Asia-Pacific Finance and Development Institute

Future of Energy Systems and Implications to Developing Countries

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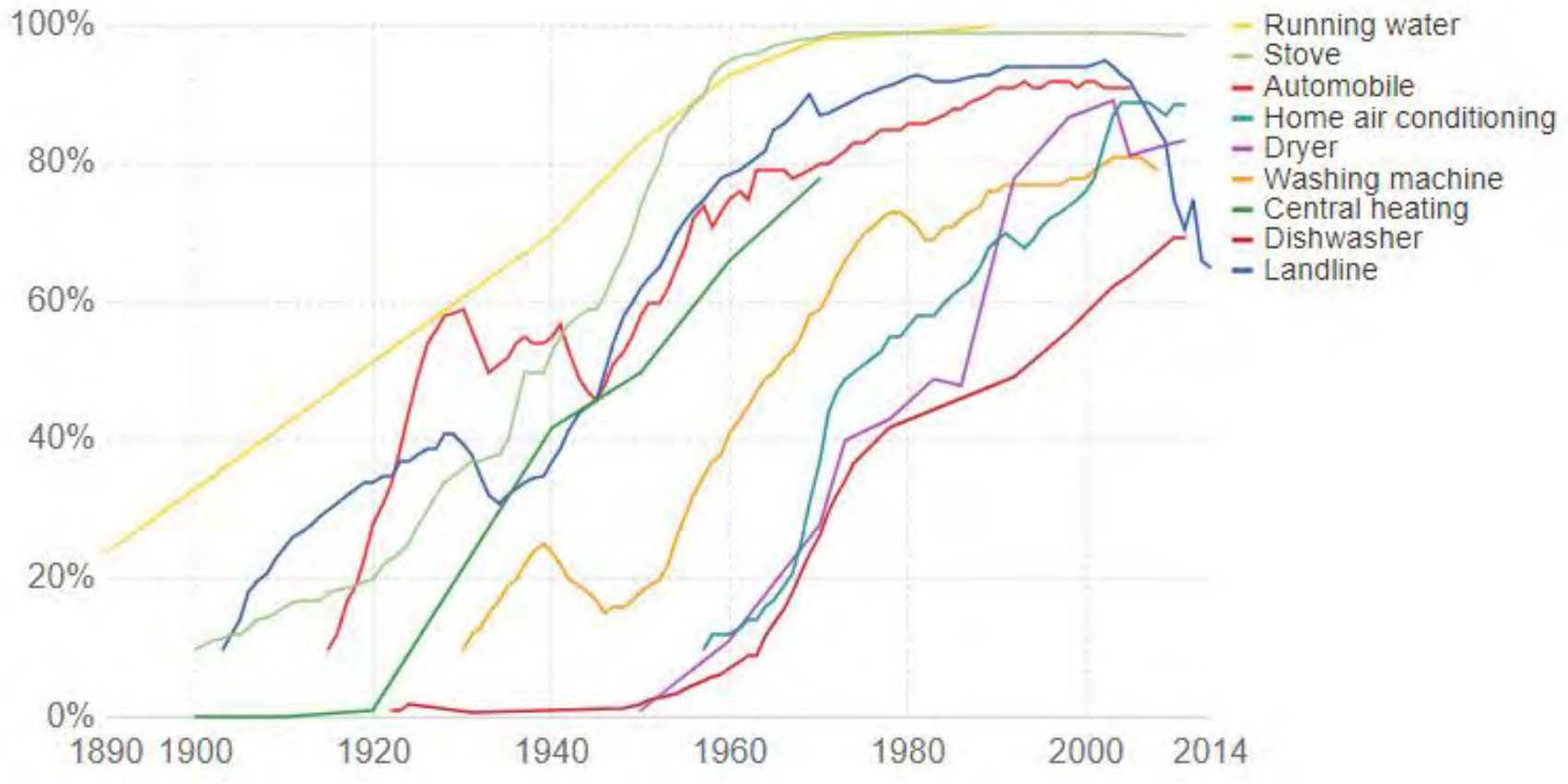
Self Introduction:

From Tsinghua University to ADB Avenue

Old Tech: Rate of Penetration in USA

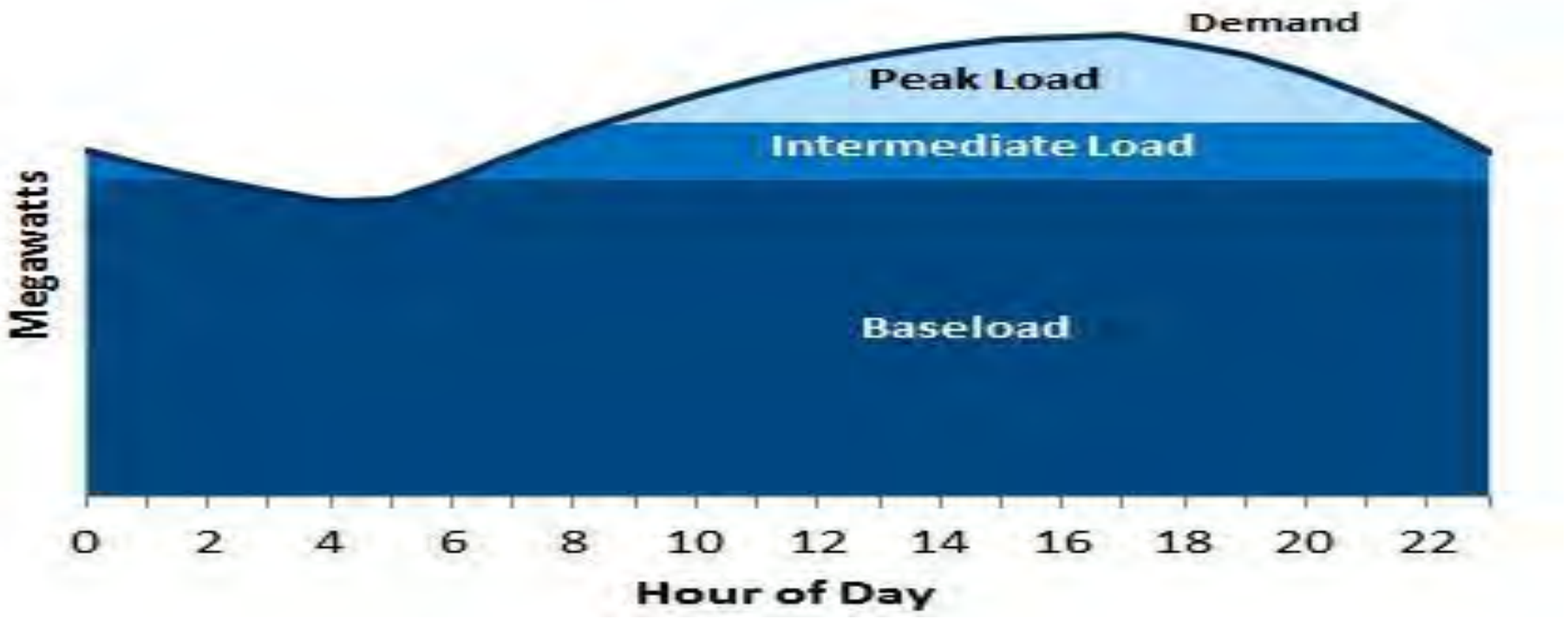


What’s the Old (and current) World Energy Order?

Old Tennessee power tower built in early 1900's

Modern power towers built in 2000s

Baseload Plants vs. Peak Plants



Economies of Scale

BIGGER IS ~~OFTEN~~ CHEAPER!

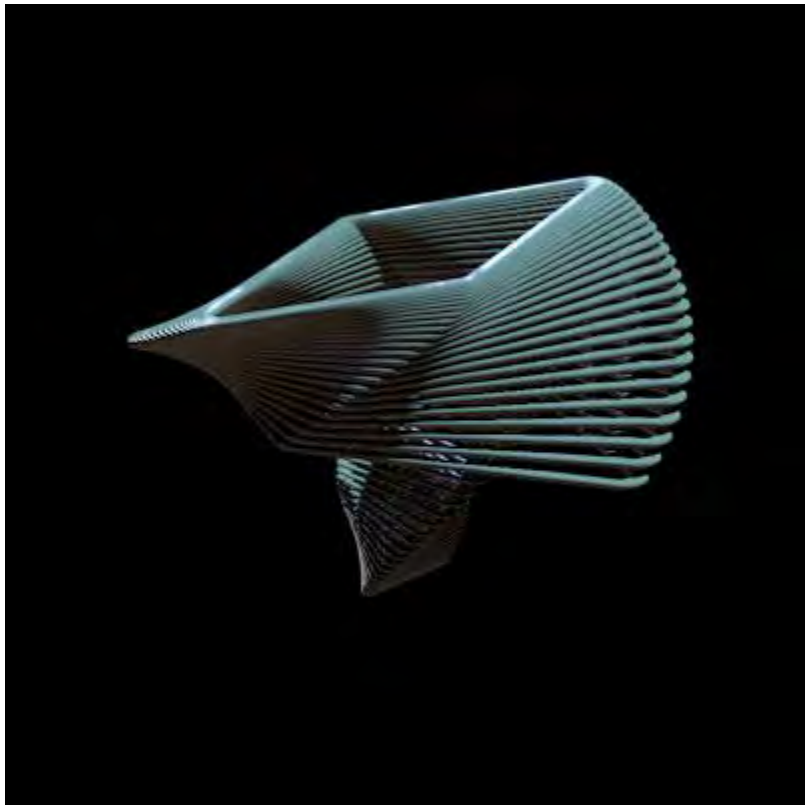
Largest Solar PV Plant in the World

1 GW Ultra Mega Solar Park in Kurnool , Andhra Pradesh , India

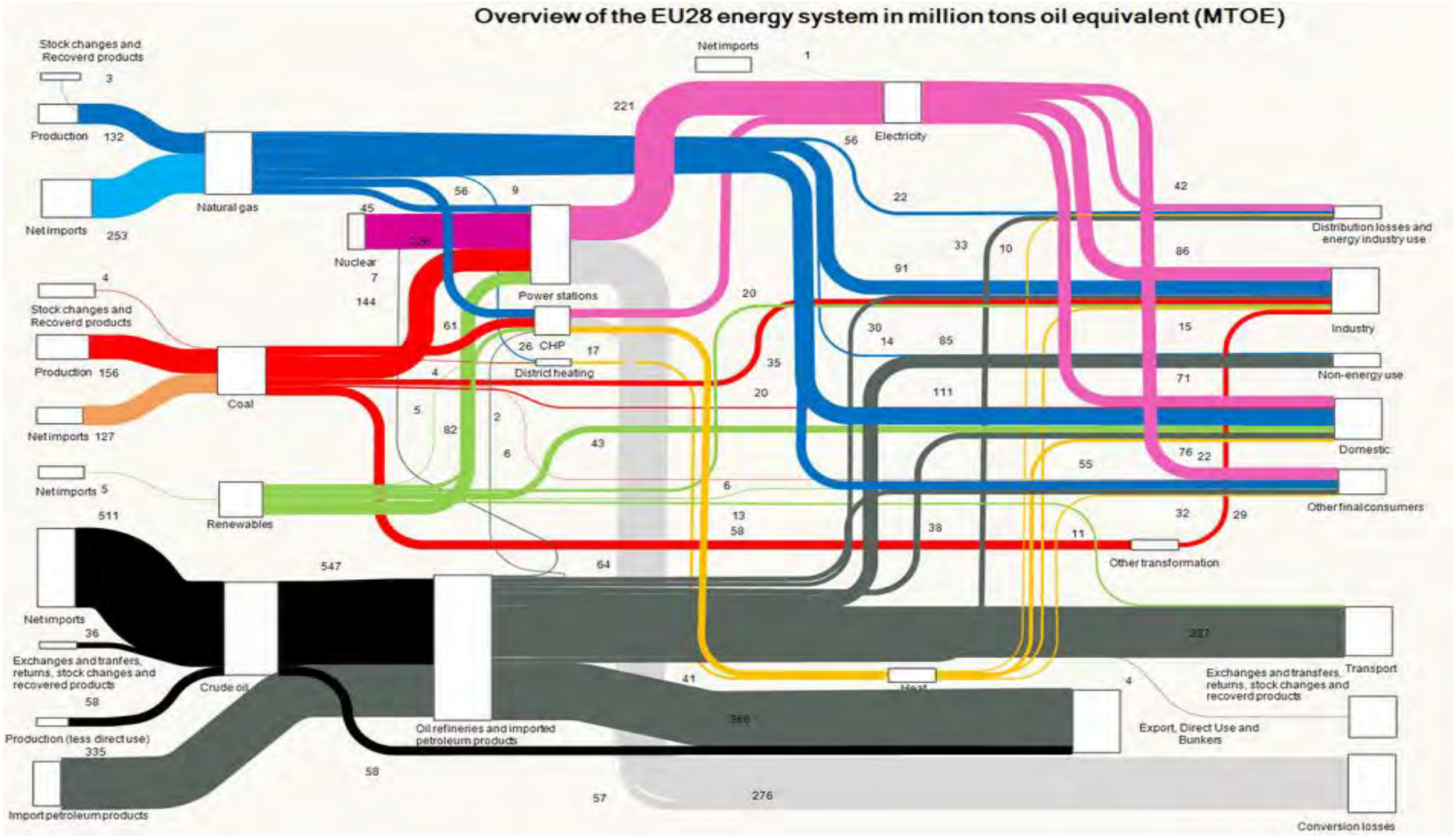
Largest Onshore Wind Farm in the World

1.3 GW Alta Wind Energy Center, Kern County, California, USA

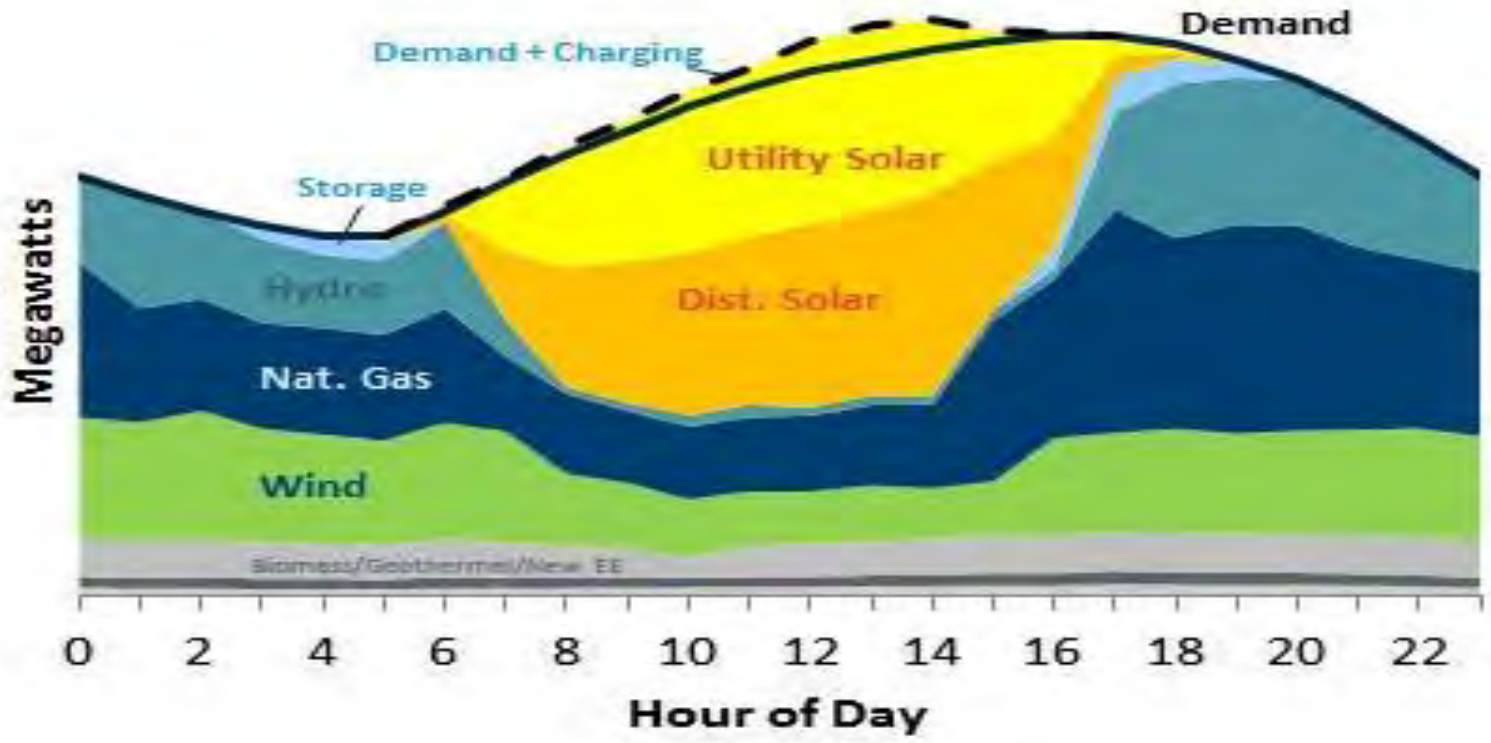
Energy or Not: Towards a New 4 D World?



1St D – Diversification
(Energy Mix, Technology Mix)

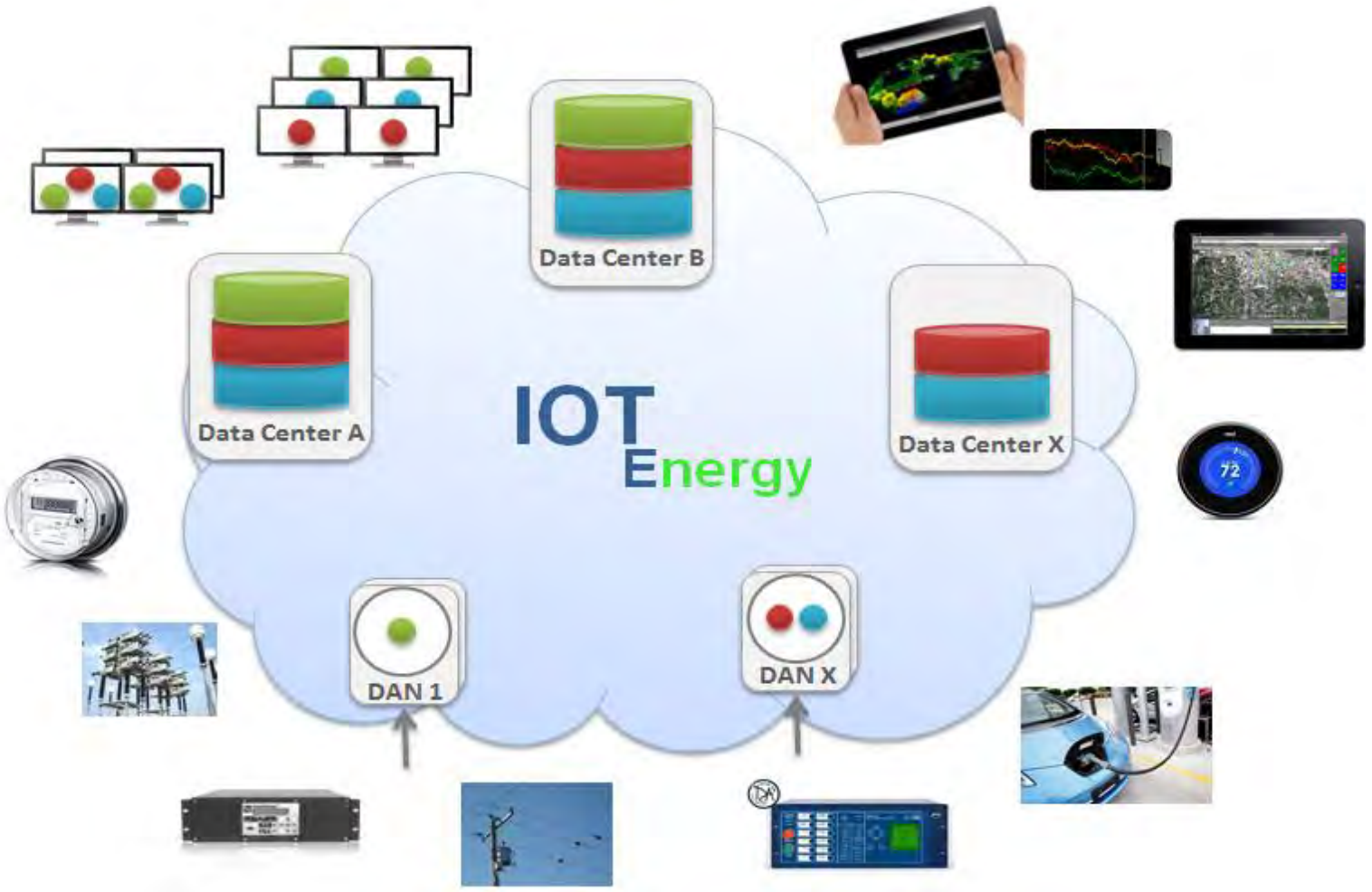


2nd D – Decarbonization

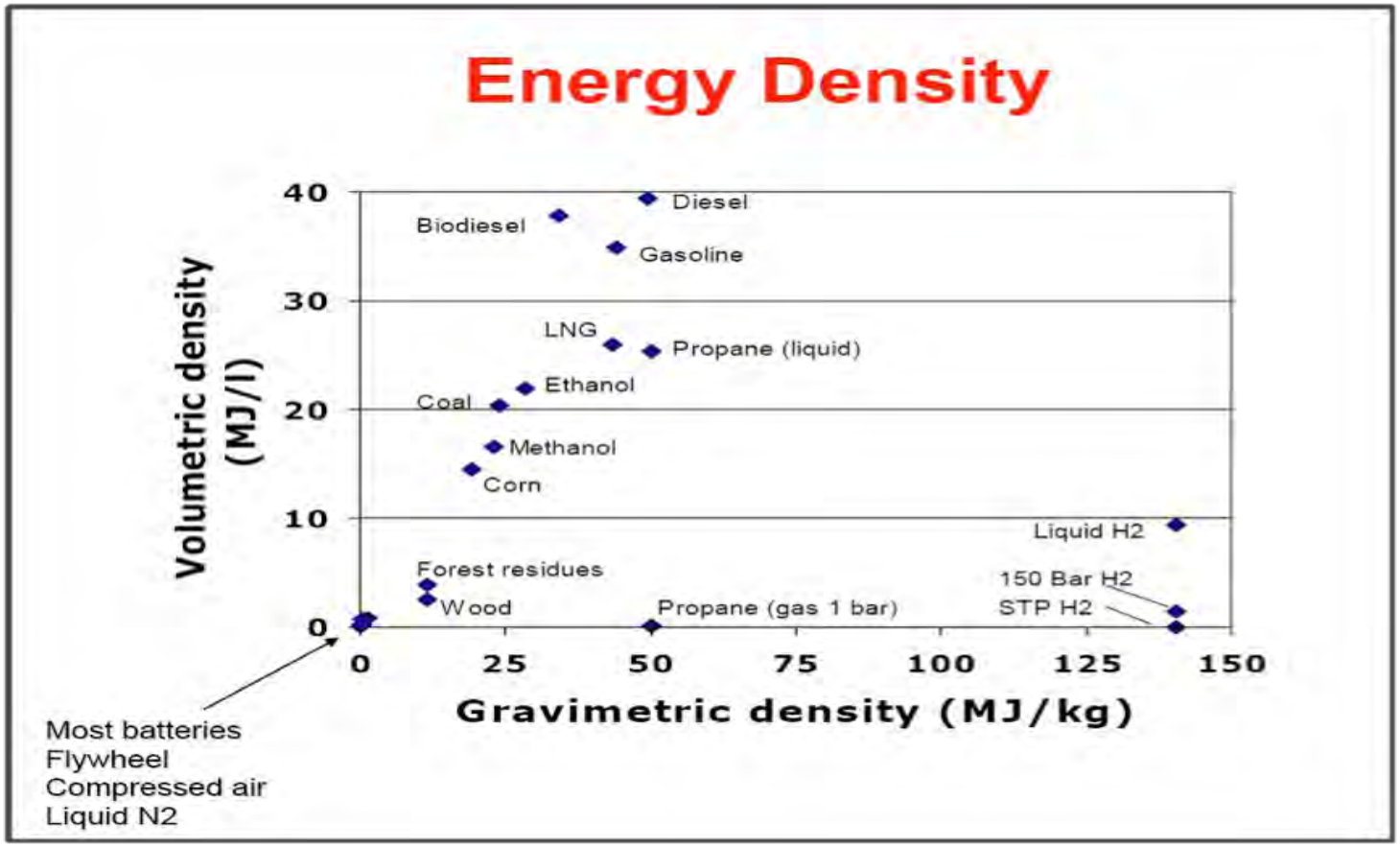


3rd D – Decentralization (distributed systems)

4th D – Digitalization
(Internet of Things)

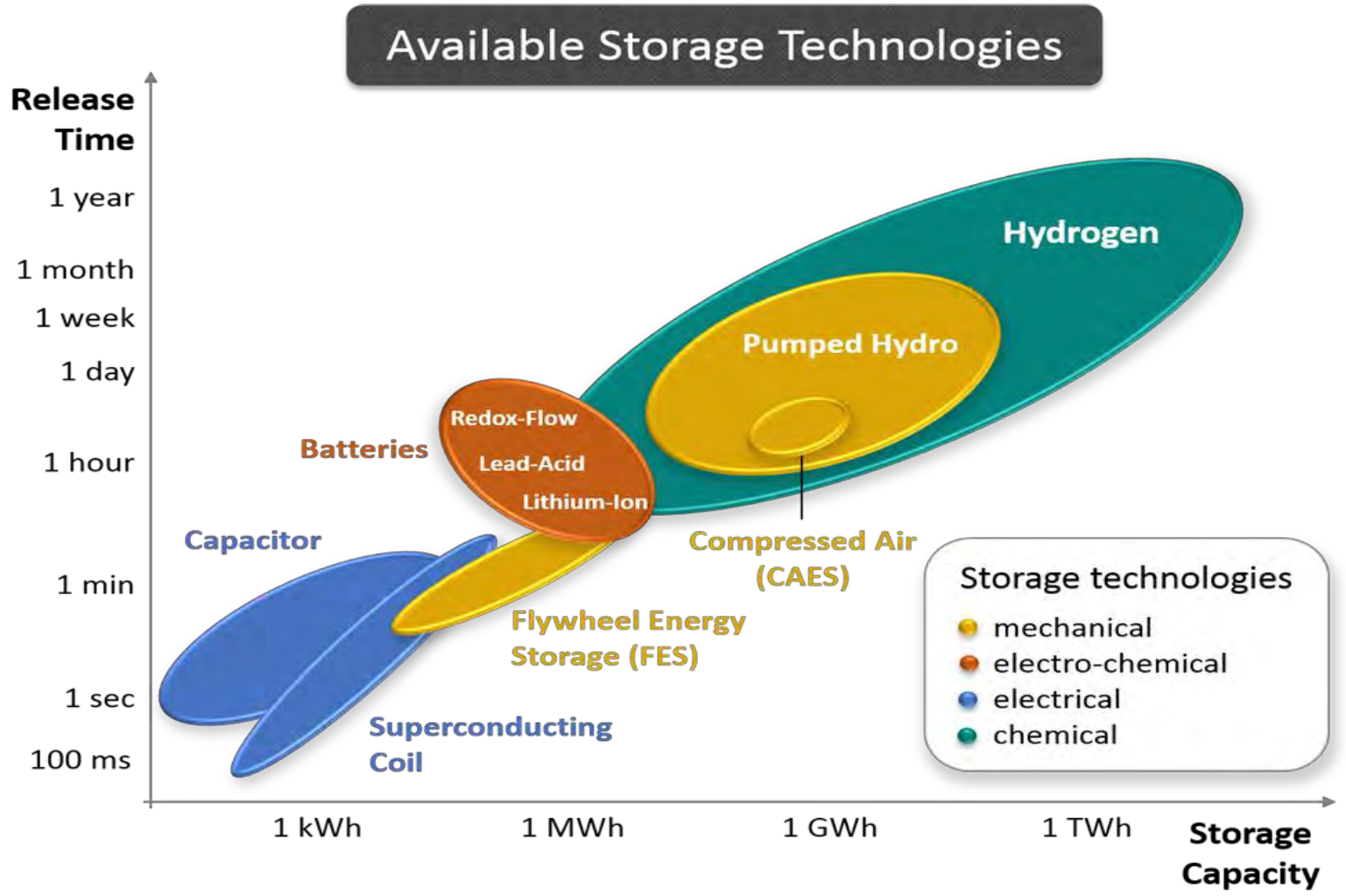


The Problem is an another D - Density

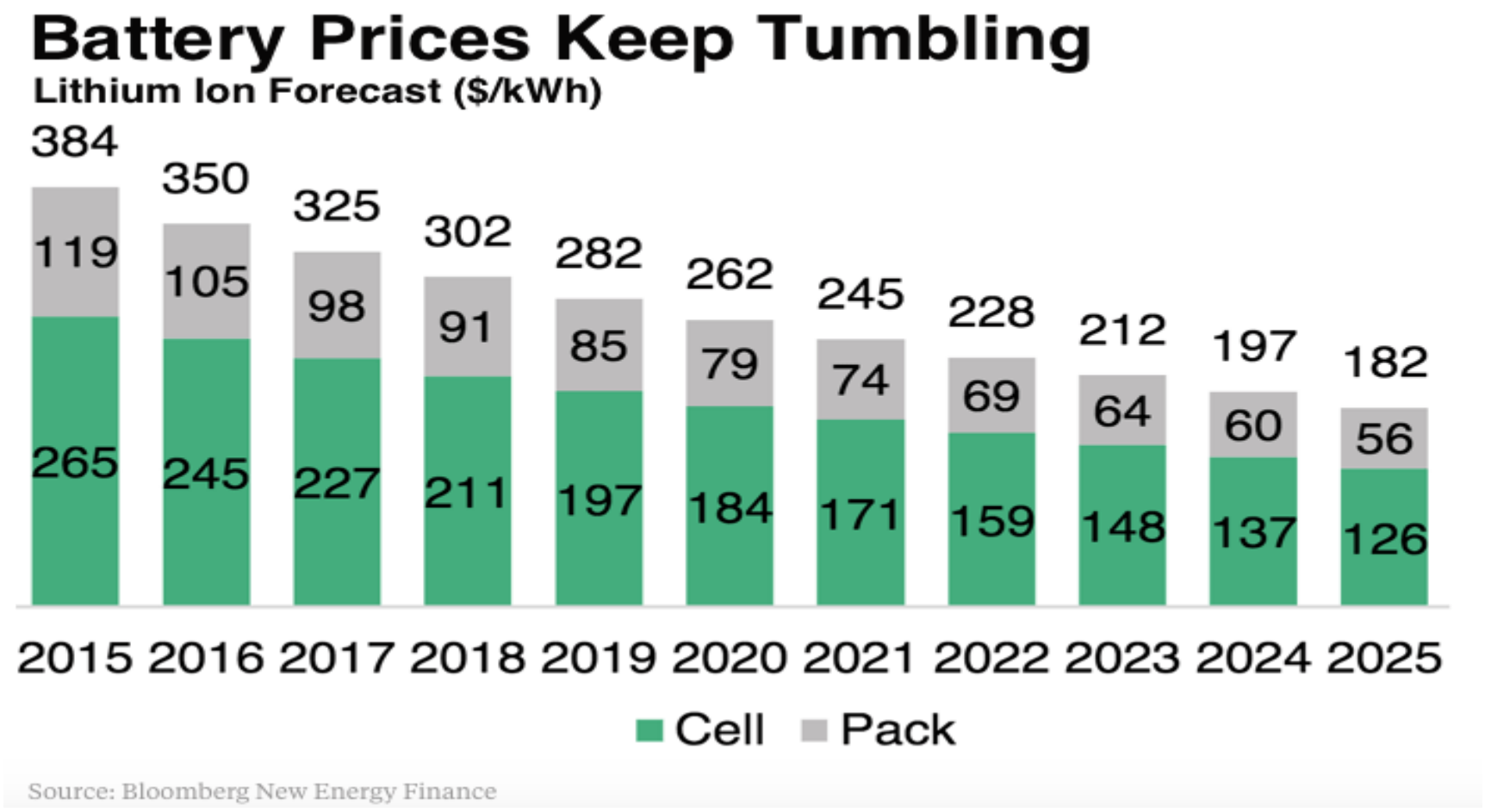


Li-ion Battery =0.5KWh/kg; Coal = 8 KWh/kg; Diesel = 13 KWh/kg

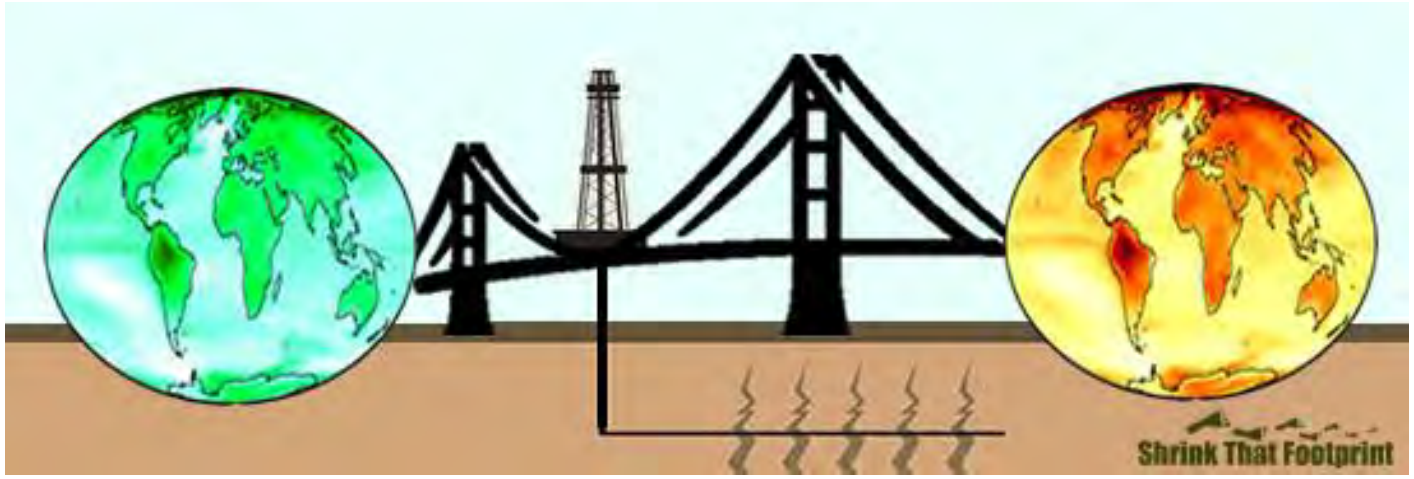
For 4Ds+D to work, Need 1S – STORAGE!



There is HOPE: Storage cost is declining



And we have natural gas – A Transition Fuel



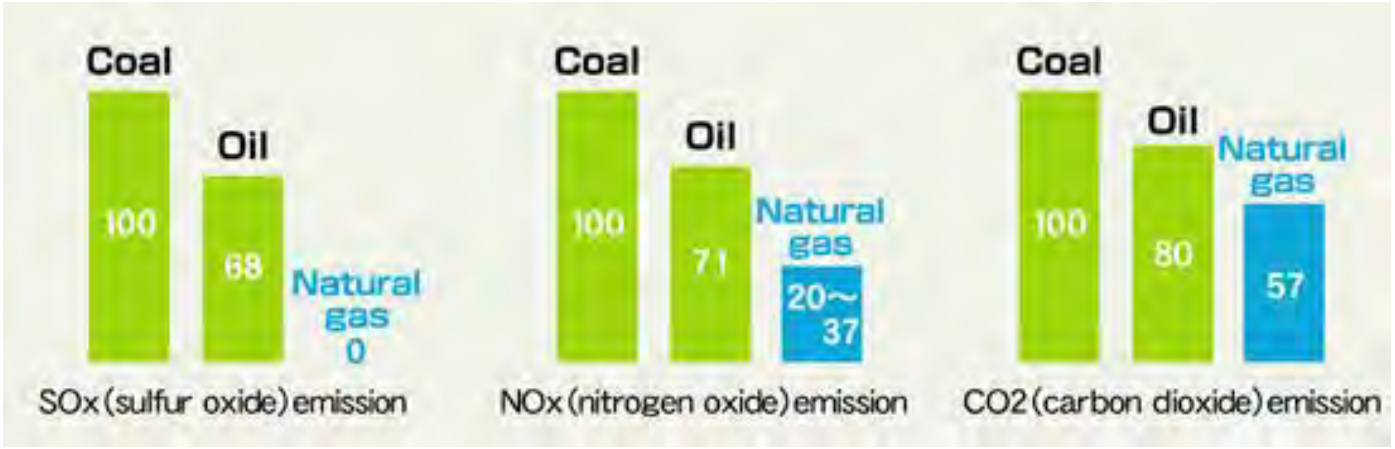
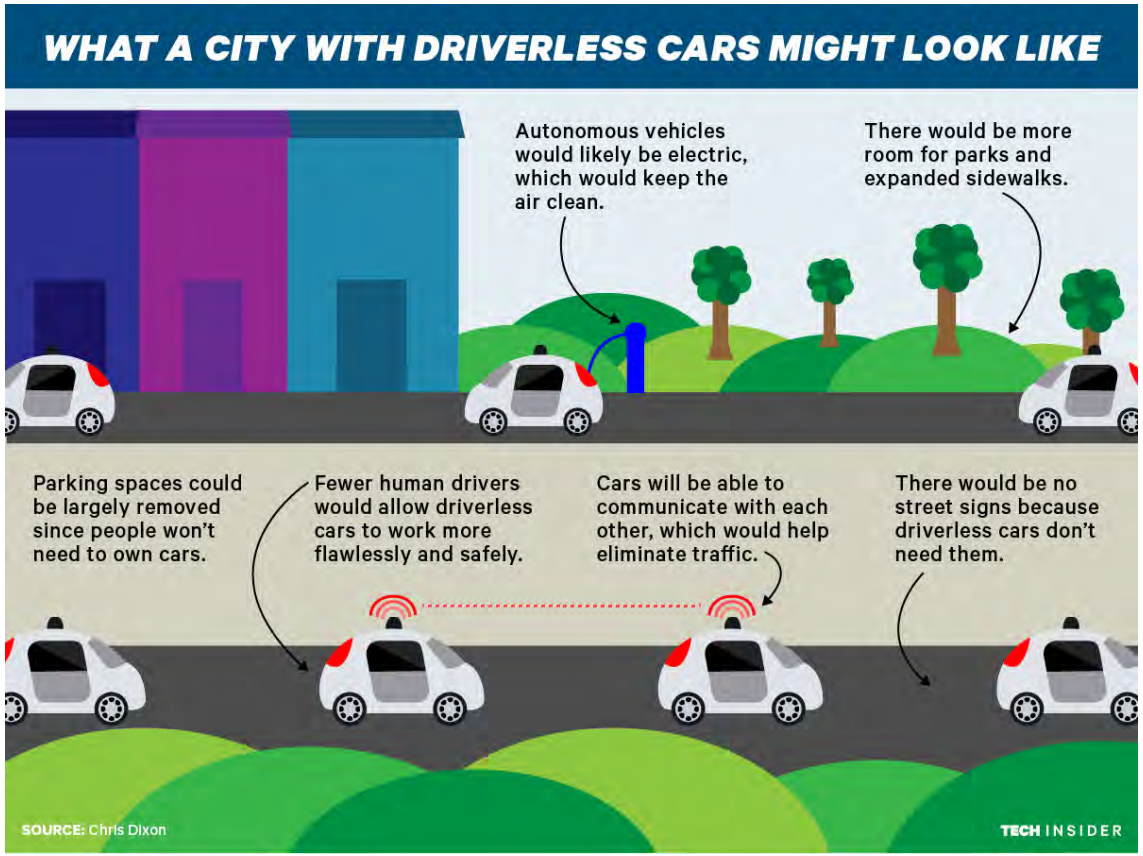


EXHIBIT 1| Expectations Run High for AI's Effect on Business Across Industries

Source: Joint BCG–*MIT Sloan Management Review* survey on the Impact of artificial intelligence on business, 2017.
Note: Average of all respondents per industry, based on a five-point scale.

AI will accelerate 4Ds Process

Case of Self-Driving (Electric) Cars

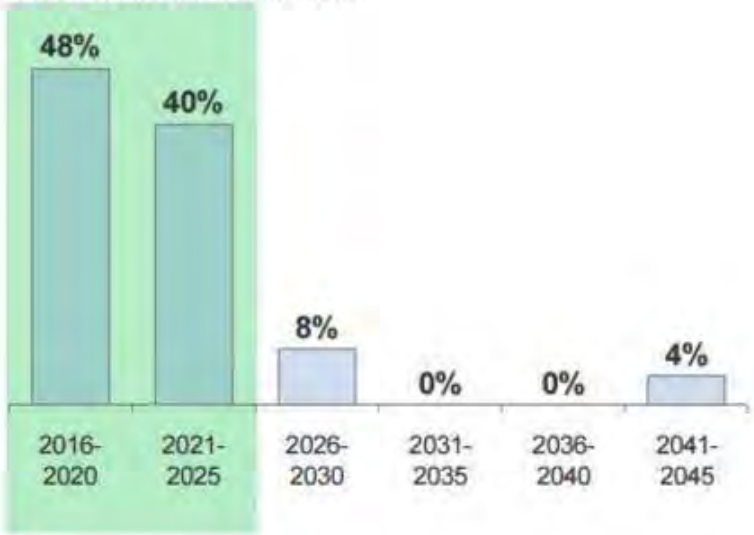


- Vehicles (being electric) will be able to provide portable power for a variety of purposes
- Large scale battery vehicles (such as trucks with huge batteries) may fill the role of power lines
- Roads will be much emptier and smaller as self-driving cars need much less space; and the road can generate power to charge vehicles

7 Cities believe that self-driving vehicles become a reality in the next 10 years

Most cities expect commercialization in next 10 years

In % of total interviewees[1]



" We are **very supportive** of self-driving vehicle testing in our city."

" We **want to test self-driving vehicles in real-life** to see how they could change our city."

And many of them have specific SDV related initiatives under way

Singapore

Extensive multi-year SDV trials announced in October 2015

Gothenburg

DriveME project with 100 self-driving Volvo cars on public roads to start in 2017

Pittsburgh

Uber and Carnegie Mellon University developing and testing SDVs in Pittsburgh

Amsterdam

Promotion of self-driving vehicles development as part of Dutch EU presidency 2016

Milton Keynes

Trials of autonomous pod cars starting in 2016 as part of project UK Autodrive

London

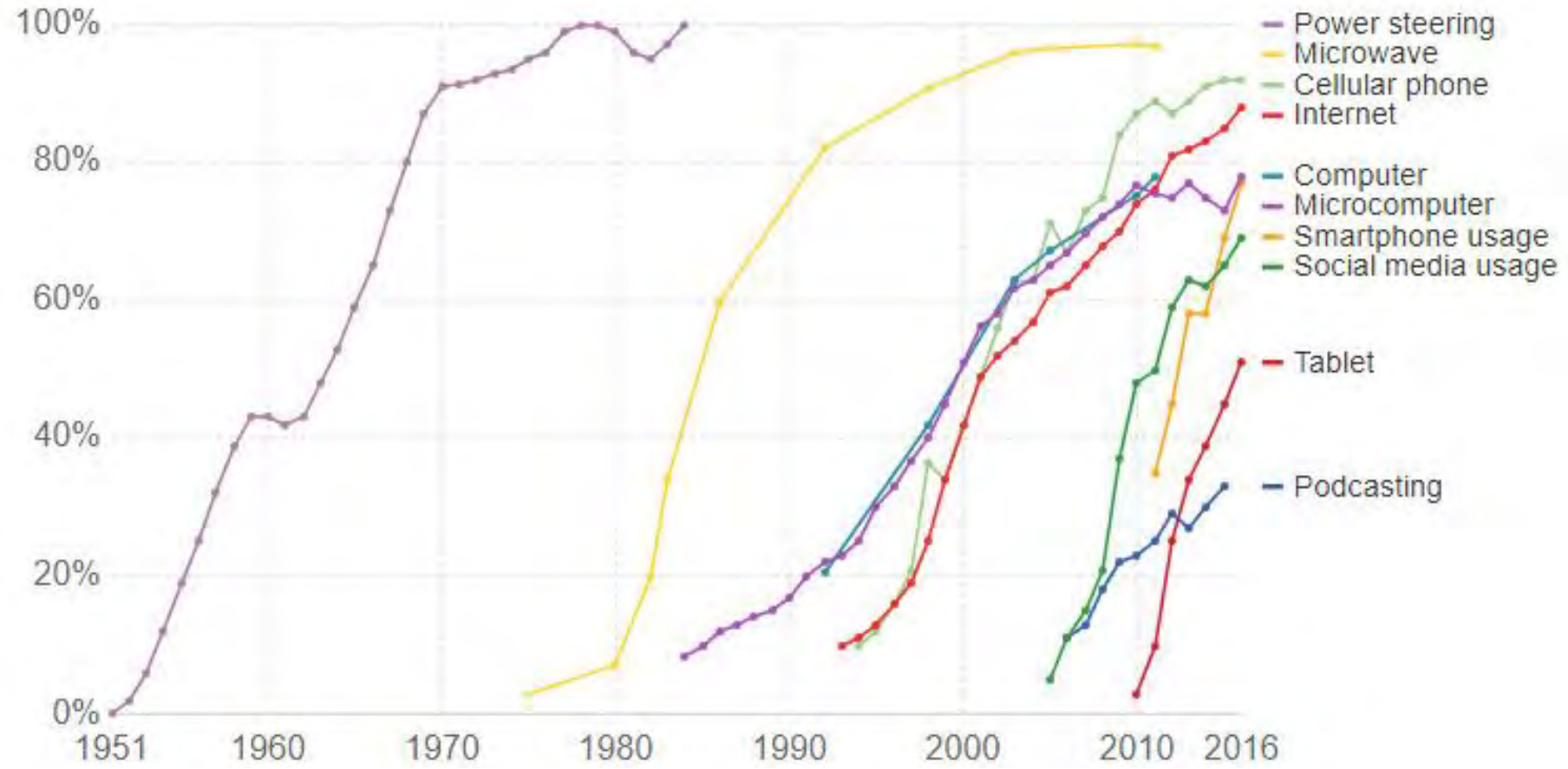
Project GATEway to start trial of pod cars in Greenwich area in 2016

Toronto

Started exploring impact on city; plans to develop two-year roadmap by year end

1. Due to small sample size results are not statistically representative; Note: This survey was prepared with the support of The Boston Consulting Group
Source: World Economic Forum; BCG analysis, city policy maker interviews 2015

New Tech: Accelerated Rate of Penetration in USA



We are here!


EVOLVE
ADAPT
CHANGE
SURVIVE

New Energy Order:
Discussions on Implications to All Stakeholders

- Policy Makers and Planners:

- Diversification is the key - And leapfrog (e.g. “landline”?)

- Investors/Financiers:

- Avoid investing stranded assets

- Energy Utilities:

- Flexibilities to meet flexible generation and flexible demand

- Energy Consumers

- Prosumers & shared economy

For Developing Asia: Challenges and Opportunities

Energy Access

439 million people without access to electricity in Asia - 70% of this population (mostly in remote areas and islands) will depend on innovative technologies (e.g. renewable energy mini/micro grids/energy storage) to access electricity

Climate and Environment

Climate change mitigation and air pollution control requires

- multi sectoral intervention (energy, urban, transport, water, agriculture, etc.)
- energy efficiency improvement at the consumers' demand side (dealing with big number of different clients, instead of one big state owned utility)

So, ADB will support developing countries to change and adapt in terms of:

- New skills/knowledge on advanced technologies
- Innovative approaches/financing instruments
- Methods of work that allows for more cross-sectoral and cross-departmental collaboration

ADB Energy Sector Priorities and Targets

Climate Mitigation

Expand clean energy investment financing to $3 billion by 2020

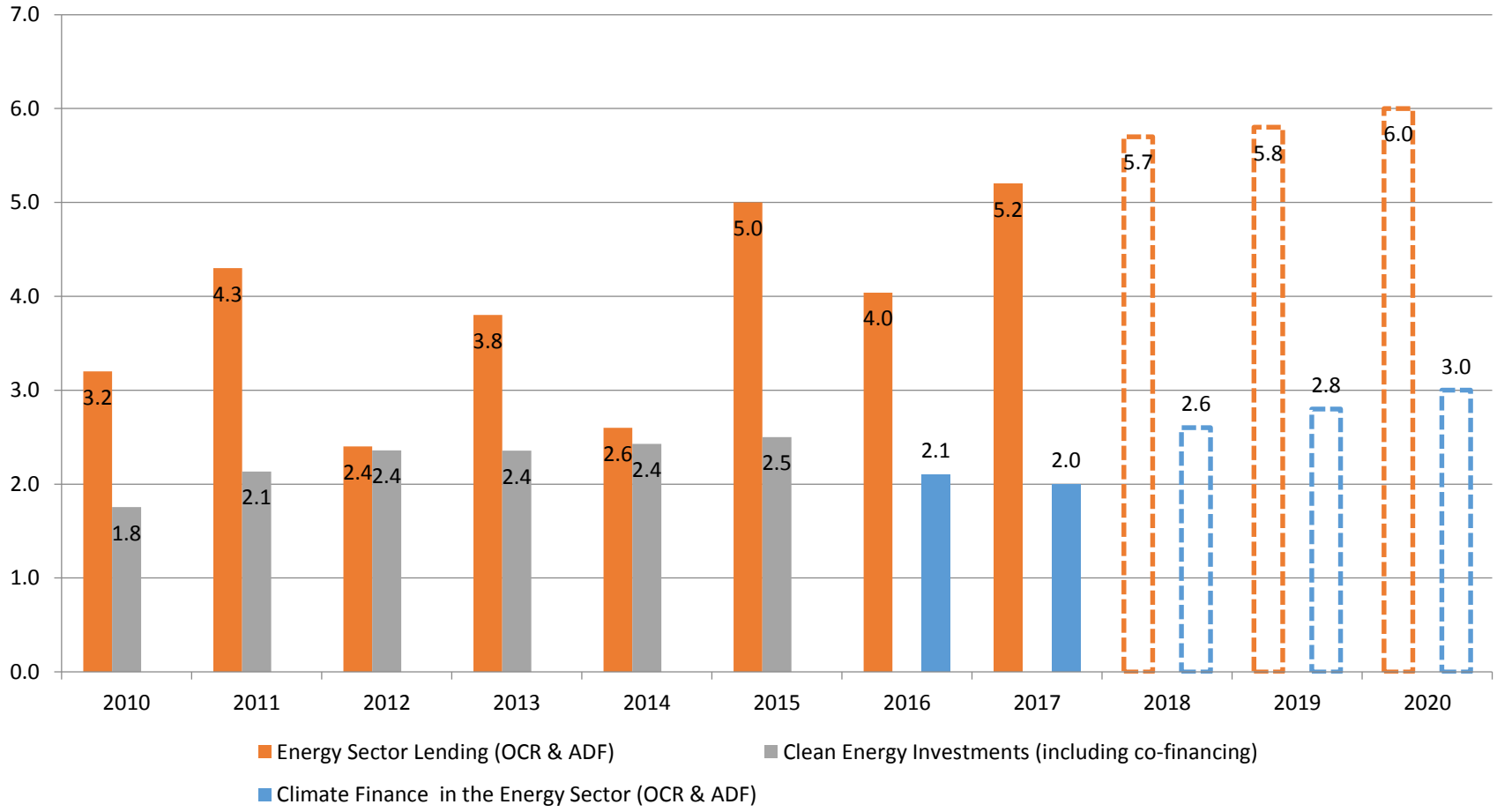
Deployment of new and advanced technologies will help to achieve energy access and climate mitigation finance targets

Energy for All

100% energy electricity access achieved by 2025-2030

ADB Energy Sector Targets

Energy Sector Progress and Way Forward



Selected ADB Supported Innovative Projects

KAZ: Samruk Energy Restructuring and Transformation Project
(Approved in 2017, ADB loan-$120 million)

- **Issue:** Samruk Energy's financial standing which had $700 million FOREX exposure significantly deteriorated by 76% value-loss of Kazakh tenge (KZT) in 2015.
- **Approach:** Demonstrates the One ADB approach where CWRD's sector knowledge and PSOD's financial skills were harnessed to process the project that is ADB's first ever non-sovereign transaction with a state-owned enterprise in KAZ and the first energy sector project for CWRD.
- **Design/Specifications:** ADB's loan supports the company's goal of an initial public offering by 2020 through: (i) balance sheet restructuring to eliminate foreign exchange risk exposure; (ii) improvement of operational efficiency; and, (iii) decarbonization. It is a local currency loan funded by ADB's issuance of local bonds.
- **Energy SG Role:** Provided technical review during project processing in the concept and RRP stages.

PHI: Cobrador Island Solar Hybrid Pilot Project

Funded by TA 7512 (REG) under the Energy for All Program (ADB share - $100,000 for the battery unit)

- **Issues:** Cobrador Island in Romblon Province, the Philippines is home to 1,000 people whose economic opportunities, lifestyle and well-being are curtailed by the limited supply of diesel-fueled electricity available only for 8 hours a day.
- **Approach:** The pilot project demonstrates viability of solar-diesel hybrid power plants with energy storage for remote island systems.
- **Design/Specifications:** The project installed a hybrid system consisting of a 30 kW rooftop solar PV capacity to generate immediate use during the day, and 180 kWh lithium-ion batteries to store excess energy for use at night. This is combined with a 15 kW diesel generator and control system to allow for switching to diesel when solar power runs out. The project was implemented by ADB in collaboration with Korea Energy Agency, the Philippine's National Electrification Administration, Romblon Electric Cooperative. BJ Power, Republic of Korea carried out the design, installation and commissioning of the system.
- **Energy SG Role:** Energy SG initiated the pilot project under its Energy for All Program. Similar pilots were also done in Bangladesh, Myanmar and Nepal.

PRC: Air Quality Improvement in the Greater Beijing-Tianjin- Hebei (BTH) Region – Regional Emission-Reduction and Pollution Control Facility

(Approved in 2017, ADB loan - €428 million or $499 million)

- **Issue:** Deteriorating air quality in the greater Beijing-Tianjing-Hebei (BTH) region.
- **Approach:** Support **advanced emissions reduction technologies** in key emission intensive sectors via **financial intermediation** to mitigate air pollution in the greater BTH region.
- **Design/Specifications:** Deploy advanced low-emission and emission reduction technologies in the greater BTH region (i) by establishing an innovative technology fund, (ii) leveraging sizable amount of co-financing from domestic banks and institutional investors, (iii) implementing by using a market based approach to ensure sustainability, and (iv) achieving co-benefits of climate change mitigation
- **Energy SG Role:** ESG (i)Provided technical inputs, (ii) provided TA resources for project preparation, (iii) participated in the fact finding mission, and (iv) recommended potential subprojects that could be financed by the fund.

REG: Pacific Renewable Energy Facility Control Facility

(Approved in 2017, ADB loan is up to $200 million financing across 11 Pacific member countries (PIC-11))

- **Issue:** The PIC-11, with a combined population of less than 1.5 million, face unique challenges transitioning to a renewable energy (RE) future.
- **Approach:** The Facility will upscale ADB support to RE financing and sector reform as well as streamline project processing through financing a series of individual small-value RE projects in the PIC-11.
- **Design/Specifications:** The facility is designed to support: increased co-financing, innovative financing modalities, systematic support for sector reform, private sector development and capacity building as well as streamlining ADB processing procedures that significantly hastens project processing and reduces transactions costs. The Facility is being supported by (i) $5 million TA for sector reforms and capacity building; and, (ii) $6.2 million for project preparation. Two projects have been approved in 2017 with 3 more in the pipeline for 2018.
- **Energy SG Role:** Provided technical review, facilitated co-financing through the CEFPF and will provide technical support during subproject design.

SRI: Wind Power Generation Project
(Approved in 2017, ADB loan - $200 million)

- **Issues:** There is urgent need to develop other clean energy sources and diversify renewable energy sources (i.e., wind and solar energy) to improve generation mix, energy security and environment to take Sri Lanka out of its dependence on imported fuel that poses a serious threat to the country's energy security and environment.
- **Approach:** Develop clean energy sources: increase supply from nonconventional renewable energy sources from 7% in 2012 to 20.0% by 2020.
- **Design/Specifications:** Introduce a large scale wind power generation facility for the first time in Sri Lanka with the inclusion of advanced technologies for improved environmental performance such as the detection of bird movements to take mitigating action.
- **Energy SG Role:** The project preparatory technical assistance (TA) was funded in the amount of $2,000,000 on a grant basis by the Clean Energy Fund under the Clean Energy Financing Partnership Facility (CEFPF) which is administered by the Energy SG. Energy SG also provided technical review during concept and RRP stages.

INO: Sustainable Energy Access in Eastern Indonesia – Electricity Grid Development Program

(Approved in 2017, ADB results-based loan - $600 million)

- **Issues:** Eastern Indonesia suffers from fragmented island grids and low electrification rates compared with Java and Sumatra.
- **Approach:** The program funds results on distribution network buildout while introducing design and technology suited for small grids to increase efficiency and enable a higher mix of renewable energy into the local grids.
- **Design/Specifications:** System design and quantum of transformers are aimed at reducing technical losses, and introduce advanced metering, smart grid pilot projects, and improvement of waste management practices. Co-financing in the amount of $300 million is expected from KfW that will be confirmed in Q2 2018. Project team provided all due diligence material to support KfW to expedite their management and government approval. Independent verification arrangement will be shared by ADB and KfW (as in the first RBL in Sumatra with World Bank)
- **Energy SG Role:** Chief of Energy SG provided substantial input as peer reviewer to strengthen rationale and linkage to SDGs. Energy SG is requested to provide technical expertise for the implementation of the smart grid pilot projects.

BAN: Reliance Bangladesh LNG and Power Project

(Approved in 2017, ADB non-sovereign operations: $253 million loan and $330 million partial risk guarantee)

- **Issues:** Bangladesh suffers from chronic energy deficit averaging about 22% of unmet demand. Gas reserves, on which 70% of the country's installed capacity is based, are falling.
- **Approach:** Combined private sector loan to a top-tier sponsor, Reliance Power Limited and partial risk guarantees (PRG) to finance the entire LNG-to-power value chain.
- **Design/Specifications:** The project will provide critical LNG supply and power to Bangladesh with the construction of a 718 MW combined-cycle power plant, 500 mmsdfd floating storage and regasification unit; and, associated infrastructure. ADB leads as the structuring bank and mobilizes the PRGs. Co-financing will be coming from private commercial banks and DFIs
- **Energy SG Role:** Provided technical review during interdepartmental circulation.

REG: ASEAN Distributed Power Project

(Approved in 2017, ADB non-sovereign operations: $75 million equity, $20 million from CCFPS; $235 million corporate loan for B. Grimm Power)

- **Issues:** There is lack of investment and technological know-how for the deployment of renewable energy in less-developed DMCs in the ASEAN.
- **Approach:** Combined IPO equity investment, corporate loan and concessional financing: using blended finance to incentivize a leading Thai power producer to expand in ASEAN and invest in renewable energy in poorer countries in the region.
- **Design/Specifications:** Being a key anchor investor in a well-established energy company, ADB is able to extend its reach to multiple energy and renewable power projects, notably towards the company's 114 MW solar projects and 16 MW wind power projects in Thailand. The concessional financing provides the incentive to invest in renewable energy in less developed markets in the ASEAN while the corporate loan will finance B. Grimm's future expansion and development of gas-fired and renewable power projects in the region.
- **Energy SG Role:** Provided technical review during interdepartmental circulation and facilitated the CCFPS loan that contributes to: (i) diversification of the ASEAN region's energy mix; (ii) establish renewable energy solutions in some of ASEAN region's more challenging legal and regulatory contexts; and (iii) demonstrate a track record of successful financing to encourage private sector developers to take on higher risks associated with these types of projects.

Asian Clean Energy Forum 4-8 June 2018
Harnessing Innovation to Power the Future

Innovation focus across all thematic tracks

- Innovation in renewable energy, energy efficiency and energy access

Increase in engagement for ADB Operations

- Clean Energy Day: training and knowledge sharing for ADB Energy Staff
- ADB on the Ground: External sharing of ADB project successes

Energy Leaders Round Table

- Parallel meeting of Energy Leaders Round Table and ***Young –*** Energy Leaders Round Table
- Joint lunch for idea-sharing and “reciprocal mentoring”.

Using IT for best practices in registration, information sharing and data gathering to support ongoing improvement of ACEF


Asia Development Bank Rooftop Project / 571 KW / Manila, Philippine


ADB
PROPMECH
110.7 kWp ADB
Solar Power Plant
Solar Power PV Panels
Fast Facts:
• Plant Capacity: 110.7 kWp
• Panel Qty: 369.0 pcs.
• Brand/Model: Suntech/STP 300-24/Ve
• Rated Power: 300 Watt-peak @ 1000 W/m2 25 deg C
• Technology: Silicon Polycrystalline
• Conversion Efficiency: 15.5 %
• Positive Power Tolerance at +5% (315 Wp)
• Excellent Weak Light Performance
• Extreme Material design to withstand 3800 Pascal or 280 kph wind pressure
• Lowest mis-match losses at 2%
• Performance Warranty of 25 years

Thank you!