV Subsidy Program, 1. Renewable Energy Development Act,
2. Feed in Tariff(F.I.T), 20 Years buyout.

North

F.I.T. + 15% Mark –Up

South

F.I.T.

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Unit2: Forward-looking Infrastructure Development Program: Green energy (Executive Yuan)

Target	1. energy self-reliance 2. nuclear-free nation by 2025.
Action	● A special budget of NT$20.785 billion (US$687 million) to fund this green energy program, these funds will be used to shore up the infrastructure and certification capabilities needed for the development of green energy. ● By stimulating domestic demand and pushing industrial growth and innovation, the government hopes to make Chinese Taipei a major Asian center for green energy production.

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Forward-looking Infrastructure Development Program 4-Strategies

- conserving energy
- storing energy
- creating energy
- integrating systems

to spur private investment of NT$1.8 trillion (US$59.5 billion) by 2025.

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Forward-looking Infrastructure Development Program

1. Smart energy conservation initiatives:

To install low-voltage smart meters across Chinese Taipei, beginning with 200,000 units in 2017, 1 million units by 2020, and 3 million units by 2024. Combine these meters with time-of-use electricity pricing plans so end-users can select the price plan best suited to their consumption habits to conserve energy.

2. Storing energy

To boost competitive photovoltaic batteries market and build a comprehensive industrial chain, Chinese Taipei is promoting research and development platforms to improve module reliability, the two-year solar power technology platform program is to help industries develop high-efficiency, low-cost parts and technologies.

3. Wind power:

The government will construct the underwater foundations and heavy cargo piers needed for wind power development, including one at Kaohsiung's marine technology industrial innovation zone and the Port of Taichung's offshore wind power industrial zone.

4. Shalun Green Energy Science City:

To create an innovative green-energy industry ecosystem, setting up a technical certification platform to commercialize green energy technology and a regional demonstration and certification site for energy storage equipment technology to drive domestic green energy sector development.

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Expected benefits of green energy infrastructure Development Program

For energy industry transformation

- 1. energy security, make the nation nuclear free.
- 2. increase renewable energy sources to 20 percent of total supply by 2025,

Ensure environmental sustainability.

For industries

These programs aim to turn Chinese Taipei into a major Asian center for green energy production and development zone.

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Unit3: Financial Supervisory Commission supports the development of the green energy industry

1.Assisting the green energy industry obtain finance:

The Bankers Association has drafted the "Program to encourage domestic banks to provide loans to green energy technology and increase the SME credit guarantee loan to value from 80% to 90%.

2. Equator Principles

The Bankers Association has adopted it in "Guidelines for Members of the ROC Bankers Association to Extend Credits" which will spur financial institutions to consider social or environmental impact when carrying out loan evaluation.

3.Guiding investment of insurance industry capital into green energy industry.

4.Enhancing green finance talent nurturing program :

To hold various courses through the Taiwan Academy of Banking and Finance to nurture green finance talent, to help the financial industry obtain information and understand the characteristics of the green energy industry to serve as the basis for assessing risk control.

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Green Finance Program

by Million Rooftop PVs Office

(sponsored by Bureau of Energy of the Ministry of Economic Affairs)

and Taiwan Academy of Banking & Finance(TABF) since 2013

To bridge the gap between PV and Finance field

1.Annual Solar Photovoltaic Finance Training Programs

2.Held various conferences open to the public each year

3.Conduct various research projects related to PV finance and business law topics (Asset securitization, close company law, etc)

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Taiwan Academy of Banking and Finance

TABF PV Finance Vocational Training Programs

Market	Risk	PV Technology
PV financial business training courses.	Financial model and risk control	PV Technology and Financial Services Competitiveness Forum
European and U.S. PV Market Outlook and power plant valuation	Risk control mechanism- Third party verification	Support the green energy industry – develop green finance seminar
Asia Solar Market outlook and Power Plant Pricing	Green Energy Industry Investment Strategy and Development	New Trend of PV Industry and Innovative Financing Model

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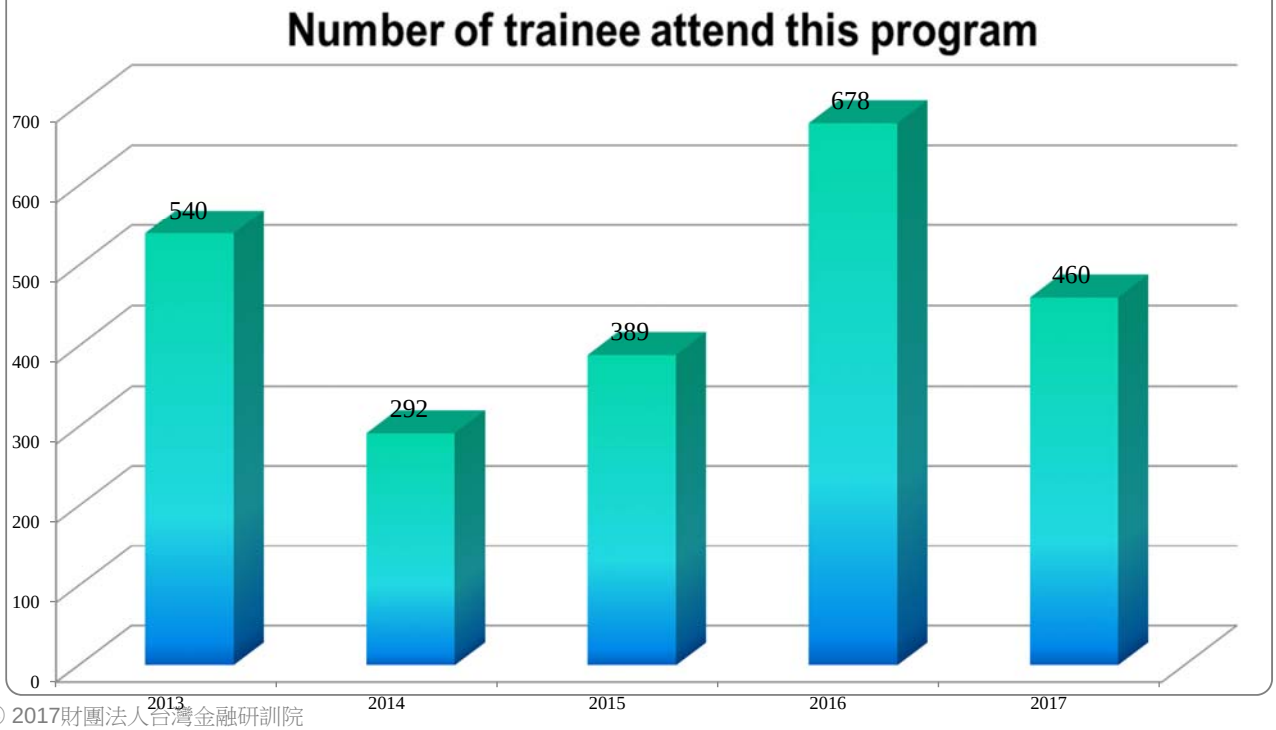
Annual PV Finance vocational training Programs



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Unit4 : Challenges of Green Financing in Chinese Taipei

1.A lot of idle capital.

Few domestic investment opportunities.

2.Local insurance firms have billion dollars of cash.

Hard to find an ideal investment object.

3.Low Interest Rate Environment.

Hard to design a financial commodity with attractive profit margin.

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Green Finance in Action

1	To boost direct finance Engagement	1.To encourage insurance enterprise funds investing in renewable energy projects. 2. To encourage commercial banks taking part in long term project finance.
2	To accelerate green bond issuance	To foster the renewable industry development, issuing green bond.
3	Tax incentive mechanism	Tax exemption program, lower interest income of buyers of green bond.
4	Credit guarantee program	The government backs up credit enhancement act to assist the financing activity.
5	To amend laws	To amend laws regarding renewable energy and loosen restrictions on the establishment of electric power facilities and regulations regarding land-use permission and designation.

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A List of Green Bond (2017)

Company	Date of issuance	Amount	Duration	Interest rate	
E.SUN Bank	2017-05	$60 million	30yr	Zero coupon	IRR4.1%
Sinopac Bank		$45 million	30yr	Zero coupon	IRR4.5%
China Trust Bank		$33 million	3yr	0.83%	
KGI Bank		$33 million	3yr	0.9%	

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Thank you for attention

Best Practices in Renewable Energy Financing in Thailand

Biography

Miss Sutthasini Glawgitigul

Sutthasini Glawgitigul has worked at the Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy for 7 years where I am currently a senior professional scientist. Before that I worked at the Office of Natural Resources and Environmental Policy and Planning as an environmentalist for more than 10 years. I graduated with a Master of science degree in Water, Energy and Waste at from University of Salford. I have been active in many projects for promoting renewable energy in Thailand, especially biomass, wind and waste to energy. I were in a team that developed alternative energy development plan (AEDP 2015).

Best Practices in Renewable Energy Financing in Thailand

Miss Sutthasini Glawgitigul
Scientist, Senior Professional level
Department of Alternative Energy Development And Efficiency
Ministry of Energy, Thailand

Workshop: APEC Conference on Green Energy Finance Capacity Building
28-29 September 2017 : GIS MOTC Convenction Center, Taipei, Chinese Taipei

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

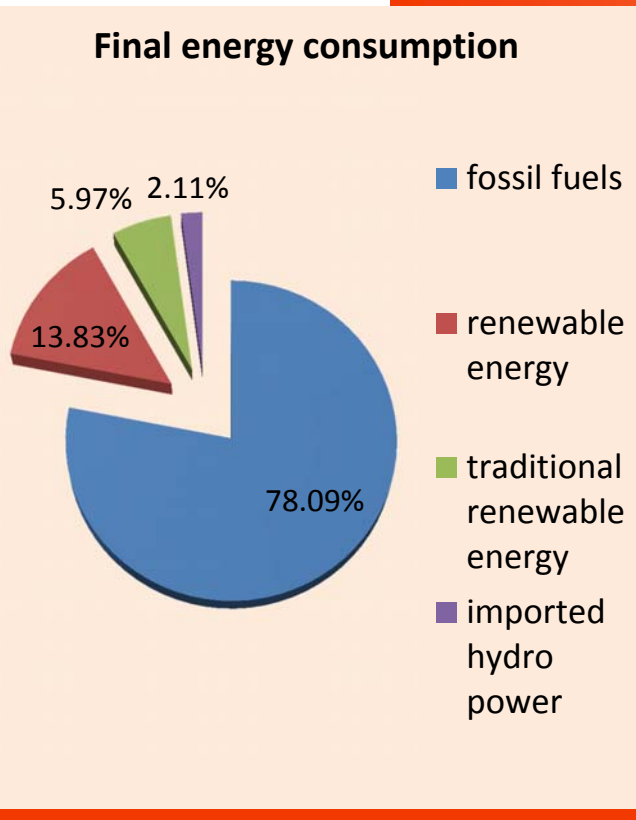
Content

- Thailand's Energy Situation
- Thailand's Energy Policy
- Green Financing Policy for RE

Content

Thailand's Energy Situation

Final Energy Consumption



Final Alternative Energy Consumption	
Power generation (Solar/Wind/Biomass/ Biogas/MSW)	2.27%
Small hydro power	0.03%
Large hydro power	0.35%
Heat(Solar/Biomass /Biogas/MSW)	8.98%
Biofuels	2.2%
Total	**13.38%**

Data: 2016

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Content

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Thailand Integrated Energy Blueprint : TIEB

2015 - 2036

Security

- Ensure the security of all power system components
- Power generation, transmission and distribution
- Fuel diversification to reduce the risk of fuel dependency

Economy

- Appropriate determination of power tariff to reflect the primary cost

Ecology

- Reduce/Minimize ecological impact to environment and community

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Alternative Energy Development Plan (AEDP) 2015-2036

Foundation: Commitment to the development of a low-carbon society

Facilitator: *Private-led investment*

Strategy: Alternative Energy Development Plan 2015-2036

Facilitator: *Government funded RD&D*

Goal: Target 30% renewables in Total Energy Consumption by 2036

Bio-Energy

Biomass	Biogas	MSW
5,570 MW	1,280 MW	550 MW
22,100 ktoe	1,283 ktoe	495 ktoe

19,684.4 MW Power | 25,088 Ktoe Heat

Bio-Fuel

Ethanol	Biodiesel	CBG + Pyrolysis oil
11.30 ML/Day	14.0 ML/Day	4800.53 ML/Day

Solar

6,000 MW

1,200 Ktoe

Wind

3,002 MW

9,002 MW Power | 1,200 Ktoe Heat

Hydro

Mini (<1 MW)

Micro (<100 kW)

376 MW

Other heat Energy

Geothermal + others

10 MW

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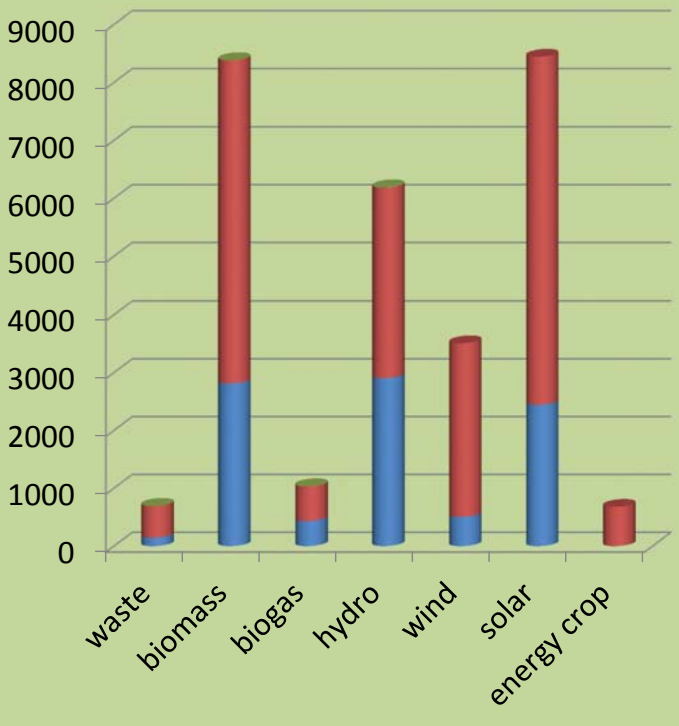
Status: alternative energy in Thailand



	current capacity (MW)	Target (MW)
waste	145.28	550
biomass	2814.7	5570
biogas	434.86	600
hydro	2906.40	3282
wind	507.04	3002
solar	2446.12	6000
energy crop	0	680

Data: 2016

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Content

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Green Financing Policy for RE

- Feed-in Tariff
- Tax Incentive : BOI Privilege
- ESCO Fund
- Subsidized

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Feed-in Tariff (FiT) for VSPP in 2015

Installed Capacity (MW)	FiT (THB/kWh)			Supporting Period (years)	FiT Premium (THB/kWh)	
	FiT_F	(1) $FiT_{V,2560}$	FiT		Biobased Fuel (for the first 8 yrs)	special Southern zones (2) (for project lifetime)
Waste-to-Energy						
≤ 1 MW	3.13	3.21	6.34	20	0.70	0.50
> 1-3 MW	2.61	3.21	5.82	20	0.70	0.50
> 3 MW	2.39	2.69	5.08	20	0.70	0.50
Landfill organic waste	5.60	-	5.60	10	-	0.50
Biomass						
≤ 1 MW	3.13	2.21	5.34	20	0.50	0.50
> 1-3 MW	2.61	2.21	4.82	20	0.40	0.50
> 3 MW	2.39	1.85	4.24	20	0.30	0.50
Biogas from wastewater/manure	3.76	-	3.76	20	0.50	0.50
Biogas from energy crops	2.79	2.55	5.34	20	0.50	0.50
Small hydro						
≤ 200 kW	4.90	-	4.90	20	-	0.50
Wind	6.06	-	6.06	20	-	0.50

(1) FiT_V is subjected to be adjusted by core inflation
(2) Includes 3 Southern provinces (Yala, Pattani, Narathiwas) and 4 districts in Songkhla province

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Feed-in Tariff (FIT) Rate for VSPP Projects (Solar cell)

Installed Capacity	FIT (Baht/kWh)	Supporting period (y)	Project 3 southern provinces Premium(Baht/kWh)
Solar Farm	4.12		
≤ 90 MWp	5.66	25	0.50
PV rooftop (Households)			
≤ 10 kWp	6.85	25	0.50
PV rooftop (Business building/Factories)			
>10-250 kWp	6.40	25	0.50
>250-1,000 kWp	6.01	25	0.50
Solar cell for Government Sector and Agriculture Cooperative			
≤ 5MWp	5.66	25	0.50

1US dollar = 35 Baht (Thai)

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FiT for SPP Hybrid Firm + VSPP Semi-Firm

- National Energy Policy Commission approved FiT rate for SPP Hybrid Firm and VSPP Semi-firm on 17 FEB 2017
- Approved Purchasing Target as follows:
  - SPP Hybrid Firm 300 MW
  - VSPP Semi-firm 269 MW

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FiT rate for SPP Hybrid Firm

FiT rate for SPP Hybrid Firm

Consider the initial cost of mixing various sources of RE (Hybrid)

Installed capacity(MW)	FiT (THB/kWh)			Period (years)
	FiT_F	$FiT_{V,2560}$	$FiT^{(1)}$	
SPP Hybrid Firm				
Installed capacity >10-50 MW	1.81	1.85	3.66	20 years

Note: Fit rates will be applied for projects that COD within 2017. After that, FiTv rates will continuously increse by core inflation

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FiT rate for VSPP Semi-Firm

Installed Capacity (MW)	FiT (THB/kWh)			Period (years)	FiT Premium (THB/kWh)	
	FiT_F	$FiT_{V,2560}$	$FiT^{(1)}$		Firm period not exceeding 6 months (project lifetime)	Projects in the southern border provinces (2) (project lifetime)
1) Biomass						
- Installed Capacity ≤ 3 MW	2.61	2.21	4.82	20 years	0.40	0.50
- Installed Capacity > 3 MW	2.39	1.85	4.24	20 years	0.30	0.50
2) Biogas (sewage/waste)	3.76	-	3.76	20 years	0.50	0.50
3) Biogas (energy crops)	2.79	2.55	5.34	20 years	0.50	0.50

Note: (1) FiT rates will be used for projects that COD within 2017. After 2017, FiTV rates will continuously increase by core inflation.
(2) Projects in province Yala, Pattani, Narathiwat and 4 districts in Songkhla, i.e. Chana, Tepa, Saba Yoi and Nathawee District

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Tax Incentives: BOI Privilege

Exemption of income corporate taxes resulting from selling RE or saving energy for periods up to 8 years

Exemption or reduction of imported tax equipment or machines

THAILAND BOARD OF INVESTMENT

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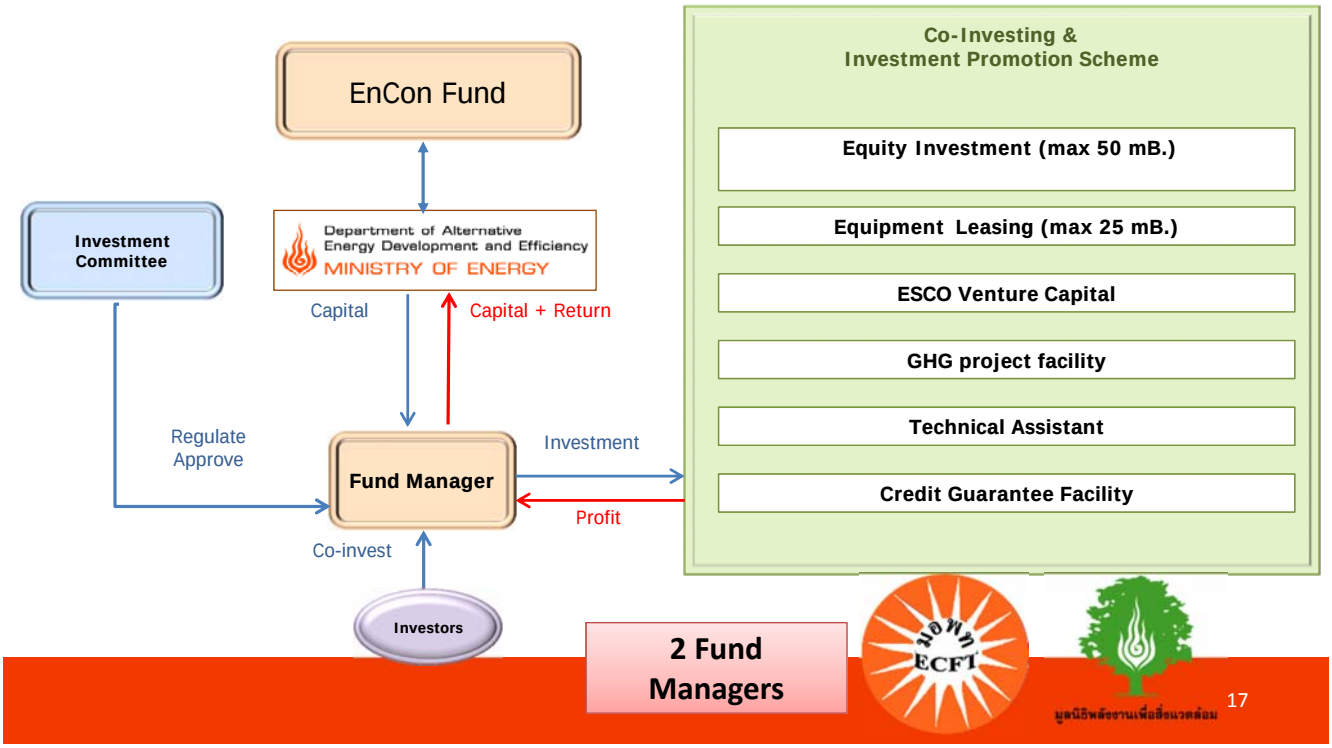
MINISTRY OF ENERGY

ESCO Fund

Aims to encourage private investments in renewable energy and energy efficiency projects which are viable, but seek for project finance



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ESCO Fund : Investment services

1. EQUITY INVESTMENT: make equity investment in Energy efficiency or renewable energy projects.

- Size of equity investment: 10%-50% of total equity but limited to 50 million baht per project, and not to be the major shareholder.
- Investment period : no longer than 7 years
- Exit method : Shares sell-back to the project developer/ the major shareholder or the new investors.
- Exit price : As agreed in the shareholder agreement.

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ESCO Fund : Investment services

2. EQUIPMENT LEASING : provide long – term leasing service for entrepreneurs in purchasing equipment for energy efficiency or renewable energy, and allow the entrepreneurs to make constant repayment with low interest

- A maximum of 100% of equipment cost but limited to 25 million baht per project.
- Repayment duration : no longer than 5 years.
- Interest rate : 3.5% per annum (Flat Rate)
- not charge the project evaluation cost.
- Grace period: no longer than 6 months.

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ESCO Fund : Investment services

3. ESCO VENTURE CAPITAL: venture with Energy Service Company (ESCO) to raise capital for investments in energy saving projects of the ESCO

- Size of equity investment: 10%-30% of registered capital but limited to 50 million baht per project, and not to be the major shareholder.
- Investment period : no longer than 7 years.
- Exit method : Shares sell-back to the project owner.
- Exit price : As agreed in the shareholder agreement

Department of Alternative Energy Development and Efficiency
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ESCO Fund : Investment services

4. GHG PROJECT FACILITY : facilitate project owners in developing project document and liaison with the relevant authority to ensure that they can benefit from greenhouse gas emission reduction activity

5. CREDIT GUARANTEE FACILTY : cooperate with financial institutions or credit guarantee agencies to assist entrepreneurs in accessing to the long-term loan from bank by providing credit guarantee depending on the project risk and limited to 10 million baht at low premium rate

6. TECHNICAL ASSISTANCE : provide technical support, e.g. walk-through audit to indentify the potential measures. In case the project owner has doubt about the energy saving, E for E will co-inspect the M&V after the measures have been implemented.

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Example of Project under ESCO Fund (Renewable energy)

- Biomass Power Plant: Steam turbine 7.5 MW (Wood Chip)
- Biomass Power Plant: Co-generation 5.3 MW (Para Wood Chip)
- Biomass Power Plant (Gasification)
- Micro Hydro Power
- Biomass + Biogas
- Solar farm : 6.1 MW, 0.9 MW
- Biogas (30 kW)

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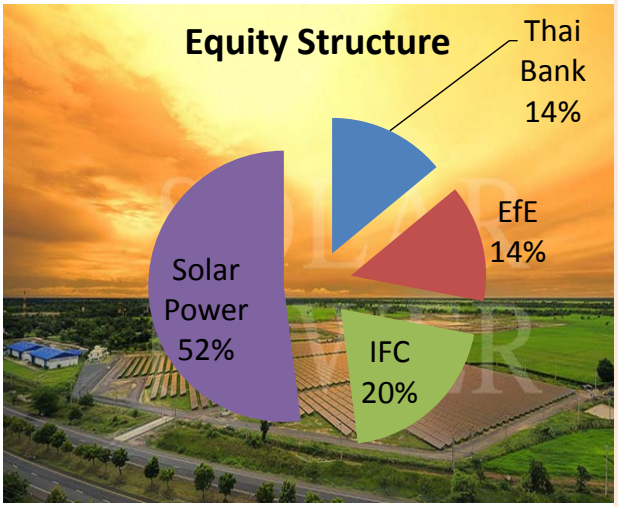
Solar Power (Korat 1) Co., Ltd

Installed Capacity: 6.1 MW (Solar Farm)
Location : Nakornratchasima
Project Cost: 700 MB



- First large scale solar farm project in Thailand
- Use proven PV module with efficiency warranty
- Debt: Equity = 60:40
- Bank required cash deposit and Personal Guarantee.
- Success of this project creates Thai banks' confidence to provide loan financing, resulting of a lot of solar farm projects come out.

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Results – ESCO fund(2008 – 2016)

Allocated budget to **145** projects (EE & RE)

Investment:
USD 34 million

Energy saving :
USD 30.71 million /year
or 41.19 ktoe/year

Subsidized

Subsidized

To Provide a capital subsidy for the installation of parabolic solar dryer.

Subsidize:

the 1st phase: subsidize 60% in 2011.

Later year: 5%discount every year

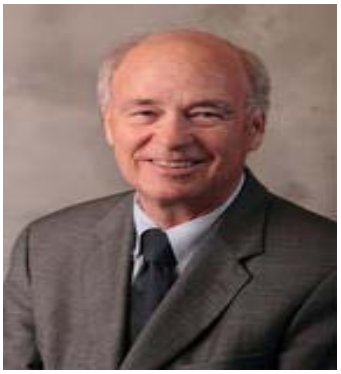
Now: subsidize 30%

Subsidized

2015: subsidy 100% for changing burner.

Changing the fuels heating from fossil oil to biomass pellet by changing the burner on boiler.

US Federal and State-Based Energy Policy and Technology in Regards to Renewable Energy



Terry Surles, Ph.D.

Dr. Surles just finished being an emergency hire as the Interim Administrator for the Hawaii State Energy Office. He has a distinguished career in energy and environmental management and consulting positions. Since 2012, he has been at the University of Hawaii and the California Institute for Energy and Environment. During this time, he has also served as an expert for APEC and IEA in Indonesia, China, Vietnam, Peru, and Korea. In 2015, he led an analysis of DOE's Grid Modernization Initiative for Booz, Allen, Hamilton. From 2010 to 2012, as Desert Research Institute Vice President, he led program development and management for three research divisions and four research centers in environmental and energy sciences. From 2006 to 2010, he was the Technology Integration and Policy Analysis Program Manager at the Hawaii Natural Energy Institute focusing on grid integration of variable renewable resources and energy storage technologies. From 2004 to 2006, he was Vice President at EPRI focusing on air quality, health, energy/water nexus, and climate change issues. From 2000 to 2004, he was on loan to the California Energy Commission as the PIER Program Director where the emphasis was on energy efficiency, renewable energy, grid modernization, and regional climate assessment. For this position, he took leave from Lawrence Livermore National Laboratory where he was Associate Laboratory Director for Energy Programs from 1998 to 2000, focusing on energy efficiency, energy storage, and climate change science and analysis. In 1997, he was appointed by Gov. Wilson to be Deputy Secretary for Science and Technology at California EPA. From 1978 to 1997,

he was at Argonne National Laboratory (ANL) with his final position being General Manager for Environmental Programs. Major program areas included energy systems assessment, climate change science, risk analysis and assessment, emergency planning and response, and energy and environmental modeling. From 1974 to 1978, he was at Camp, Dresser, & McKee, with his final position as Vice President.

Dr. Surles received his Ph.D. in Chemistry from Michigan State and has more than 330 publications, technical reports, and presentations. He has served on a number of committees, including seven appointments with the National Research Council as well as advisory groups for DOE and its laboratories. In addition to those listed above, he consulted or is currently consulting with NELHA, the Northeast Asia Economic Forum, East-West Center, the United Kingdom Energy Research Centre, the California Public Utility Commission, and the State of Victoria.

US Federal and State-Based Energy Policy and Technology in Regards to Renewable Energy

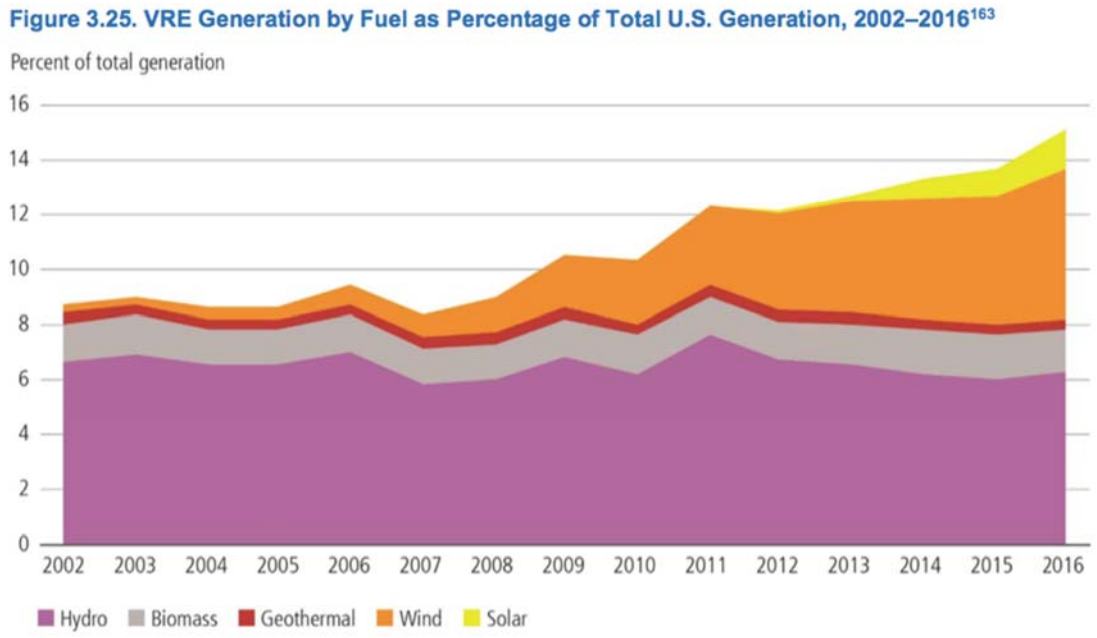
Terry Surles, surles@hawaii.edu

APEC Conference

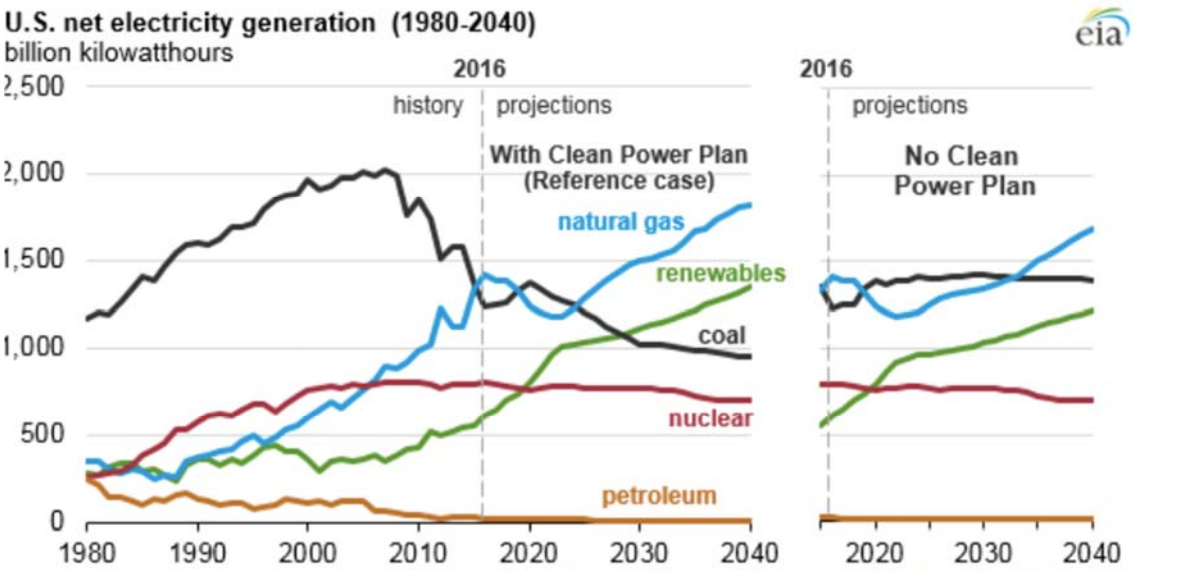
Taipei

September 28, 2017

Renewable Generation Has Increased Significantly Over the Past Decade – from DOE August 2017 Report

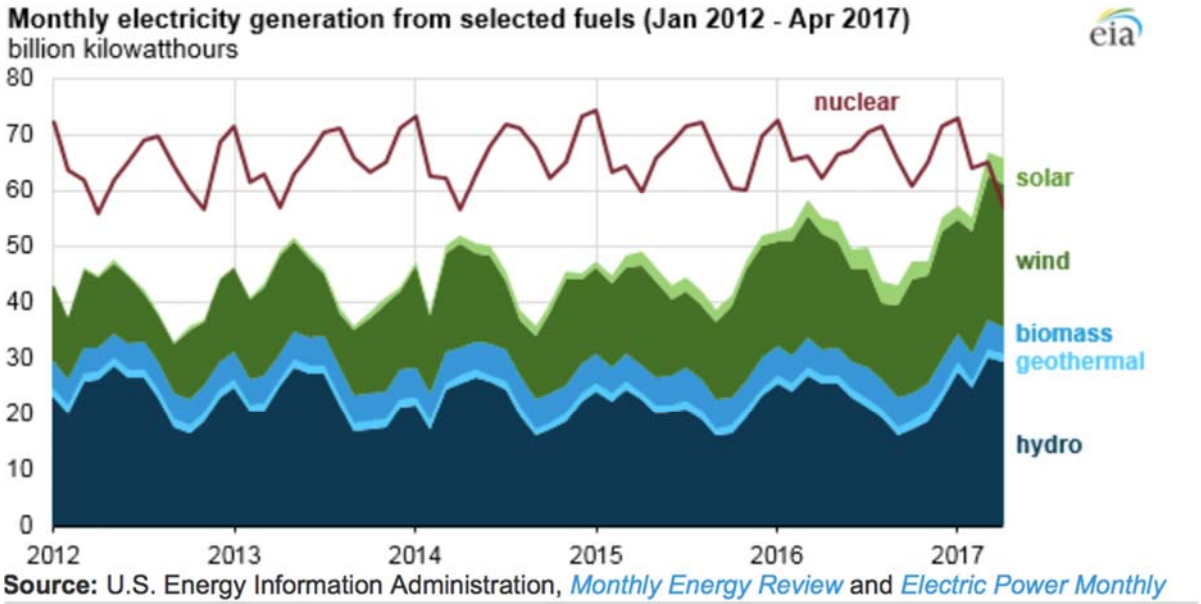


Natural Gas and Renewables Growth at Expense of Coal Will Continue - Natural Gas ($2.94/MBtu on 9/27/17) Overtook Coal-Fired Generation in 2016



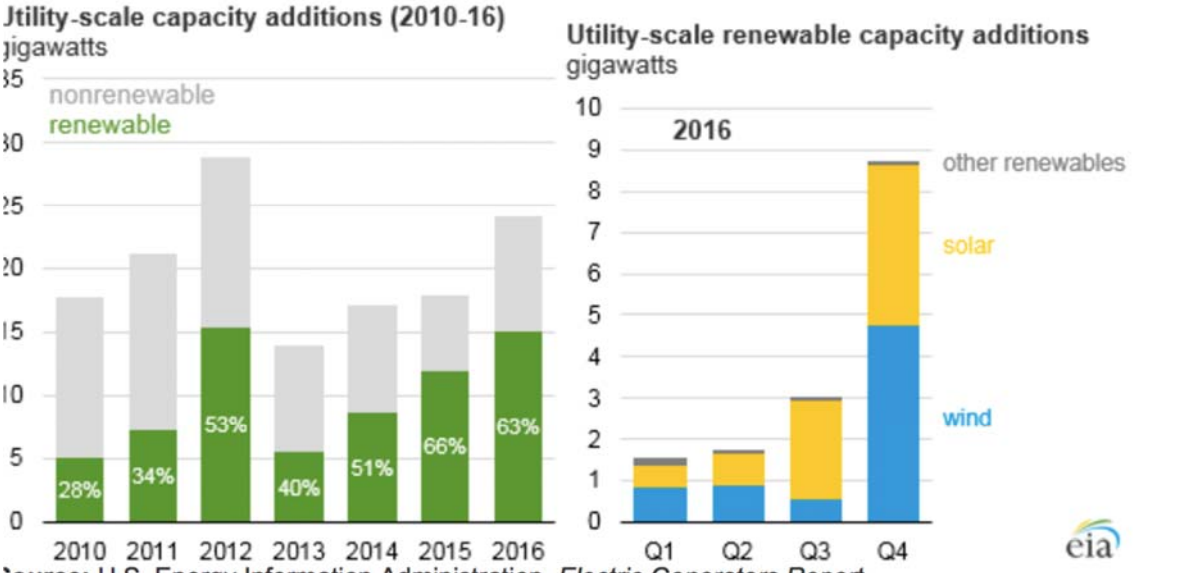
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2017* Interactive Table Viewer

As of April, More Electricity Generated from Renewables than Nuclear



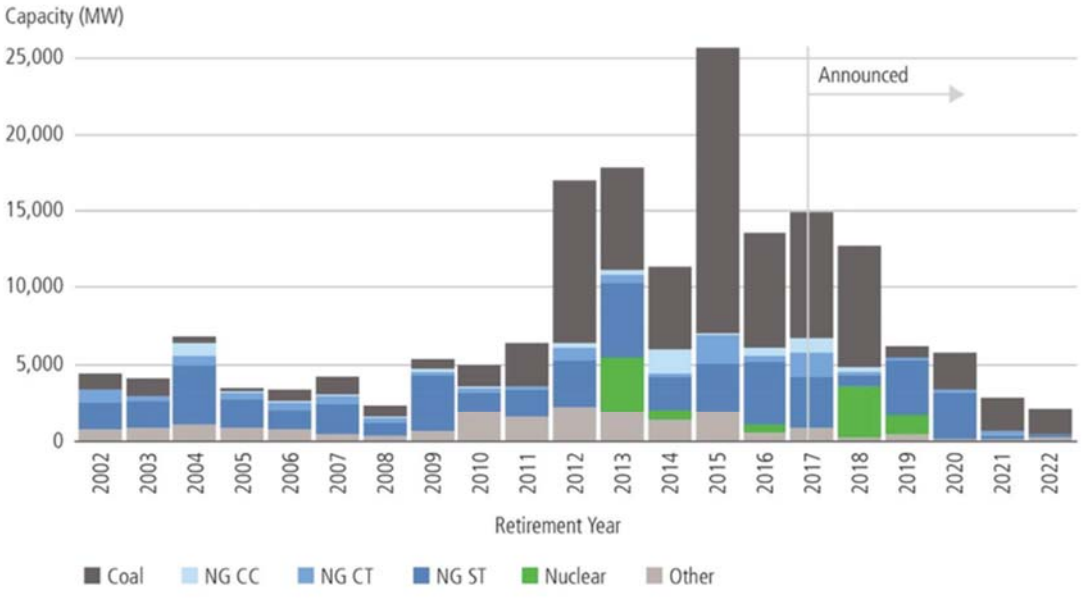
Source: U.S. Energy Information Administration, *Monthly Energy Review* and *Electric Power Monthly*

Substantive Increase in Renewable Resource Generation for 2016, 2/3 of Installed Generation

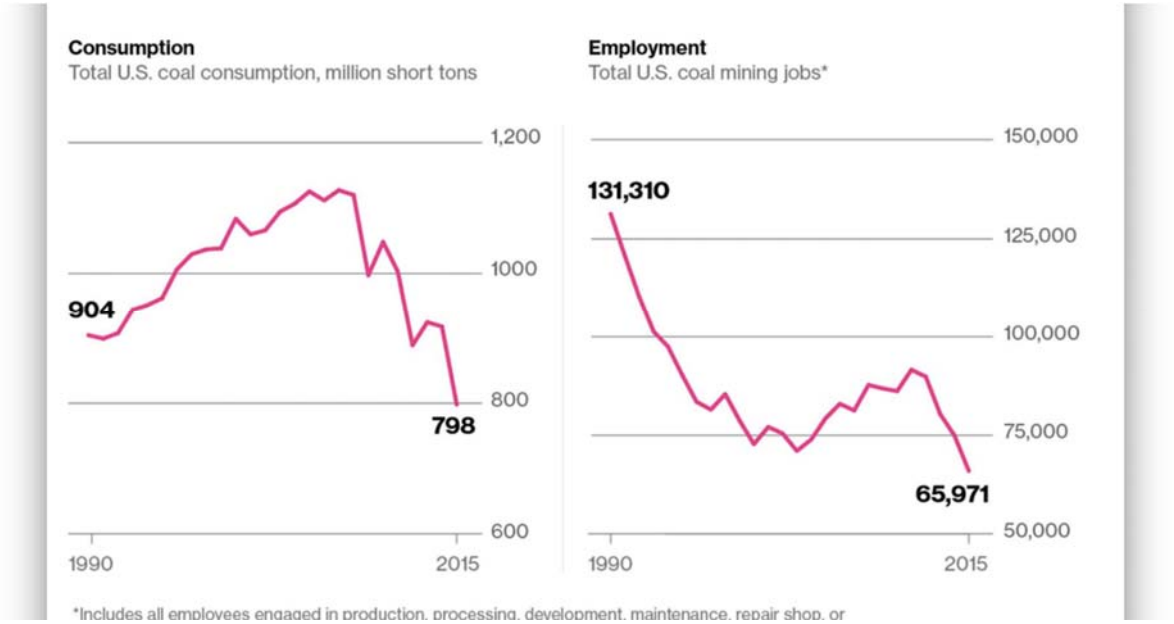


Source: U.S. Energy Information Administration, *Electric Generators Report*
Note: The last two months of 2016 are based on planned reported additions and are subject to change.

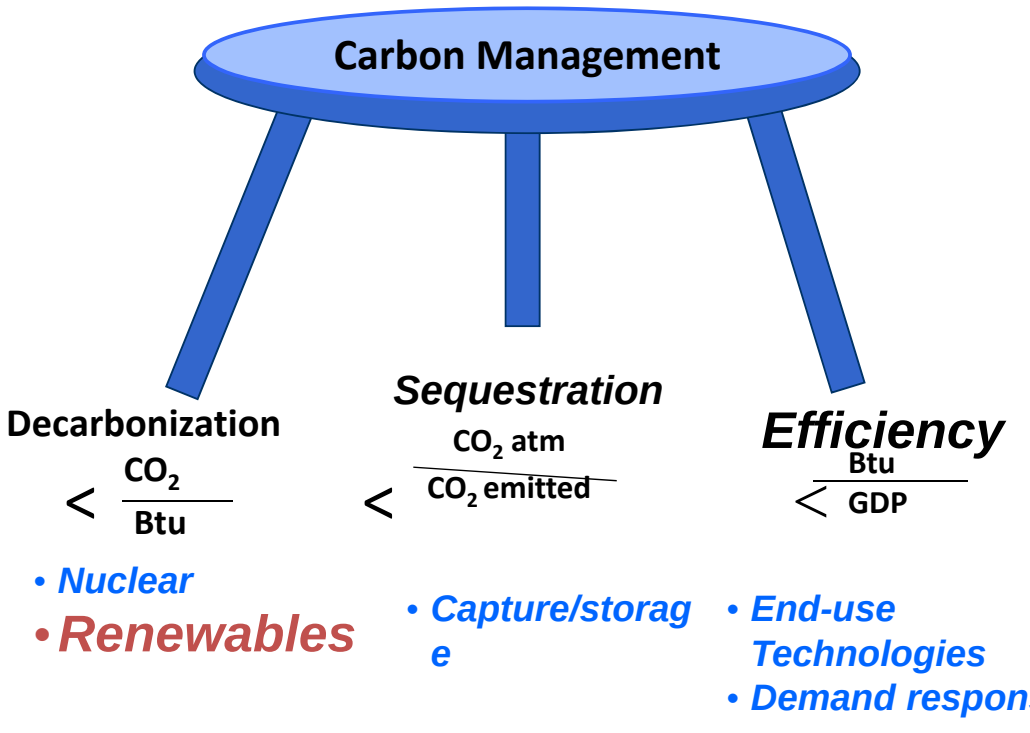
Coal Retirements Driven by New Fine Particulate and NESHAPS Regulations, NG Driven by Economics and Poor Efficiencies as Compared to Newer NGCC



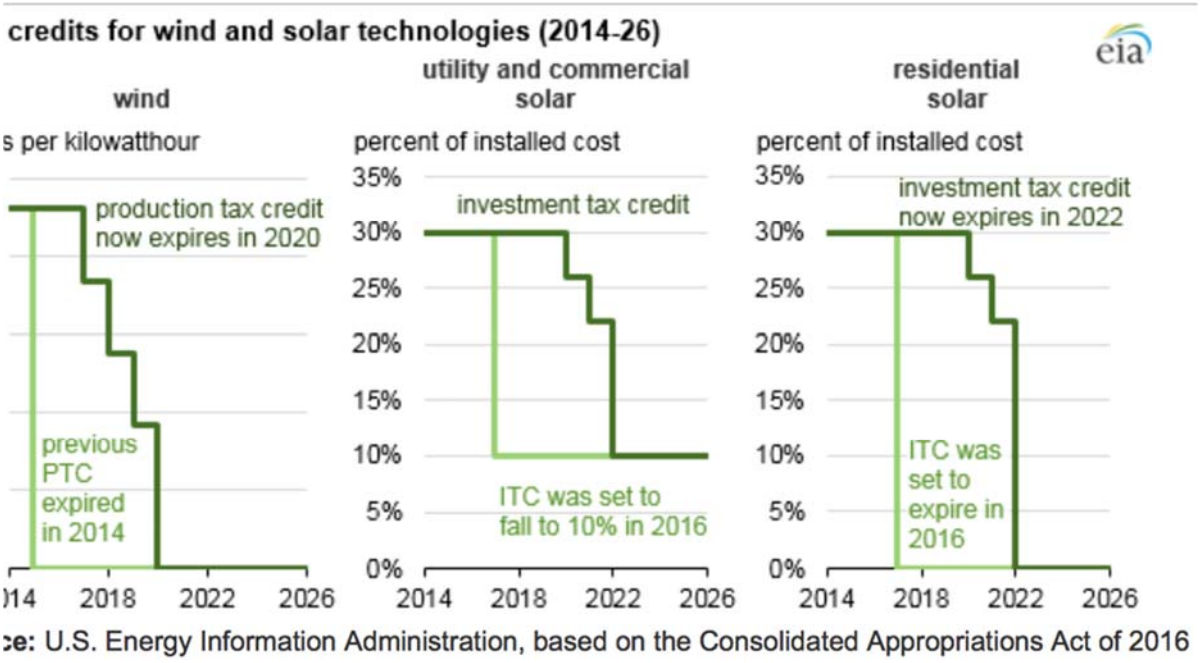
Despite Campaign Rhetoric, Lots of Coal Jobs Will Not Happen



Carbon Management and Energy Security – Help from Congress, but Renewable Leadership Is in the States

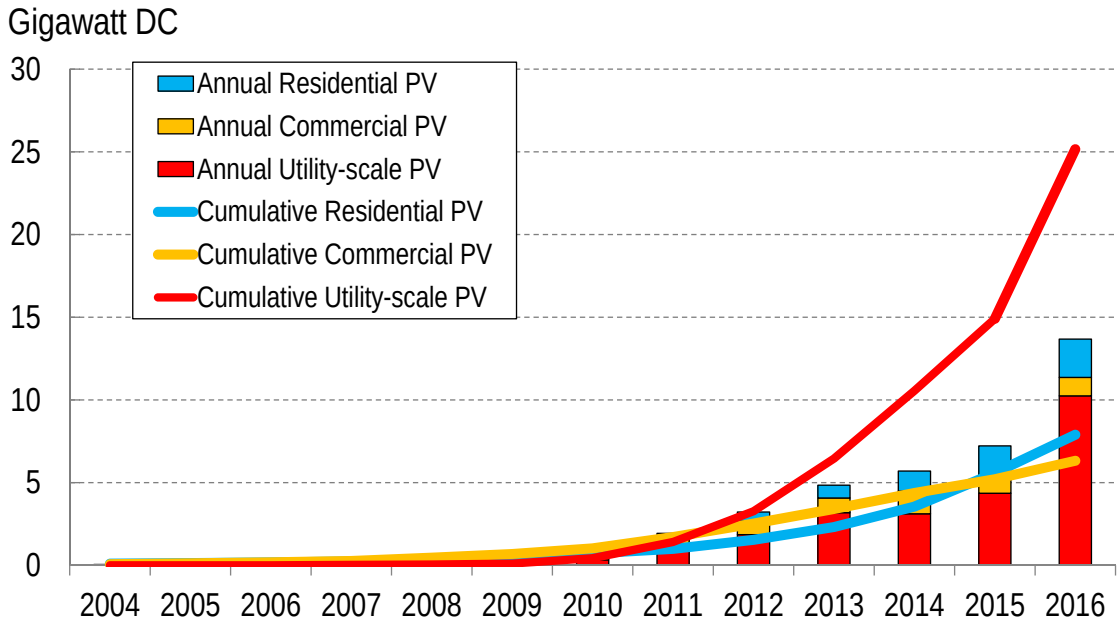


Recent Agreement on Tax Credits Allows for a Degree of Certainty for Investment Community



Solar Installations Have Been Exponential in Growth – Bloomberg (2017)

However, Decision Last Week by US International Trade Commission on Solar Cell Tariffs May Negatively Impact US Installation Prices



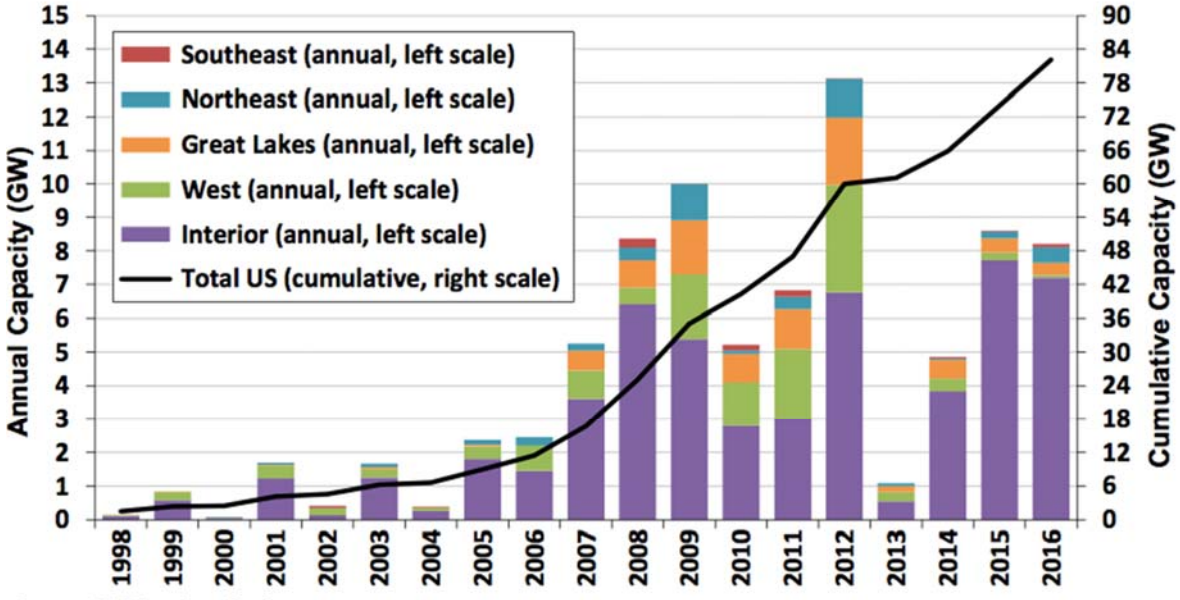
Wind – Per Trump's Idea that Climate Change is a Chinese Hoax, the Chinese Are Not Listening to Themselves!

Table 1. International Rankings of Wind Power Capacity

Annual Capacity (2016, MW)		Cumulative Capacity (end of 2016, MW)	
China	23,370	China	168,732
United States	**8,203**	**United States**	**82,143**
Germany	5,443	Germany	50,018
India	3,612	India	28,700
Brazil	2,014	Spain	23,074
France	1,561	United Kingdom	14,543
Turkey	1,387	France	12,066
Netherlands	887	Canada	11,900
United Kingdom	736	Brazil	10,740
Canada	702	Italy	9,257
Rest of World	6,727	*Rest of World*	75,576
TOTAL	**54,642**	**TOTAL**	**486,749**

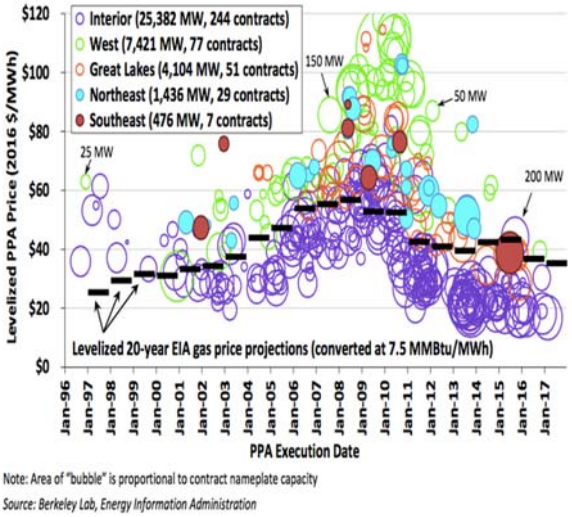
Source: GWEC (2017); AWEA project database for U.S. capacity

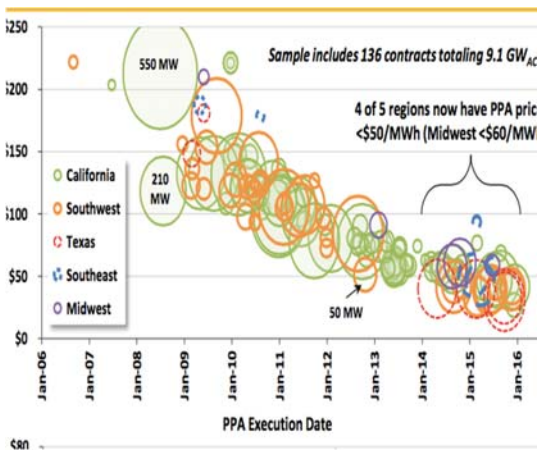
Production Tax Credit Expiration – Note Wind Installations as Installed Capacity Went from 13GW in 2012 to 0.4GW in 2013



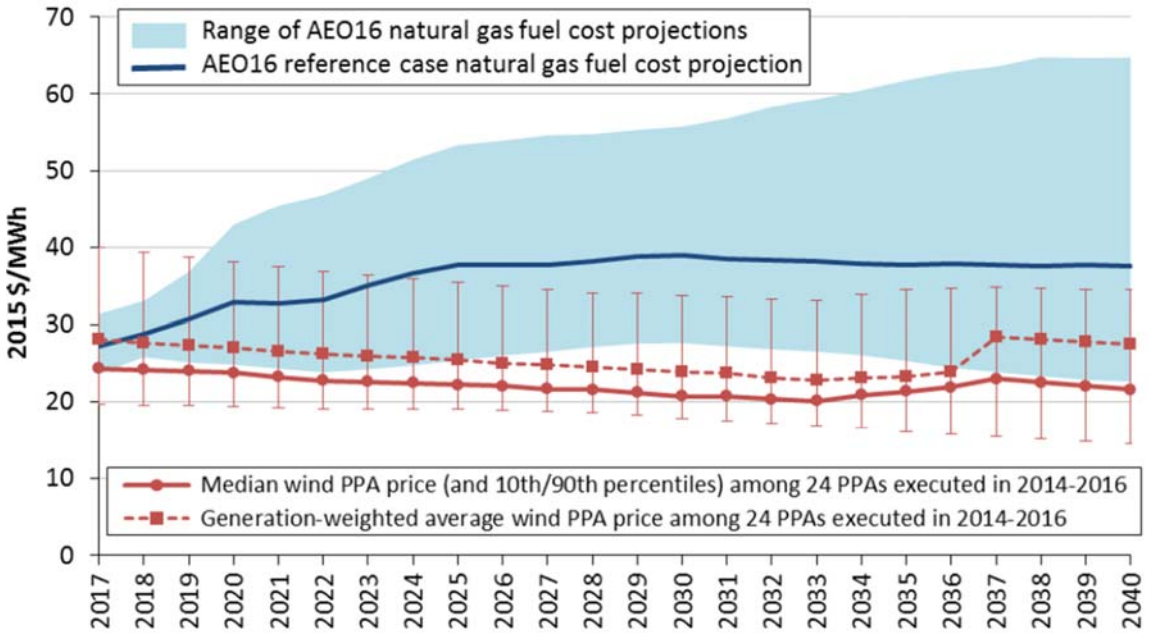
Source: AWEA project database

Renewable PPA Prices Trend Downward: ~$15/MWh (with PTC) for Wind, Levelized PPA ~$35/MWh (with ITC) for Solar





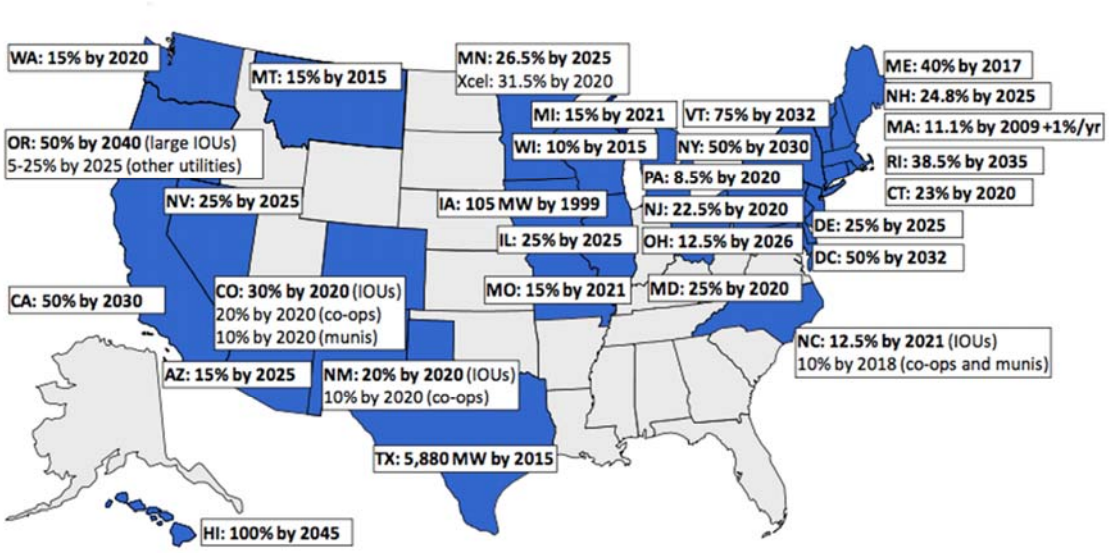
PPA Agreements Suggest Wind Is a Viable Economic Competitor with Natural Gas



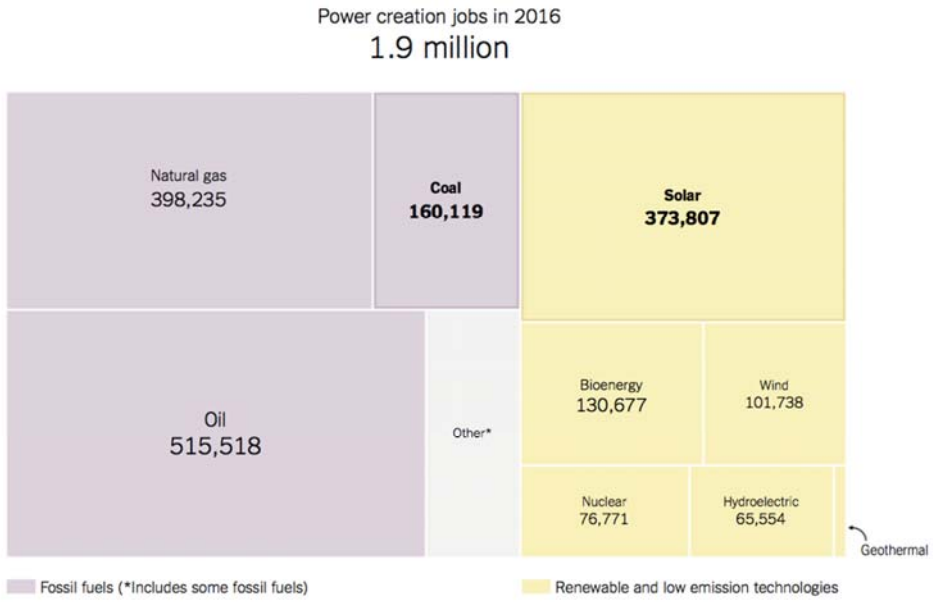
States Remain More Effective in Developing New Policies, Programs, and Addressing (or Forcing) Changing Utility Business Models

- **Energy Efficiency and DSM Standards and Goals**
  - **Standards developed for building codes and appliances**
- **Renewable Portfolio Standards (RPS)**
  - **Feed-in tariffs and net metering laws and regulations**
- **Power Purchase Agreements - Growth of IPP generation (as an example, only 20% of SCE electricity is from their generators)**
  - **New PPAs now take into account ancillary services - grid stability, reliability, Var support**
  - **Push for grid stability and power quality is leading to new mandates for the use of energy storage, two-way meters, other Smart Grid devices**
  - **All PPAs approved by state regulatory commissions, with lots of input from intervenors and from State Consumer Advocates**
  - **PPA can be denied or modified based on price, location, other factors**

State Renewable Portfolio Standards (January 2017)

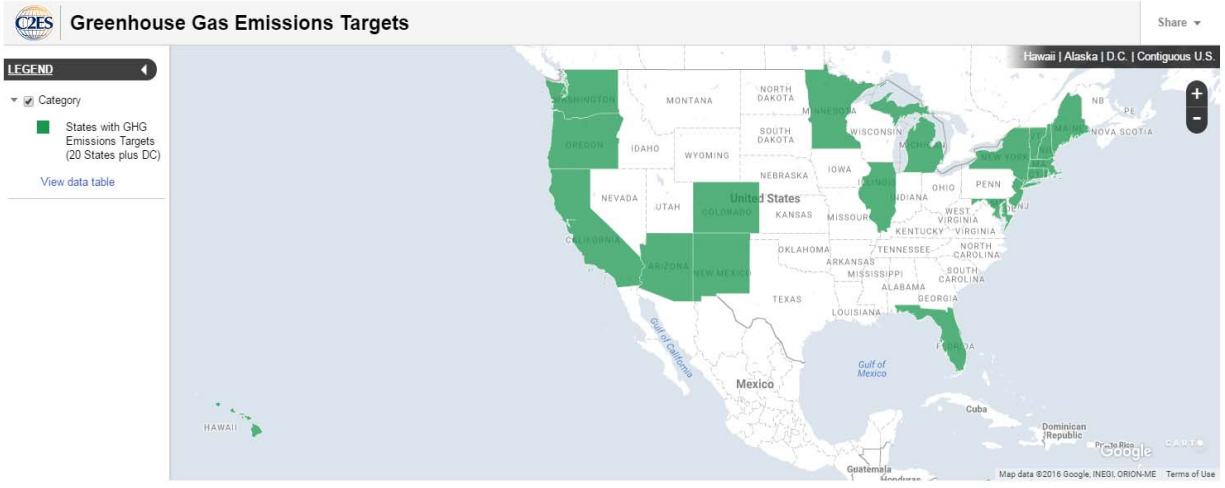


State Policies Result in Job Growth Focused in Renewable Energy Sector – more solar jobs in California than coal mining jobs in the entire country!



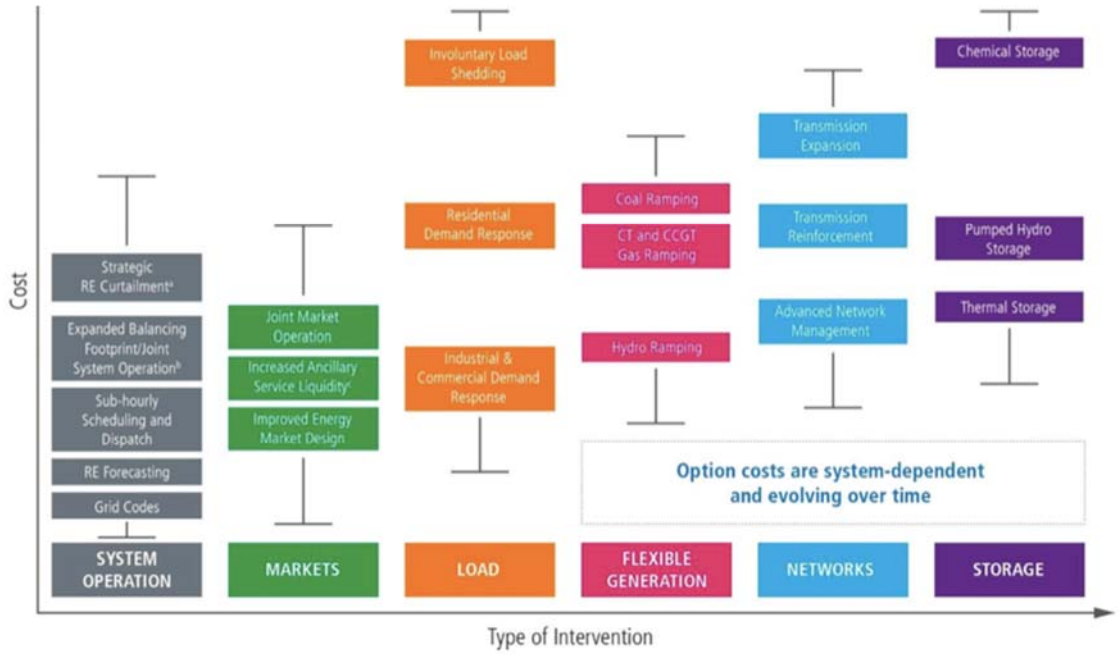
State GHG Emissions Targets

- **Nineteen states use a variety of baseline years, ranging from 1990 to 2006.**
- **Most states have an ultimate target year of 2050.**



Source: http://www.c2es.org/print/us-states-regions/policy-maps/emissions-targets

There Are a Variety of Mechanisms for RTOs and ISOs to Increase Renewable Energy Penetration

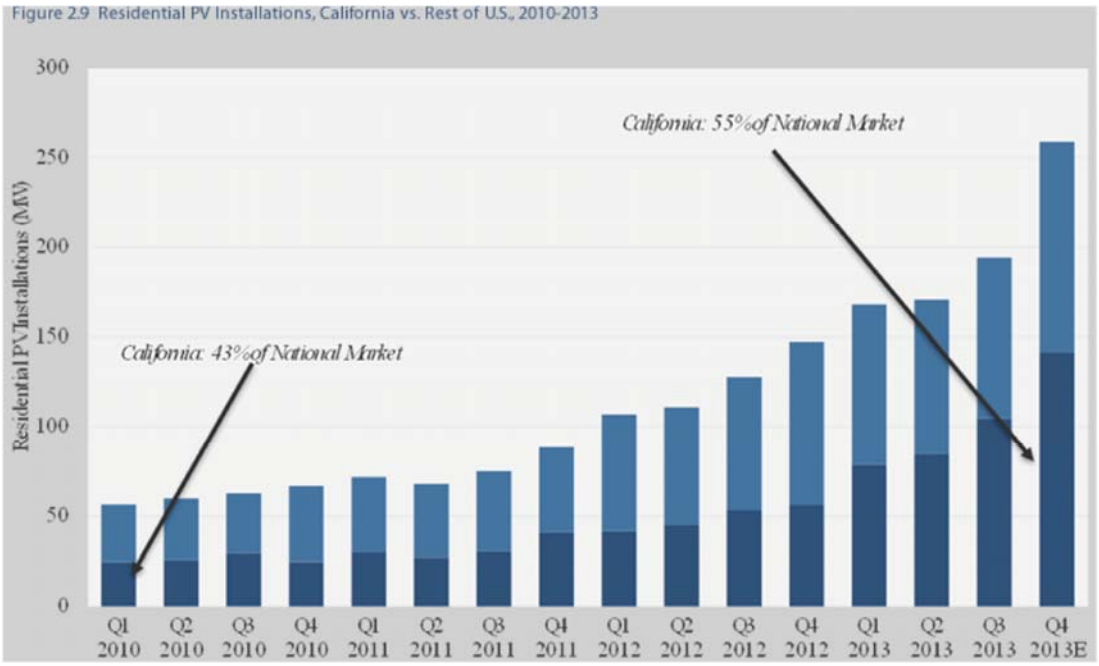


California Policy Landscape – Leadership From Governor

Governor's ambitious new clean energy 2030 goals:

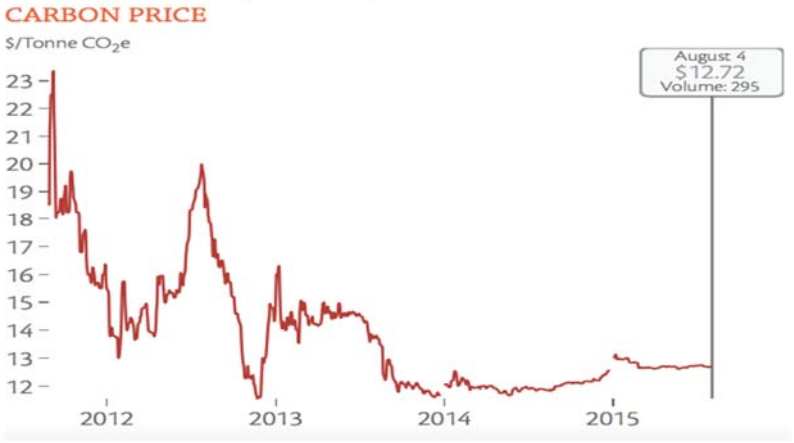
- Increase renewable electricity use from 33% to 50% - new environmental rules may make achieving this goal difficult (remember the "dog's breakfast" slide from yesterday)
- **All buildings Zero Net Energy by 2020 – aspirational goal**

Regulations Drive Growth: 4 GW Behind-the-Meter in July 2016, 15GW Total



Cap and Trade in California, with Partnerships with Quebec and, as of last week, Ontario

- **AB 32: Reduce 2050 carbon emissions 80% below 1990 levels**
- **Rebates to electricity end-users**
- **Highest gasoline prices in the nation, adds about 10 cents/gallon**
- **Use funds generated by permit sales on other projects: WET**
- **Latest auction in August 2017, $14.75/ton carbon dioxide**



While There Have Been Many RE Initiatives, the Million Solar Roof Program Has Been Most Successful

- Million solar roof program – SB1
  - 3GW of solar by 2018 (exceeded)
  - Raised net metering cap (since changed under AB327)
  - Builder of more than 50 houses must offer solar on 50% of the housing
  - 10% of funds for low income housing
- In addition to regulated IOUs, similar programs are run by:
  - SMUD
  - LADWP
  - Silicon Power

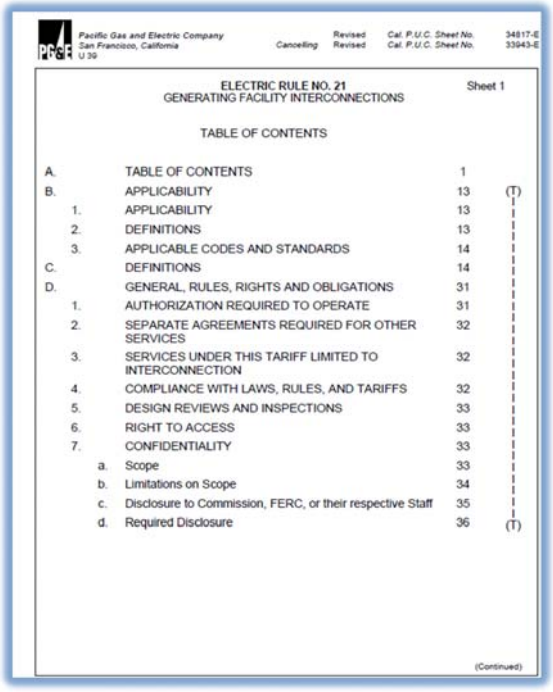
CPUC Feed-In Tariffs (Re-MAT) Are Alive and Well for Small Generators

- Up to 493.6 MW allowed for procurement of small (less than 3MW) renewable facilities
  - PG&E – 218.8 MW
  - SCE – 226.0 MW
  - SDG&E – 48.8 MW
- AB1979 increased the allowance for small hydropower to 4MW
- SCE treats Re-MAT as their approach to IDER as regulated by CPUC

Example – Southern California Edison's Renewable Energy Solicitations

- Request for proposals (RFP)
  - Similar to auctions discussed yesterday
- Solar Photovoltaic Request for Offers (RFO)
- Renewable Auction Mechanism
  - For smaller distributed facilities in remote areas
- Combined Heat and Power
  - Modification of QF requirements under old PURPA
- Re-MAT Feed-In Tariff
  - For renewable facilities up to 3MW

California Rule 21 Interconnection Standards Critical for Distributed Generation Deployment



Pacific Gas and Electric Company
San Francisco, California
U 39

Revised Cal. P.U.C. Sheet No. 34817-E
Cancelling Revised Cal. P.U.C. Sheet No. 33943-E

ELECTRIC RULE NO. 21
GENERATING FACILITY INTERCONNECTIONS
Sheet 1

TABLE OF CONTENTS

(Continued)

- The latest California Rule 21 adopted on December 18, 2014
- Rule 21 allows smart inverters with advanced inverter functions that offer system support to grid
- A number of advanced inverter functions in Hawaiian Electric's Rule 14H are similar to California's Rule 21
- Costs related to these standards can be onerous

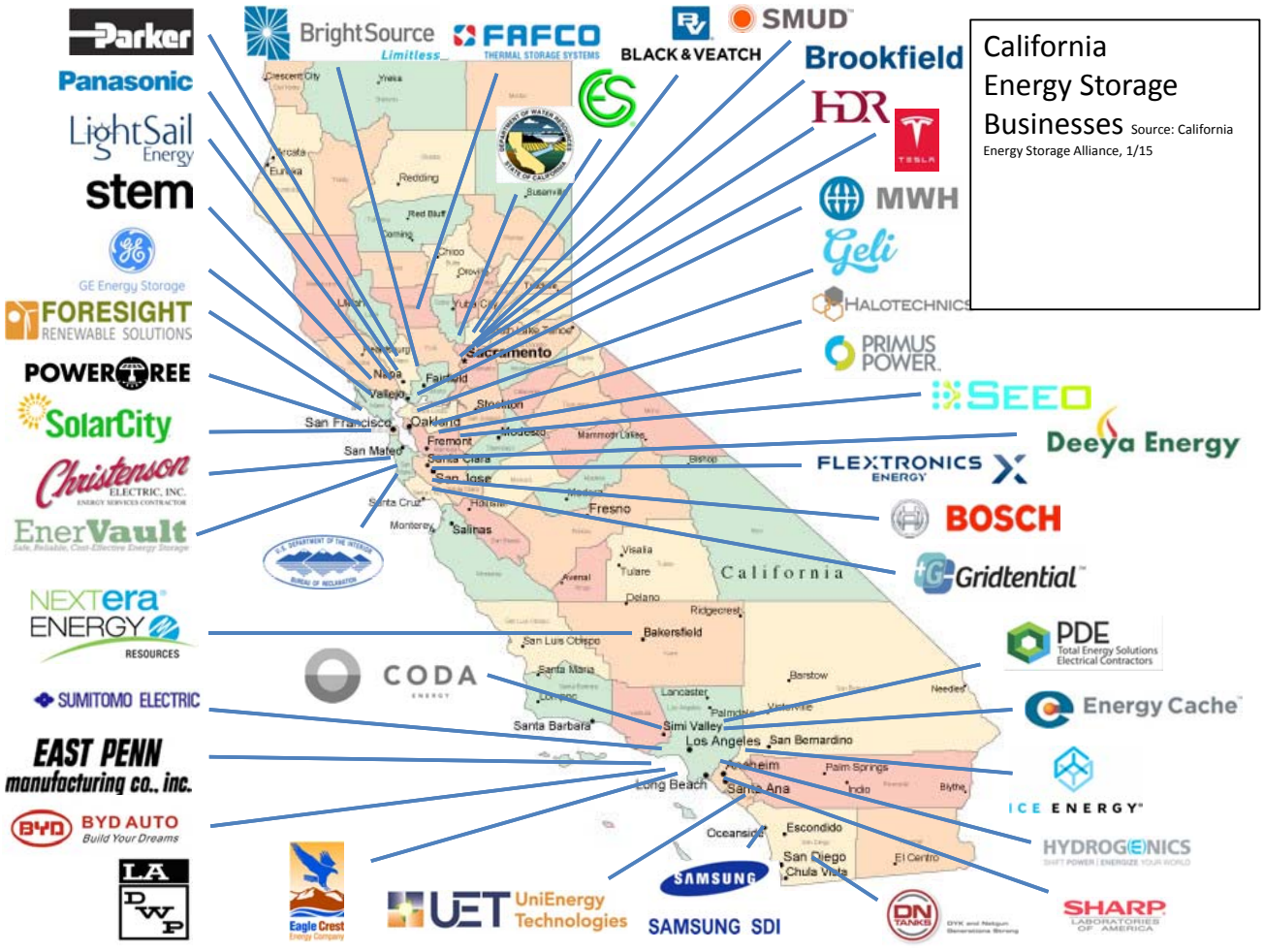
AB 2514 – Landmark Energy Storage Law in California

» Considered establishing Energy Storage Procurement Targets for 2020
  » IF cost-effective
  » IF commercially available

» Directed California Public Utility Commission to convene a proceeding to evaluate energy storage procurement targets:
  - Required CPUC to consider information from CAISO and integration of storage with other programs, including demand side management
  - Utility-owned, customer-owned, and third party-owned are eligible

CPUC decision on October 17, 2013 requires utilities to purchase 1.3 GW of storage

400 MW permitted to date

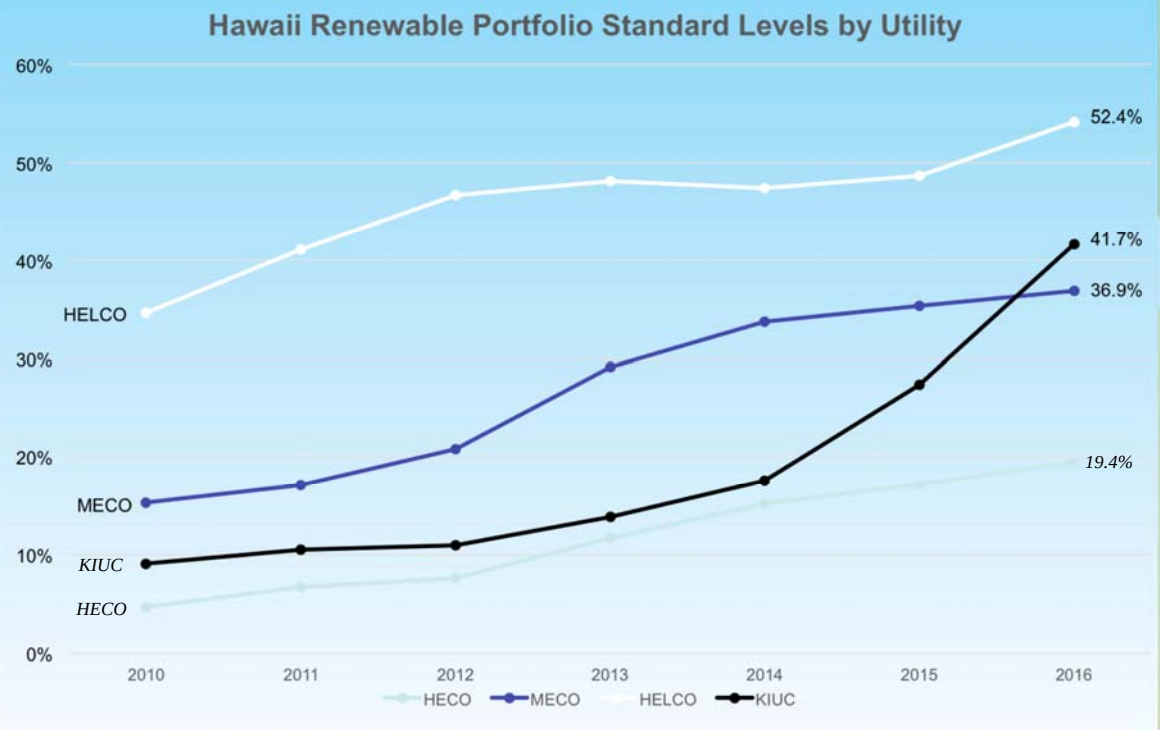


• Hawaii Clean Energy Initiative - HCEI

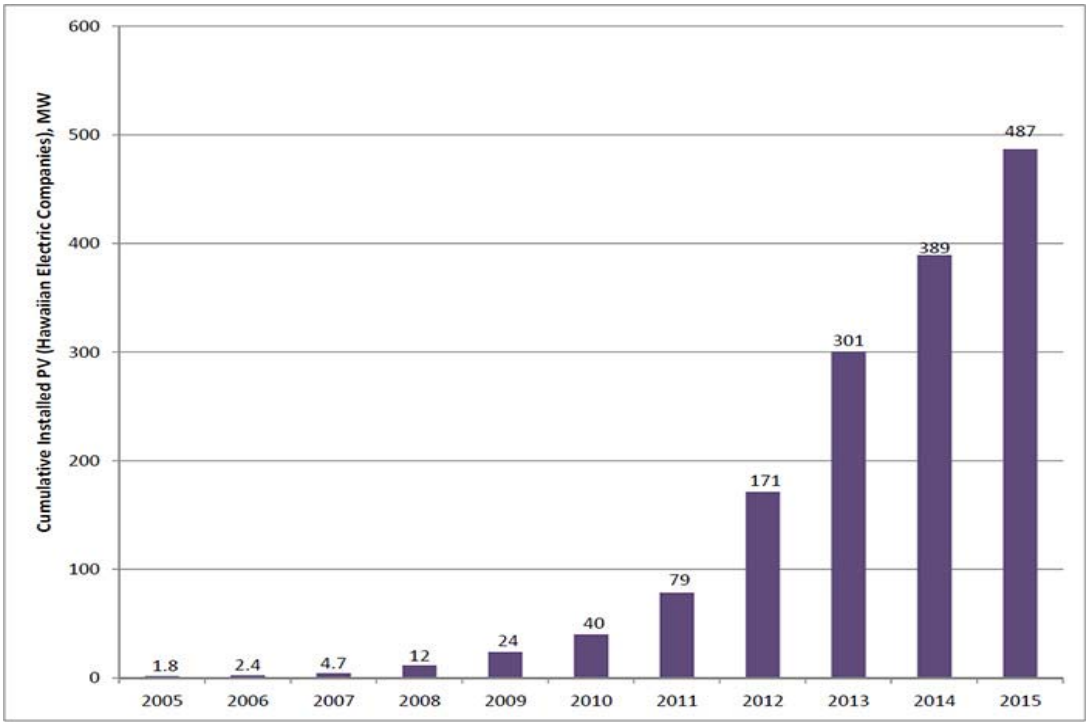
- 100% Renewable (electricity sector) by 2045, 40% by 2030
- Reduce 4,300 Gwh by 2030 - Since 2008, Hawaii has reduced energy consumption by 8%



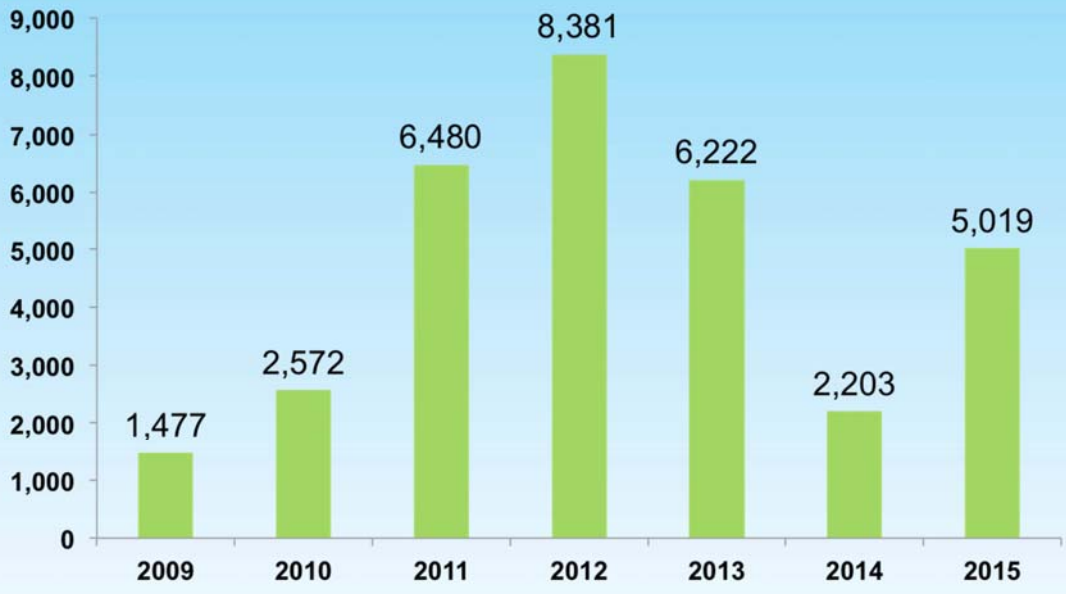
• RPS: Growth in BTM PV Due to 30% State and 30% US Tax Credit



Hawaii (BTM) Solar Continues to Grow – Original Regulations Allow for Annual "True-Up" at Retail Rates, Now at Wholesale Rates



- Solar-Related Jobs – Installation of BTM Solar Energy Systems Is About 10% of Construction Activity in Hawaii



Source: Research & Economic Analysis Division, DBEDT

Innovative Approaches to Clean Energy Financing – Provide PV to Lower Income Households

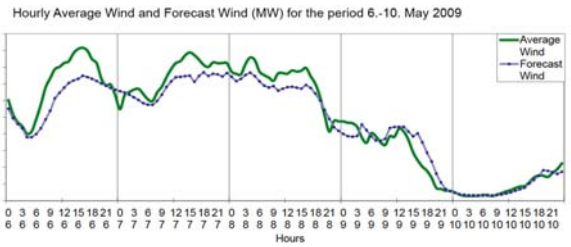
GEMS

- Program helps underserved and lower income consumers finance PV panels and other clean energy improvements
- The state issued $150 million in green infrastructure bonds to support the GEMS program
- Bonds will provide a source of low-cost capital for clean energy that will not compete with private-sector financing
- In 2017, $50 million given to schools for lighting retrofit and air conditioning retrofit – move by Governor Ige to be more aggressive about education and energy efficiency

New York - Fundamental Change in Their Grid System (Reforming the Energy Vision – REV)

- **Strategy behind new laws enacted starting in 2011 to more aggressively reduce greenhouse gases**
- **Regulatory changes for more efficient use of energy, deeper penetration of renewable energy resources, wider deployment of "distributed" energy resources**
  - **Microgrids, roof-top solar, other on-site power, and storage**
  - **Subsidizing nuclear power as carbon-free alternative**
- **Promote markets for greater use of advanced energy management products to enhance demand elasticity and efficiencies**
- **Installation of Maple Creek Wind Farm with 50% financial support from NYSERDA**

Negative Impacts Caused By Large Increases in Variable Renewable Energy (Intermittency, Big Ramps) Also Create Opportunities



Improved Forecasting – Significant Impact on Profits

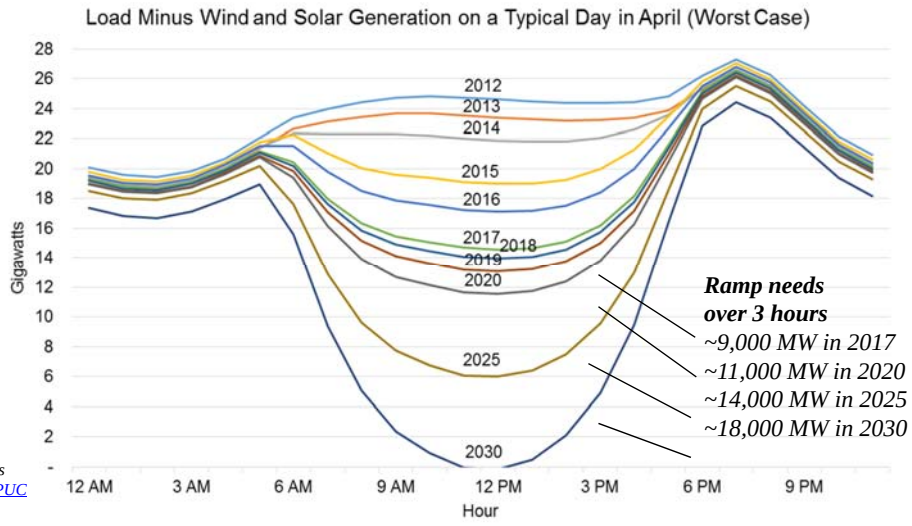
Wider Area Aggregation (Transmission)

Flexible Dispatchable Generation or Using Load as a Resource

Energy Storage for Transmission, Distribution, BTM

California's Regulations
Implications for Load Shape - 2030

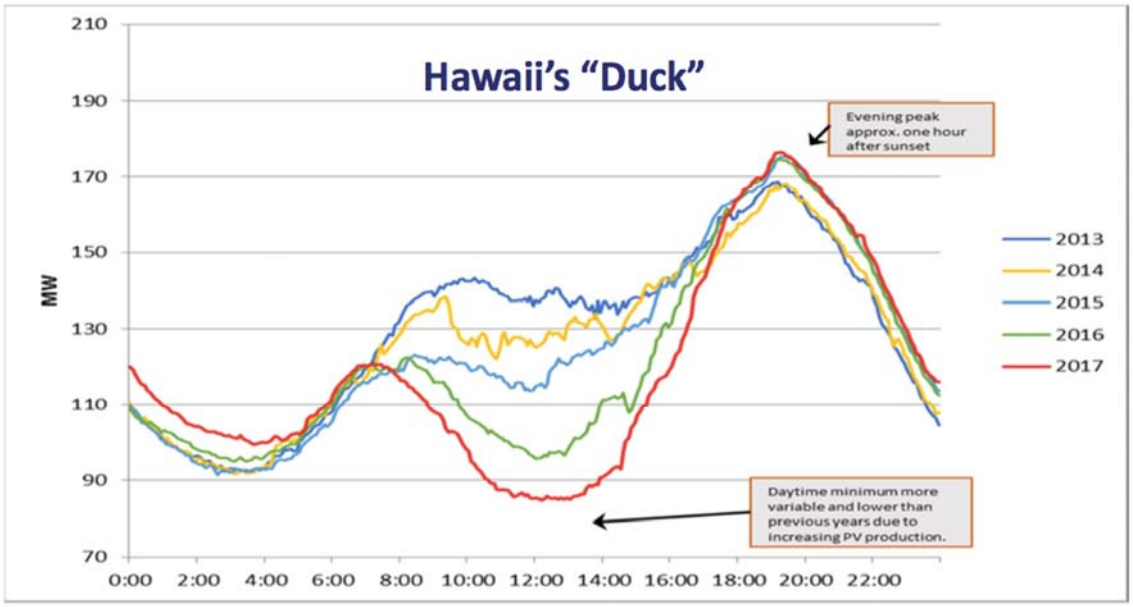
- NERA's (P. Bernstein) analysis of 2030 portfolio indicates worsening conditions of oversupply and steep ramping requirements
- 50% RPS could lead to increased curtailment and reliability risks



Source: NERA analysis using data from the CPUC RPS Calculator

Large additions of intermittent resources under the 50% RPS will necessitate changes to California's electricity system

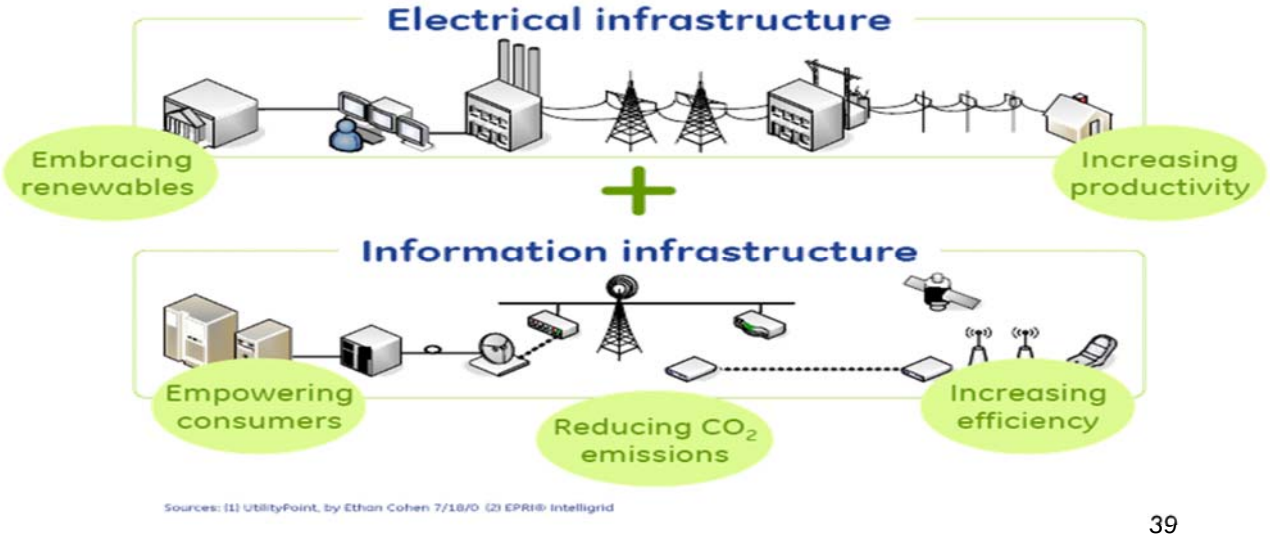
Dealing with "Duck's Back" in Hawaii (Big Island) – Thermal Units Soon to Operate Below Min Power



So, It's Not Easy Being Green

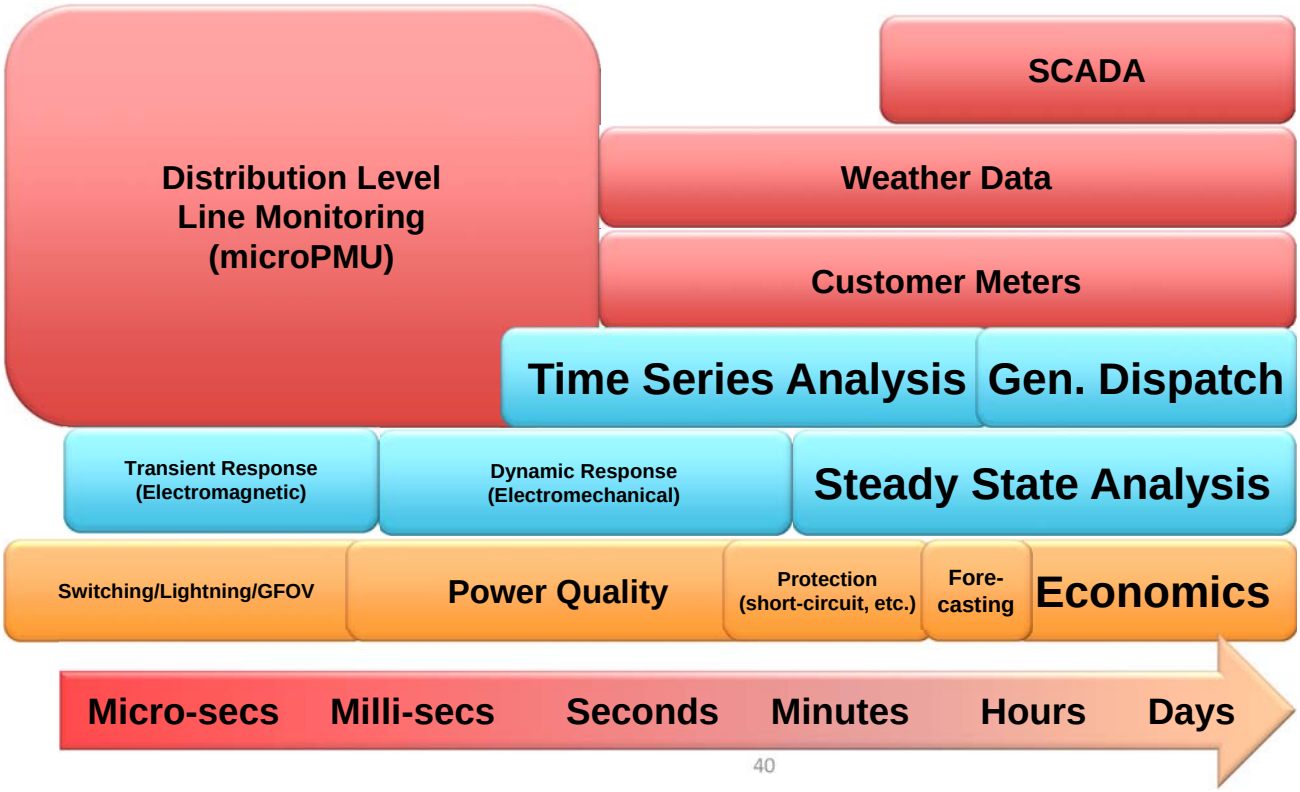
Renewable DG Has Most Impacts at Distribution Level: "Smart Grid" Solutions Offer Opportunities to SMEs

- Many assets are aging, and based mostly on old (~1950s) technology:
  - Little monitoring & control ability beyond substation
- Not designed for generation at the customer level
  - Two-way power flow and potential for islanding create threats to human safety, asset protection and life, and power quality control

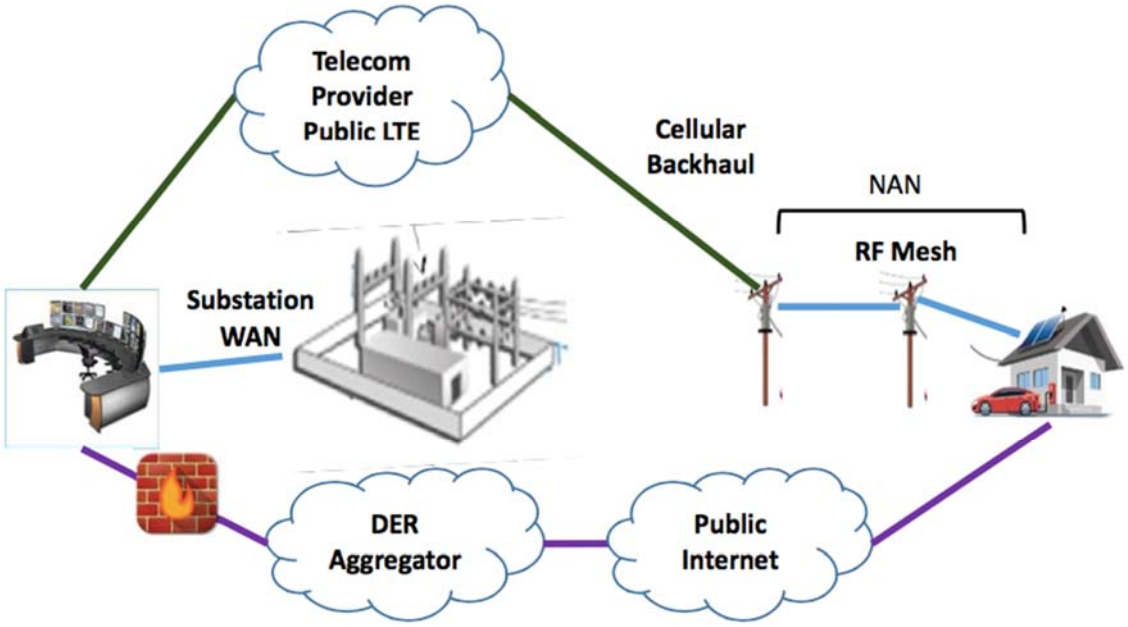


Sources: (1) UtilityPoint, by Ethan Cohen 7/18/0 (2) EPRI® Intelligrid

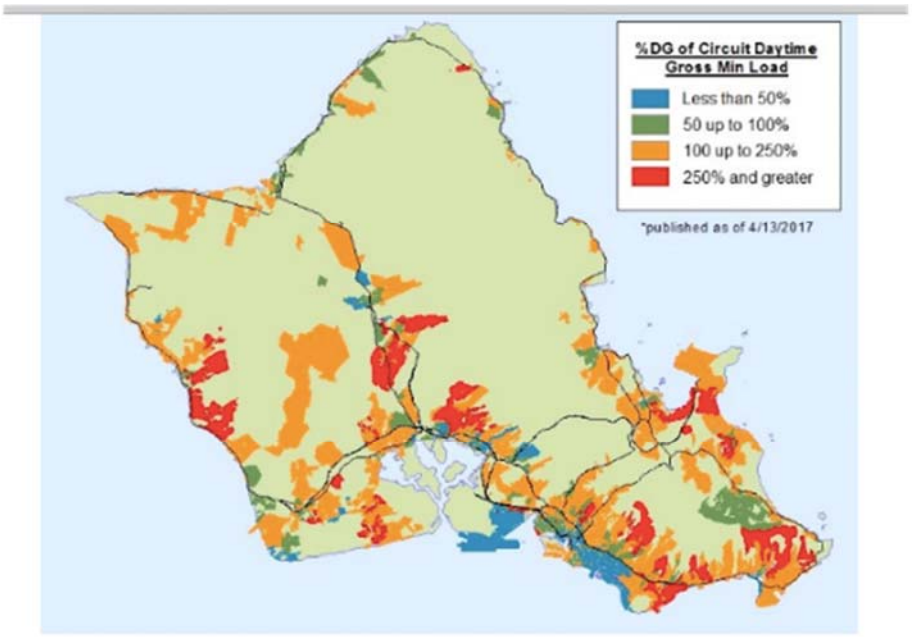
Need for Telecommunications – How Do Utilities Plan for and Manage Tsunami of Data Coming Their Way?



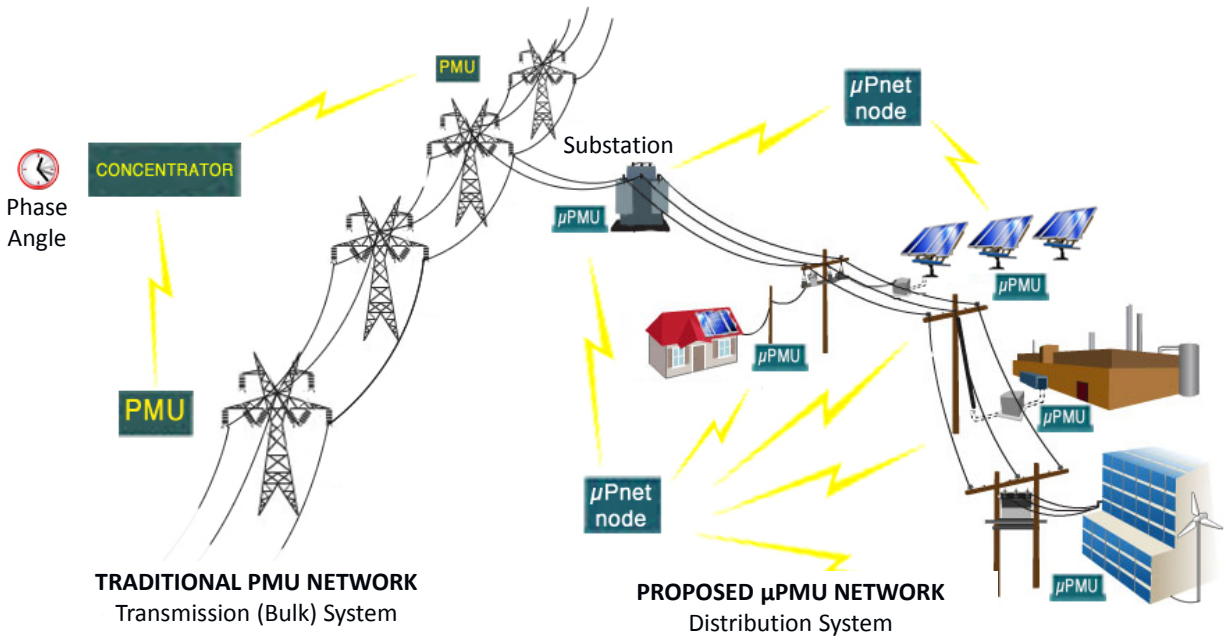
HECO's Communications Approach Between Customers and Operations – Part of New Docket on Grid Modernization



Need to Address Two-Way Flows: Many Distributions Lines are at 250% MDL

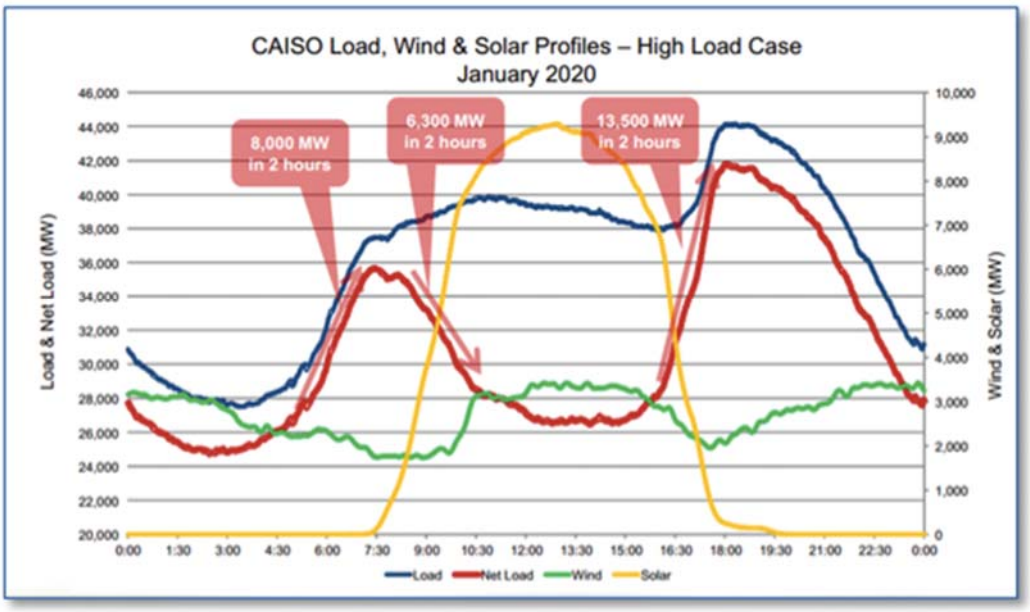


Distributed Systems µPMUs (PSL) for Providing Information to System Operators – But Need for Advanced Algorithms



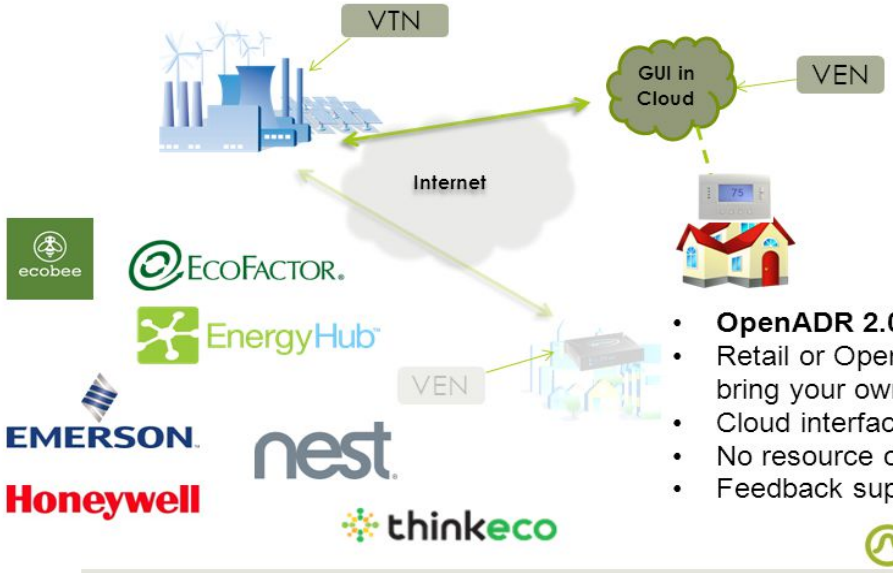
ciee California Institute for Energy and Environment

California Independent System Operator Projections For Ramping Needs in 2020



OpenADR with Cloud Communications

Cloud Interface



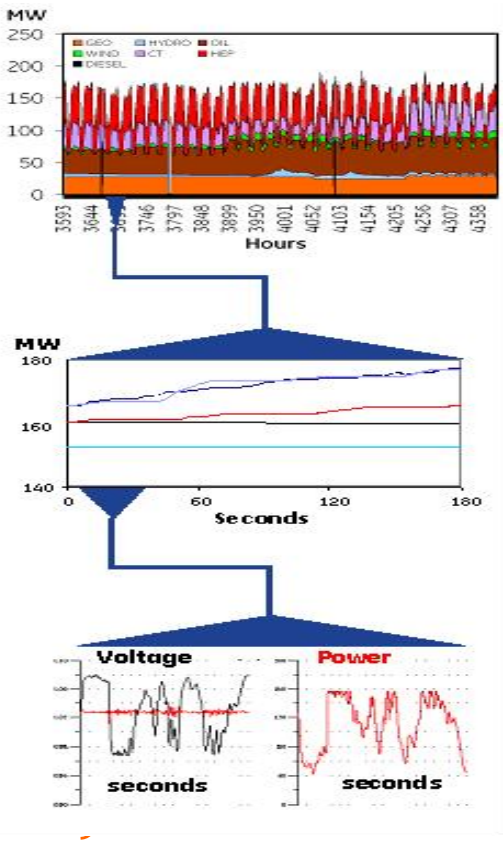
- **OpenADR 2.0 a or b** enabled
- Retail or Operator provided or bring your own thermostat
- Cloud interface
- No resource constraints
- Feedback supported

Energy Storage: What Problem Are We Trying to Solve

"Hours"
Spinning reserve & day-ahead scheduling

"Minutes"
Load-following for ~~big ramps in the late~~ afternoon

"Seconds"
Faster than AGC, for frequency regulation, grid resiliency and stability

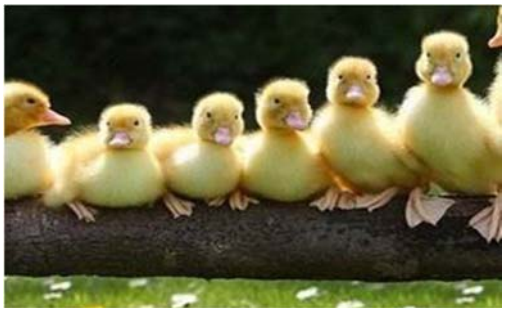


Existing (and Future) Applications of Energy Storage

Application	Type	Description	Value
Energy Arbitrage	Energy	Buy low, sell high	Displaces most expensive generation
Generation Capacity	Energy	Time shift energy from off-peak to peak load	Defers investment in new generation
Equipment Capacity	Energy	Reduce flow through overloaded lines and transformers	Defers investment in new equipment
Line Congestion	Energy	Time shift delivery of renewable energy during congestion	Delays transmission line reinforcement
Wind/Solar Smoothing	Power	Reduce ramp rates of wind and solar plants	Contributes to reserve & regulation requirements
Frequency Regulation	Power	Rapidly inject and remove power for short intervals	Contributes to regulation requirements
Reserves	Power	Dispatch power in < 10 minutes	Contributes to system reserves
Governor / Inertial	Power	Provide dynamic equivalents of synchronous generators	Reduces severity of frequency variations

Changes Continue for US Grid – "stuff will move more quickly that we now anticipate."

- **State Regulators – subject to legislative mandates**
  - **Evaluate societal/actual costs of various business models**
  - **Flexible regulations adapt to technological advances**
- **Utility business models must change due to changes in technology and government policy**
  - **Insertion of new technologies must be considered from a systems perspective**
  - **Innovative, transformational, disruptive transitions will occur**
  - **Understanding and developing strategies and architectures for operating a much more information-rich distribution grid.**
  - **Bolting new things on legacy systems, while keeping lights on**
- **Everyone must work to ensure that utilities are profitable and electricity prices are reasonable**



In 2014, Vietnam MOIT Hosted an APEC Meeting on Facilitating Renewable Deployment

- International standardization is critical for raising capital and in supporting consistent government policies
  - **Bankability – legal and financial services will want to have a mechanism for properly evaluating the technology and company worth**
  - **Product certification very useful for obtaining capital**
- Consistent government policies
  - **Critical for attracting investment**
  - **But be flexible in responding to new technologies and other events**
- Make effective use of national resources
  - **Develop national training programs for enhancing intellectual capacity**
- Country collaboration on a regional level

Energy Systems' Complexity, Risk, and the Attendant Policies and Politics - The Future

- "The road that I have turned on, the road that I have taken, it might be the beginning, it might be near the end."
- Enya, circa 2000

Since This Is the Last Presentation

“Everybody have fun tonight

Everybody Wang Chung tonight!”

Wang Chung, circa 1986