AFEEC & FAPECA Conference 2023

15th - 17th November 2023
Marina Bay Sands, Singapore - Halls B & C

Hosted by

SINGAPORE ELECTRICAL CONTRACTORS & LICENSED ELECTRICAL WORKERS ASSOCIATION

In conjunction with

ABS Architecture & Building Services 2023
Designing a Safe and Resilient Built Environment

Green Technologies for the Built Environment

Sustainability, Maintainability, Alternative and Renewable Technologies

Contents

WELCOME Message

SINGAPORE ELECTRICAL CONTRACTORS & LICENSED ELECTRICAL WORKERS ASSOCIATION

MR. JOHN TAN CHYE TONG

President
Singapore Electrical Contractors & Licence Electrical Workers Association (SECA)

Dear Delegates from AFEEC & FAPECA Members.

SECA is honour to hold the AFEEC & FAPECA Conference 2023 on 15th to 17th Nov 2023 in Singapore, Marina Bay Sands Expo & Convention Centre.

We will like to extend our warmest welcome to all participants and delegates, this international conference which is held yearly in the past, due to the pandemic, we have waited for almost 4 years since our last conference held at Gwangju, South Korea.

This year our conference title is “Green technologies For Build Environment” which allow us to share various updates on the green technologies across the region that will benefit our delegates and bring back knowledge to contribute to our society and make a better world for you and me.

I will like to express my appreciation to all delegates for spending your time to travel to Singapore to support this conference, and I wish everyone an enjoyable journey in Singapore.

Congratulatory Message

EMIL YU
President
The Federation of Asian and Pacific Electrical Contractors Association

I would like to extend my sincere congratulations to Singapore Electrical Contractors & Licensed Electrical Workers Association (SECA) on its 47th Anniversary on behalf of the Federation of Asian and Pacific Electrical Contractors Association (FAPECA).

SECA has consistently demonstrated its commitment to excellence and professionalism in the electrical industry, and this milestone is a testament to its dedication. We applaud SECA for its continuous efforts in promoting safety standards and fostering collaboration among electrical contractors and workers in Singapore.

Additionally, I would like to thank SECA for organizing the AFEEC-FAPECA Conference in 2023. The major theme “Green Technologies in Built Environment” helps achieve carbon neutrality in the future, as industry professionals will have a great opportunity to share expertise and perspectives about sustainable practices at the conference. By discussing the role of green technologies in the built environment, SECA has shown that it is dedicated to making Singapore and other regions of the world more sustainable and ecologically friendly.

My best wishes go out to President Mr. John Tan and his team. May SECA continue to thrive and achieve even greater success in the years ahead.

With my best regards,

EMIL YU | *President, The Federation of Asian and Pacific Electrical Contractors Association*

Congratulatory Message

Asean Federation of Electrical Engineering Contractors (AFEEC)
Accredited ASEAN Entity on Economic Community

ARTHUR N. ESCALANTE
President
AFEEC

I welcome the distinguished delegates from the member country organizations of AFFEC and FAPECA to this conference hosted by Singapore Electrical Contractors Association.

The COVID 19 pandemic made impossible for all of us to gather and enjoy the most sought camaraderie every year since 2020.

Let us rekindle the spirit of camaraderie, enjoy the toast, country sharing on how we managed the years we feared the seemingly insurmountable Covid 19.

By the look on how SECA meticulously addressed all concerns on hosting an AFEEC-FAPEC conference and the respective countries enthusiastically answered all calls, no doubt we are looking into a very successful and rewarding conference.

Kudos to SECA!

Let's enjoy another worth reminiscing conference!

ARTHUR N. ESCALANTE | *President,AFEEC*

Congratulatory Message

PUJI MUHARDI
President
AKLI, Indonesia

We AKLI -INDONESIA would like to welcome and greetings to all, members, very happy to join the AFEEC FAPECA Conference this year, held in Singapore with the theme “Green Technologies for Build Environment”. It is mutual effort to protect our planet and create a sustainable environment.

Today, we will talk about green technologies, also known as eco-friendly technologies, as we strive to build a healthier environment and sustainable communities where people and nature can co-exist in harmony.

Green technology is an innovation developed to integrate the principles of sustainability and environmental friendliness into various aspects of our lives, including energy, transportation, construction, and more in the hope that green technology can provide opportunities to reduce negative impacts on humans and the environment, reducing energy dependence on environmentally damaging fossil fuels.

To achieve this vision, there needs to be collaboration from various parties, including governments, businesses, communities, and individuals.

We hope that the AFEEC FAPECA Conference will bring inspiration and deeper understanding to create green technologies by building our awareness as individuals and communities of the importance of protecting the environment and playing a key role in building a sustainable environment.

In this opportunity, let us together commit, contribute and work together, to create a better future for next generations and more sustainable future , better quality of life for our children and grandchildren.

PUJI MUHARDI | *President*

Congratulatory Message

KM CHOI
President
Hong Kong Electrical Contractors' Association (HKECA)

Dear Singapore Electrical Contractors & Licensed Electrical Workers Association (SECA)

On behalf of Hong Kong Electrical Contractors' Association {HKECA}, I would like to extend my heartfelt congratulations to SECA on its 47th Anniversary. This significant milestone is a testament to SECA's unwavering commitment, dedication, and contributions to the electrical contracting industry.

Over the past 47 years, SECA has played a pivotal role in promoting excellence, professionalism, and safety within the electrical sector. Your association has been instrumental in fostering collaboration, knowledge sharing, and best practices among electrical contractors and licensed workers in Singapore.

SECA's commitment to upholding high standards, providing training opportunities, and advocating for the welfare and rights of electrical workers is truly commendable. Your efforts have not only benefited the industry but have also contributed to the development and progress of Singapore as a whole.

As a member of FAPECA, SECA has demonstrated leadership and actively participated in regional initiatives aimed at advancing the electrical contracting profession. Your association's involvement and engagement have enriched the collective knowledge and expertise of our federation, fostering a spirit of cooperation among electrical contractors across Asia and the Pacific.

On this joyous occasion, I would like to express my appreciation for SECA's valuable contributions and congratulate you on your outstanding achievements. The 47th Anniversary of SECA is a testament to the strength, resilience, and vision of your association's leadership, members, and stakeholders.

May this anniversary celebration be a time of reflection, celebration, and renewed commitment to the goals and aspirations of SECA. I have no doubt that under your continued guidance and the collective efforts of SECA's members, the association will continue to thrive, innovate, and make significant strides in the years to come.

Please accept my best wishes to President Mr. John Tan and his Team for continued success, prosperity, and fruitful collaborations within the electrical contracting industry.

Sincerely

KM Choi | *President, Hong Kong Electrical Contractors' Association {HKECA}*

Congratulatory Message

한국전기공사협회
KOREA ELECTRICAL CONTRACTORS ASSOCIATION

MR JANG HYUNWOO
President
KECA, Korea

We would like to express sincere gratitude to SECA for hosting the FAPECA Conference and the Board of Directors, which have not been held for three years from 2020 to 2022. We are very pleased to be able to deliver a congratulatory message for this conference. This time, the host chose a very interesting conference themem which is “Green Technologies in Built Environment.”

In the last century, technology in all fields, not just electricity, has been emerging at an innovative and rapid pace. As a result, ecosystem disruption is increasing quickly.

Environment and energy are one of the important areas of human life that cannot be thought of separately. No matter how convenient technologies are developed, if the environment is destroyed, they cannot lead a happy life and furthermore, human survival can be threatened.

Through this conference and board meeting, we hope to have a meaningful time to learn about the Green New Deal and ESG management policies of each country.
We hope that the SECA’s 2023 FAPECA and AFEEC conferences to be held successfully, and we sincerely wish the FAPECA association executives’ and all its members’ continued success.

2020년부터 2022년까지 3년동안 개최되지 못했던 파페카 컨퍼런스 및 이사회 개최를 진행하신 싱가폴 전기공사협회 여러분들께 진심으로 감사의 말씀 드립니다.
저희는 본 컨퍼런스를 위해 축하 메시지를 전달할 수 있어 기쁘게 생각하고 있습니다.
이번 개최국은 “Green Technologies in Built Environment”라는 매우 흥미 있는 컨퍼런스 주제를 선택하였습니다.
지난 세기 동안 전기뿐만 아니라, 모든 분야의 기술은 혁신적이고 빠른 속도로 떠오르고 있습니다. 그리고 이에 따른 생태계 혼란도 가중되고 있습니다.
환경 에너지는 인류의 삶에 있어 따로 생각할 수 없는 중요한 분야 중 하나입니다. 아무리 편리한 기술들이 개발되어도 환경이 파괴된다면 행복한 삶을 영위할 수 없고 더 나아가 인류의 생존도 위
협받을 수 있습니다.
이번 컨퍼런스 및 이사회를 통해, 각국의 그린 뉴딜 및 기업의 ESG 경영정책을 배우는 뜻깊은 시간을 가졌으면 좋겠습니다.
SECA의 2023년 FAPECA 및 AFEEC 컨퍼런스의 성공적인 개최를 바라며, 앞으로도 항상 열심히 노력하는 파페카 연합회 임직원분들과 모든 회원들의 계속적인 성공을 진심으로 기원합니다.

Congratulatory Message

ARIEL P. DURAN
President
SPECS, Phillipines

My most cordial greetings to the Officers and Members of the Asean Federation of Electrical Engineering Contractors (AFEEC) and the Federation of Asian and Pacific Electrical Contractors Associations (FAPECA) on this momentous affair, the AFEEC-FAPECA Conference 2023 in partnership with ABS — Architecture and Building Services Expo.

The choice of our theme, "Green Technologies for Built Environment" appropriately match with our coping with the challenge of change, becoming a shared concern among us, for a better if not the best and safer if not the safest. Certainly, SPECS and the rest of the AFEEC-FAPECA members, as well as our local and international industry partners, continue to work towards a concerted effort to address the need to counter the adverse effects of climate change and engineering a sustainable future, to continuously develop and apply innovative technologies and methods to contribute in the realization of a more dynamic environment for global progress.

More than ever, it is a distinct pleasure to be among friends at this conference, after a stand-still due to the pandemic; once again, to foster a closer relationship and create business opportunities in the region. My fellow delegates of the Society of Philippine Electrical Contractors and Suppliers (SPECS) look forward to a meaningful dialogue during the 3 -days auspicious gathering with our fellow AFEEC and FAPECA delegates.

We are partners in supporting the development and advancing the green technology; and in the process, contributing to our respective country's progress. Together, let us work for a more responsive construction sector.

On behalf of SPECS, I extend a warm hand to congratulate SECA (Singapore Electrical Contractors and Licensed Electrical Workers Association), the organizers and working committees on its 47th anniversary and hosting the AFEEC-FAPECA Conference 2023 slated on November 14 17, 2023 at the Marina Bay Sands.

More power to us all, best wishes and Mabuhay!

ARIEL P DURAN | *President, SPECS*

Congratulatory Message

Mr. CHANG, LI-TSAI
President
Taiwan Electrical Contractors Association, R.O.C

Dear President & Members of FAPECA & AFEEC:

I would like to express my greatly appreciate for SECA to host 2023 FAPECA & AFEEC Conference from 15th to 17th November 2023 at Marina Bay Sands SINGAPORE.

The theme of this year Conference is “Green Technologies for Built Environment”, the presentation of papers will to promote exchange and understanding among FAPECA & AFEEC members.

I hope 2023 FAPECA & AFEEC will be a successful & fruitful Conference, exchange knowledge and experiences, foster the friendship with each other. I would like to offer my best wishes to all of you and prosperous development of SECA 40th Anniversary.

Thank you!

Sincerely yours,

Mr. CHANG, LI-TSAI | *President of TECA*

Congratulatory Message

IR. CHANG YEW CHEONG

President
The Electrical And Elecronics Association
Of Malaysia (TEEAM)

On behalf of The Electrical and Electronics Association of Malaysia (TEEAM), I congratulate the great host, the Singapore Electrical Contractors & Licensed Electrical Workers (SECA) for the success of this year's AFEEC & FAPECA Conference and Meeting 2023. The venue at the world-renowned Marina Bay Sands will be spectacular and we are very excited to be there from 15th to 17th November 2023.

Meanwhile, it is my great honour to write a supporting message for the Conference E-Booklet themed "Green Technologies in the Built Environment". With all the bustling environmental issues going on right now, construction industries are taking the necessary steps to lessen their impact on the environment by using Green Technologies in their buildings. In this upcoming Conference, we hope to learn more from the esteemed Speakers regarding the key areas where Green Technology is making an impact.

The ASEAN Federation of Electrical Engineering Contractors (AFEEC) is comprised of five ASEAN Electrical Industry Associations from Indonesia, Philippines, Malaysia, Singapore and Thailand. As a Non-Governmental Organisation (NGO) recognised and affiliated to the ASEAN bloc, AFEEC looks forward to the standardisation of electrical engineering contracting practices in the five ASEAN member countries and to work towards the higher level of professionalism of the electrical engineering contracting industry. On a broader spectrum, AFEEC is also a member of the Federation of Asian and Pacific Electrical Contractors Associations (FAPECA) -- comprised of AFEEC, Korea, Hong Kong, Taiwan, Australia, USA, Mexico, New Zealand and Japan. All the delegates look forward to the forthcoming exchange of ideas, market/industry updates and opportunities to explore win-win business partnerships.

At this juncture, TEEAM wishes to congratulate SECA on your 47th Anniversary Celebrations, which will be held on 17th November 2023 and we enthusiastically look forward to joining SECA on this very special occasion!

Last but not least, TEEAM wishes all delegates a successful and rewarding event in Singapore. Our best wishes to the continuous success of SECA members in all your future endeavours.

Thank you.

Ir. Chang Yew Cheong | *President, The Electrical and Electronics Association of Malaysia (TEEAM)*

Congratulatory Message

BOONSAK KIATJAROONLERT

President
TEMCA, Thailand

On behalf of TEMCA, it gives me a great pleasure to convey my congratulations to SECA on the occasion of the 47th Anniversary in 2023. I also would like to thank all those of SECA who have strenuously made contributions and support for organizing AFEEC-FAPECA Meeting & Conference during 15-17 November 2023 and bringing together all AFEEC & FAPECA member countries.

The year of 2023 is the first year we will meet each other after the covid-19 pandemic has passed. It is the precious time to celebrate SECA 47th Anniversary, to learn and to explore for the new opportunity and information with other countries through the conference under the theme “Green Technologies in Built Environment” in conjunction with Architecture and Building Services (ABS) 2023. We will experience the other practices and knowledge in the conference and exhibition. Our network and relationships will be fostered in the golf competition and dinner parties. Thank you SECA to provide a good platform and valuable event.

Again, on this auspicious occasion, I would like to wish board and member of SECA continued success in all current and future endeavors.

Boonsak Kiatjaroonlert | *President, TEMCA*

Welcome To The AFEEC & FAPECA Conference 2023

The AFEEC & FAPECA Conference is held once a year and is rotated among AFEEC & FAPECA member countries. It is indeed an honour for SECA to celebrate our 47th Anniversary and host the AFEEC & FAPECA Conference 2023 Meeting at the same time.

The ASEAN Federation of Electrical Engineering Contractors (AFEEC) comprises five ASEAN electrical industry associations from Indonesia, Philippines, Malaysia, Singapore and Thailand. As a non-government organisation recognised and affiliated to ASEAN, AFEEC looks forward to the standardisation of electrical engineering contracting practices in the five ASEAN member countries and work towards higher levels of professionalism in the electrical engineering contracting industry.

AFEEC is also a member of the Federation of Asian and Pacific Electrical Contractors Associations (FAPECA) which comprises AFEEC, Korea, Hong Kong, Taiwan, Australia, USA, Mexico, Hawaii, New Zealand and Japan. The Conference is expected to have around 200 overseas delegates on top of the ABS Expo Attendees.

SECA warmly welcomes you to the AFEEC & FAPECA Conference 2023!

Tuesday | 14th November 2023

19.00-21.00	Registration at the Lobby of Hosting Hotel Hotel 1 – One Farrer Hotel Hotel 2 – Hotel Royal @ Queens Hotel 3 – Value Hotel Thomson Other Hotels – HKECA (Furama City Centre Hotel) - Own Transport KECA (YMCA Fort Canning) – Own Transport

AFEEC & FAPECA Conference 2023

Wednesday | 15th November 2023

08.00 onwards	Pick-Up of Country Delegates from Official Hotels to Marina Bay Sands –Hotel 1 – One Farrer Hotel, Hotel 2 – Hotel Royal @ Queens, Hotel 3 – Value Hotel Thomson Other Hotels – HKECA (Furama City Centre Hotel) – Own Transport and KECA (YMCA Fort Canning) – Own Transport
08.30-09.00	Registration of Delegates for AFEEC & FAPECA Conference
09.00	Delegates Adjunct to Conference Room
09.30	Arrival of Guest of Honour Senior Minister of State for National Development Mr Tan Kiat How Received by SECA President Mr John Tan, AFEEC President Mr Arthur Escalante, FAPECA President Mr Emil Yu, SECA Secretary General Mr Edward Kway and Mr Edward Liu, Managing Director of CEMS to the Conference Lounge
09.45	Conference Opening by Guest of Honour, SECA, AFEEC, FAPECA Presidents and Mr Edward Liu, Managing Director of CEMS
09.55	Opening Address by SECA, AFEEC and FAPECA Presidents
10.10-10.30	Tour of Exhibition with Guest of Honour
10.30	Departure of Guest of Honour
10.30-10.45	Coffee / Tea Break
10.45	Delegates Return to Conference Venue / Call to Order by Conference MC Mr Somchai Virabhak and Moderated by Mr Benedict Goh
10.50-12.50	AFEEC & FAPECA Conference 2023 “Green Technologies for the Built Environment” – Session 1
10.55	1 – SECA Keynote Presentation 1 by Guest Speaker Mr Davide Pacheco, CEO Asia Pacific at Amarenco Paper Title: Beyond Rooftops Solar - Unlocking the Multifaceted Potential of Solar Energy
11.15	2 – Institute of Technical Education of Singapore Speaker: Mr Chew Yong Hui (Covering Course Manager, Electrical Engineering, School of Engineering) Paper Title: Electrical Engineering Training Pathway
11.25	3 – AKLI Speaker: Dr. Ir. Supriyadi Legino (Advisor), Doctor in Management, Practitioner of Waste to Energy, Lecturer of Management and Renewables Paper Title: Community-Based Waste to Energy as Renewable Distributed Generation (RDG)
11.45	4 – HKECA Speaker: Ir Dr F.C. CHAN, BBS (BSc., MBA, MA, LLM, PhD, DIC, FHKIE) Paper Title: Emerging Technologies for Sustainability

AFEEC & FAPECA Conference 2023

Wednesday | 15th November 2023

12.05	5 – KECA Speaker: Prof. Hong-Chong, Cho, Professor of Department of Economics at Dankook University, South Korea Paper Title: Direction of Reforming the Korean Electricity Market
12.25	Q & A – Moderated by Mr Benedict Goh
12.40-13.40	Lunch for Delegates Venue: Marina Bay Sands
13.40-15.40	AFEEC & FAPECA Conference 2023 "Green Technologies for the Built Environment" – Session 2
13.40	Delegates Return to Conference Venue / Call to Order by Conference MC Mr Somchai Virabhak and Moderated by Mr Benedict Goh
13.45	6 – SECA Keynote Presentation 2 by Guest Speaker from Gardens By The Bay Speaker: Mr Jason Koo Chin Siang, Director, Attractions Operations Paper Title: Gardens by the Bay: A Green Marvel of Sustainability
14.05	7 – SPECS Speaker: Engr. Ariel P. Duran, Professional Electrical Engineer, President of Polyphase.one Construction Inc., President of SPECS (2022 – 2023) Paper Title: Green Building Initiatives in the Philippines
14.25	8 – TECA Speaker: Dr. Chun-Lien, Su - 1. Professor, Department of Electrical Engineering, National Kaohsiung University of Science and Technology. 2. Advisor of Taiwan Electrical Contractors Association Paper Title: Strategies to Strengthen Power Grid in Taiwan
14.45	9 – TEEAM Speaker: Ir. Chow Pui Hee (Ms) Founder and Managing Director of Samaiden Group Berhad (listed on Main Board Bursa Malaysia), Professional Engineer with Practicing Certificate registered with the Board of Engineers, Malaysia, member of TEEAM Paper Title: The Evolution of Solar PV and Battery Energy Storage Systems and Its Innovations: Driving Energy Sustainability
15.05	10 – TEMCA Speaker: Dr. Werachet Khan-ngern, Chief Innovation Officer, Kumwell Corporation PLC Paper Title: Sustainable Smart, Safety and Green Technology for Building and Industry: Environmental, Social and Governance in Practice
15.25	Q & A – Moderated by Mr Benedict Goh
15.40	Presentation of Appreciation Plaques to All Conference Speakers by SECA President Mr John Tan
15.40-17.30	Free & Easy / Continue Tour of Exhibition

Welcome Gala Dinner

Wednesday | 15th November 2023

17.30 onwards	Pick-Up of Foreign Delegates / Spouses / Others for Welcome Dinner. Shuttle Buses Will Be Arranged to Pick Up Delegates / Spouses / Others from Marina Bay Sands and Official Hotels (Hotel 1 – One Farrer Hotel, Hotel 2 – Hotel Royal @ Queens, Hotel 3 – Value Hotel Thomson, Other Hotels – HKECA (Furama City Centre Hotel) – Own Transport and KECA (YMCA Fort Canning) – Own Transport
18.00-22.00	Welcome Gala Dinner Venue: Brand Ballroom, Level 6, One Farrer Hotel 1 Farrer Station Road, Singapore 217562 Dress: National Costume / Formal
18.00-18.45	Registration and Reception – Hotel Ballroom Foyer Reception Desk
18.45	All SECA Delegates and Local Guests to be Seated in Banquet Room
18.50	All Overseas Delegates to Assemble at the Ballroom Foyer for Entrance to the Banquet Room
19.00-19.05	Emcee Sylvia Tham - Announcement of the Arrival of AFEEC & FAPECA Delegates Overseas Delegates Enter Banquet Upon Association Name Being Called (Sequence – ALKI of Indonesia, HKECA of Hong Kong, KECA of South Korea, SPECS of Philippines, TECA of Taiwan, TEEAM of Malaysia and TEMCA of Thailand)
19.05-19.20	Welcome Address by Host, SECA President, Mr John Tan - 5 mins Speech by AFEEC President Mr Arthur Escalante – SPECS - 5 mins Speech by FAPECA President Mr Emil Yu – HKECA - 5 mins
19.20-19.35	Emcee's Introduction of Overseas Delegates, VIP Guests and Sponsors
19.35	Emcee Declares Dinner Commence
19.45-20.00	Welcome Session & Song by Emcee Sylvia Tham
20.00-20.20	Presentation by Guest Speaker: Mr Eric Ng of Malkin & Maxwell LLP on The Making of Security of Payment Act in Singapore
20.20-20.35	Presentation by Ms Johana Tanudjaja , Strategic Partner Development of SIMPRO Software SG Pte Ltd on The Total Business Management Software for Trade Service Businesses
20.35-20.50	Presentation by Ms Karine Polycarpe, Business Development Manager, Electrical and Fastening Solutions, nVent, on nVent ERIFLEX FleXbus Advanced Easy-To-Install Flexible Power Connection Solution from 500A to 6300A. nVent's Demo Booth is located at the Foyer
20.50-21.00	Presentation / Exchange of Souvenirs to All AFEEC & FAPECA Presidents by Mr John Tan, President, SECA
20.55-21.10	Presentation of Souvenirs to All Sponsors by SECA President by Mr John Tan, President, SECA
21.10-21.30	Session & Song by Emcee Sylvia Tham
21.30-21.45	Stage-Toasting Session by all AFEEC & FAPECA Presidents
22.00	End of Dinner Foreign Delegates / Spouses / Others Proceed to Return to Official Hotels via Pre-Arranged Transport. Timing: 22.00 Onwards Route: Hotel 1 – One Farrer Hotel, Hotel 2 – Hotel Royal @ Queens, Hotel 3 – Ibis Singapore on Bencoolen, Hotel 3 – Value Hotel Thomson, Other Hotels – HKECA (Furama City Centre Hotel) – Own Transport and KECA (YMCA Fort Canning) – Own Transport

AFEEC & FAPECA Board Meeting

Thursday | 16th November 2023

08.00 onwards	Pick-up of Country Delegates from Official Hotels to Marina Bay Sands (Hotel 1 – One Farrer Hotel, Hotel 2 – Hotel Royal @ Queens, Hotel 3 – Value Hotel Thomson, HKECA (Furama City Centre Hotel) – own transport and KECA (YMCA Fort Canning) – own transport
Note:	Attended by Member Countries' Key Personnels, Council Members and Secretariats
08.30-10.00	AFEEC Board Meeting Venue: Marina Bay Sands Meeting Room
09.30-09.45	Coffee / Tea Break
09.45-11.30	FAPECA Board Meeting Venue: Marina Bays Sands Meeting Room
11.30-12.15	Transport to Institute of Technical Education College West for Technical Educational Tour for Delegates Attending ABS Exhibition and AFEEC & FAPECA Board Meetings Who Opted for the Technical Visits (Pick-up at Marina Bay Sands)
12.15-13.15	Lunch at Institute of Technical Education College West 1 Choa Chu Kang Grove, Singapore 688236
13.15-15.30	Educational Tour of Institute of Technical Education College West
15.30-16.30	Transport to Gardens By The Bay 18 Marina Gardens Drive Singapore 018953
16.30-17.30	Visit of Photovoltaic Solar Panels on The Supertrees and Central Energy Centre Biomass Plant for the Generation of Electricity from The Plant Waste
13.30-17.30	Free & Easy / Guided Tour Around City for Other Delegates and Guests (Refer to Guided Tour Packages)

SECA 47th Anniversary Golf Tournament

Friday | 17th November 2023

09.30	Tour of ABS 2023 Exhibition, Venue: Marina Bay Sands / Guided Tour Around City for Other Delegates and Guests (Refer to Guided Tour Packages)
10.30 Onwards	29 Golfers get ready at their respective Hotel Lobbies (Hotel 1 – One Farrer Hotel, Hotel 2 – Hotel Royal @ Queens, Hotel 3 – Ibis Singapore on Bencoolen, Hotel 4 – Value Hotel Thomson, Hotel 5 – Furama City Centre Hotel)
11.00-11.30	Shuttle Bus Pick-Up from Hotel to Golf Course at Orchid Country Club
11.30-12.45	Golf Registration and Lunch for Golfers at Orchid Country Club
12.45	Group Photos for Golfers
13.00	Networking Golf Shot-Gun Commences
Afternoon	Free & Easy for Other Delegates / Guests

Farewell Dinner

Friday | 17th November 2023

18.00-19.00	Bus Pick-Up for Golfers from OCC / Delegates and Guests from Official Hotels to Dinner Venue
19.00-22.30	Farewell Dinner (Transportation Provided from Official Hotels / Orchid Country Club) Venue: Eternal Garden Restaurant Level 3 The Grassroots' Club 190 Ang Mo Kio Ave 8 #03-01, Singapore 568046 Tel: 6970 0002 Dress Code: SECA T-Shirt
22.30	End of Dinner Foreign Delegates / Spouses / Others Proceed to Return to Official Hotels via Pre-Arranged Transport. Timing: 22.30 Onwards (Route TBC)

Saturday | 18th November 2023

Departure of Delegates and Spouses (Bon Voyage!)

SPEAKERS' PROFILES

Mr Davide Pacheco

CEO Asia Pacific at Amarenco

Paper Title: Beyond Rooftops Solar - Unlocking the Multifaceted Potential of Solar Energy

Davide is CEO Asia Pacific at Amarenco, with 15 years of experience in the Renewable Energy sector. He has a strong ability to streamline business operations resulting in increased operational efficiencies and enhanced bottom-line.

Before moving to Singapore, in 2022, he was Amarenco Group CFO/CIO and Board Member.

Progressive leadership experiences have created for Davide a passion for cost optimization and achievement of targets through efficient financial management, development / execution of commercial strategies and process improvements.

Davide is a Solutions Architect with proven skills in leading change and leveraging innovation in the drive for better profits and increased shareholder value. Davide has several years of international experience, having worded in numerous cities of Europe, and is an exceptional multilingual communicator in French, Portuguese, Spanish and English. David holds a graduate degree in economics, and an executive MBA from EM Lyon obtained in 2016.

Mr Chew Yong Hui

Covering Course Manager, Electrical Engineering, School of Engineering,
Institute of Technical Education of Singapore

Paper Title: Electrical Engineering Training Pathway

Chew Yong Hui is a Course Manager for Electrical Engineering at ITE College West in Singapore. With a commitment to educational innovation and a passion for green technologies, Yong Hui infused Project-Based Learning Pedagogy into his teaching methodologies.

By actively engaging students in real-world meaningful projects which enhanced their learning experiences. Dedicated to enabling students to explore technological pathways leading to a cleaner energy future.

Yong Hui oversees a dedicated team of Section Heads and Lecturers to ensure the quality of teaching and effectiveness of curriculum delivery while maintaining collaborative partnership efforts with external agencies, industry and parents.
Yong Hui received the Crescendas Medal for Outstanding Engineering Physics Teacher (Poly/ITE) from the Institute of Physics Singapore in 2017 and the Best Teacher Award in 2013 from ITE.

SPEAKERS' PROFILES

Dr. Ir. Supriyadi Legino (Advisor)

Doctor in Management, Practitioner of Waste to Energy, Lecturer of Management and Renewables Association of Indonesian Electrical and Mechanical Contractors (AKLI)

Paper Title: Community Based Waste to Energy as Renewable Distributed Generation (RDG)

Dr. Supriadi Legino is the Director of School of Technology at Institut Teknologi PLN Jakarta, and is a Practitioner of Waste to Energy, a Lecturer of Management and Renewables and a certified Principal Assessor of Electricity Systems. Dr. Supriadi is backed by thirty years of working experience in the public sector and twenty years of experience teaching in university.

Dr. Supriadi obtained his Doctor of Management and Master of Art in International Business from Webster University Saint Louis, a Master of Business Administration and Graduate certificate in Human Resources the University of Missouri St. Louis, Magister Manajemen in Finance from Universitas of Sriwijaya Palembang and completed his undergraduate studies at Institute Teknologi Bandung as an Electrical Engineer in 1979. In 2014, Dr. Supriadi obtained his certification in Advanced Train The Trainer in PV, Biogas, and Wind Energy by GIZ, the main German development agency.

Dr. Supriadi also run a blogsite to share his knowledge with the industry (https://sttplnsupriadi.blogspot.com/).

Ir. Dr. F.C. CHAN

BBS (BSc., MBA, MA, LLM, PhD, DIC, FHKIE)
Hong Kong Electrical Contractors' Association (HKECA)

Paper Title: Emerging Technologies for Sustainability

Ir. Dr. F.C. CHAN received his education in Hong Kong and United Kingdom. He graduated with first class Honours from the University of Hong Kong in Electrical Engineering. He carried out research in power systems protection and obtained his Doctor of Philosophy from the Imperial College, University of London. Afterwards he obtained a Master of Business Administration from the Chinese University of Hong Kong, a Master of Arts in English with Distinction for the Professions from the Hong Kong Polytechnic University and a Master of Laws from the University of London.

Ir. Dr. CHAN has extensive experience in power systems specialising in power system protection, distribution automation, substation design, plant construction and cable installation works. As an electrical contractor he provided with technical services in lighting applications, high voltage installation, traction supply and energy services. Ir. Dr. CHAN has served in various HKSAR government committees and was awarded the Bronze Bauhinia Star in 2017. He is a Fellow and a past President of the Hong Kong Institution of Engineers.

Currently, Ir. Dr. Chan the Honorary Secretary of the Hong Kong Electrical Contractors' Association.

SPEAKERS' PROFILES

Prof. Hong-Chong, Cho

Professor of Department of Economics at Dankook University, South Korea
Korea Electrical Contractors Association (KECA)

Paper Title: Direction of Reforming Korean Electricity Market

Prof. Cho is a Professor at the Department of Economics at Dankook University, is a Member of Power Cost Assessment of the Korea Electricity Exchange, and Editor-in-Chief of Energy Economy Research. Prof. Cho also serves as the Vice-President of the Korea Resource Economics Association and is also a Member of the Energy Committee of the Ministry of Trade, Industry and Energy.

Contributes in multiple committees involving Macroeconomics and the Energy Resource Economy. In addition to holding a Bachelor and Masters in Economic from the Seoul National University, Prof. Cho also obtained a PhD in Economics from the University of Pennsylvania. His consulting field focuses on the Energy Resources Industry and Environment.

Dr. Supriadi also run a blogsite to share his knowledge with the industry (https://sttplnsupriadi.blogspot.com/).

Mr Jason Koo Chin Siang

Director, Attractions Operations, Gardens By The Bay

Paper Title: Gardens by the Bay: A Green Marvel of Sustainability

Jason Koo is the Director of Attractions Operations at Gardens by the Bay, where he oversees the frontline operations of the Gardens' key attractions such as Flower Dome, Cloud Forest and the OCBC Skyway at Supertree Grove, among others. His responsibilities cover the areas of ticketing, visitor services, the call centre as well as security.

Jason has been with Gardens by the Bay for 17 years. When he first joined the project in 2006, he was part of the pioneer team involved in the master planning and construction phase. During this period, he worked on business-related projects such as the development of commercial clusters, visitorship and financial projections, sponsorship, as well as the formation of a company limited by guarantee which would subsequently manage Gardens by the Bay. Jason previously spent several years in the private sector in sales and marketing roles.

SPEAKERS' PROFILES

Engr. Ariel P. Duran

Professional Electrical Engineer, President of Polyphase.one Construction Inc.
President of the Society of Philippine Electrical Contractors (SPECS) (2022 – 2023)

Paper Title: Green Building Initiatives in the Philippines

Engr. Duran is a Professional Electrical Engineer by Profession with more than 23 years combined experience in Business Development, Project Management, Engineering Services in the Power Utilities, Industrial and Commercial Industry. Has been involved in the Design & Construction for Power Substations, Commercial & Industrial Power Distribution Systems.

Engr. Duran is the Engineer Consultant of SEAMEO-INNOTECH - South East Asian Ministers Education Organization Regional Center for Education and Technology, and is also the President of Polyphase.one Construction, Inc. which is engaged in Design and Build for Electrical Infrastructures.

Engr. Duran concurrently also holds various posts such as:
- Incumbent Municipal Councillor of the Local Government of Basey, Samar
- National President of Society of Philippine Electrotechnical Constructors & Suppliers, Inc. (SPECS), and
- Secretary General of AFEEC-ASEAN Federation of Electrical Engineering Constructors

His former roles include:
- Metro Manila Regional Governor of the Institute of Integrated Electrical Engineers of the Philippines, Inc (IIEE)
- Chairman and National President of the Mechatronics and Robotics Society of the Philippines (MRSP)
- President of the United Professional Electrical Engineers of the Philippines (UPEEP)

Dr. Chun-Lien, Su

Professor, Department of Electrical Engineering, National Kaohsiung University of Science and Technology
Advisor of Taiwan Electrical Contractors Association (TECA)

Paper Title: Strategies to Strengthen Power Grid in Taiwan

Dr. Chun-Lien Su was born in Taiwan and holds both M.S. and Ph.D. degrees in Electrical Engineering from the National Sun Yat-Sen University, Taiwan in 1997 and 2001, respectively.

From 2002-2017, he was with the National Kaohsiung Marine University, Taiwan.

And since 2018, he has been with the National Kaohsiung University of Science and Technology, Taiwan.

Dr Su is now Distinguished Professor at the Department of Electrical Engineering and Director at Center for Electrical Power and Energy in NKUST.

His research areas include Power System Analysis and Computing, Power Quality, Microgrids, Renewable Energy, and Power and Industrial Control Cybersecurity.

SPEAKERS' PROFILES

Ir. Chow Pui Hee (Ms)

Founder and Managing Director of Samaiden Group Berhad
Professional Engineer with Practicing Certificate Registered with the Board of Engineers Malaysia
The Electrical and Electronics Association of Malaysia (TEEAM)

Paper Title: The Evolution of Solar PV and Battery Energy Storage Systems and Its Innovations: Driving Energy Sustainability

Ir. Chow Pui Hee Presently, is the Group Managing Director of Samaiden Group Berhad, and brings with her 21 years of experience in the engineering field, renewable energy and environmental sectors.

A graduate of Universiti Putra Malaysia with a Bachelor of Engineering (Chemical) (Honours). She is a member of the Institution of Engineers, Malaysia, a registered Professional Engineer with Practicing Certificate in Chemical Engineering with the Board of Engineers Malaysia, an Environmental Impact Assessment (Wastewater) Subject Consultant with the Department of Environment Malaysia and an Electricity Energy Manager with Energy Commission Malaysia.

Ir. Chow also holds a Certificate of Competency for Grid Connected Photovoltaics ("PV") Systems Design by Sustainable Energy Development Authority (SEDA).

In July 2014, she joined Samaiden Sdn Bhd as General Manager and has been spearheading the growth and expansion of the company from a contractor of solar PV system to providing end-to-end services for solar PV power plant projects covering front-end consultancy, Engineering, Procurement, Construction & Commissioning ("EPCC") and Operation & Maintenance ("O&M") services.

Assoc. Prof. Dr. Werachet Khan-ngern

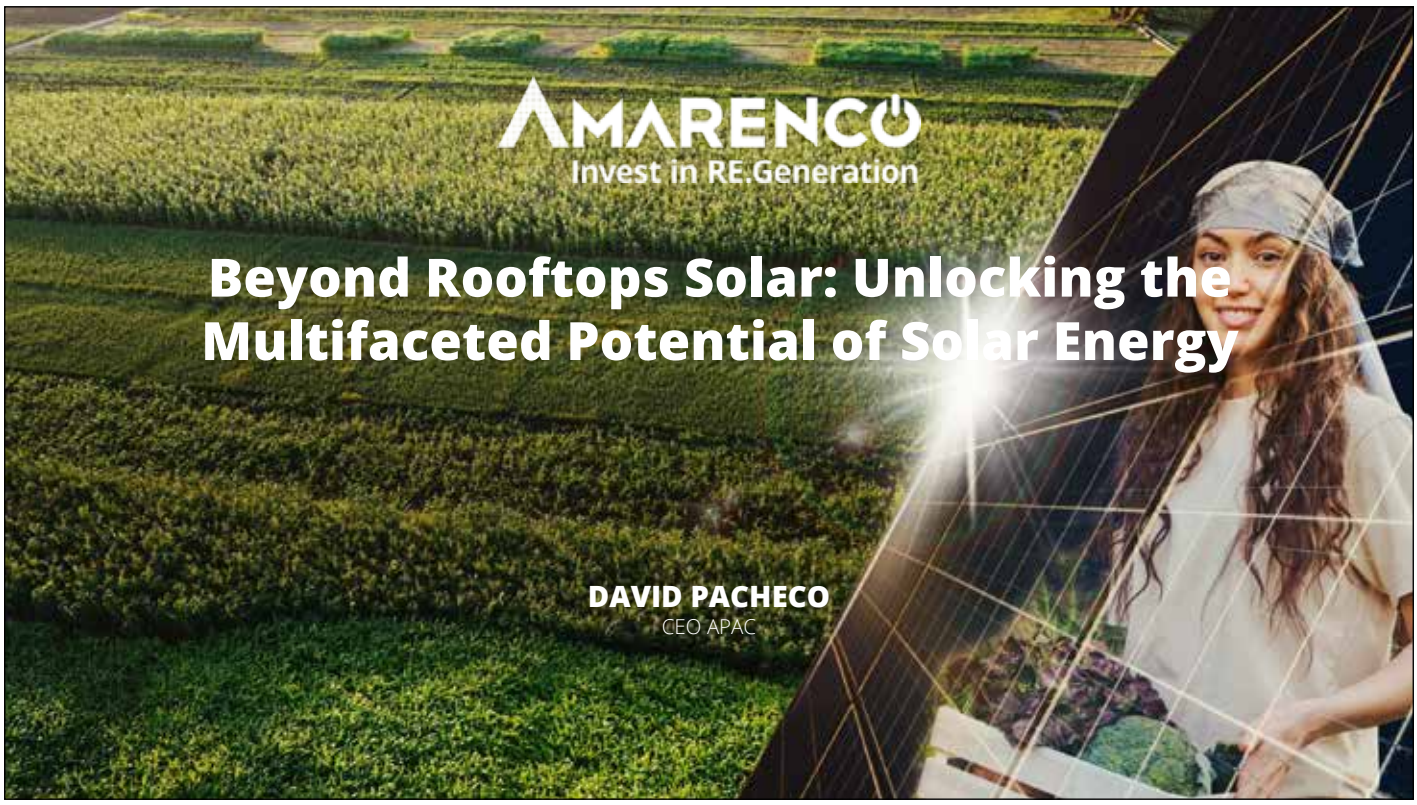
Chief Innovation Officer, Kumwell Corporation PLC
Thai Electrical & Mechanical Contractors Association (TEMCA)

Paper Title: Sustainable Smart, Safety and Green Technology for Building and Industry: Environmental, Social and Governance in Practice

Dr. Werachet is the Chief Innovation Officer of Kumwell Corporation PLC, and current AFEEC & FAPECA Secretary. Since 2020, Dr Werachet has been part of the Committee of Electric Vehicle Policy of Thailand.

Dr. Werachet's research covers the fields of:
- EMC: Electromagnetic Emission / Immunity Control
- Power Electronics: Converters and Inverter Applications
- Energy: Green Energy, Proton-Exchange Membrane (PEM) Fuel Cell Power Supply / EV, PV Design, Net Zero Energy Buildings
- Electric Vehicle: Amphibious, Scooter, Electric Motorcycles, Tow Traction Electric Vehicles
- Wireless Power Transmission: Wireless Power Charging

Dr Werachet obtain his PhD., DIC (Electrical Engineering, Power Electronics) from Imperial College, University of London in 1996, and B.Eng, M.Eng. (Electrical Engineering) King Mongkut's Institute of Technology Ladkrabang KMITL in 1983 and 1987 respectively.


AMARENCO
Invest in RE.Generation
Beyond Rooftops Solar: Unlocking the Multifaceted Potential of Solar Energy
DAVID PACHECO
CEO APAC


THE ISSUE
1 - CARBON EMISSIONS
Global greenhouse gas emissions by sector
Our World in Data
Agriculture, Forestry & Land Use
Energy
72.2%
STILL 85% FROM FOSSIL FUELS IN 2021
2 – DEGRADATION CARBON SINKS
30 FOOTBALL STADIUMS EVERY MINUTE
3 – THE HYDRIC IMBALANCE
6,900
4,500
4,200

AMARENCO

OUR « QUEST »

PRODUCE ELECTRONS WITH A POSITIVE SOCIETAL IMPACT

SOCIAL POSITIVE IMPACT

ECONOMIC POSITIV IMPACT

ECOLOGICAL POSITIVE IMPACT

THESE ELECTRONS, WE CALL THEM REGENERATIVE ELECTRONS

AMARENCO

IS A GLOBAL VILLAGE

AMARENCO IS DEPLOYING ITS VISION AND SOLUTIONS ON 3 CONTINENTS

Europe

Middle East

Pacific-Asia

HUBS

Cork (Ireland), Lagrave and Lyon (France), Porto (Portugal), Dubaï (UAE) and Singapour

FIGURES

+ 200
EMPLOYEES

+ 2 000
SOLAR AND SOLAR-POWERED INFRASTRUCTURES BUILT TO DATE

+ 500
FARM INFRASTRUCTURES PROTECTING CROPS, EUROPEAN LEADER IN AGRIVOLTAICS

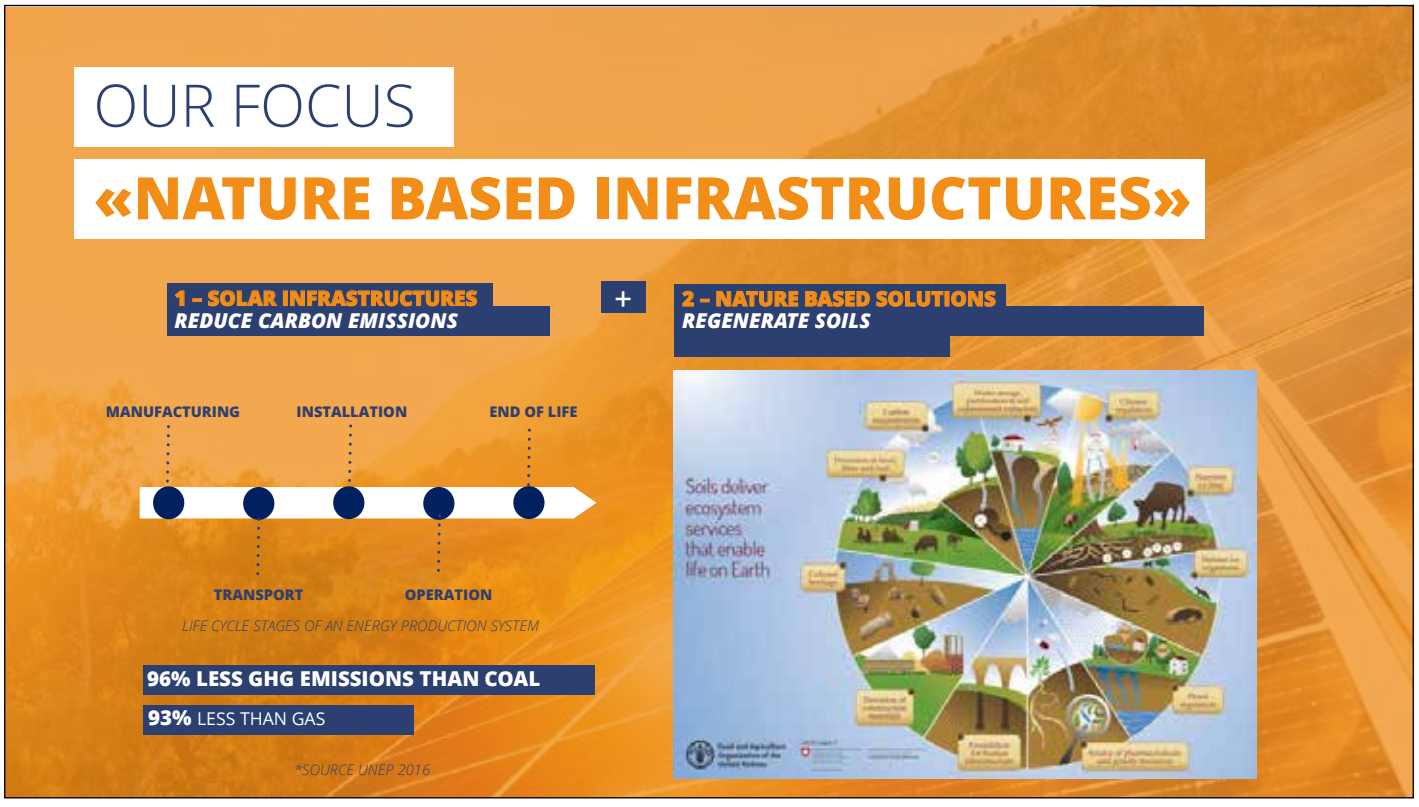
10 GW
OF PROJECT PIPELINE

500 MW - 1 GW
OF RENEWABLE ELECTRICITY IN CONSTRUCTION AND IN OPERATION EVERY YEAR

500 mn - 1 bn €
OF INVESTMENTS EVERY YEAR AROUND THE WORLD

OWNER
OF THE LARGEST STORAGE BATTERY IN EUROPE


AMARENCO PLEDGE
& ECHO PROGRAMS
AMARENCO
AMARENCO PLEDGE" is a commitment by the company to allocate 2 million Euros per GW of solar power plants invested in regeneration programs, as well as 500,000 Euros per GW of operating assets each year, through our Echo programs, from 2022
THE REGENERATIVE MODEL
Soil health and biodiversity improvement
Tree and regenerative fore st planting
Regenerative agriculture
Renewable energy
Biodiversity restoration
Food security
Keep global warming <1.5°C
Create Local and Social value

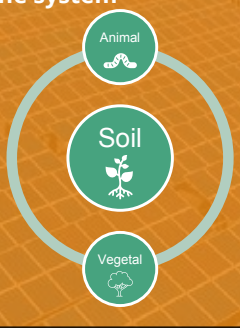

OUR FOCUS
«NATURE BASED INFRASTRUCTURES»
1 – SOLAR INFRASTRUCTURES
REDUCE CARBON EMISSIONS
+
2 – NATURE BASED SOLUTIONS
REGENERATE SOILS
MANUFACTURING
INSTALLATION
END OF LIFE
TRANSPORT
OPERATION
LIFE CYCLE STAGES OF AN ENERGY PRODUCTION SYSTEM
96% LESS GHG EMISSIONS THAN COAL
93% LESS THAN GAS
*SOURCE UNEP 2016
Soils deliver ecosystem services that enable life on Earth

OUR VISION

OF AGRICULTURAL TRANSITION

MASS REGENERATIVE AGROECOLOGY IS POSSIBLE

Comprehensive approach that places the soil at the heart of the system



PLURALITY OF MODELS

Transition from a single intensive monoculture model to a plurality of agricultural models

DECARBONISATION OF RURAL TERRITORIES

Development of electric renewable energy for farmers and territories

Why agrisolar ?

THE DUAL APPROACH OFFERS INNOVATIVE AND EEFICIENT SOLUTION TO SIMULTANEOUSLY PROMOTE SUSTAINABLE AGRICULTURE AND THE CLEAN ENERGY TRANSITION...

- Protect your crop from weather events : violent rains, hail, heatwaves...
- Improve water management to reduce your need for water
- Climate-smart : better adaptation to global warming
- Potential extra revenue stream for local farmers and communities
- Animal Welfare: feel of protection under the panels
- Optimized use of the plot : The dual use of land

...WITH PLENTY OF ROOM FOR IMPROVEMENT

AMARENCO
Invest in RE.Generation

OUR VALUE PROPOSAL

FOR THE AGRICULTURAL SECTOR

TO PROVIDE AN AGRICULTURAL TOOL

- To mitigate the challenges of your farming operations (climatic hazards, animal welfare)
- At low or no cost

TO SUPPORT THE AGRICULTURAL TRANSITION

- Towards a regenerative agriculture
- Thanks to our dedicated program : ECHO
- By securing income

TO SECURE THE FARM INCOME

- By sharing the income from the sale of electricity

BEST PRACTICES GUIDELINES

DEFINITIONS

Agrisolar refers to the integration of solar photovoltaic projects within an agricultural activity

Agrisolar is a specific approach to solar projects that comines sustainable agricultural practices and solar photovoltaïcs

AgriPV or Agrivoltaics are solutions where a PV installation and a sustainable agricultural activity are co-located, and light management is performed

BEST PRACTICES

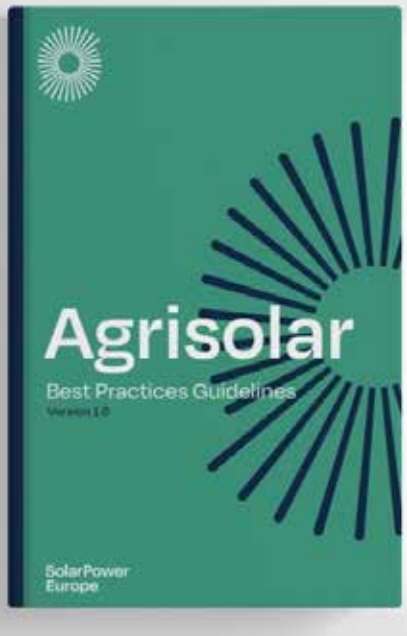
The dual approach can generate several positive synergies but also has additional complexities compared to agricultural projects and standard PV installations.

Defines 19 good practices to ensure virtuous projects with best level of performance in Agriculture, Energy production and Socio & Environmental impacts.

+ Maximize the sustainability/sustainability of agricultural projects, from an agronomic, ecological and financial point of view.

Introduction to the Concept of Sustainable Agriculture

Describes the main obstacles for agrisolar and how to overcome them.



AVAILABLE FOR DOWNLOAD

SOLUTIONS IN OPERATION

> 5 YEARS OF EXPERIENCE (Crop selection and technical course adaptation)

ENERAGRI GREENHOUSES

Amarenco and Eneragri have joined forces to build 392 agricultural greenhouses integrating electricity production with a light-sharing roof by testing 2 models of "south-facing" and "checkerboard" greenhouses. Constant experimental monitoring over 5 years enabled the farmer to adapt, improve and develop these innovative models.

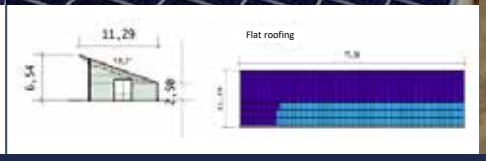
MAIN OBSERVATIONS

- 3 designs of greenhouses tested
- Light distribution and management
- Agricultural yields (>40 varieties tested)

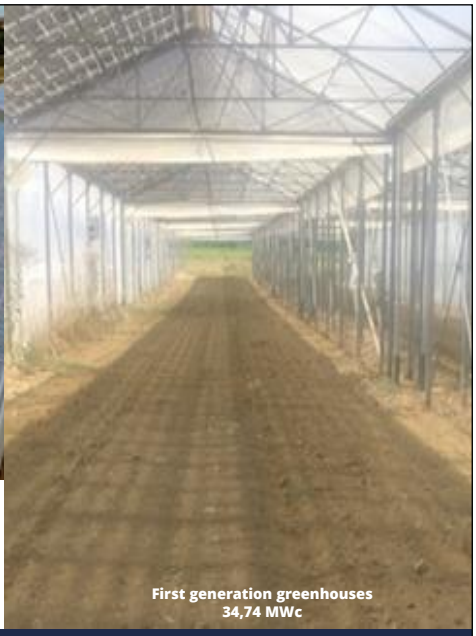
MAIN OBJECTIVES

- Experiment with new models of combined agricultural and electricity production to secure investment and farm income and protect production from climatic hazards
- Select successful crops that can withstand the conditions offered by these new facilities and expand production
- Work on the integration of new parameters: water management and the transition from organic to agroecological (regenerative) farming
- Communicate successful models and train a new generation of interested farmers.

'Single-slope checkerboard greenhouse"
Approximately 1 in 3 glass tiles
13% direct roof light



« Single-slope greenhouse with full sunlight "
19% direct roof light



First generation greenhouses
34,74 MWc

"Single chapel greenhouse with 54 or 48 cells "
17% or 27% direct roof light

Effect of radiation on checkered system

Border effect
Checkered greenhouse 13%
Torreilles 66 - FRANCE

Border effect
Checkered greenhouse 13%
Perpignan 66- FRANCE

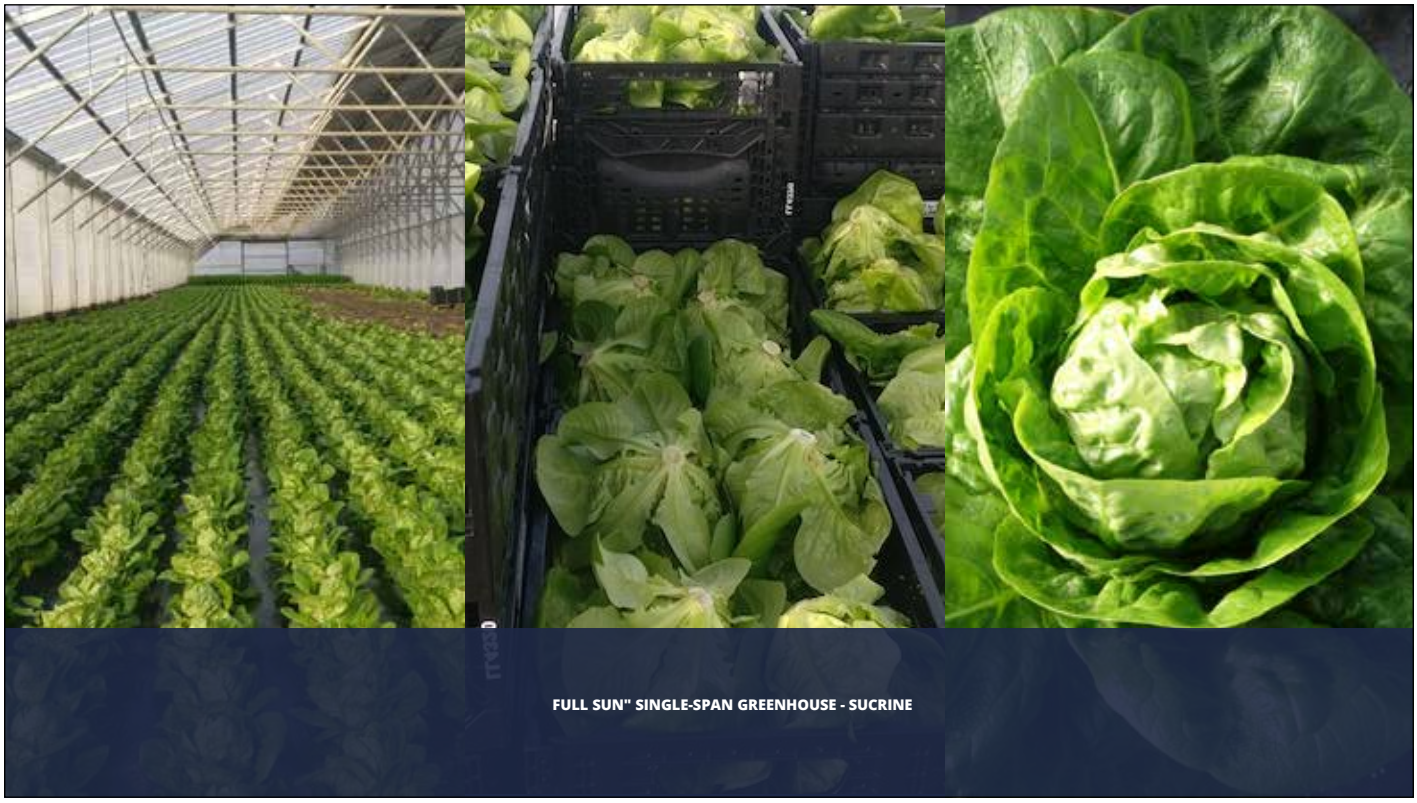
Flash effect
Checkered greenhouse 13%
Villeneuve 66 - FRANCE

Staircase effect
Checkered greenhouse 13%
Perpignan 66 - FRANCE

Effect of radiation on full sun

Border effect
Full sun greenhouse 13%
Bezier 34- FRANCE

CHECKERBOARD GREENHOUSE -
RASPBERRY, BLACKBERRY



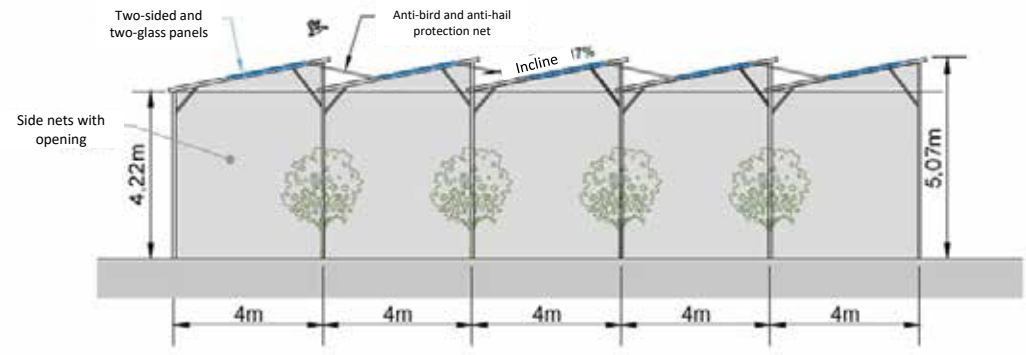
FULL SUN" SINGLE-SPAN GREENHOUSE - SUCRINE

SYMMETRICAL GREENHOUSE WITH SEMI-TRANSPARENT PANELS 17%-MARKET GARDENING

SOLUTIONS IN PROGRESS

STATIC AGRIVOLTAICS: SHEDS, GREENHOUSES AND SHELTERS

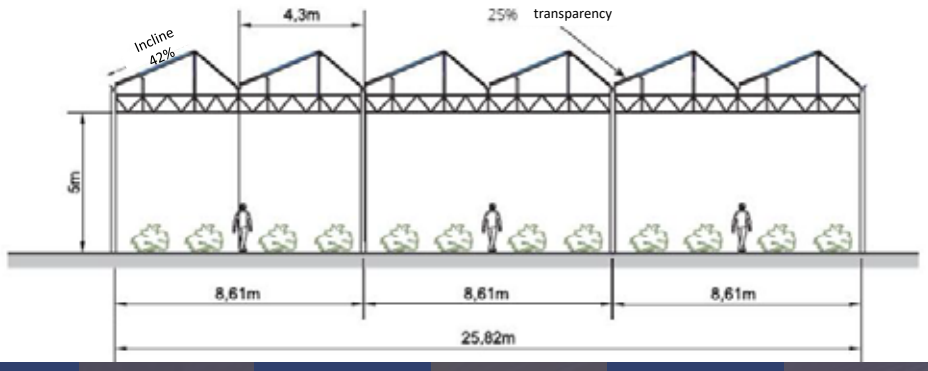
AGROFORESTRY SHELTER



GROW SHELTERS
10,05 MWp (4 projects)

Semi-transparent panels 5 to 34% transparency on current projects	**High working height 5.07m**	Agricultural glass cladding (folding wall) or retractable compatible with flood zone	Modular structure: height and width (+0.5 to 1m), orientation, panel positioning, etc.	Rainwater collection for irrigation

ASYMMETRICAL MULTICHAPEL GREENHOUSE



GREENHOUSES :
73,81MWp (27 projects, 2,7ha/project)

South panel partially covered (2/3 of the surface) with photovoltaic panels	Semi-transparent panels	High light levels inside the greenhouse	Working height 5m	Agricultural glass or retractable mesh cladding compatible with flood zones	Rainwater collection for irrigation

PILOT PROJECT LACAMPAGNE

AGROPVFORESTERY

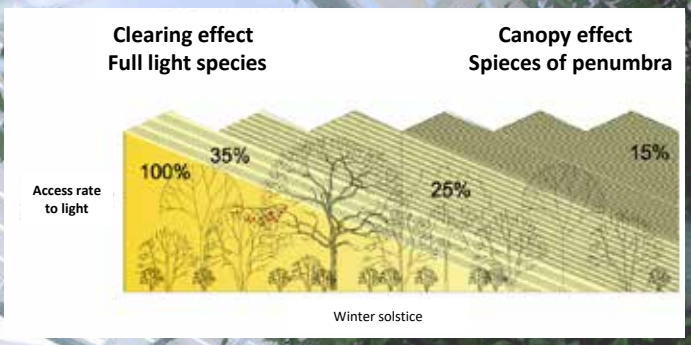
AGRICULTURAL PROJECT

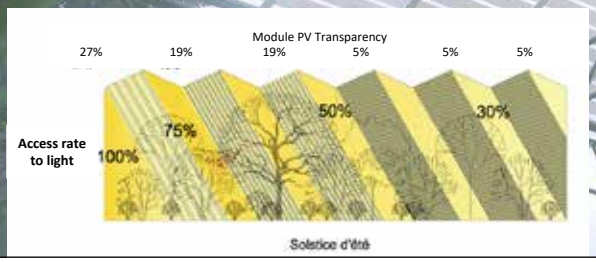
- South – Gironde FRANCE
- Regenerative agriculture project : successive agroforestry for fruit growing in a short circuit
- Surface : 6 ha (Sau)
- Soil type: poor in organic matter (<1%), poor water retention

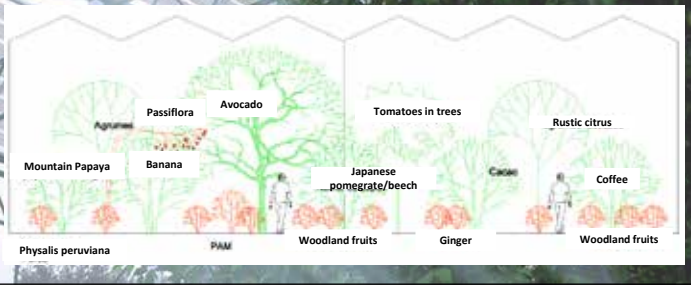
SOLAR

- Photovoltaic greenhouses with semi-transparent modules
- 1 000 m²
- Power: 100 kWp

PILOT PROJECT LACAMPAGNE





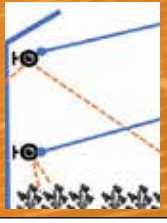


FUTURE TRENDS (AGRI-FOOD TECH)

URBAN FARMING + PV:
Adapting and combining food and energy resiliency topics

FARMING MOBILITY (EV / HYDRO)
Adapting to the electrification of farming machinery

ENABLING SMART DIGITILIZATION
Smart systems to capture deep data using IoT technologies



IN ORDER TO PURSUE **DISCUSSIONS**

We are looking to develop our:

- **Cooperation with farmers and agri-food industry**
- **Cooperation with scientists and institutions**
- **Investment in local pilots**
- **Research on new revenues schemes and business models**

And also to:

- **Integrate innovative solutions**
- **Complementary solutions for the Agricultural sector**

DAVID PACHECO
CEO APAC

+65 9231 4057
d.pacheco@amarencogroup.com

www.amarencogroup.com

WORK-STUDY DIPLOMA

TALENT CAPITAL FOR YOUR WORKFORCE

An initiative of SkillsFuture

ITE

ALTERNATIVE TRAINING PATHWAY FOR ELECTRICAL ENGINEERING

Add a Footer

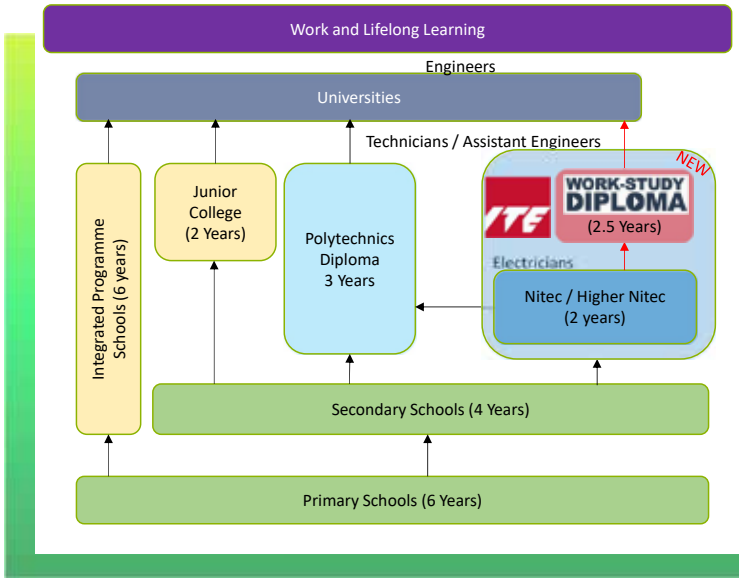
1

OVERVIEW OF SINGAPORE PUBLIC EDUCATION SYSTEM

Add a Footer

3

OVERVIEW OF SINGAPORE PUBLIC EDUCATION SYSTEM

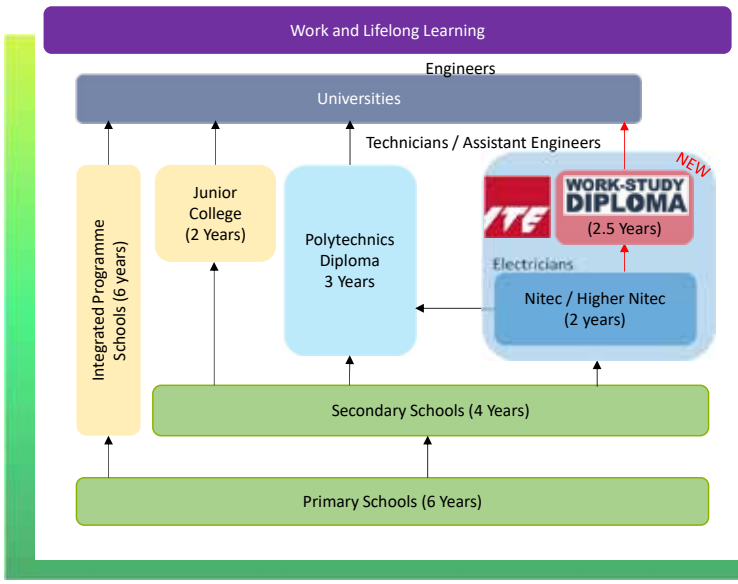


- Junior College and IP Schools offers a more academically-orientated a range of subjects that emphasise analytical and evaluative skills.
- ITE and Polytechnic offers a more practice-oriented mode of learning with course focused on building relevant skills.
- Work-Study Diploma is an alternative path to the Polytechnics. Trainees can find full-time job, gain work experience and pursue a specialized diploma at the same time
- Universities, Polytechnics and ITE also offers a wide range of specialized course, supporting the Lifelong Learning

Add a Footer

4

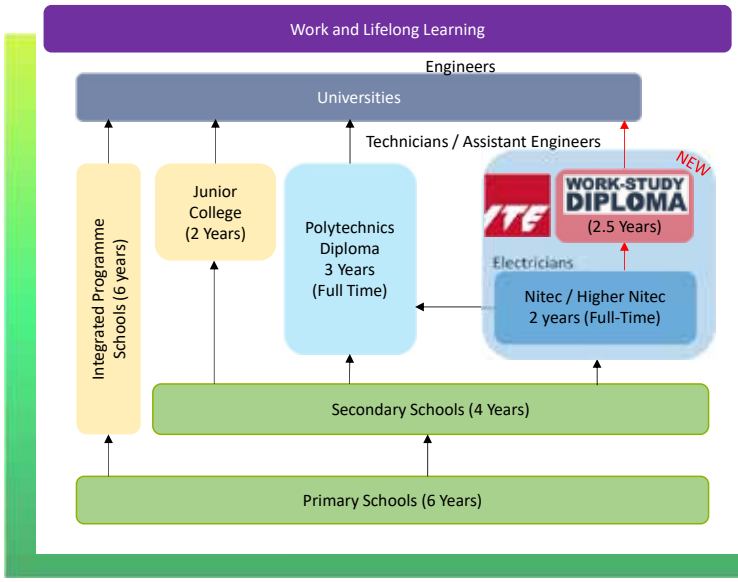
WORK-STUDY DIPLOMA IN ELECTRICAL ENGINEERING (SINCE 2020)



An **apprenticeship** avenue for companies seeking to develop **a talent pipeline**.

WSDip Trainees will join co-training companies as **full-time employees** while upgrading for their diploma.

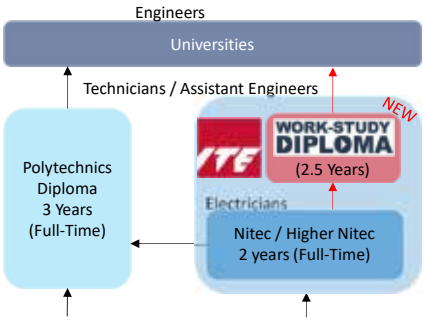
WORK-STUDY DIPLOMA IN ELECTRICAL ENGINEERING (SINCE 2020)



For Trainees

- Trainee continue to upskill themselves through **certified diploma courses**, where they develop competencies and bridge theory and practice.
- Receiving practical OJT at the workplace guided by industry experts and continue to learn also from lecturers at ITE.
- **Work-Life balance**. Trainees work 4 days at the companies and study 1 day at campus each week.
- As an employee of the participating company, trainees will enjoy a **stable income, employee benefits, full sponsorship** of their ITE training and a clear career pathway.

WORK-STUDY DIPLOMA IN ELECTRICAL ENGINEERING (SINCE 2020)



Provides alternative pathway for young people who

- need to **earn for their family;**
- wish to start **achieving financial independent;**
- find **meaning learning** through doing, seeing and experience the real work environment;
- need the **feel good effect**. They felt fulfilling and gained confidence seeing how their work or the projects they are involved contributes to the society.

INDUSTRIAL TRAINING PARTNERSHIP

SUPPORTING INDUSTRIAL UPGRADING AND ECONOMIC TRANSFORMATION

Industrial Development determine Education Structure

- Transformations of industries demand that workers continually upskill and reskill to match the emerging industry needs
- Industry participation in training curriculum and workplace training opportunities is vital in enhancing relevance.
- Industry need to fulfil its manpower needs
- Employability of graduates is critical

The global skills dilemma: how can supply keep up with demand?: the Hays Global Skills Index 2019/20

SINGAPORE GREEN PLAN AND ROADMAPS

SG GREEN PLAN

Greener-energy vehicles

- New registration of diesel and petrol powered vehicle to cease
- New for more Electric vehicle charging points

Greener Buildings

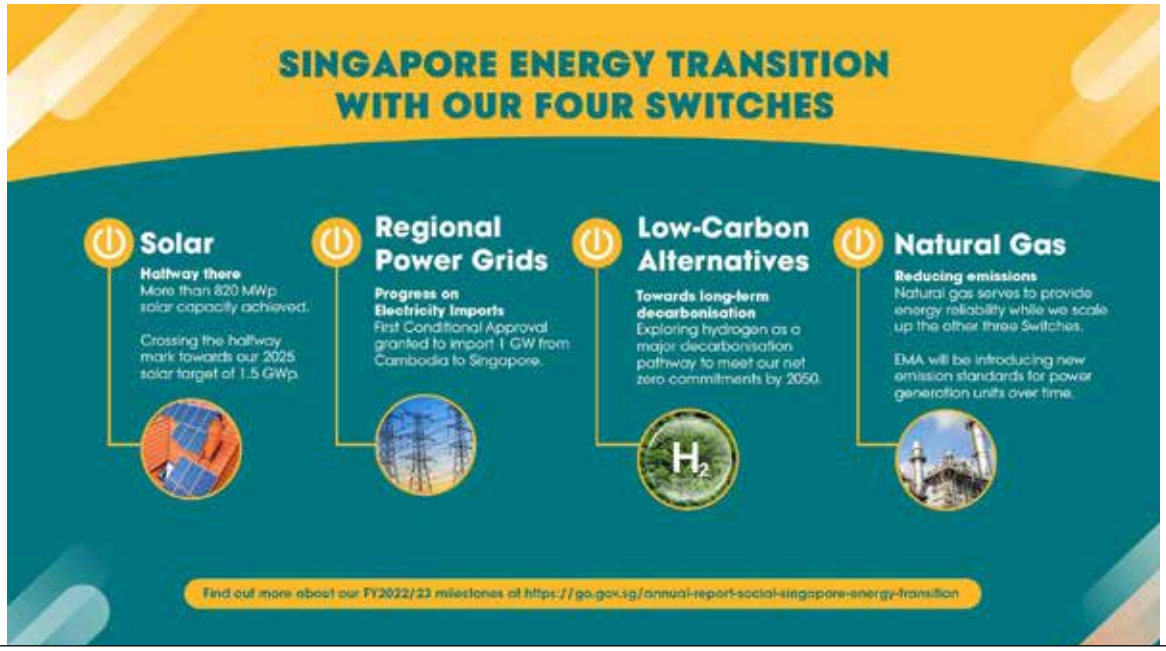
- 80% of new buildings are to meet Super Low Energy buildings' standard
- 80% if all buildings are to achieve Green standard
- Achieve 80% improvement in energy efficiency by 2030 (over 2005 level)

Green Energy

- Quadruple solar energy deployment to 2GWp by 2030
- Import renewable energy from the regional (ASEAN Green Grid Network)

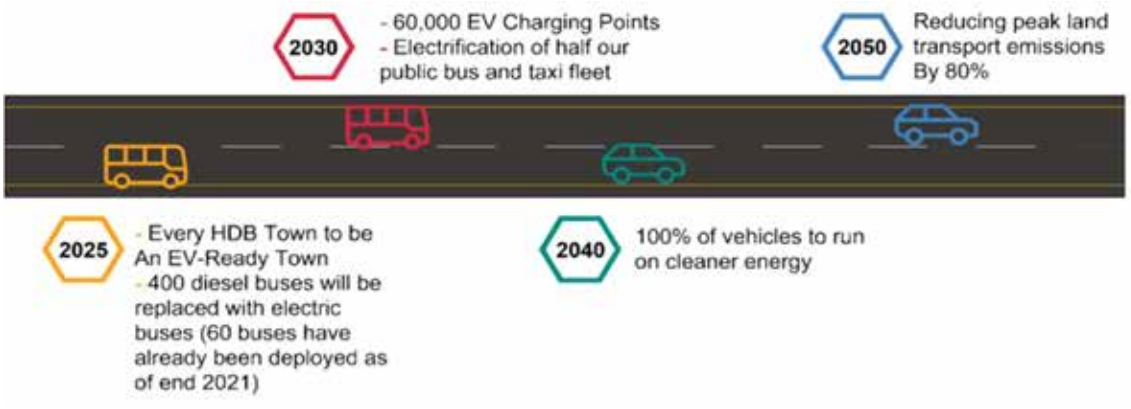
11

SINGAPORE COMMITS TO ACHIEVE NET ZERO GREENHOUSE EMISSIONS BY 2050



12

ELECTRICAL VEHICLE ROAD MAP



https://www.lta.gov.sg/content/ltagov/en/industry_innovations/technologies/electric_vehicles/our_ev_vision.html

13

CHALLENGES AND JOB OPPORTUNITIES

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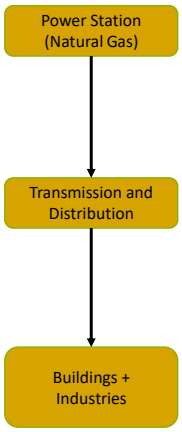
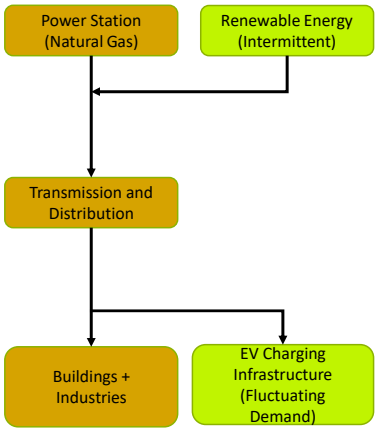
14

GOING GREEN - CHALLENGES AND OPPORTUNITIES (ELECTRICAL SECTOR)



- Power generation is relatively stable as long as there is fuel
- Power transmission and distribution are simpler, knowing where are the demands, primary the industrial, commercial and residential zones.
- Electrical demand is predictable according to the time of the day, workdays vs weekends

GOING GREEN - CHALLENGES AND OPPORTUNITIES (ELECTRICAL SECTOR)



The integration of **intermittent Renewable Energy**

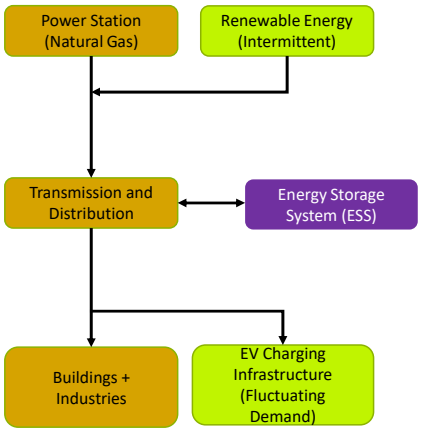
AND

the **fluctuating demand** from the increase EV penetration

can cause

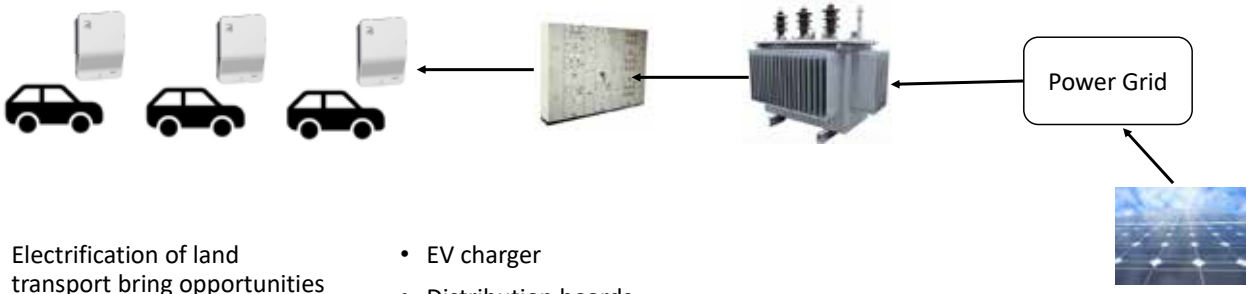
instability to the whole electrical system

GOING GREEN - CHALLENGES AND OPPORTUNITIES (ELECTRICAL SECTOR)



Energy Storage System is critical to meet the flexibility needs in the decarbonized electrical grid.

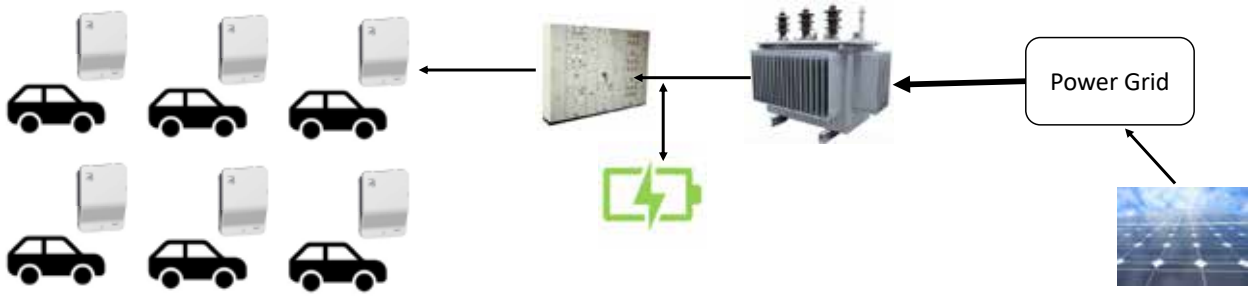
JOB OPPORTUNITIES FROM SG GREEN PLAN



Electrification of land transport bring opportunities not just to the EV charger installation and maintenance but also whole upstream.

- EV charger
- Distribution boards
- Transformers
- All the connecting cables

JOB OPPORTUNITIES FROM SG GREEN PLAN



As EV penetration increases, so will the number of chargers to be installed.

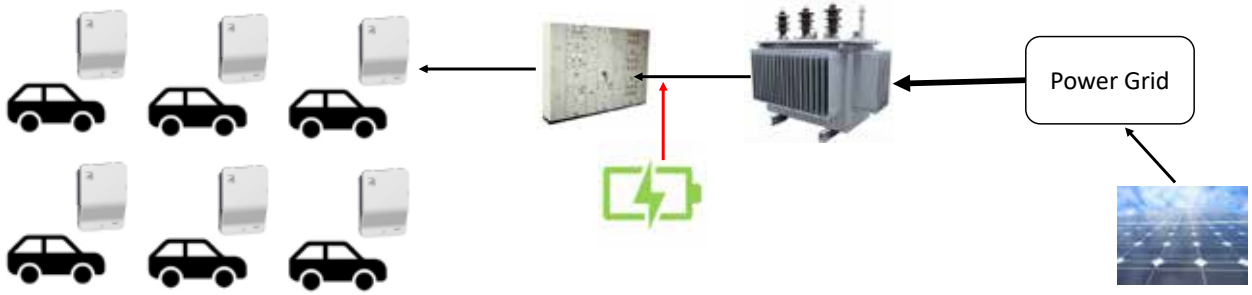
It may be more cost effective to install Energy Storage to handle the peak EV charging demand compared to addition transformers and laying new cables to the Power Grid.

JOB OPPORTUNITIES FROM SG GREEN PLAN

When EV charging demand is low,

the supply charges the both EVs and the energy storage.

JOB OPPORTUNITIES FROM EMERGING APPLICATIONS

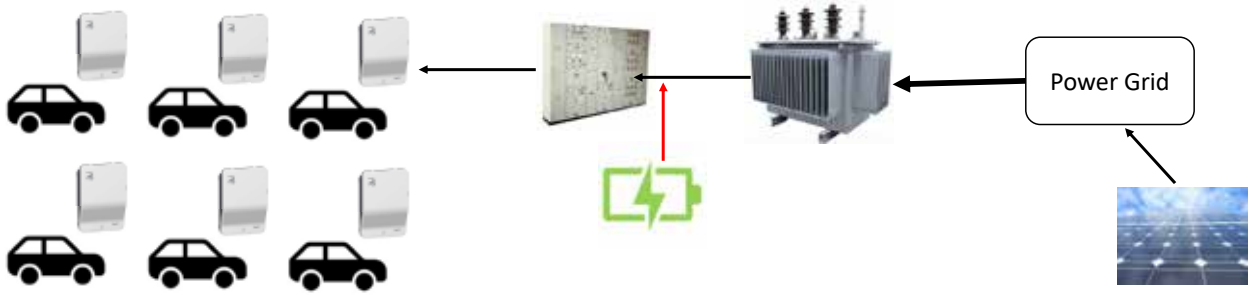


When EV charging demand is high,

the energy storage supplement the power grid in charging the EVs.

This reduce the number of transformer and intake capacity for the grid.

JOB OPPORTUNITIES FROM EMERGING APPLICATIONS



~70% of WSDip graduates in Electrical Engineering in 2022 and 2023 are involved in either in equipment manufacturing, installation or maintenance in the renewable energy, power distributions, down to the electrical appliances.

JOB OPPORTUNITIES FROM EMERGING APPLICATIONS




The remaining of the WSDip in Electrical Engineering graduates are mostly employed in the customized machine builder, facility management and land transport sectors.

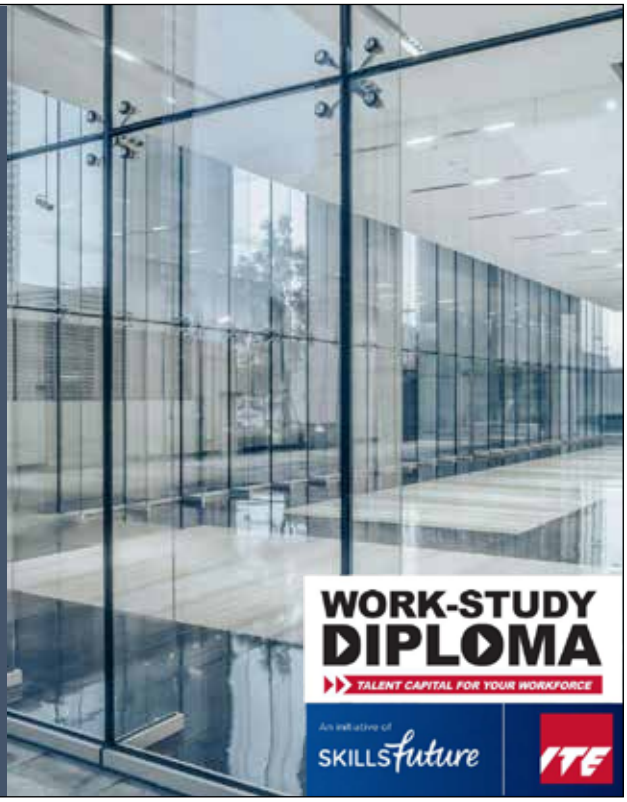
EMPOWERING INDUSTRY-EDUCATION COLLABORATION:

WORK-STUDY DIPLOMA IN ELECTRICAL ENGINEERING

Yong Hui Chew
Institute of Technical Education

Covering Course Manager
Electrical Engineering / ITE College West

Scan QR to save contact



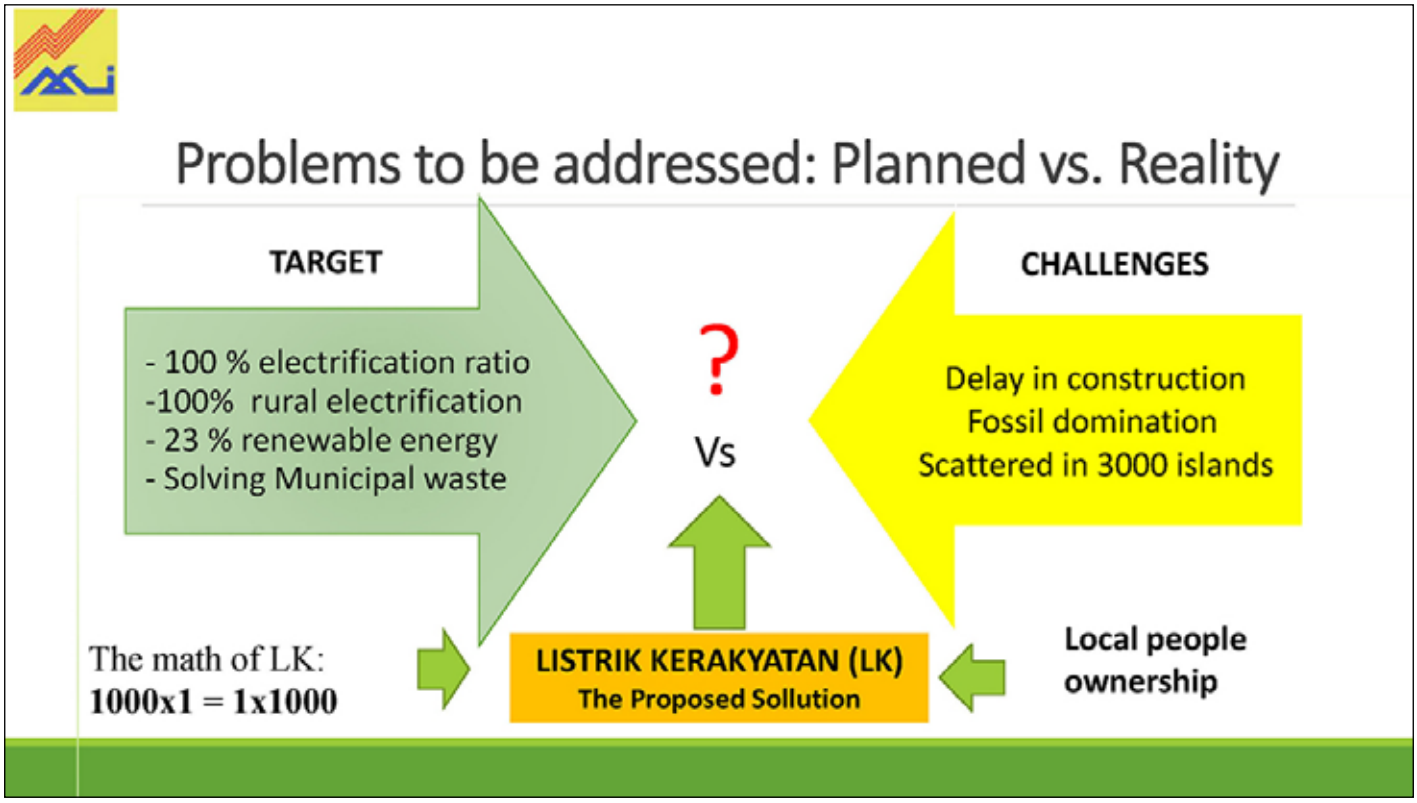
Community Based Waste to Energy as Renewable Distributed Generation (RDG)

Supriadi legino

Asosiasi Profesionalis Electrical & Mechanical Indonesia (APEI) 2023

BACKGROUND

- Conventional power system (CS) with large centralized power plant is no longer meet the intended efficiency and reliability because most of the projects are delayed and the overall loss due to the delay may offset the economies of scale benefit
- The domination of fossil fuel and less utilization of renewable energy sources
- Renewable energy development plan is still rely on large hydro and geothermal power plant that always delay and ignoring those are surrounding communities such as sun, wind, and biomass including waste
- The domination of felw giant investors while there are huge potential and rural funding for small and medium enterprise
- The challenges to electrify scattered customers living over the thousands island of Indonesia Archipelago



Renewable Energy Distributed Generation (REDG_

The model of simple and small scale renewable energy plants owned and managed by local people , which energy sources are available around the communities
(sun, wind, & waste) but waste is the best energy sources

Community Based Waste to Energy (CB WtE)

The simple method to convert waste to energy that can be executed by local people

Commutative Law of Math Strategy

Commutative law of math or commutative property:

$$ab = ba, for\ all\ a, b$$

May answer the problem associated with conventional system as illustrated by the algebraic expression:

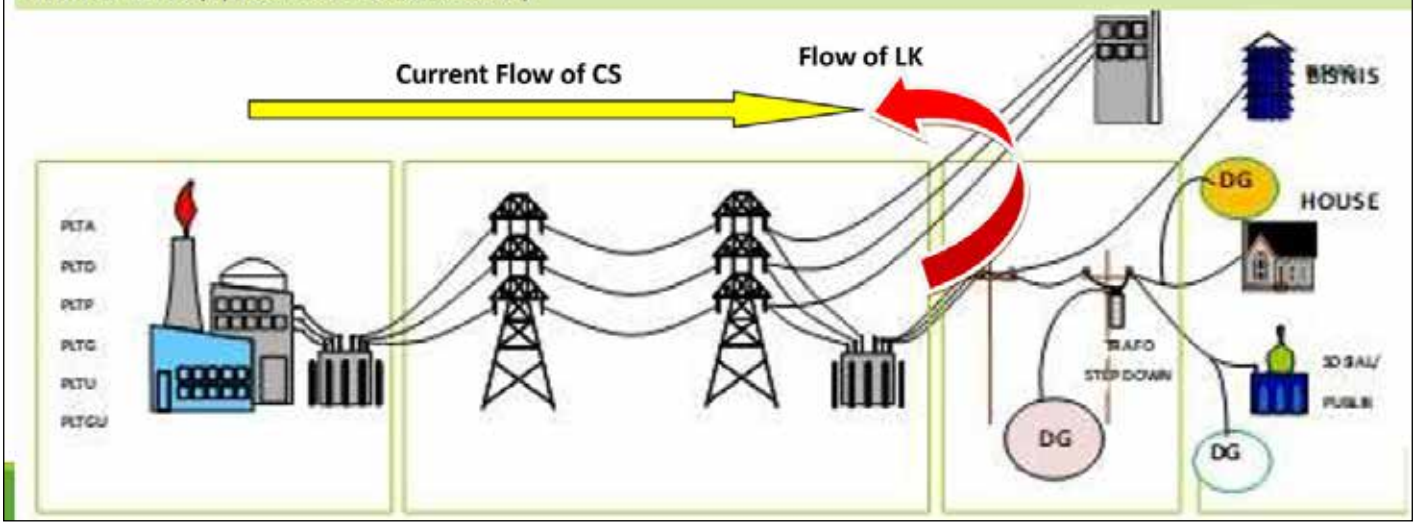
$$1000x1 = 1x1000$$

To build one large unit plant of 1000 MW equals to building 1000 small units of 1 MW

It is more beneficial to give 1 MW ownership to 1000 local people SME instead of giving 1000 MW to one giant investor

RDG System

Conventional system of large and interconnected power plants needs around 5 years of serial process of construction while LK power plants can be built in less than one year since it can be built at many places simultaneously



PREVIOUS STUDY: DISTRIBUTED GENERATION

Economies scale fallacy or electricity: Many big power plants are delayed due to more complex land acquisition, permit, financial closing, and social resistance, so, its cost may offset the benefit of the economies of scale and interconnection system [3].

Some previous studies propose the concept of distributed generation that may be beneficial for voltage improvement and stability and could reduce power losses [4]

Some studies reported the decentralization Distributed Generation in India may increase energy security and reduce carbon pollution. [5] [6]

PREVIOUS STUDY: THE BENEFIT OF RDG

By adopting small scale and distributed generation model, the government can give a chance to empower local people to involve in electricity development through Small and Medium Enterprise, namely [2].

LK is distributed generation with small scale power plant that has flexibility to utilize renewable energy such as solar, wind and waste, which are available surounding

The math expression of LK (Democratic Electricity) is 1000x1 = 1x1000; means that building one unit of 1000 MW power plant is similar to the simultaniously building scattered 1000 units of 1 MW plant [3].

LK is sufficient for Indonesia, a country with 17,000 islands because LK can produce energy any place in the country in a shorter time without necesseraly building the conventional but expensive T/D lines

WtE unit as a part of RDG plant: Local waste to energy processing unit

Potential implementation: A Case of Rural Electrification

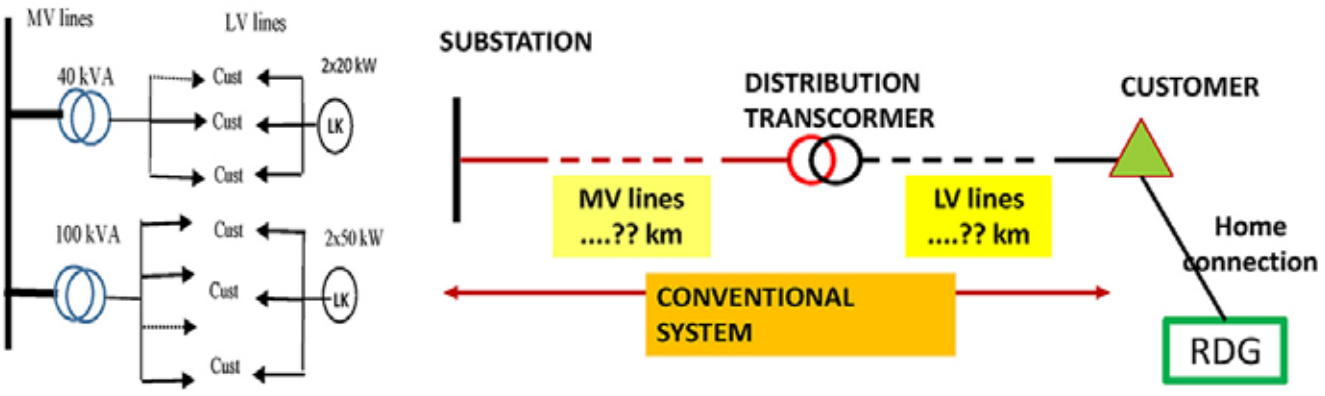
The type of RDG that will be used is a **municipal waste power plant**, so that it can also solve waste related problems including Ozon destruction,

Conventionally, rural and isolated areas are electrified by laying a distribution lines consisting of Medium Voltage (MV) lines, Low Voltage (LV) lines, and Distribution Transformer (DT).

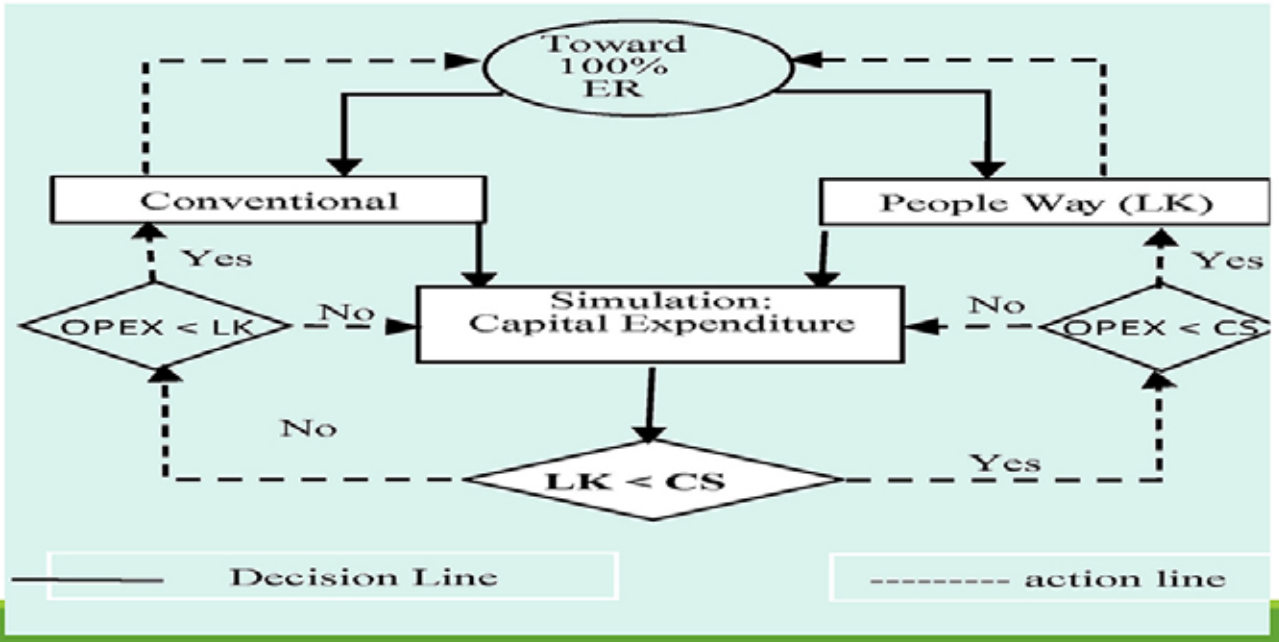
The study simulated the techno-economic aspect comparison between the model of LK and the conventional system (CS).

The result of this study can be used to propose model of electricity development as an option for the future of electricity development in Archipelago country of Indonesia that consists of around three thousand islands.

DISTRIBUTION LINES Vs. RDG



SIMULATION FLOW TO COMPARE DISTRIBUTION LINES vs RDG



Producing Pellet from 3 ton of Gross Waste

Investment cost te Pellet from 3 ton of gross waste consistinf of:

- Preparation and training : USD 1,000
- Civil work : USD10,000
- Bamboo Container (10 units) : USD 1,000
- Shredder machine : USD 3,000
- Pelleting machine : USD 3,500
- Hammer mills : USD 1,000
- Gasifier Stove : USD 500

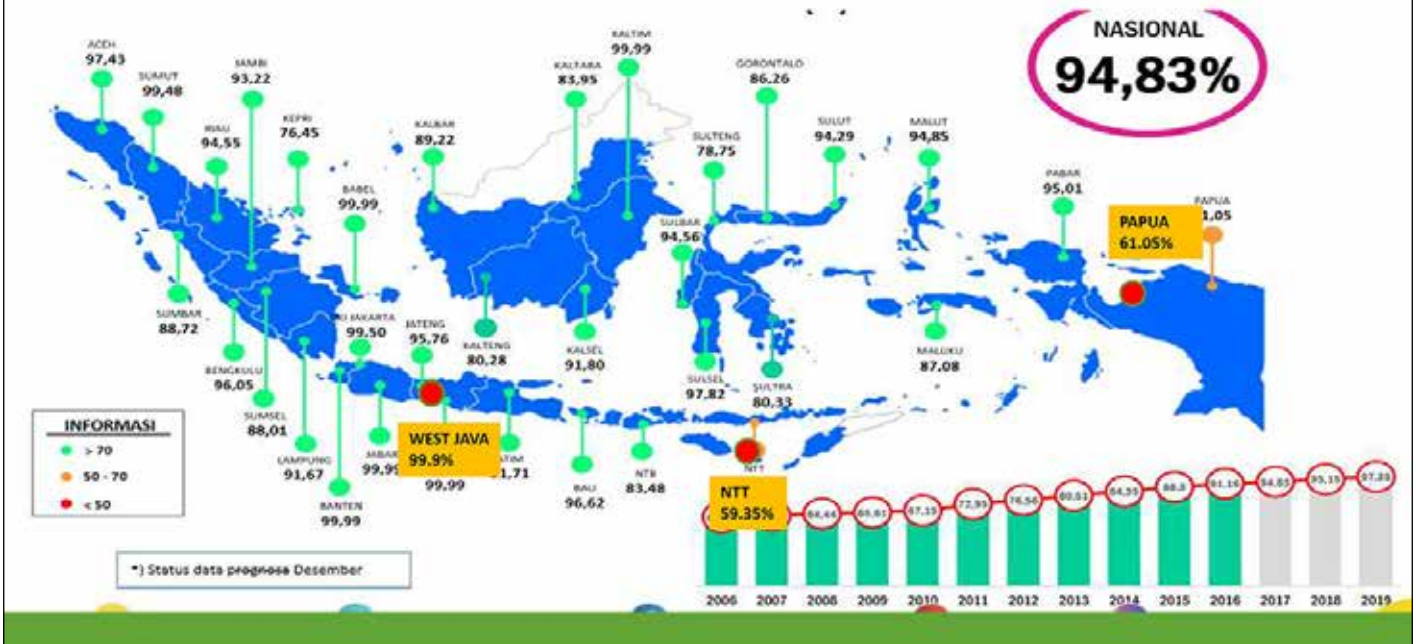
Total investment cost for 3 ton of waste : USD 20,000

Operational cost

- Salary of 3 workers : USD: 5,400
- Spare part and material: USD 1,000
- Oper. & maint. : USD 1,440
- Overhead/utility : USD 1,200

Total operation expense: 3 ton of waste per year: USD 9,040

ELECTRIFICATION RATIO IN EACH REGION

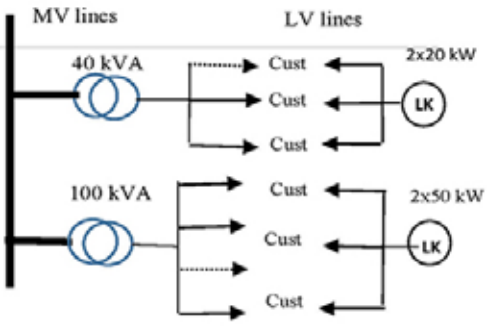


Capex comparison RDG vs Dist. Lines for Rural

Table 2. Capital Expenditure of LK unit (in USD)

Unit size	2x20 kW	2x50 kW
Gasifier USD	15.600	28,100
Genset (USD)	25.200	45,400
Control n monitor	1.250	1,800
LV lines cost West Java	17,162	38,614
LV lines cost of NTT	37,756	84,951
LV lines cost of Papua	22,825	51,357
Total Capex West Java	59,212	113,854
Total Capex NTT	79,806	160,191
Total Capex Papua	64875	126597

Region	MV lines/kms (Mio USD)	LV lines/kms (Mio USD)	Dist.Trf /kVA (Mio USD)
National	31	17	0,8
West Java	28	15	0,7
NTT	37	20	0,9
Papua	62	33	1,52



Average consumers capacity is 1 kVA/customer.→ A smallest number of distribution transformer is 40 kVA can serve 40 customers

Simulation of Rural Electrifacion Cost: NTT Region
RDG vs Overhead Lines

Capex for MV overhead lines: 37 Mio USD
Capex for LV overhead lines: 20 Mio uSD
Capex for DT : 0,9 Mio USD/kVA

Capex for RDG 2 x 30 kW: 0,8 Mio USD
Capex for RDG 2x 50 kW: 1,6 Mio USD

#of Cust	MV (kms)	LV (kms)	Tr Dis (kVA)	Dist cost (USD)	LK cost (USD
40	3	1	40	268182	79,806
80	3	2	80	358069	159612
120	3	3	120	447596	239418
240	3	6	240	472901<	478836

Result: If the number of customers >240 and the length of MV lines< 3km and LV lines<,6 km , then RDG is better or otherwise

RESULT: OPERATIONAL COST COMPARISON

Conventional system

Electricity production cost:
- West Jawa : USD 0.0681
- NTT : USD 0,20
- Papua : USD 0,016

While production cost of LK
2x20 kW : USD 0.06
2x50 kW : USD 0.07

Listrik Kerakyatan

Capacity	2x20 kW	2x50kW
Operator	6,000	9,000
Fuel cost (USD)	8300	16,600
Material & spare part (USD	1,000	4,000
Overhead & other cost (USD)	400	1,000
Total operation cost (USD)	15,700	30,600
Energy production (kWH)	262,800	657000
Operation cost (cent/kWh)	6	4,7

In all cases, operational cost of LK is more economical compare to that of conventional distribution system

Conclusion

- This study shows that biomass including waste under the RDGScheme can be the future energy to substitute fossil energy
- The study also shows that RDG by WtE is most likely cheaper than the conventional electricity development using MV and LV lines as well as distribution transformer.
- RDG by WtE is not only beneficial for the remote area such as Papua and NTT, but also in the populated area like West Java area
- RDG by WtE can be a good alternative for attaining 100% electrification ratio compare to that of Conventional System.in addition to solving landfill waste problem
- RDG by WtE creates business and employment opportunity, particularly for local businessman
- RDG by Wte halts the use of fossil fuel that harm the environment.

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Emerging Technologies for Sustainability

Ir Dr F.C. CHAN

1. Introduction

Nowadays, people ask ChatGPT to write article for a specific topic. When this paper title "**Emerging Technologies for Sustainability**" was input to ChatGPT, the following short paragraph was generated:

> *"Emerging technologies such as electric vehicles, energy storage systems, smart grid technologies, carbon capture and storage (CCS), and circular economy approaches have the potential to contribute to sustainability and help achieve the Sustainable Development Goals. These technologies offer solutions to some of the sustainability challenges we face, such as reducing greenhouse gas emissions, improving energy efficiency, and minimizing waste. By promoting the development and adoption of these technologies, we can help create a more sustainable future and move towards achieving the Sustainable Development Goals."*

Interestingly, this paragraph has rightly highlighted some emerging technologies which are related sustainable development goals!

2. Sustainable Development Goals.

"Green" refers to anything that benefits the environment and essentially to improve how humans utilise natural resources. Sustainability is much broader than "Green" and it is the ability to meet the current needs without compromising on the future generation's ability to meet their needs. In September 2015, the United Nations General Assembly adopted a set of Sustainable Development Goals (SDGs) for the post-2015 development envisioning a world that is comprehensively sustainable: socially fair, environmentally secure, and economically prosperous for a concerted effort to build a future based on sustainability targets intended to be achieved by 2030. These 17 goals are shown in Table 1.

Goal No.	Goal	A brief description of the Goal
SDG 1	No Poverty	End poverty in all its forms everywhere
SDG 2	Zero Hunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
SDG 3	Good Health and Well-being	Ensure healthy lives and promote well-being for all at all ages
SDG 4	Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
SDG 5	Gender Equality	Achieve gender equality and empower all women and girls
SDG 6	Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all
SDG 7	Affordable and Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all
SDG 8	Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
SDG 9	Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
SDG 10	Reduced Inequalities	Reduce inequality within and among countries
SDG 11	Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable
SDG 12	Responsible Consumption and Production	Ensure sustainable consumption and production patterns
SDG 13	Climate Action	Take urgent action to combat climate change and its impacts
SDG 14	Life below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development

SDG 15	Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
SDG 16	Peace, Justice and Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG 17	Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development

Table 1 17 Sustainable Development Goals

Governments are expected to take ownership and form policies and roadmaps to reach these goals. Each government should collect relevant data to review annual progress and take the required follow-up actions. These goals can be more effectively implemented by embedding all their required initiatives in the action plans of government's functional departments. Governments represent not only today's generation but also those to come, ensuring the rights of future generations. Energy is the heart of these 17 SDGs, particularly the SDG 7 which aims to ensure access to affordable, reliable, sustainable and modern energy for all by 2030. Sustainability is the objectives and process to achieve the above mentioned goals.

3. Emergency technologies

Digital technology is an enabler of sustainability. Efficient and affordable information and communication technologies and infrastructures allow digital economy to boost economic development. It is therefore essential to build resilient infrastructures, promote inclusive and sustainable industrialisation, and foster innovation. The paper describes some emerging technologies including artificial intelligence, internet-of-things, blockchain, carbon-neutrality, and metaverse etc.

3.1 Artificial Intelligence (AI)

Traditionally, computers are programmed with detail design and instructions so that computers can carry out a certain task by following those instructions. On the other hands, machine learning is to let the computers to learn themselves through experience, or to get trained to generate its own programme and instructions then to perform the required task. Machine learning is therefore the technology to allow computer to self-generated such programming instructions or algorithm. The functions of machine learning can be classified into 3 forms: descriptive – uses data to explain what happened, predictive – uses data to predict what will happen, prescriptive – uses data to take action. Machine learning hence will give computers the desired ability to learn without being explicitly programmed.

Machine learning techniques can be classified into four categories: (i) supervised learning; (ii) unsupervised learning; (iii) semi-supervised learning; (iv) reinforcement learning. In Supervised learning algorithm, the training data is labeled and the algorithm is to find hidden patterns in the data then to make predictions. In Unsupervised learning, the training data is not labeled and the algorithm is to organize the data to describe the structures. In Semi-supervised learning, the training data are mixed, most of the data are without labels and only some with labels. In Reinforcement learning, the algorithm is to learn from experiences and link with reward feedback. The Reinforcement algorithm provides a set of actions, parameters and end values; by trial and error method, an optimal output solution can be found.

3.2 Internet-of-Things (IoT)

The internet of things (IoT) is a network of physical devices, capable of communicating to one another including sensors, actuators, computers and machines. Each device is assigned with a unique identifier (UID), establishing the context of a device within a larger wired or wireless network. Through a host of network protocols, the device is able to transfer data and self reporting in real time. Hence an IoT platform manages these devices by digitally monitored and controlled both hardware and software.

Examples of application include smart cities, healthcare and smart homes, possibly some 50 billion of IoT devices are being used globally and these applications are enhanced by integrating IoT with cloud computing. Thus, IoT data are transmitted continuously to a cloud centre for processing and central storage.

An IoT sensor is a device such as a camera, motion, flow or air quality sensor or multiple functions integrated into one sensor. There are various types of sensors in collecting data for transmission over the IoT platform in performing the required role and functions. Information from multiple sensors can be combined and correlated to infer conclusions either in one IoT device or combined in software at the information level. For example, temperature sensor and vibration sensor data can be used to detect some mechanical failure. Basically, a smart sensor can convert detected variable to digital data then with locally in-built microprocessor unit for some data processing like filtering, compensation or process-specific function then handling local function, keeping local data and forwarding the data to central for further processing. Smart sensor allows IoT devices to be more independent, storing, processing, and analyzing data locally instead of just sending it to a centralized server.

With the scale and complexity of IoT generated data are tremendously increasing, data processing by centralized or cloud based approach may cause network bandwidth, bottlenecking and possible delay in analyzing these data. Edge computing is a better alternative by processing and analyzing these data closer to the point where it is being created. It thus creates opportunity for deeper insights, faster response time and improved user experience. A typical application is the video which is sent by a security camera with 24 hours continuing monitoring. Without edge computing, the security camera would constantly transmit all its contents to the central location for processing. While with edge computing, only those videos with suspicious activity identified by local computing or AI will be sent to the central for alarm and action. Edge computing thus provides the benefits of collecting key information from smart sensors rapidly and effectively with greater reliability and enhanced security

3.3 Blockchain

Blockchain is a digital database or ledger that is distributed among the nodes of a peer-to-peer network. A database structures its data into tables, whereas in Blockchain, structures its data into blocks (stringing them together). It is a database of information and a distributed ledger; it is a database of information and a distributed ledger; it contains a series of blocks with a sequential chain-like structure. A transaction can be a cryptocurrency, contract, document or a piece of data. Upon a transaction request is made by a user, the request information will be passed to all the nodes in the network (of all users). A verification process is then taken place through the hashes. Hash can be considered as an address. After the verification is successfully completed, the transaction can proceed by adding a new block with putting in the hash address of previous block and the new block. This process is carried out with a consensus algorithm, with defined validation interval, is used to prevent the duplication and manipulation of transaction added to the chain.

3.4 Carbon-neutrality

Power industry is the largest carbon emission sector and hence it is essential to take all required carbon mitigation measures and to achieve zero emission. Carbon Neutrality is to end carbon dioxide emission and power industry is to produce energy without emission. There is also a short term target to achieve: Carbon Peaking. Carbon peaking is the process that the annual carbon dioxide emission of a region or a country reaches the highest value in history and then enters the continuous decline through the platform period. Hong Kong Climate Change action Plan is strived to achieve carbon neutrality before 2050 with four major decarobisation measures: net-zero electricity generation, energy saving & green buildings, green transportation and waste reduction. China has made commitments on dual hydrogen targets to achieve carbon peaking (short term) by 2030 and carbon neutrality (long term) by 2060.

At 2021, the estimated $CO2_2$ emission is around 37 Gt. The pathways to achieve carbon neutrality can be shown in Figure 7. During the carbon peaking plateau period, steps are required to reduce energy consumption, increase non-fossil energy generation. During the deep decarbonisation period, the fossil energy generation will require rapid reduction with replacement by renewable energy or nuclear energy generation, and electrification of various industries will take place. For the carbon neutrality period, all other non-CO_2 emission will also be greatly reduced.

For the power industry to reduce CO_2 emission, decarbonisation process must be accelerated by phasing out conventional coal-firing plant and speedily adopting non-fossil energy. Hence the renewable energy and nuclear energy production need to be increased. It is expected that 90% of electricity generation should come from renewable energy. For those where fossil fuel generation is still employed, carbon capture, utilization, storage (CCUS) technology must be employed to supplement to CO_2 reduction by CCUS.

3.5 Metarverse

The development of Metaverse became noticeable from 2021 as all related supporting technologies were the enablers, including the Graphic Display Power Chip Unit (GPU), Game Engine, VR (Virtual Reality), AI (Artificial Intelligence), IoT (Internet of Things), 5G and Blockchain technologies. These groups of technologies can be abbreviated as BIGANT (**B**lockchain, **I**nteractivity, **G**ame, **A**I, **N**etwork - 5G, **T**- IoT. Using VR headset (eyeglasses) and hand devices, individual users have their respective avatars (similar to the user's physical self, to experience an alternated life in the virtuality. Metaverse is a virtual world built in real world for social, entertainments, create, exhibit, educate and exchange activities. There are eight key characteristics of Metaverse: Identity, Friends, Immersive, Low Friction (minimum delay), Variety, Anywhere, Economy and Civility. One major application of Metaverse is the VR Training.

4. Applications

The following are 3 examples in using emerging technologies for enhancing sustainability. The first example is on Smart Construction Sites – with emphasis on site safety enhancement. The second example is on Smart Cities– with an vision to build a world-famed Smart Hong Kong characterized by a strong economy and high quality of living. The third example is about Smart Grids – the grid basically has the ability to rapidly detect, analyze, respond and restore power after a failure event. A smart grid is essentially an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end users.

4.1 Smart Site Safety System

In Hong Kong, Safety is an utmost important element in construction industry. The HKSAR Government has specified that for all government capital works contracts with an estimated contract sum exceeding HK$30 million, a Smart Site Safety System (SSSS) is required for the construction work. Basically, SSSS comprises three components:

(a) smart safety devices for monitoring high-risk construction activities and identifying safety hazards;
(b) a communication network for transmission of data collected from smart devices; and
(c) a centralized management platform1 for providing a one-stop hub for data analysis and alerts generation, as well as facilitating follow-up actions with potential hazards and abnormalities identified.

In terms of functional features, there are 10 components in a typical Smart Site Safety System.

- **Centralized Management Platform**: a platform integrates spatial data, images, video and IoT sensors data. Acting as the common data environment (CDE) for receipt and display of required safety data.
- **Digitalized Tracking Subsystem**: covering Asset management and Status reporting. QR code is adhered on equipment and information is provided from mobile/web Apps to view or edit or update equipment information including maintenance status.
- **Digitalized Permit-to-work Subsystem**: it is ae-form approach to manage Permit-to-work flow. It also works with Telegram chatbot Apps
- **Hazardous Areas Access Control**: application of smart lock for electrical cabinet, life fence door, confined space entrance restricted room, floor opening with latch.
- **Unsafe Acts & Dangerous Situation Alert**: AI camera could identify human or vehicles in dangerous or hazardous area and generate real-time alerts on-site. Real-time streaming and record footage can help incident investigation. Proximity detection can trigger alert to supervisor when workers are too close to dangerous movable machinery or equipment.
- **Tower Crane Alert**: This is a tower crane lifting zone monitoring system. AI camera could identify human or vehicles in dangerous or hazardous lifting area and generate real-time alerts.
- **Smart Monitoring Devices for Workers**: Smart Watch can detect worker's positioning, standstill, free-fall, body condition and proximity detection. Smart helmet with IoT sensors is another example in identifying workers live location and measuring vital signs such as body temperature and even heart rate.
- **Safety Monitoring Subsystem using AI Camera**: Zonal control, PPE Detection, Temporary Traffic Arrangement with Impact Detection
- **Confined Space Monitoring Subsystem**; access control, people management, real time toxic gas sensor are three major areas to enhanced confined space safety in construction site
- **Safety Training with Virtual Reality Technology**: VR Training can be provided with safety materials. The technologies adopted for metaverse are useful in developing the required training courses.

4.2 Smart Cities

The HKSAR Government published in December 2020 the Smart City Blueprint 2.0 for Hong Kong with more than 130 smart city initiatives covering six smart areas. These new initiatives aim to bring benefits and convenience to public through innovation and technology in their daily lives.

(a) Smart Mobility

- Develop a Traffic Data Analytics System to enhance traffic management and efficiency;
- Set up the Smart Traffic Fund to promote research and application of vehicle-related I&T;

(b) Smart Living

- Use the "iAM Smart" platform to streamline the Transport Department's licensing services;
- Explore the use of telehealth, video-conferencing and remote consultation in Hong Kong;

(c) Smart Environment

- Launch the "smart toilet" pilot programme and explore the application of technologies in public toilets;
- Improve pest control using technologies such as Internet of Things technology;

(d) Smart People

- Implement the IT Innovation Lab in Secondary Schools Programme;
- Continue to implement the STEM Internship Scheme;

(e) Smart Government

- Develop the Electronic Submission Hub for processing building plans;

- Implement the Be the Smart Regulator Programme to facilitate online application for all licences, and reform government services involving applications and approvals under the Streamlining of Government Services Programme;

(f) Smart Economy

- Develop an online platform to provide efficient and cost-effective online dispute resolution and deal-making services; and
- Develop the eMPF Platform by the Mandatory Provident Fund Schemes Authority.

As an example, smart Street lighting is one key element inside the Smart Cities. Smart lamp pole is an important component in supporting the development of autonomous driving by providing essential infrastructure for vehicle-to-infrastructure (V2I) communication. V2I communication involves the exchange of information between autonomous vehicles and roadside infrastructure, to support navigation, safety, and traffic flow management.

Our mobility using fossil fuels has significant consequences for CO_2 emissions as well as air pollution with particulates and nitrogen oxides. The transformation to Electro-mobility which also called as E-Mobility has taken place in using electric propulsion in a wide range of transportation application including Electrical Vehicle (EV) or even ships. Railways electrification was carried out a few decades ago but combustion engine in vehicles has started and is accelerating. Energy to drive is therefore towards electrical power sources supplied from power grid. E-Mobility ensures that eco-friendly, quiet and efficient vehicles will be on our roads. The common feature of all of these moving vehicles is that a means of storing energy on board.

Furthermore, Vehicle to Grid (V2G) is a technology where bidirectional flow of power between EV and the power grid is possible. From Grid to Vehicle is the normal charging of EV. V2G is used to provide power backup for the home or company or selling back to power grid to stabilize demand variation in the grid. It thus provides the flexibility of using the energy storage of EV to support grid operation.

4.3 Smart Grids

Grid is inside a transmission system and is the interconnected group of circuits and related equipment for moving electrical energy of high voltage from source to load areas and stepping down to a lower voltage for energy delivery to customers. There are many definitions of Smart Grid. One good definition of Smart Grid is the ability to rapidly detect, analyze, respond and restore power after a failure event. The grid design should mitigate and be resilient to physical and cyber-attacks and provide power quality needed by current and future users. A smart grid is essentially an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end users.

For power system fault diagnosis, AI is useful in faults detection, classification and location estimation. It can form a knowledge based (quantitative and qualitative) fault diagnosis and with historical data based (using statistical by regression, pattern recognition classifier) for classification. Support Vector Machine technique is also developed by inputting post-fault current and voltage signals for classification of faulty phase classification with high accuracy.

In the area of power system control, AI can contribute in security control, stability control, voltage and reactive power control. The Deep Learning Gated Recurrent Unit (DLGRU) technique can solve the reconfigurable power grids by learning the topological patterns and understand the complex nonlinear characteristics of the grid in a “learn to optimize” manner.

For the power system operation, AI can serve in the following areas: system resilience, mircogrid operation, voltage and frequency control, renewable generation, voltage stability assessment, cyber-attack detection, system anomaly detection, outage forecasting etc. For decision areas, AI can serve in: optimal system planning, market trading, fault detection and diagnosis, restoration, risk management and life cycle management. For comprehensive perception areas, AI can serve in: wide area monitoring system, advanced metering infrastructure, renewable generation prediction, condition monitoring.

Battery Energy Storage Systems (BESS) are basically rechargeable batteries which can store electrical energy from various sources and discharge for use when it is needed. Normally, the emergency power provided by standby or backup generators would be accordingly to the initial estimation of the requirement together with the N-1 contingency for single unit failure. Nowadays with more renewable energy installed in the power system, BESS is a good approach in handling fluctuation of sources supplies.

5. Conclusion

With various emerging technologies developed and with new approaches, our future should follow the roadmap of sustainability. This paper describes these technologies with an objective for achieving SDGs formulated by the United Nations. The key issue is on understanding of these technologies and applying in an innovative manner towards the required sustainability.

Direction of Reforming Korean Electricity Market

Prof. Hong Chong Cho
Dep. of Economics,
Dankook University

FAPECA

Nov. 15. 2023

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1. Issues in the Korean Electricity Market

2

1. Korea's Energy Master Plan Abolished by Carbon Neutrality Act

The revised roadmap for achieving the national greenhouse gas reduction target of 2030

Framework Act On Carbon Neutrality And Green Growth For Coping With Climate Crisis

Presidential Decree No. 32557, Mar. 25, 2022
Act No. 18469, Sep. 24, 2021

The Third Emissions Trading Scheme Basic Plan

The 10th Basic Plan for Electricity Supply and Demand (2022~2036)

The 15th Long-term Natural Gas Supply Plan (2023~2036)

The Fifth Basic Plan for the Development and Deployment of New and Renewable Energy

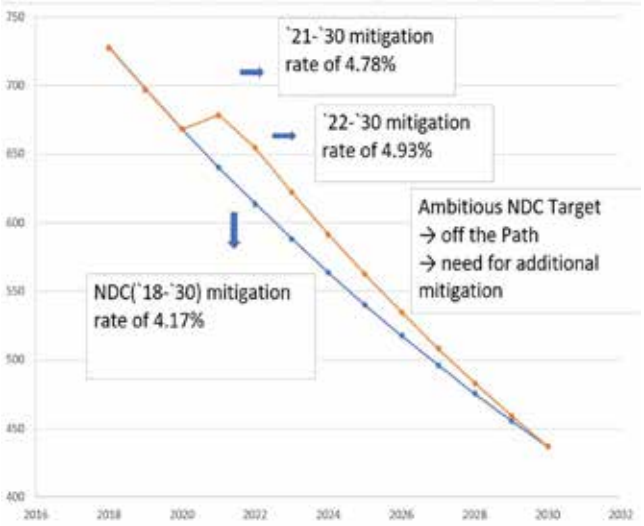
The 5th Basic Plan for Group Energy Supply

The 1st Basic Plan for the Transition to a Hydrogen Economy

3

1. NDC Pathway & Roadmap

If Korea tries to bind a 40% reduction from the NDC `18,
⇒ It may not match the reality when finding the optimal path backward from the ending period
⇒ Or must reduce dramatically



(unit: million tons of CO2e, in parentheses is the reduction rate compared to 2018)

Category	Sector	2018 Performance	2030 target	
			Previous NDC (`21.10)	Current roadmap (`23.3)
Total emissions		727.6	436.6 (40.0%)	436.6 (40.0%)
Emissions	Transition	269.6	149.9 (44.4%)	149.8 (44.4%) -4.0[1]
	Industry	260.5	222.6 (14.5%)	230.7 (11.4%)
	Buildings	52.1	35.0 (32.8%)	35.0 (32.8%)
	Transportation	98.1	61.0 (37.8%)	61.0 (37.8%)
	Agrifood	24.7	18.0 (27.1%)	18.0 (27.1%)
	Waste	17.1	9.1 (46.8%)	9.1 (46.8%)
	Hydrogen	(-)	7.6	8.4[2]
	Fugitive	5.6	3.9	3.9
Absorption and removal	Sinks	(-41.3)	-26.7	-26.7
	CCUS	(-)	-10.3	-11.2[3]
	International	(-)	-33.5	-37.5[4]

※ **The emissions for the base year (2018) are total emissions**
Emissions for 2030 are net emissions (total emissions - absorption and removal)

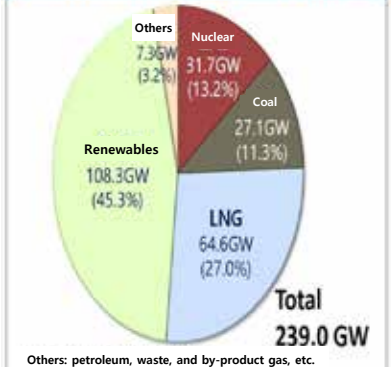
1) 400 million tons of additional reduction through the expansion of clean energy, such as solar and hydrogen
2) Consideration of the expansion of supply based on the latest update of hydrogen demand (blue hydrogen + 10.5 million tons → increase in greenhouse gases by 0.8 million tons)
3) Expansion considering the overseas CCS potential (0.8 million tons) and the progress of CCU demonstration (0.1 million tons)
4) Expansion of international reduction by 400 million tons for cost-effective reduction

1. The 10th Basic Plan faces NDC challenges

- Growing electricity demand
- Massive expansion of renewable energy
- Growing nuclear power
- Declining coal-fired generation
- Need for additional LNG power plants

- **Ambiguity on electrification demand (EVs, data centers) model (GCAM-KAIST), never published, and even more so, only reflecting 50% without any basis**
- **Jeju Island's Renewable E Curtailment Problem Expands onshore:** Jeju Wind and Solar Output Limits ('21) 65 times, 12,045 MWh → ('22) 132 times, 28,853 MWh
- **Realism of renewable facility planning?**
- **Coupling of renewables with nuclear power?**

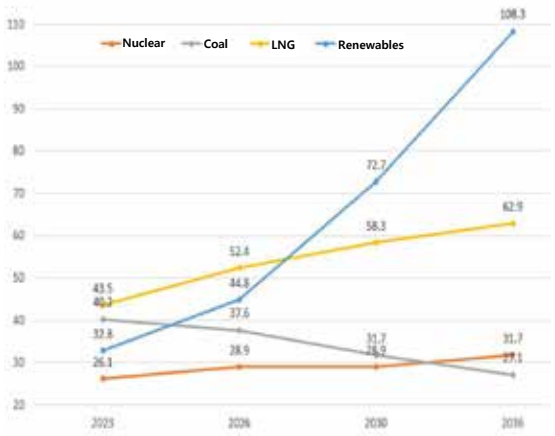
Power Generation Mix Outlook ('36, Installed Capacity)



Others: petroleum, waste, and by-product gas, etc.

Electricity Demand Outlook

Year	Reference demand		Target demand	
	Consumption (TWh)	Maximum power (GW)	Consumption (TWh)	Maximum power (GW)
2023	558.3	102.5	553.4	98.8
2030	637.6	119.8	572.8	109.3
2036	703.2	135.6	597.4	118.0



5

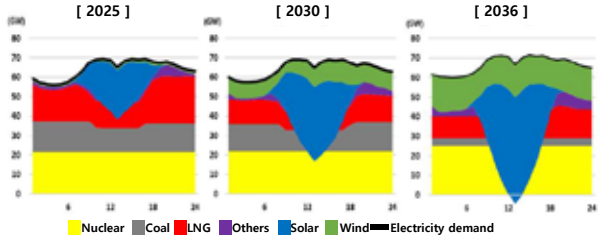
1. Flexibility Challenges in the Electricity Market Due to Renewable E Growth

- **Need to Address Electricity Market Instability Caused by Increased Renewable Energy**
- **Addressing the Need for Inertia, Frequency Maintenance, and Balancing Regional Energy Disparities**

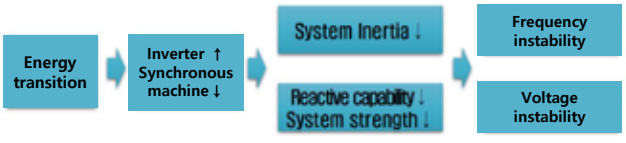
< Renewable energy deployment stages and challenges >

Category	Renewable E share (domestic reach)	Grid impact	Challenges
Stage 1	3% or less (~`17)	Minimal grid impact from Renewables	Examining localized grid impacts
Stage 2	3~15% (`18~`26)	Recognize Renewables Volatility Impact	Gaining visibility
Stage 3	15%~25% (`27~`34)	Prioritizing flexibility	Increasing flexibility
Stage 4	25%~50% (`35년~)	Increasing importance of grid stability	Improving reliability

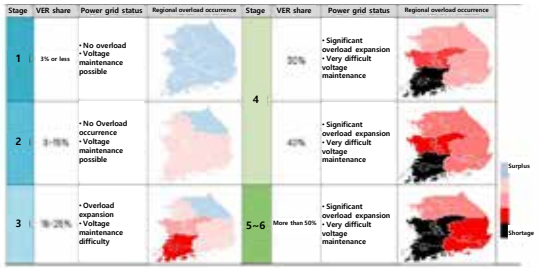
◆ RE variability → requires a breakthrough expansion of flexibility resources (such as storage)



◆ In the era of inverter-based renewable energy as the main power source, securing system inertia and system strength is essential



◆ RE regional imbalance → power grid reinforcement and new stability resources (synchronous condensers, grid forming devices, etc.)



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1. Rising Social Costs in the Pursuit of Carbon Neutrality

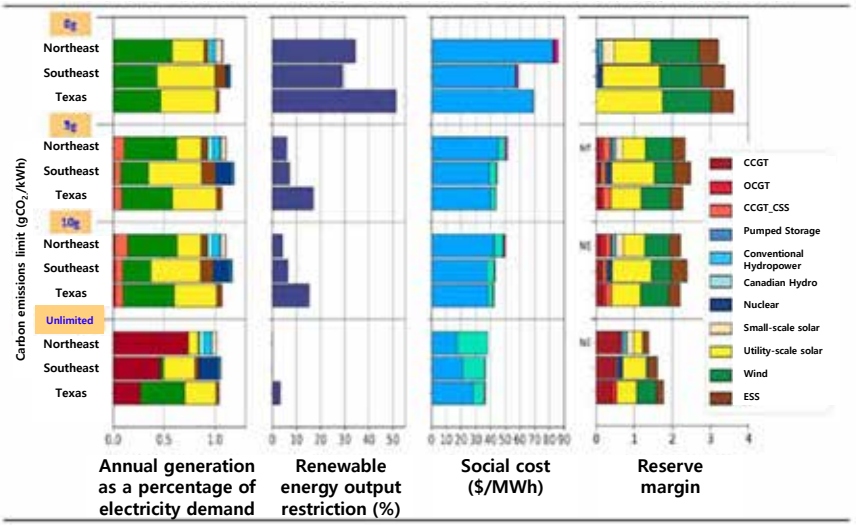
- Increased social system costs due to the increase in the share of renewable energy in the United States
- Output restrictions (exceeding 50% in Texas)
- Social costs: The social costs are expected to double or triple by 2050 due to the need to reinforce the grid and increase backup capacity.
- Increased reserve margin: 40-80% (in the case of no carbon emissions restrictions)
- -> 220-250% (in the case of carbon neutrality)

*SCOE: Society's Cost of Electricity

**South Korea's reserve margin at the end of 2021: 44.1%

To address output restrictions, reduce grid and facility infrastructure costs, and achieve an appropriate reserve margin, a distributed system must be built.

< Carbon emissions reduction in major regions of North America: changes in output restrictions, social costs, and reserve rates >



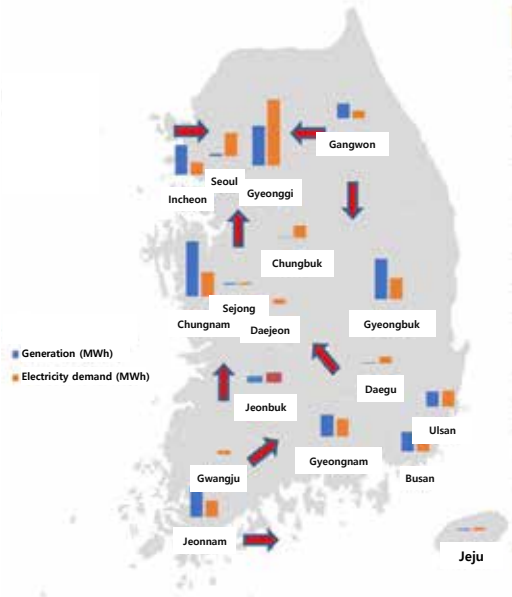
KEMRI, 23.02.03

1. Regional power supply imbalances

- Gap between electricity production and demand
- Seoul 11% self-sufficient
- Gyeongbuk 184% self-sufficiency
- Jeonnam 185% self-sufficiency

Large-scale transmission and distribution grid expansion required

<Municipal electricity self-sufficiency rates (2021)>

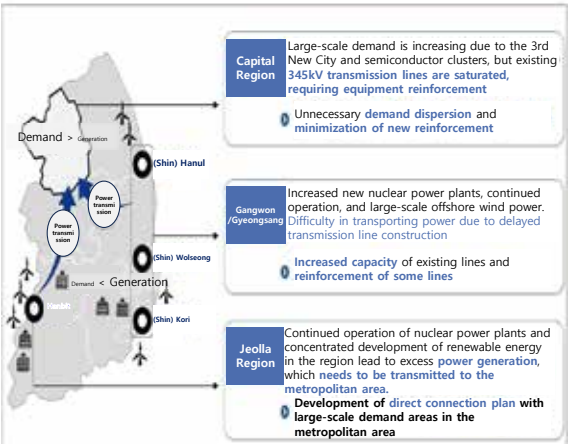


Municipal electricity self-sufficiency rates	
Seoul	11%
Busan	192% (Nuclear)
Daegu	18%
Incheon	243% (LNG, Coal)
Gwangju	7%
Daejeon	2%
Ulsan	94%
Sejong	88%
Gyeonggi	62%
Gangwon	182% (Nuclear, Coal)
Chungbuk	8%
Chungnam	228% (Coal)
Jeonbuk	67%
Jeonnam	185% (Nuclear, Renewables)
Gyeongbuk	184% (Nuclear)
Gyeongnam	123% (Coal)
Jeju	70%

1. Future Power Grid: Establishing a Grid Primarily Utilizing HVDC

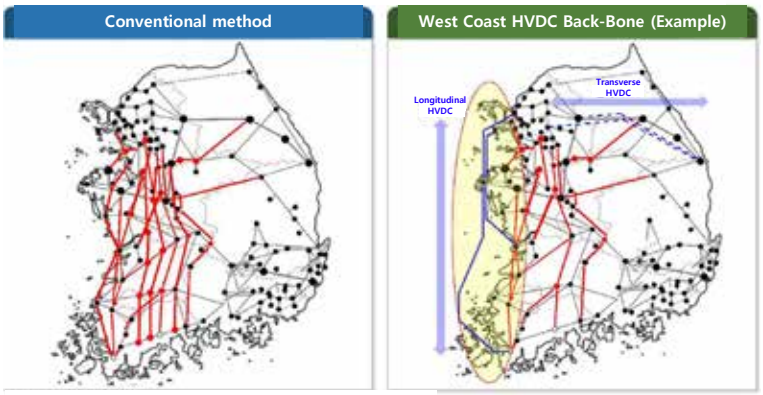
- **New transmission lines need to be expanded beyond the 10th Power Transmission and Distribution Plan**
  - The existing transmission lines are saturated, and the mismatch between energy supply and demand needs to be resolved urgently
  - HVDC lines will be the backbone of the future power grid, with lines running along the West and East Seas
  - Basic transmission and distribution networks need to be built and complemented urgently

- **Proposed optimal power grid construction plans tailored to regional new demand and supply plans**



Source: Korea Electrical Association, Future Power Grid Construction Plan, April 13, 2023

- **HVDC transmission lines needed to transmit power from the West and South Sea regions to demand centers**
- **National core power grid to be built using longitudinal(↕) and transverse(↔) HVDC**



Source: KEPCO Transmission Planning Department

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2. Direction of Reforming Korean Electricity Market

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2. Considerations for the Future Energy Market

- Increased impact of electrification
- Expanding carbon-free power
- Strengthening energy security
- Ensuring grid stability
- Reduction of greenhouse gas emissions

A. Increased impact of electrification

- (Acceleration of electrification) Electrification is being promoted as a key measure to achieve carbon neutrality, and the share of electricity in final energy is expected to increase significantly.
  - According to the NEW Energy Outlook (BloombergNEF, 2023), electrification (23%) is the second-largest contributor to carbon neutrality, after clean energy transition (51%)
- (Expansion of sector coupling) Major countries are establishing sector coupling strategies to respond to the increase in cross-sector conversion demand.
  - Excess electricity generated from renewable energy is being converted into hydrogen, heat, and other forms of energy to improve the flexibility of the power system.

- Actively utilize demand-side resources to build a sustainable energy system by integrating analysis across the energy system, including electrification and sector coupling, and going beyond the limits of supply-side resources.

B. Expanding carbon-free power

- (Carbon-free energy transition) To reduce greenhouse gas emissions in response to climate change, the supply system of the energy system is being converted from a fossil fuel-based system to a renewable energy and carbon-free energy-based system.
  - Coal-fired power generation is being reduced and phased out, and carbon-free power generation, such as nuclear power and renewable energy, is being maximized to develop measures to achieve carbon neutrality goals
  - It is necessary to promote the commercialization of new resources such as hydrogen ammonia and SMR to quickly secure core energy technologies.

- Build a carbon-free power supply system centered on a carbon-free energy mix, the expansion of various power generation technologies, and the securing of system stability in response to changes in the future energy system

C. Strengthening energy security

- (Energy security) Energy security has emerged as a key issue due to the global energy crisis triggered by the Russia-Ukraine conflict.
  - Major countries are re-evaluating their energy policies to promote renewable energy and expand nuclear power in order to enhance energy security.
  - The International Energy Agency (IEA) has recently released a report (World Energy Outlook 2022) that outlines 10 key policy actions to enhance energy security in the context of energy transition.

Promoting clean energy and reducing fossil fuels in parallel, recognizing the importance of demand management and prioritizing efficiency improvements, and increasing investment in power system flexibility.

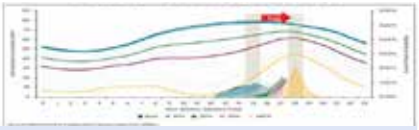
- To address the climate crisis and accelerate the transition to carbon-free energy, it is imperative that energy transitions and decarbonization take into account national energy security

KRX Future Energy System Construction Plan (Draft)

D. Ensuring grid stability

- (System stability assurance) Due to climate change and the increasing share of renewable energy (RE), volatility and uncertainty are increasing, and proactive measures are needed to ensure the reliability of power supply.
  - Even in a situation with high reserve margin, a power crisis situation can occur depending on the amount of solar power generation.
  - It is necessary to establish a time-based reliability evaluation system that reflects the characteristics of the system with the increasing share of RE and takes into account flexible demand response.

[Shift of peak power generation time due to the increase in the share of solar power]



- Establish a power supply reliability evaluation system to ensure system stability in conjunction with the expansion of a carbon-neutral energy mix and the expansion of various power generation technologies

E. Reduction of greenhouse gas emissions

- (Global response status) Major countries are committed to energy transition and carbon neutrality to address climate change and accelerate the transition to carbon-free energy, taking into account their energy conditions.
  - Carbon neutrality will continue to be pursued, but energy policies will be reset to promote the use of renewable energy and increase the share of nuclear power in order to ensure energy security in each country.
  - Each country has taken measures to overcome the energy crisis, such as securing alternative fuel sources, stockpiling gas, extending the operating life of some nuclear power plants, and promoting the use of renewable energy.

Major country policy trends

UK	Policy direction: Achieve carbon neutrality by 2050 and reduce reliance on foreign energy Nuclear power expansion: Announced a plan to build up to 8 additional nuclear power plants by 2050 for energy security in 2022.
France	Policy direction: Achieve carbon neutrality by 2050, achieve a 50% share of nuclear power by 2035, and achieve a 40% share of renewable energy by 2030. Expansion of renewable energy: Set a target of installing 100 GW of solar power and 40 GW of offshore wind power by 2050.
US (CAISO)	Policy goal: Achieve carbon neutrality by 2050 and provide stable and affordable clean energy. Decarbonization: Plan to phase out all coal by 2026 and 15 GW of LNG by 2040.

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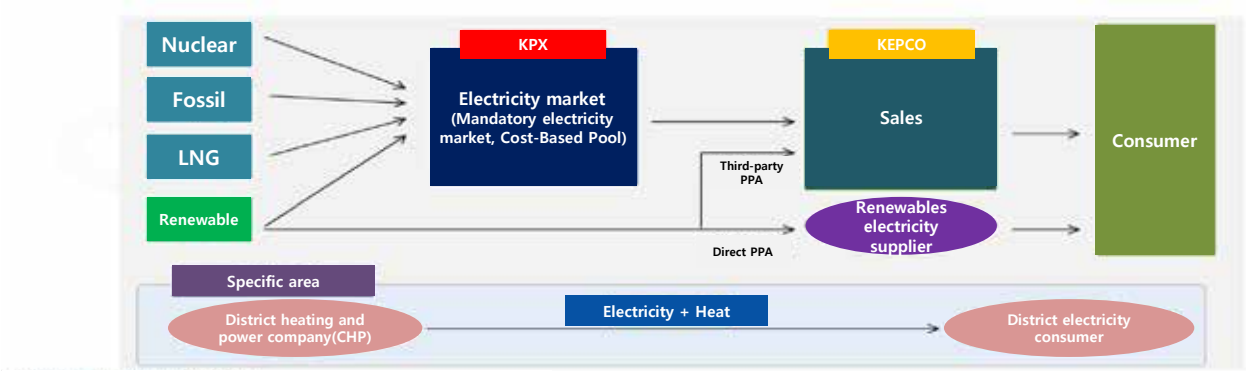
2. The Reality of South Korea's Electricity Market

- Outdated Market System Relative to Economic Size
  - (Mandatory Pool) All electricity transactions must go through the electricity market (excluding renewable PPA)
  - (Cost based Pool) Competition based on evaluated fuel costs, capacity fees to compensate for fixed costs
  - (One-way market) Only supply bids from generators, no demand bids from retailers, demand is forecasted by the power exchange
    - Non-central generators, including renewable energy, do not participate in bidding, only central dispatch generators such as fossil and nuclear power participate in supply bidding
  - (Limited competition) The retail market is not open, and generators are prohibited from engaging in sales businesses (Article 7 of the Electric Utility Act)



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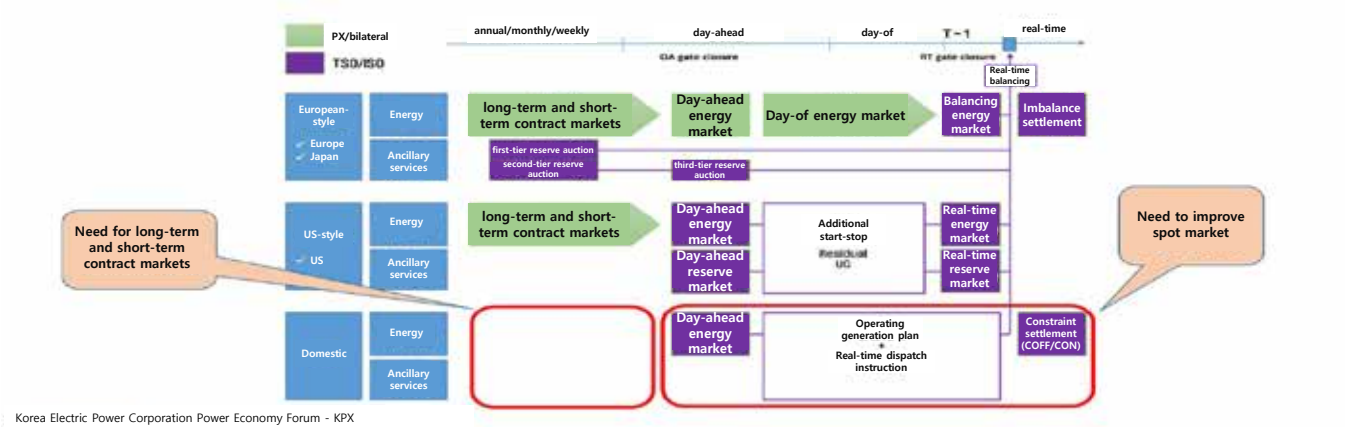
2. Characteristics of South Korea's Electricity Market

- Compared to advanced markets, neither Forward contracts, real-time markets, or balancing energy markets exist
- Need to improve long-term and short-term contract markets and spot markets
- The structure of the Korean electricity market
  - The Korean electricity market is currently only composed of a day-ahead market.
  - In overseas electricity markets, the current forward contracts (derivatives, hedging contracts) are also short-term contracts within 1 month to 3 years.
    - ➢ long-term contracts that increase with the lifespan of power plants (15-20 years) are promoted by central contracts (CfD) or PPA contracts.



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2. Reform Direction and Roadmap for the Electricity Market

- Single day-ahead market → Diversification of power market structure and diversification of fuel price risk
  - Single price (SMP) + single market (day-ahead market) →Synchronization of price volatility risk of entire power market
  - Renewable energy SMP+REC compensation structure →Revision of tariff system for separation of fuel-free power plants
- Revision of renewable energy control and settlement system
  - Response to insufficient storage
  - Inability to compensate for synchronous compensators and grid forming using only ancillary services
  - Revision of clean hydrogen support system and structure for early escape from subsidies
  - Construction of central contract structure for new energy
- Revision of spot market to auction market
  - Renewable energy non-central power plants →Contributing to market operation through central dispatch
  - Mandatory auction of two-way price auction
  - Price signals: regional marginal price, regional differentiated transmission and distribution charges, regional differentiated electricity charges
  - Imposition of real-time imbalance penalty
- Establishment of tariff system based on cost-first principle
  - Principle of implementation of fuel price linkage system
  - Prohibition of politicization of electricity charges

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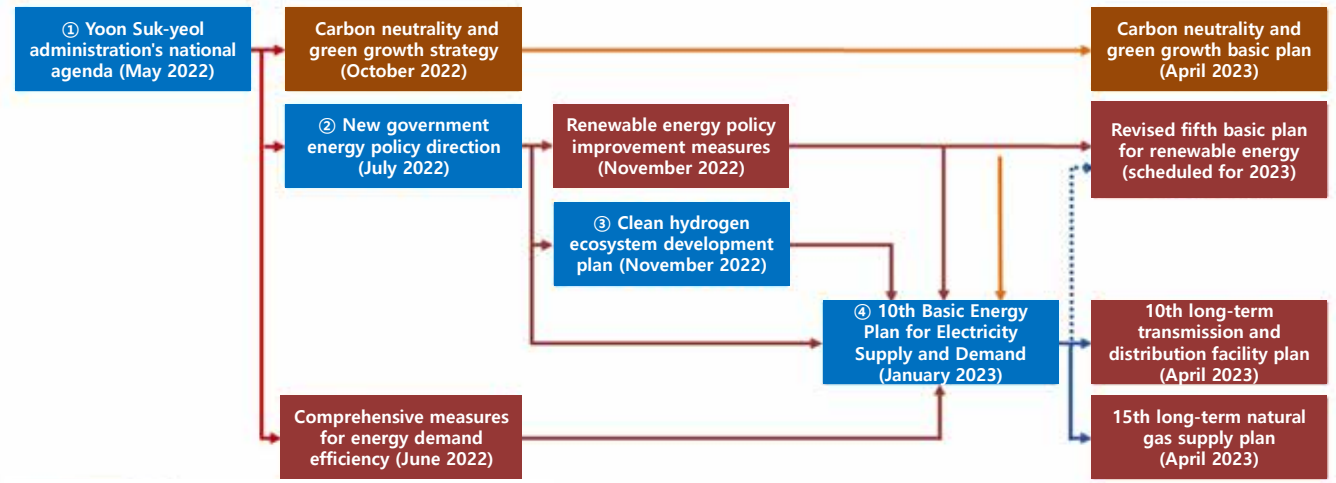
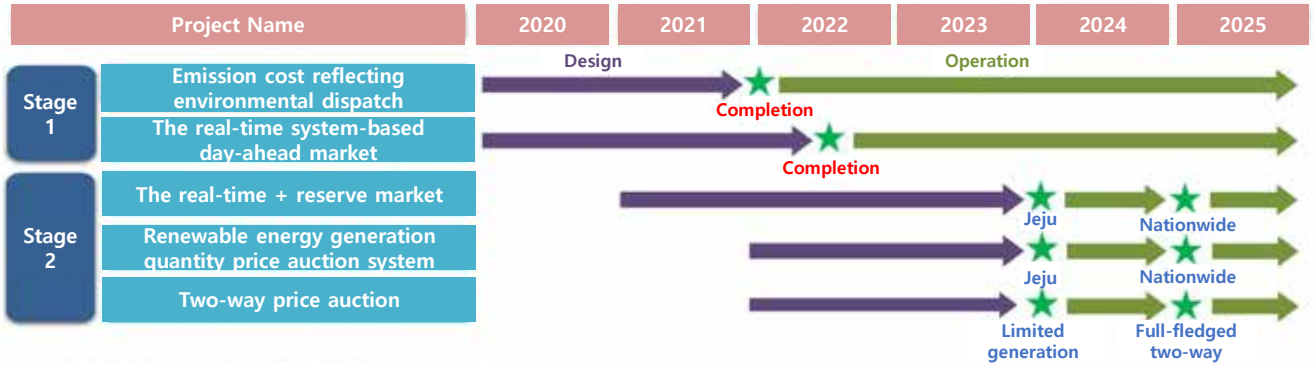
2. Government Energy Policy Direction

- Implement realistic carbon neutrality through scientific energy policies, while revitalizing the nuclear power ecosystem, green investment, and energy new industries to drive economic growth and create jobs.

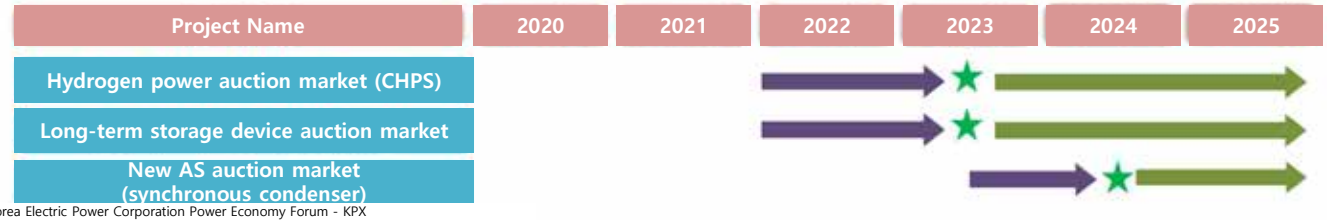


2. Reform Direction and Roadmap for the Electricity Market

Spot market improvement



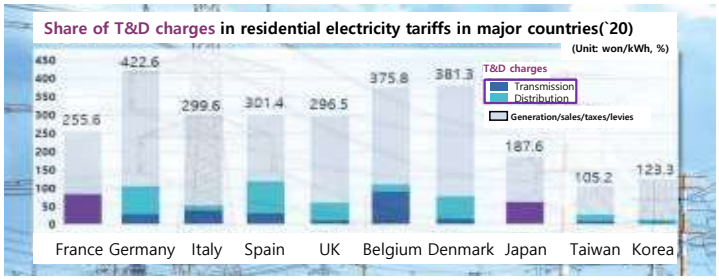
Introduction of auction market (central contract)

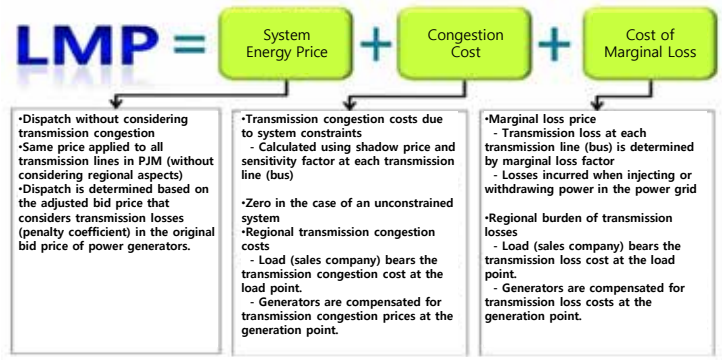


2. Reform Direction and Roadmap for the Electricity Market

- **(1) Implementation of real-time system-based day-ahead market (22.09.01) completed**
  - Determination of constraint-based SMP, abolition of transmission COFF, reserve power compensation plan
- **(2)Real-time reserve power market introduction → Jeju pilot project (23.12)**
  - Introduced a 15-minute real-time market in Jeju, and set prices for real-time deviations from the day-ahead forecast.
- **(3)Introduction of renewable E bidding system → Jeju pilot project (23.12)**
  - Resourcing central power supply through renewable energy bidding, participation in day-ahead market and real-time bidding for renewable energy exceeding 1MW
  - Suppresses renewable energy generation by creating a negative market price when there is an oversupply of renewable energy.
- **(4)Introduction of a two-way price bidding system → by 25.12**
  - (Step 1) Limited supply-side bidding, (Step 2) Full two-way bidding
  - Consideration of must-run generation, expansion of contract volumes including hedging contracts, and enhancement of market monitoring system
- **(5) Long-cycle BESS bidding market → Expanded to the whole country after Jeju on 22.06**
  - Competitive bidding for long-cycle BESS volumes, with preferred bidders selected by the Central Contract Market Committee based on price and non-price.
  - Obligation to construct BESS within the facility completion deadline
  - Preemptive implementation of 65MW/260MWh in `24, applied based on discharge capacity

1. Locational Marginal Price



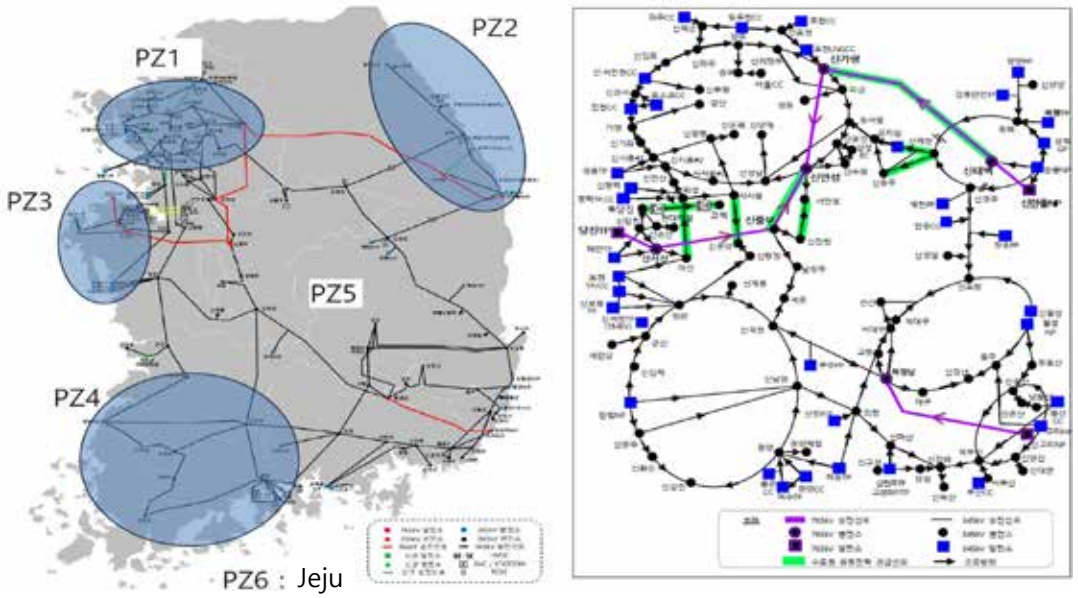


Source: Korea Electric Power Research Institute, Study on the Provision of Rational Price Signals for Efficient Operation of Power Grids, 2014

- **Regional power supply imbalance causes transmission problems and social conflict.**
- **All regions bear the same cost of power loss caused by transmission distance.**
- **In Korea, the proportion of transmission and distribution network usage fees is very low, and a uniform rate system is implemented by region.**
- **It is desirable to transition to LMP in the long term.**
- **(Considerations) When calculating the fee, the following factors should be considered: the distance between power plants and electricity users, the cost of electricity supply due to generation, transmission, substation, and distribution, voltage and power reserve rate.**
- **(Additional fee system) Time-of-use (TOU) rate system**
- **(Effects) The effects expected include the diversification of generators and demand, improvement of economic efficiency of system operation, and induction of efficient location selection of power-intensive businesses.**

2. Reform Direction and Roadmap for the Electricity Market

Domestic Extra-High Voltage (EHV) grid and Price Zone example



Korea Electric Power Corporation Power Economy Forum - KPX

19

Thank you !

20


Gardens by the Bay
A Green Marvel for Sustainability

Development of our Garden City

1963: Launch of Tree Planting Campaign

1967: Announcement of Garden City Policy

1968: Formation of Parks & Trees Branch

1973: Creation of Garden City Action Committee

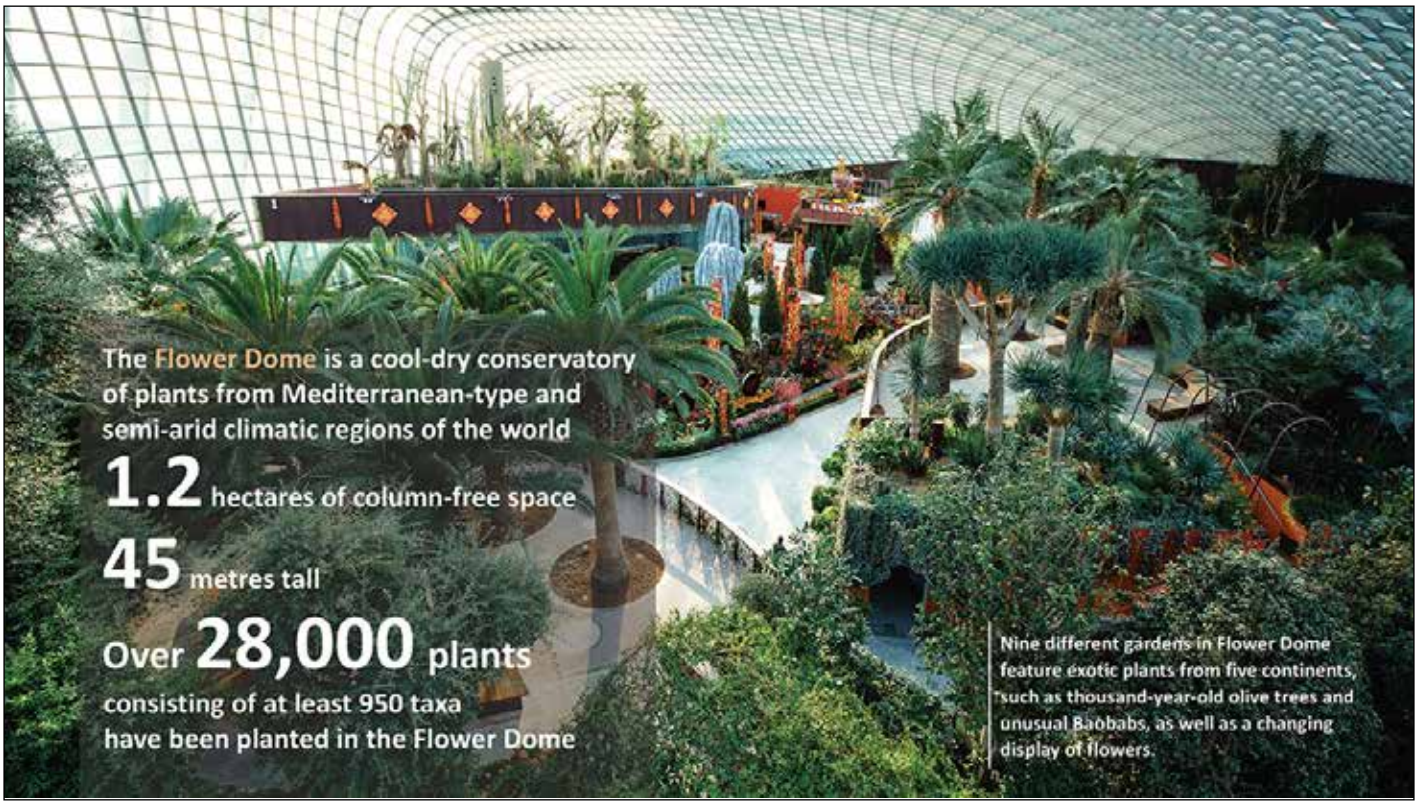
Singapore on the Equator


Challenges faced:
Reclaimed Land;
Infrastructure;
Greening
Jan 2010


A nation's garden in the heart of Singapore's downtown
101 ha National Garden and Premier Horticultural Attraction
• A Distinctive Global City
• A Source of National Pride for Singaporeans
• A Compelling Leisure Destination for locals and tourists
"Green necklace" around Marina Bay
Indoor Stadium
Bay Central
Tanjong Rhu
Esplanade Theatres
Singapore Flyer
NTUC Golf Course
Bay East
Marina Bay Sands
Bay South
Marina Barrage


The Gardens today
Over 93 million visitors
Bay East
32 ha
Bay South
54 ha
Bay Central
15 ha

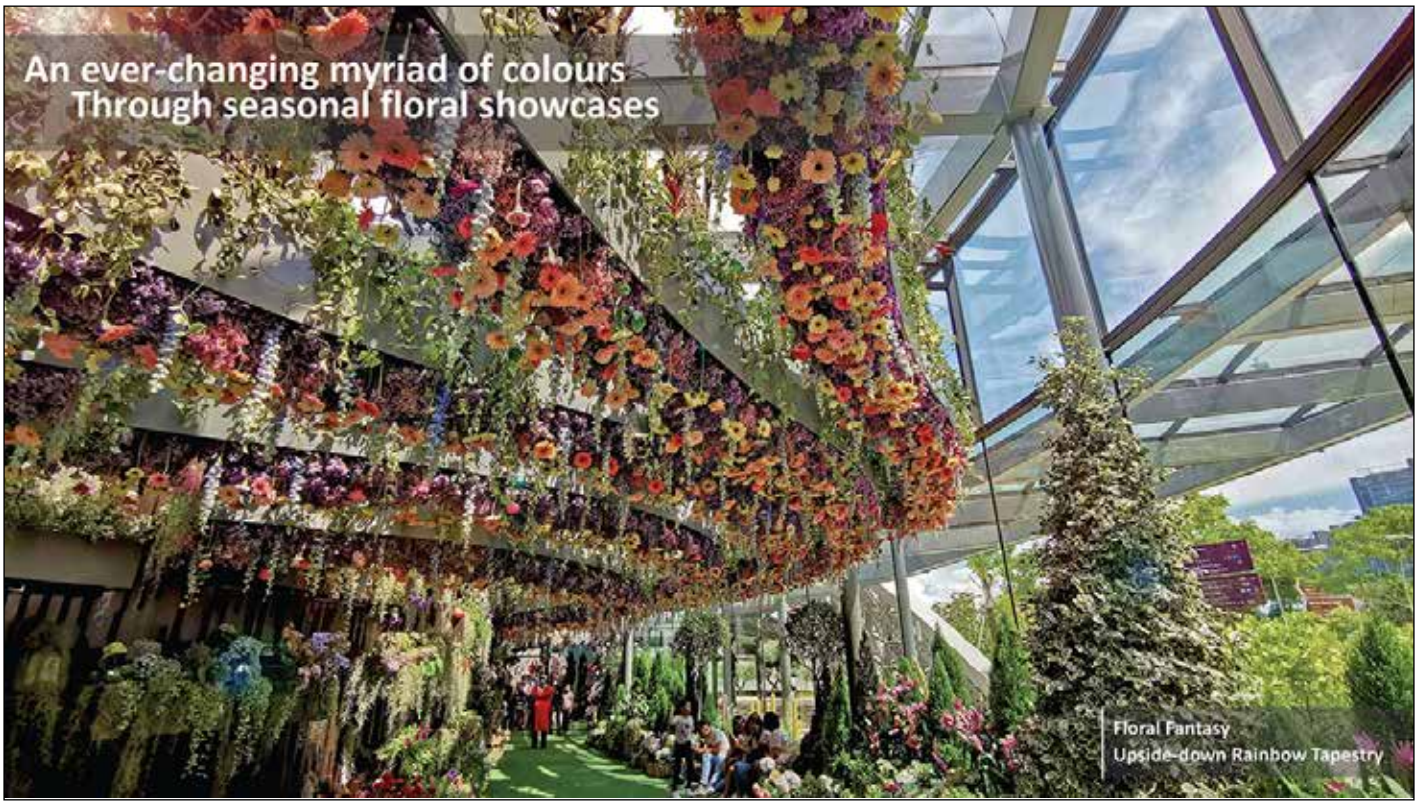

Bay South's main attractions, designed to inspire people to care for plants and planet through tropical horticulture and garden artistry, include 2 glass biomes (Flower Dome & Cloud Forest), 18 Supertrees, and a series of lakes and outdoor gardens
54 hectares
Living collection of over
1,500,000 plants
including locally and globally endangered species throughout the Gardens

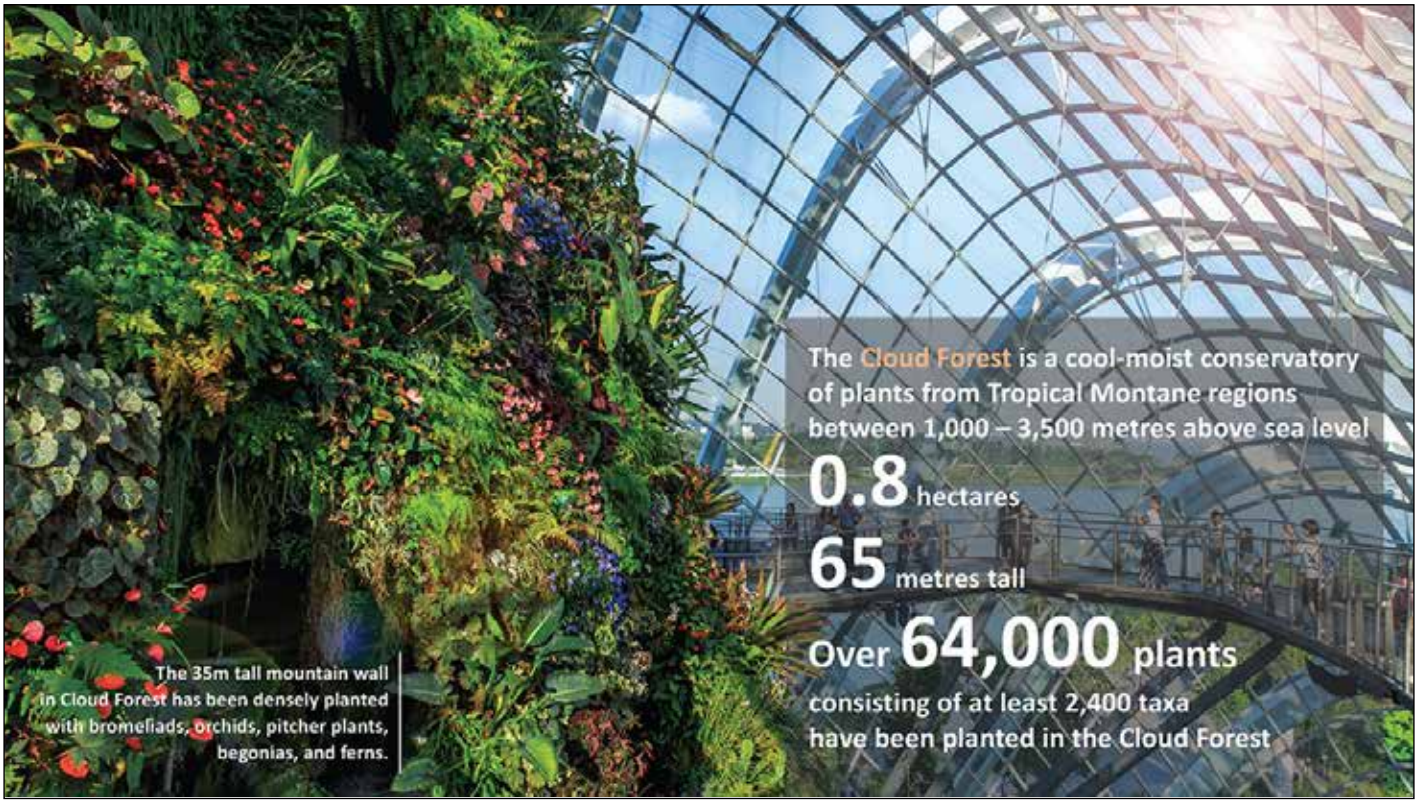

The Flower Dome is a cool-dry conservatory of plants from Mediterranean-type and semi-arid climatic regions of the world
1.2 hectares of column-free space
45 metres tall
Over 28,000 plants
consisting of at least 950 taxa have been planted in the Flower Dome
Nine different gardens in Flower Dome feature exotic plants from five continents, such as thousand-year-old olive trees and unusual Baobabs, as well as a changing display of flowers.


An ever-changing myriad of colours
Through seasonal floral showcases
Flower Dome Floral Display
'Dahlia Dreams'

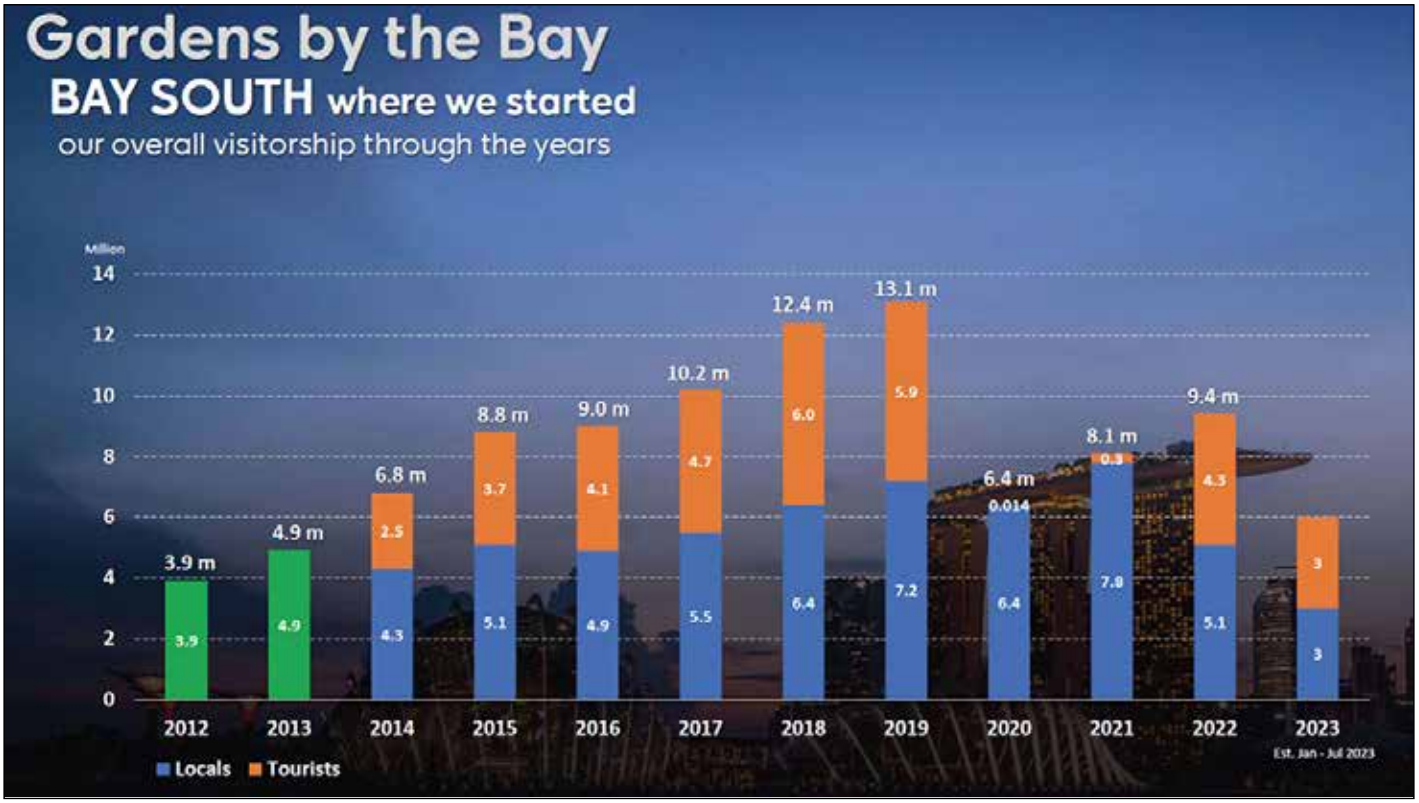

An ever-changing myriad of colours
Through seasonal floral showcases
Flower Dome Floral Display
'Sakura Matsuri'


An ever-changing myriad of colours
Through seasonal floral showcases
Flower Dome Floral Display
'Poinsettia Wishes'


An ever-changing myriad of colours
Through seasonal floral showcases
Floral Fantasy
Upside-down Rainbow Tapestry


The Cloud Forest is a cool-moist conservatory of plants from Tropical Montane regions between 1,000 – 3,500 metres above sea level
0.8 hectares
65 metres tall
Over 64,000 plants
consisting of at least 2,400 taxa have been planted in the Cloud Forest
The 35m tall mountain wall in Cloud Forest has been densely planted with bromeliads, orchids, pitcher plants, begonias, and ferns.


Each Supertree consists of a reinforced concrete trunk core, wrapped with a steel frame and panels planted with orchids, ferns, bromeliads and tropical flowering climbers.
25-50 metres tall
Over 158,000 plants consisting of at least 700 taxa have been planted on the 18 Supertrees
OCBC Skyway is a 128-metres long and 22-metres high aerial walkway connecting 2 Supertrees at the Supertree Grove


Gardens by the Bay
BAY SOUTH where we started
our overall visitorship through the years
Million
14
12
10
8
6
4
2
0
3.9 m
4.9 m
6.8 m
8.8 m
9.0 m
10.2 m
12.4 m
13.1 m
6.4 m
8.1 m
9.4 m
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Locals
Tourists
Est. Jan - Jul 2023

Strong Sustainability Principles

Integration of best-in-class technologies, innovative applications of nature and greening

The Challenge: Design two giant cool biomes in the tropics and cool them sustainably

Balancing act of horticultural lighting requirements, solar gain and cooling load along with ensuring desired humidity levels

Greenhouse Engineering

Façade elements and active cooling elements

Spectrally-selective double-glazed glass with low emissivity coating

Allows 65% light to pass through with only 35% of solar heat

External shades

Retractable, cable-tensioned, triangular blinds for use on sunny days

Displacement Ventilation

Conditioned air supply at low level within occupied zones

Active ground cooling

Chilled water pipes embedded in concrete screeds of paths and circulation areas

Absorption Chillers

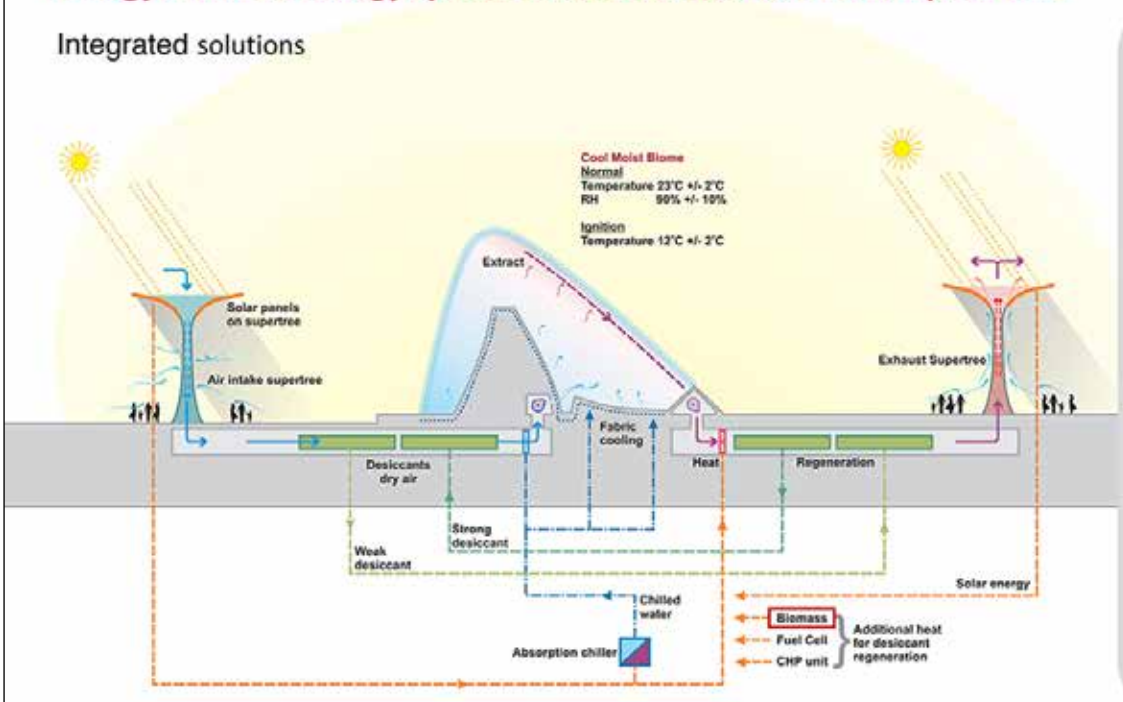
Heat dump for biomass boiler and provide base cooling load

Dehumidification and fog system

Strong liquid desiccant for dehumidification, regeneration of desiccant through heat from biomass

Energy: Biomass energy system is core to GB's sustainable operations

Integrated solutions



Cooled

Conservatories powered by horticultural waste from around Singapore

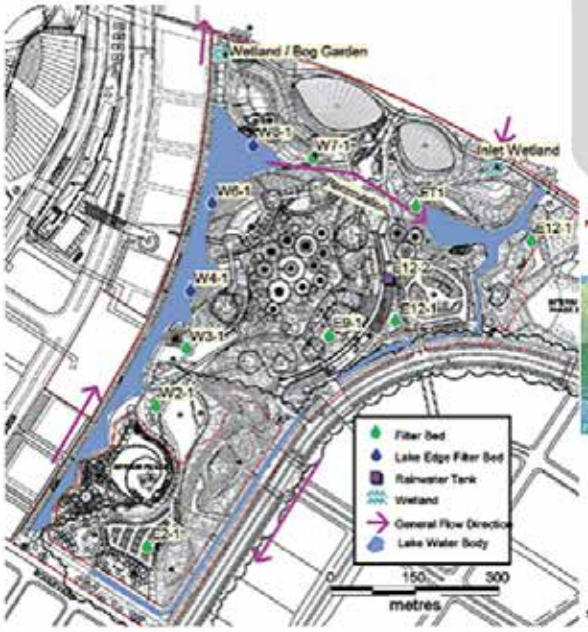
- Biomass generates electricity and waste heat (steam) for absorption chillers and regenerate desiccant that dehumidifies air
- Connected to Supertrees as exhaust pipes

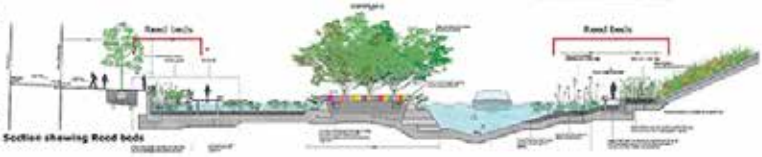
Water: Masterplanning with Water-Sensitive Urban Design

Sustainable water cycles using water retention, conservation and purification

Lake system as a water catchment

- Aquatic plants for filtration and treatment of water
- Optimal hydrologic flow and capacity that balances between drainage requirements and constant water level
- Minimisation of surface runoff through permeable paving and tanks





SMART Gardens Vision

Network Modernisation and Cloud Migration

Irrigation Pipe Leak Monitoring

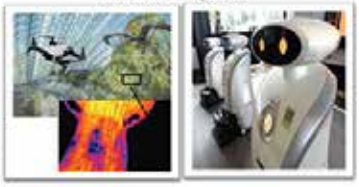
Smart Lighting

Smart Irrigation

Plant and Environmental Monitoring

Video Analytics

Robotics Integration



Example: Leveraging aerial robotics technology

Partnership with SUTD and Spinoff Robotics under a tripartite collaboration to develop and operationalise aerial robotics technology for horticultural and landscape maintenance

Applications: Tethered Drone Bromeliad Washing

We adapt, grow and progress into our future...

Aided by Sustainability and technology


Gardens
by the Bay

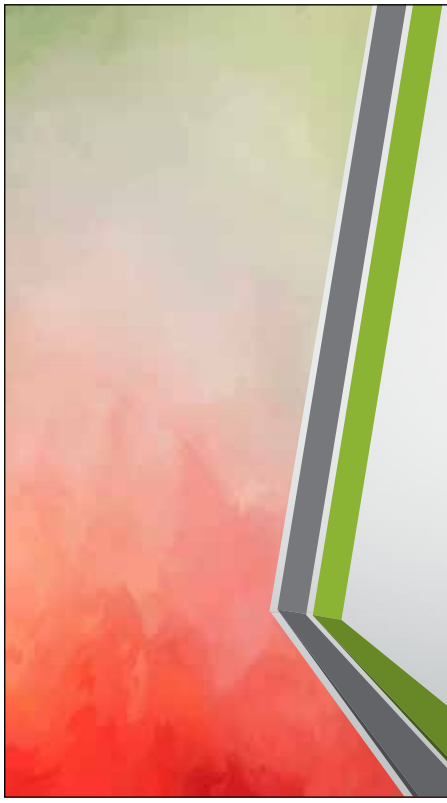
Green Building Initiatives in the Philippines

Presented by:

ENGR. ARIEL P. DURAN
SPECS President
Manila, Philippines
November 15, 2023
Marina Bay Sands, Singapore

Presentation Outline

- Risk and Vulnerability in the Philippines
- Strategic Impact
- Philippine Green Building Council – PhilGBC
- PhilGBC Programs
- Green Building Projects
- PhilGBC Advocacy
- Market Directions



1. Risk and Vulnerability in the Philippines

- The Philippines rank 3rd as the most at risk in terms of exposure to the natural hazards and vulnerabilities from susceptibility, lack of coping capacities, and lack of adaptive capacities, based on the World Risk Report 2016. (Garschagen et al., 2016)

…… Risk and Vulnerability in the Philippines

- The Philippines is the 6th Worldwide and 3rd among the economies severely affected by climate change because of its impact to the country's GDP based on Moody's Analytics. (Lafakas, Ratz, Fazio & Cosma, 2019)

..... Risk and Vulnerability in the Philippines

The Philippines is the only country within both top ten (10) countries with the highest absolute number of affected people (in millions) and number of people affected per 100,000 population averaged across the years, based on The Human Cost of Disasters – An overview of the last 20 years 2000-2019

(CRED & YNDRR, 2020)

..... Risk and Vulnerability in the Philippines

- Philippines rank 4th as the most at risk to extreme weather events based on the Global Climate Risk Index 2021.

(Ecktein et al., 2021)

- The Philippines have been named in various sources as one of the countries that is most at risk and vulnerable to climate change. We are both susceptible to the negative impacts, including the exposure to extreme weather events. In addition, we are also lagging in our readiness and capability to cope to climate change.

Costal communities are at higher risk, with 60% of LGUs in the provinces and major cities. The Climate Change Commission (CCC) of the Philippines recognized the potential economic loss if there is disregard to climate change risks, and productivity will decline due to climate-induced heat in the workplace.

While some areas in our country are developed, developing areas in our country are having or will be having difficulties in addressing climate-change issues.

2. Strategic Impact areas

- Within WorldGBC's Strategy of "Sustainable Buildings for Everyone Everywhere", our mission is to transform the building and construction sector across three strategic areas: Climate Action, Health & Wellbeing, and Resources & Cilcularity

- In the region, the national GBCs in the Asia Pacific Region, including the PHILGBC, have been focusing on programs that accelerate the adoption of net zero projects, and the promotion of the healthier buildings. While there are GBCs that are already experiencing circularity and have been incorporating these principles in their tools, more work still needs to be done to translate the global programs and objectives at the regional and national level.

- We are collectively advancing towards a net zero whole life carbon goal. Each national GBC that is part of the ANZ or "advancing net zero" program has been developing roadmaps to guide our respective countries towards decarbonization through appropriate solutions and strategies, and accelerating the adoption of net zero targets at the project and organization levels.

- In the region, we are developing the Asia Pacific Net Zero Readiness Framework to gauge and to eventually guide policy makers, project proponents and end users in incorporating net zero in the respective jurisdictions to the national GBCs.
- We are also further exploring how individual regions are addressing embodied carbon in the built environment, and how we can accelerate action in reducing embodied carbon.

- In addition to promoting better places for people, the WorldGBC aims to catalyze the change and equipping the industry with guidelines and tools to redefine the scope of health and wellbeing in the built environment. In the region, GBCs are developing educational programs, guidelines, and certification tools to empower project proponents and their stakeholders in addressing wider socio-economic priorities.

- **5 Main Objectives of Philippine Green Building Council**

1. Educate and establish knowledge-sharing platforms such as conference and seminars to provide technical exchange among public and private building sector.
2. Provide business networking opportunities to facilitate learning and green trade in the property sector
3. Shape and influence the local government policy agenda on smart and green development by providing support and insight on tax and incentives strategic planning, land use and zoning.
4. Support local government in implementing BERDE as a technical tool to facilitate greening of communities through guidance, monitoring and verification.
5. Provide certification services to the property sector to ensure integrity in green and smart building activities. This should inspire confidence and build trust in the green market.

The Philippine Green Building Council leads the action in greening our built environment in the Philippines. Our objective is to ensure that we have a sustainable environment where everyone can live, work and play.

The PhilGBC is an alliance of leaders with corporate members and partners in the building industry.

3. PHILGBC and Programs

..... PHILGBC and Programs

- We rate, educate and advocate for green building in the country. We are focused on developing programs and tools to support green building projects, including capacity building and trainings, advocacy programs with the national and local government, and the assessment, certification and rating of green building projects under the comprehensive tools developed by the PhilGBC.

..... PHILGBC and Programs

- **Building Ecologically Responsive Design Excellence** or **BERDE**.
- BERDE green building program, BERDE – District certification, Advancing Net Zero Philippines (ANZ/PH), PhilGBC Health and Well-being for Buildings tool, and Green Building Procurement Hub. The comprehensive set of tools for the project proponents are designed to help you in incorporating green building, healthy, and net zero principles when you design, construct and operate your projects. We believe through holistic approach in sustainability.

Green Building Projects

- Currently PhilGBC undergoing various stages of certification are over 3.8M sq. meter of total floor area for all projects.
  - **84** BERDE green building projects
  - **4** BERDE – Districts projects
  - **11** Advancing Net Zero Philippines projects
  - **2** PHILGBC Health and Well-being for buildings projects

Green Building Projects

- PHILGBC have also trained and certified the following since 2011:
  - **1047** green building professionals (Certified BERDE Professionals),
  - **75** Certified BERDE Assessors,
  - **45** ANZ/PH Accredited Professionals,
  - **31** H+W accredited professionals and have awarded more than 100 fellowships.

PHILGBC Advocacy

- In our advocacy, we have reached more than **10,000 individuals**, have been with more than **300 corporate members** and alliance partners, and have partnered with Local Governments, International Organizations including the UN, ILO, World Bank, ADB, USAID, AUSTRADE and the EU.

BERDE

Building
Ecologically
Responsive
Design
Excellence

BUILDING FOR ECOLOGICALLY RESPONSIVE DESIGN EXCELLENCE

- One of PHILGBC's priority programs is the **Building Ecologically Responsive Design Excellence** or **BERDE**.
- BERDE is the Philippines National Voluntary Green Building Rating System. BERDE was developed by PhilGBC.

- We also expanded the scope of the tool with industry to ensure that a green building rating tool appropriate for the country-setting is available, a tool that is responsive to the country's environmental priorities and aligned with our laws, regulations and standards.

Advancing Net Zero Philippines (ANZ/PH)

- Aligned with the net zero Philippines (ANZ/PH) Program. We encourage buildings to reduce their energy consumption through energy conservation and optimization strategies, and use on-site or off-site renewable energy for the remaining operational energy demand of the project

PHILGBC Health and Wellbeing for Building Tool

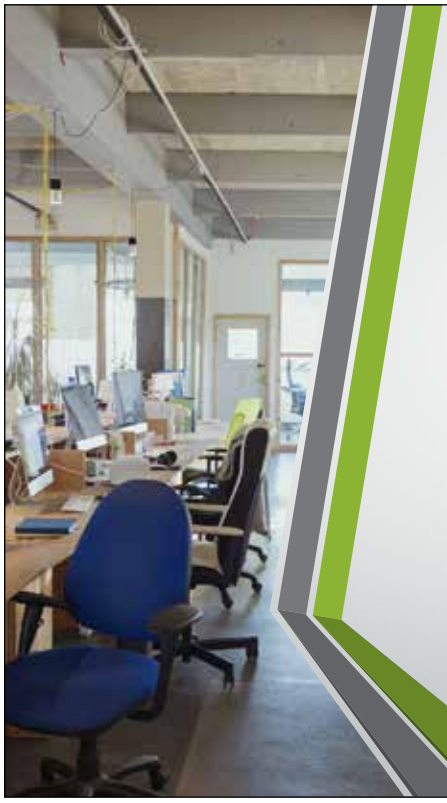
- One of the gaps that we addressing is the same values in delivering their green building projects. Through the Green Building Procurement Hub (greenbuildingph.org), you may find the listings of the green building products and services that may help you in the design, construction and operations of your green, healthy, and net zero projects.

4. Market Directions

- The Philippines' green building market is growing, especially with more projects undergoing certification under different green building rating systems.

..... Market Directions

- We have been seeing private companies, national and local governments undergoing BERDE Certification for their projects, and have been a positive direction towards a more sustainable built environment as we are more seeing examples of green buildings.



..... Market Directions

- Boutique commercial office developers and property managers are taking the lead in ensuring they deliver world-class buildings in the market.
- Top organization in the industry have been placing sustainability and their best foot forward to meet their targets for their buildings and districts

..... Market Directions

- Horizontal developers are also more engaged, even for the affordable housing market.
- Property developers also require expertise beyond the current business practice, and require a green and health-focused outlook;
- Also require Net Zero actions from their project team members and partners to achieve their net zero targets.

We have also been seeing increasing action from local governments in promoting in their jurisdictions. We applaud our leaders that are committed to pushing for better performance and understanding economic, social environmental benefit for the cities and for constituents.

At the regulatory end, the Philippine Government at the national and local levels are establishing and implementing green building policies as mandatory standards for green building in their respective jurisdictions.

- **At the National level, the Philippine Green Building Code, which serves as a referral code or an additional requirement to the existing National Building Code, sets the minimum green building requirements for larger developments (10,000 square meters and above).**

- At the Local level (Province and Cities), local government are setting their own green building policies, and requiring different levels of green buildings appropriate to their city's capacity and stakeholders' capabilities.

- LGUs that implement GBC

1. Provincial Government of Cebu

*Ordinance No. 2014-02 –Implementing the Province of Cebu Green and Disaster-Resilient Building Program

2. City Government of Mandaue

*Ordinance No, 13-2015-1047 –The Green Building Ordinance of Mandaue City

3. City Government of Pasig

*Ordinance No.2016-06 – An Ordinance Establishing the Green Building og Pasig City

4. City Government of Davao

*Ordinance No. 2018-02 – Establishing the Green Building Ordinance Authority

5. City Government of Quezon

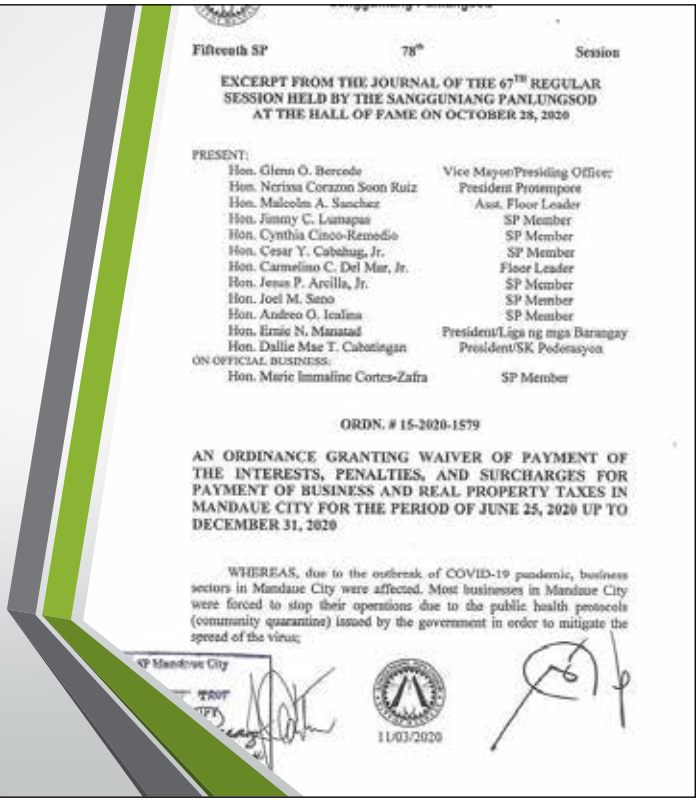
*Ordinance No. SP-1917- The Green Building Ordinance of 2009

City of Government of Mandaluyong

*Ordinance No. 535, series of 2014 – Green Building Regulations of Mandaluyong City

- Compliance prior to the issuance of construction Building Permit
- Fiscal Incentive (i.e. reduction or tax break/holiday on Real Property Tax)

- Mandaue City identified where building green is mandatory and where it is voluntary. To encourage their developers and other stakeholders, they linked their Green Building Ordinance to their Investment Code. This allowed for certain incentives such as tax rebates and/or floor area allowances, as the case maybe, for those who exceeds the green building requirements.



Fifteenth SP 78th Session

EXCERPT FROM THE JOURNAL OF THE 67TH REGULAR SESSION HELD BY THE SANGGUNIANG PANLUNGSOD AT THE HALL OF FAME ON OCTOBER 28, 2020

PRESENT:

Hon. Glenn O. Bercede	Vice Mayor/Presiding Officer
Hon. Nerissa Corazon Soon Ruiz	President Protempore
Hon. Malcolm A. Sanchez	Asst. Floor Leader
Hon. Jimmy C. Lumapas	SP Member
Hon. Cynthia Cinco-Remedio	SP Member
Hon. Cesar Y. Cabahug, Jr.	SP Member
Hon. Carmelino C. Del Mar, Jr.	Floor Leader
Hon. Jesus P. Arcilla, Jr.	SP Member
Hon. Joel M. Seno	SP Member
Hon. Andreo O. Icalina	SP Member
Hon. Ernie N. Manatad	President/Liga ng mga Barangay
Hon. Dallie Mae T. Cabotingan	President/SK Federasyon
ON OFFICIAL BUSINESS:	
Hon. Marie Immaline Cortes-Zafra	SP Member

ORDN. # 15-2020-1579

AN ORDINANCE GRANTING WAIVER OF PAYMENT OF THE INTERESTS, PENALTIES, AND SURCHARGES FOR PAYMENT OF BUSINESS AND REAL PROPERTY TAXES IN MANDAUE CITY FOR THE PERIOD OF JUNE 25, 2020 UP TO DECEMBER 31, 2020

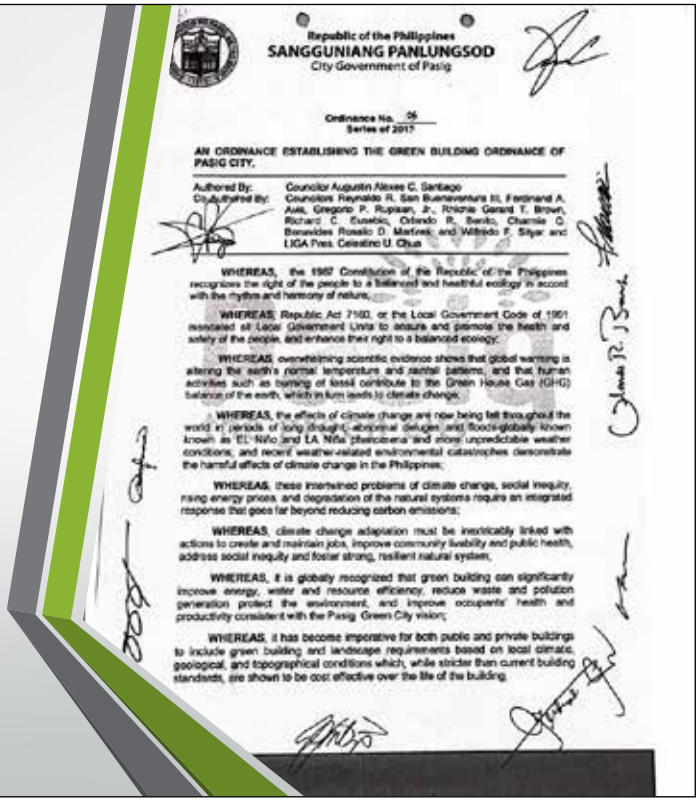
WHEREAS, due to the outbreak of COVID-19 pandemic, business sectors in Mandaue City were affected. Most businesses in Mandaue City were forced to stop their operations due to the public health protocols (community quarantine) issued by the government in order to mitigate the spread of the virus;

SP Mandaue City

11/03/2020

- Pasig City are requiring BERDE Certification in their planned unit developments, such as commercial districts or special economic zones, and are promoting voluntarily to the rest of their jurisdiction by providing incentives for green buildings.

- AN ORDINANCE ESTABLISHING GREEN BUILDING ORDINANCE OF PASIG CITY (Ordinace no. 06 Series of 2015)



Republic of the Philippines
SANGGUNIANG PANLUNGSOD
City Government of Pasig

Ordinance No. 06
Series of 2015

AN ORDINANCE ESTABLISHING THE GREEN BUILDING ORDINANCE OF PASIG CITY.

Authored By: Councilor Augustin Alexes C. Santiago
Co-Authored By: Councilors Reynaldo R. San Buenaventura III, Ferdinand A. Ave, Gregorio P. Rupisan, Jr., Rhoche Gerard T. Brown, Richard C. Eusebio, Orlando R. Benito, Charnie G. Benavides Rosario D. Martinez and Wilfredo F. Silgar and LIGA Pres. Celestino U. Chua

WHEREAS, the 1987 Constitution of the Republic of the Philippines recognizes the right of the people to a balanced and healthful ecology in accord with the rhythm and harmony of nature;

WHEREAS, Republic Act 7160, or the Local Government Code of 1991 mandated all Local Government Units to ensure and promote the health and safety of the people, and enhance their right to a balanced ecology;

WHEREAS, overwhelming scientific evidence shows that global warming is altering the earth's normal temperature and rainfall patterns, and that human activities such as burning of fossil contribute to the Green House Gas (GHG) balance of the earth, which in turn leads to climate change;

WHEREAS, the effects of climate change are now being felt throughout the world in periods of long drought, abnormal deluges and floods globally known known as 'El Niño and LA Niña' phenomena and more unpredictable weather conditions, and recent weather-related environmental catastrophes demonstrate the harmful effects of climate change in the Philippines;

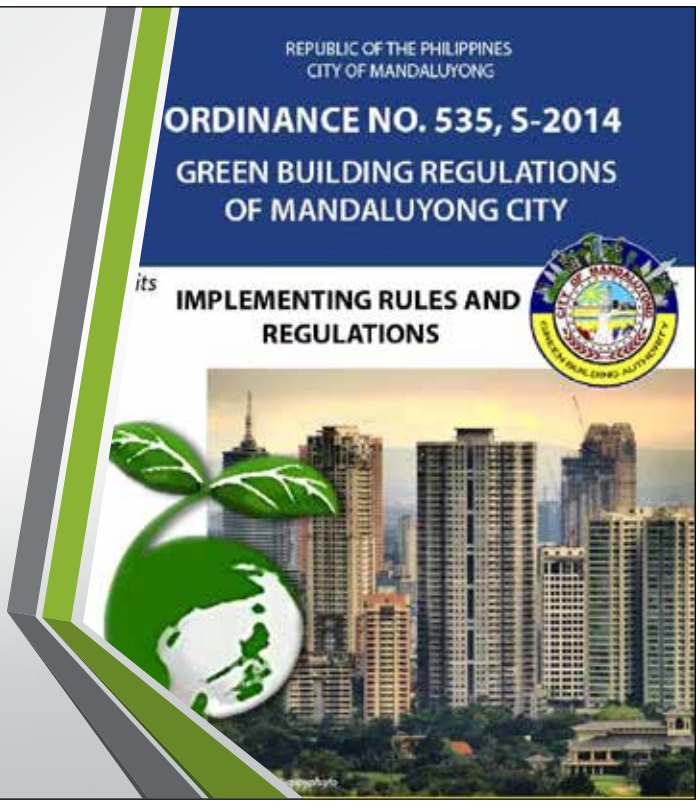
WHEREAS, these intertwined problems of climate change, social inequity, rising energy prices, and degradation of the natural systems require an integrated response that goes far beyond reducing carbon emissions;

WHEREAS, climate change adaptation must be inextricably linked with actions to create and maintain jobs, improve community livability and public health, address social inequity and foster strong, resilient natural system;

WHEREAS, it is globally recognized that green building can significantly improve energy, water and resource efficiency, reduce waste and pollution generation protect the environment, and improve occupants' health and productivity consistent with the Pasig Green City vision;

WHEREAS, it has become imperative for both public and private buildings to include green building and landscape requirements based on local climatic, geological, and topographical conditions which, while stricter than current building standards, are shown to be cost effective over the life of the building;

- Mandaluyong City are requiring BERDE Certification in their planned unit developments (PUD), such as commercial districts or special economic zones, and are promoting voluntarily to the rest of their jurisdiction by providing incentives for green buildings.



- Walking the talk on building green are government agencies that have been incorporating green building on their programs, and are developing green building projects, including Bangko Sentral ng Pilipinas, the Metro Manila Development Authority, the Department of Health, the Department of Education, and the Senate of the Philippines, among others.

- **The Bangko Sentral ng Pilipinas (BSP), have launched its commitment to undergo BERDE Certification starting off with BSP Main Complex in Manila. BSP is championing the process of having their building certified as BERDE in order to guide and discipline them as they design, construct and operate their projects in a resource efficient, economically viable, and socially responsible manner, while ensuring that we promote a safe and healthy work environment.**

In closing, I would to thanks the Philippine Green Building Council PHILGBC for the info, references and insights provided to us to shed light on the status of Green Building Initiatives in Philippines.

Lastly, before I end this presentation, I would like to quote a famous quotation coming from Henry Ford.

Coming together is a **Beginning,**

working together is **Progress,**

keeping together is **Success!**

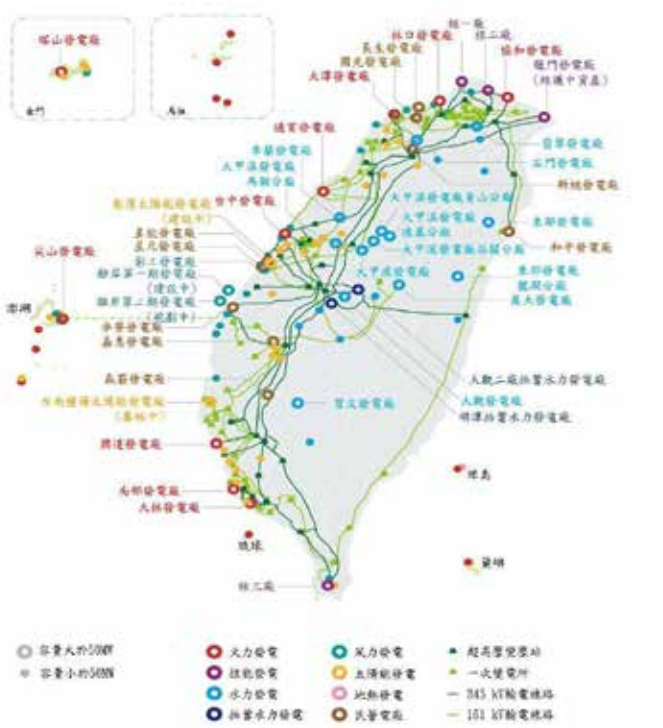

THANK
YOU

STRATEGIES TO STRENGTHEN POWER GRID IN TAIWAN

Speaker: Dr. Ming-Yuan Cho,
Taiwan Electrical Contractors Association, R.O.C.

CONTENTS

Taipower power plants:
Solar PV plant
Wind Power Plant
Hydro Power Plant
Fossil Power Plant
Nuclear Power Plant

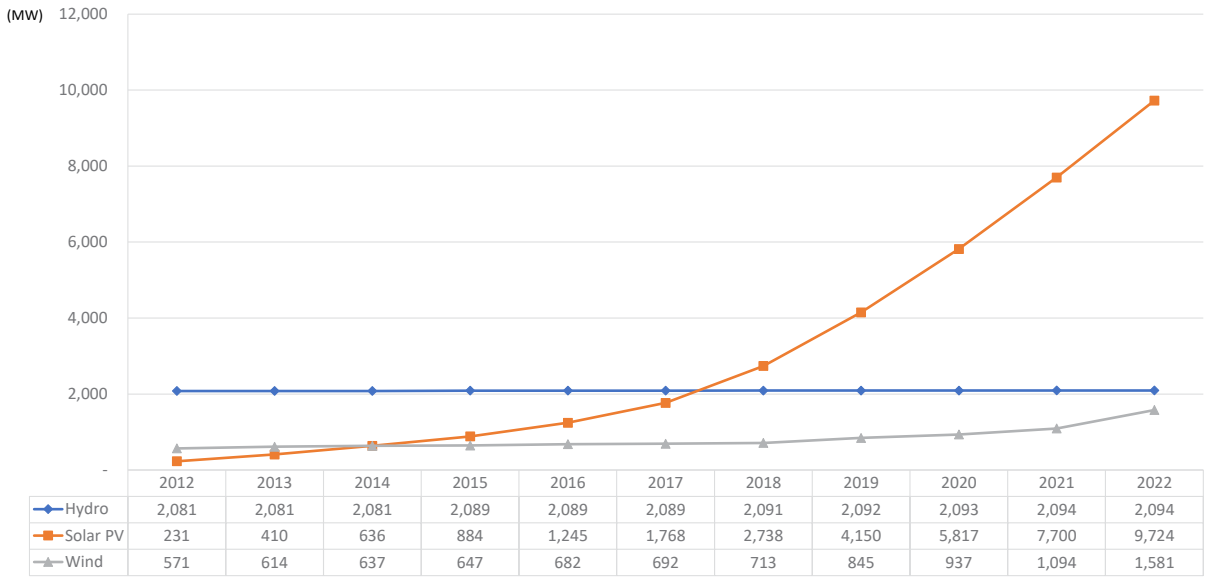


Ref.:Taipower co. Ltd.

Energy Storage System Development Status

- The Ministry of Economic Affairs plans to target 1,500MW of energy storage in 2025, minus the upcoming "light + storage configuration" and Taipower's own construction, the remaining 840MW will be purchased by Taipower from the private sector through the power trading desk. Up to 2022, 41.6MW of energy storage equipment has been combined.

Renewable Energy Installed Capacity inTaiwan



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Hydro	2,081	2,081	2,081	2,089	2,089	2,089	2,091	2,092	2,093	2,094	2,094
Solar PV	231	410	636	884	1,245	1,768	2,738	4,150	5,817	7,700	9,724
Wind	571	614	637	647	682	692	713	845	937	1,094	1,581

For a long time, power plants and power grids have been developing towards centralization.

Taiwan is narrow and densely populated and electricity consumption is growing rapidly.

For decades, the power system has been **centralized** and **large-scale** to meet the demand for electricity and pursue power supply efficiency as the goal.

Power Plants

Centralized and Large-scale

It is hard to find land for building factories to meet economic development and electricity demand.

Large-scale firepower is concentrated in western Taiwan.

Power Grids

The three main lines run through north and south.

龍潭 **中寮** **龍崎**

The three major ultra-high voltage substations are the key nodes

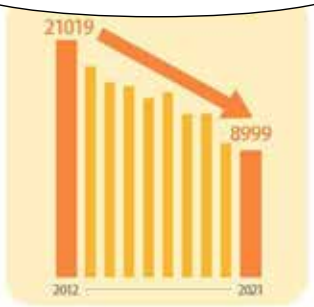
Construction Project of Strengthening grid resilience 2

Ref.:Taipower co. Ltd.

Past Efforts

Distribution System Resilience Program

Accident power outages



New Challenges

Renewable energy will reach 60~70% in 2050

Extreme Weather Test

3/3 accident
- personnel error
- Grid over-centralization
- The scope of influence is too large

Enhance toughness

Ability to respond to accidents and restore stable operation in a short time.

- Decentralized Engineering
- Reduce risk of grid concentration
- Strengthen Engineering
- Improve device stability
- Defense Engineering
- Stop the spread of power outages

Consolidation was used in the past to Improve Efficiency.

Mining Decentralization in the Future to Improve Resilience.

Construction Project of Strengthening grid resilience 3 Ref.:Taipower co. Ltd.

Strive to Disperse------ Reduce risk of grid concentration.

Central dispatch center — Regional dispatch center — Distribution dispatch center

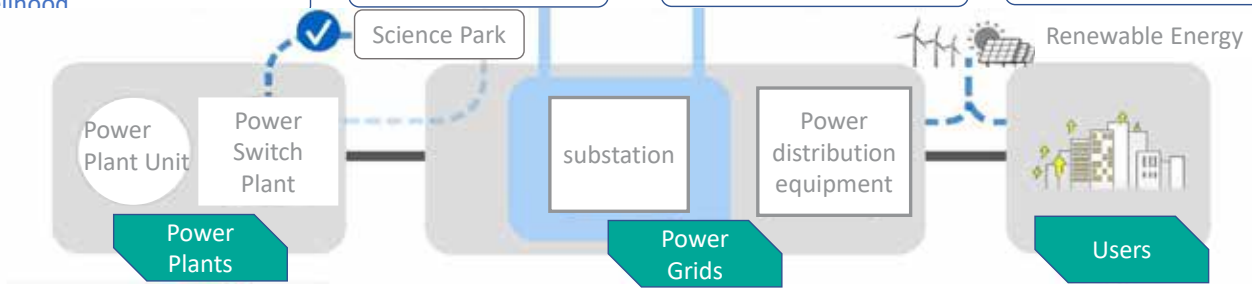
Advanced Regional Scheduling
Decentralized regulatory risk

Power plant direct supply park
Leave the main line to people's livelihood

Hub Details Grouping
reduce concentration

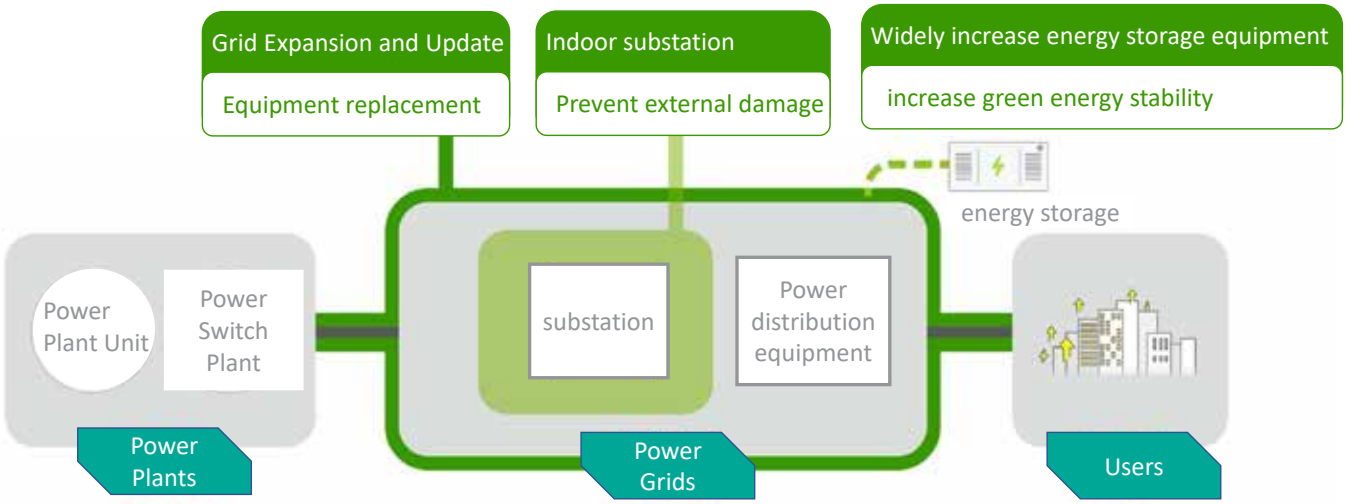
Add delivery nodes
Transmission Load Center

Green energy decentralized power supply
Promote effective usage



Construction Project of Strengthening grid resilience 4 Ref.:Taipower co. Ltd.

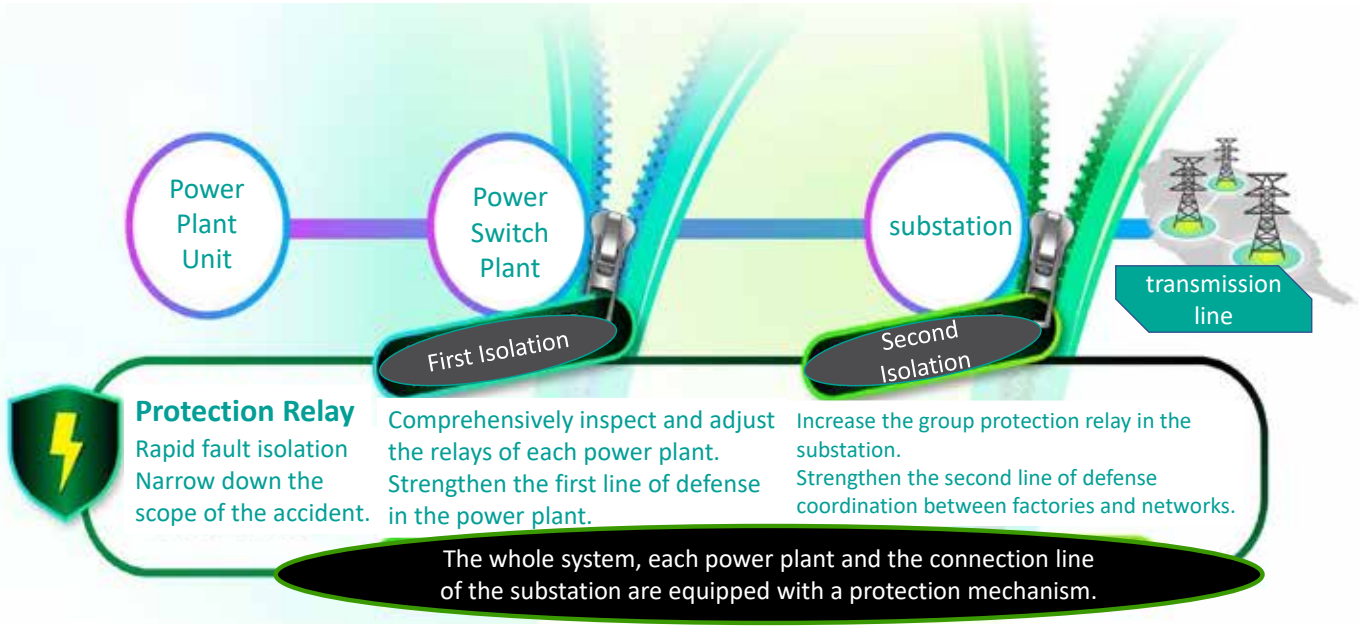
Continue to strengthen----- Improve device security and stability.



Construction Project of Strengthening grid resilience 5

Ref.:Taipower co. Ltd.

Strengthen Defense----- Stop the spread of power outages.



Construction Project of Strengthening grid resilience 6

Ref.:Taipower co. Ltd.

564.5 billion dollars in 10 years to strengthen the power grid resilience plan.

NT 437.9 billion
Decentralized Engineering
Reduce risk of grid concentration

+

NT 125 billion
Strengthen Engineering
Improve device stability

+

NT 1.69 billion
Defense Engineering
Stop the spread of power outages

=

Total NT 564.5 billion
Enhance toughness
The ability to respond to accidents and restore stable operation in a short time.

Power plant direct supply park
Gas-fired units are directly supplied to science parks and industrial parks.

Power plant direct supply park
Accelerate grid integration of renewable energy and strengthen local power supply.

Hub node grouping
Decentralize the power supply risk of hub substation.(龍潭、中寮、龍崎)

Add delivery nodes
Add key substations to bring electricity into urban areas.

Refined Regional Scheduling
Establish regional scheduling capabilities and disperse scheduling risks.

Ref.:Taipower co. Ltd.

564.5 billion dollars in 10 years to strengthen the power grid resilience plan.

NT 437.9 billion
Decentralized Engineering
Reduce risk of grid concentration

+

NT 125 billion
Strengthen Engineering
Improve device stability

+

NT 1.69 billion
Defense Engineering
Stop the spread of power outages

=

Total NT 564.5 billion
Enhance toughness
The ability to respond to accidents and restore stable operation in a short time.

Grid Expansion Update
Accelerate the upgrading and capacity expansion of old equipment.

Widely increase energy storage equipment
Increase green energy capacity and improve system stability.

Indoor substation
Avoid the threat of external interference and extreme weather.

Ref.:Taipower co. Ltd.

564.5 billion dollars in 10 years to strengthen the power grid resilience plan.

NT 437.9 billion
Decentralized Engineering
Reduce risk of grid concentration

+

NT 125 billion
Strengthen Engineering
Improve device stability

+

NT 1.69 billion
Defense Engineering
Stop the spread of power outages

=

Total NT 564.5 billion
Enhance toughness
The ability to respond to accidents and restore stable operation in a short time.

Enhanced Defense in Depth

Strengthen the setting of protection relays at different levels between the plant and the network.

Real-time dynamic defense

Monitor the status of relay equipment to improve the accuracy of defense.

The future power grid will move towards regional resilience and national accommodation.

Ref.:Taipower co. Ltd.

Key Point 1

Green energy plus energy storage ----- Decentralized power supply towards net zero.

Generate electricity locally and use it nearby to build 17 provincial roads for renewable energy.

Selection and development 2020~2025
Regional development2026~2031

Improve offshore wind power grid-connected energy

- 7 to 7 lines to strengthen the power network project.
  (Provide 11KW grid-connected capacity)

Increase the amount of solar PV connected to the grid

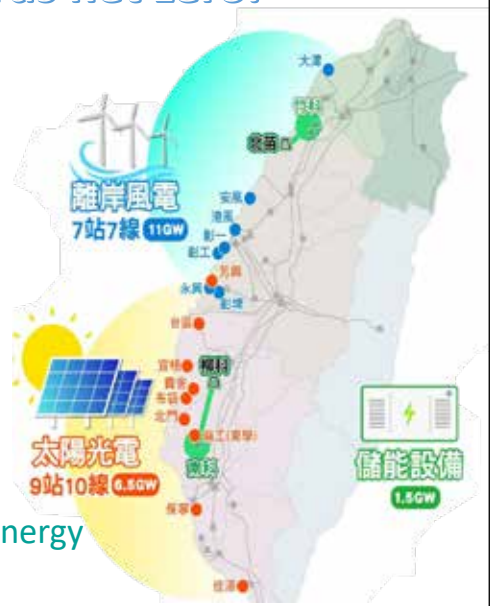
- 9 stations and 10 lines to strengthen the power network project.
  (Provide 6.5GW grid-connected capacity)

Gather regional green energy and send it directly to power consumption centers

- Newly built 柳科 ultra-high voltage substation and 345KV 嘉民-南科 with two inputs and two outputs 柳科. (2032)
- Newly built 北苗 ultra-high voltage substation and 345KV 通宵-寶山 with two inputs and two outputs 北苗. (2032)

Widely increase energy storage to improve the use of green energy

1GW of grid-connected energy storage and 0.5GW of solar energy storage.



Ref.:Taipower co. Ltd.

Key Point 2

The power plant directly supplies the park, and the main line is reserved for people's livelihood.

The five major power plants are paired with the seven parks, and 1/3 of the traffic flow takes the provincial road instead of the national road.

1. 大潭 Power Plant — directly supplied to → 新北 Industrial Park and 桃園 Industrial Park (3GW)
   161KV大潭~林口Line(2022) and 161KV大潭-梅湖Line(2025)
2. 通霄 Power Plant and offshore wind power — directly supplied to → 竹科 (3GW)
   345KV通霄~北苗~寶山Line(2032)
3. 台中Power Plant and offshore wind power — directly supplied to → 中科 (3GW)
   345KV港風~中科Line(2030) and new built中科Ultra-high Voltage(2032)
4. 興達Power Plant — directly supplied to → 南科 and 橋科(3.5GW)
   345KV興達~南科Line(2032) and 161KV興達-保定Line(2024)
5. 大林Power Plant — directly supplied to → 楠梓 Industrial Park(2GW)
   161KV大林~高港Line(2027) and High refining ultra-high voltage (20325)

Ref.:Taipower co. Ltd.

Key Point 3

Increase distribution nodes to solve the bottleneck of power delivery.

Add 28 new substations, one more substation and one more interchange.

Promote new substation projects (2022~2025 11substations) (2026~2032 17substations)

28 New built substations 大安、萬隆, etc.

The closer the substation is to the power core, the more stable and safe the power supply will be.

Ref.:Taipower co. Ltd.

Key Point 4

Indoor substation to prevent external damage.

Shielded and subdivided cabins are safe and secure.

Promoting the interiorization of substations

(2022~2032)

24 Rebuilt substations 汐止、深美, etc.

Protect the safety of equipment, improve the reliability of power supply, be a good friend of the community, no longer a NIMBY facility.

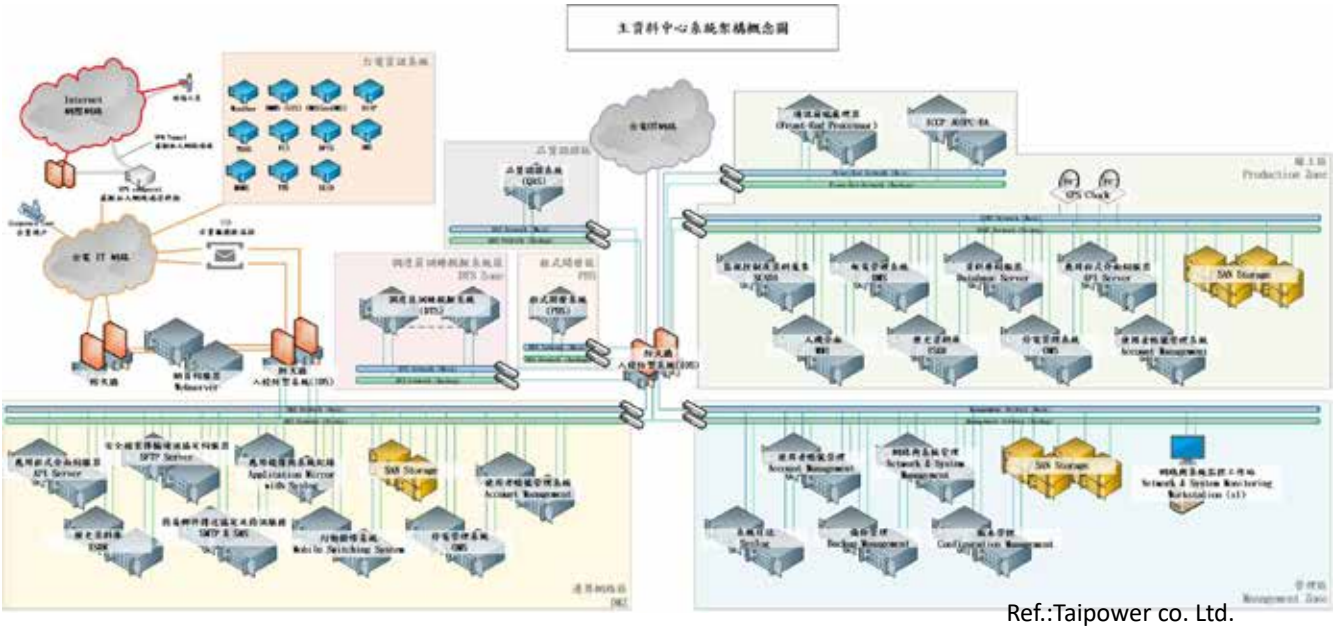
Use three intervals to deliver stage results.

Short Term 2years (2022-2024)	Mid Term 5years (2022-2027)	Long Term 10years (2022-2032)
NT 87.1 Billions dollars	**NT 170 Billions dollars**	**NT 307.4 Billions dollars**
Accelerate the implementation of resilience projects and strengthen system protection and defense capabilities.	Continue to promote grid decentralization and strengthening projects.	Completion of the decentralized project of the three major hub nodes and related long-term plans.
EX. Completed **15** transmission lines (3.5GW) to directly supply 5 parks. 南科台南/高雄園區、新北產業園區 林口工業區、永安工業區	**EX.** Completed **6** transmission lines (1.6GW) to directly supply 2 parks. 幼獅工業區、竹工銅鑼園區	**EX.** Completed **12** transmission lines (7.4GW) to directly supply 2 parks. 竹科寶山園區、南科台南園區 大發、林園及高雄臨海工業區
EX. Completed **15** substations new reconstruction. (interiorization) (如萬隆、高港)	**EX.** Completed **13** substations new reconstruction. (interiorization) (如松湖、大安等)	**EX.** Completed **20** substations new reconstruction. (interiorization) (如高煉、寶山等)
Completed the line expansion and renewal project of **521** circuit kilometers.	Complete **3** node grouping 頂湖(桃園)、南科(南部) 路北(高雄)	Completed the risk dispersion project of the three major hub nodes of 龍潭, 中寮 and 龍崎.

ADMS: Integrate following system into smart grid

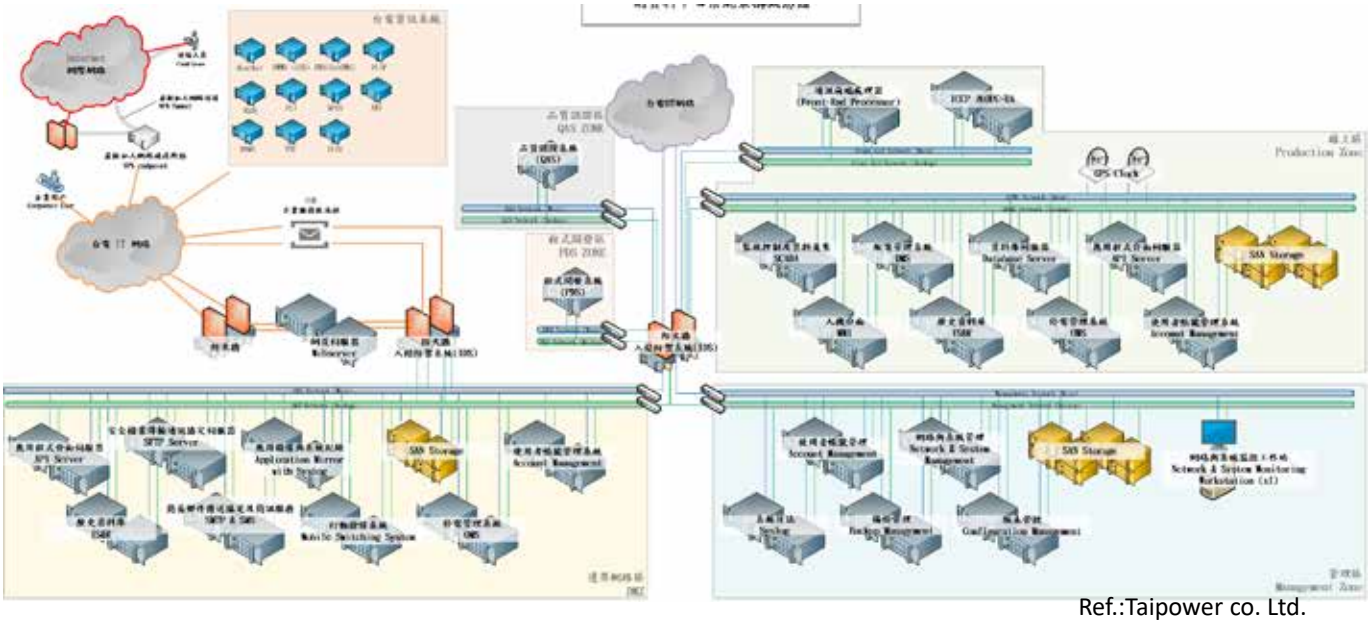
- (Distribution dispatch control system, DDCS), (Feeder dispatch control system, FDCS)
- (Outage management system, OMS), (Area Dispatch Control System, ADCS)
- (Distributed Resources Energy Advanced Management System, DREAMS)
- (Distribution Planning Information System, DPIS)
- (Advanced Metering Infrastructure, AMI), (Meter Data Management System, MDMS)
- (Distribution Map Management System, DMMS), (Taiwan Geospatial One Stop, TGOS)
- (Fault Current Identify Platform, FCI Platform)
- (Transformer Terminal Unit Platform, TTU)
- (Weather Information)
- (Distribution Information Integration Platform, DIIP)

System Structure of Main Data Center of ADMS



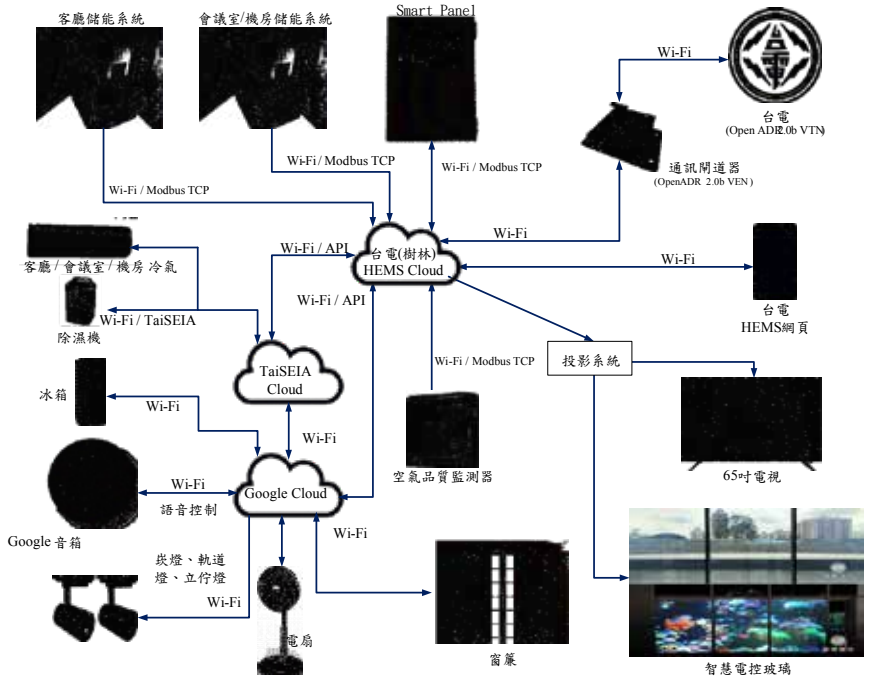
Ref.:Taipower co. Ltd.

System Structure of SubData Center of ADMS



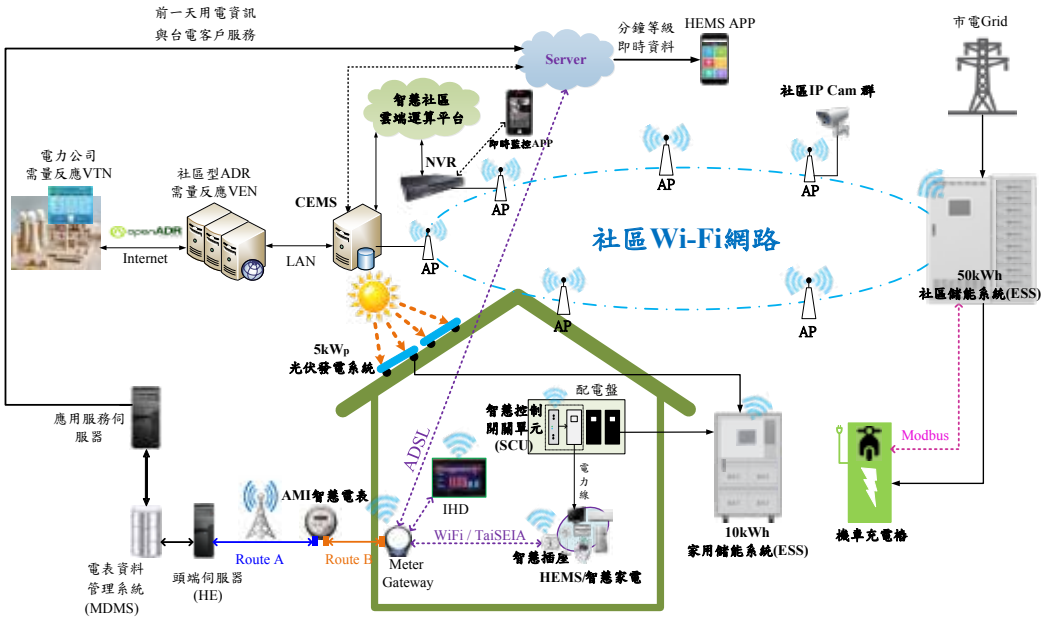
Ref.:Taipower co. Ltd.

Communication system of Smart Micro Grid of Building/House A

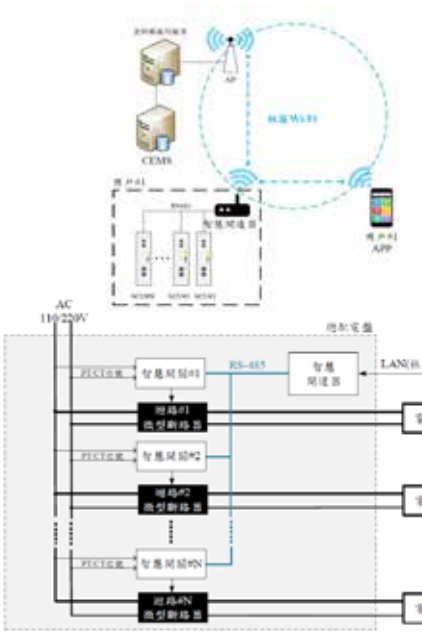


Man Machine Interface-HEMS

Communication system of Smart Micro Grid of Building/House B



Application of HEMS-Construction



Develops Smart circuit breaker (SCB), Smart gateway, integrating Wi-Fi module to implement ADR function

Application of HEMS-Automatic Demand Response

IOS

Android

APP Functions

26

27

Smart Home HEMS Energy Management System with Low-Voltage Time Tariff Solution and (Energy/Cost) Benefit Analysis for Domestic Mobile Energy Storage

Function 1：Energy Storage System

- Support the whole isolated island operation
- Supports bi-directional charge and discharge time setting
- Benefit analysis with time tariff for low voltage customers

Function 2：Battery simulator for electric vehicles

- Support smart charging mechanism
- Support V2H function

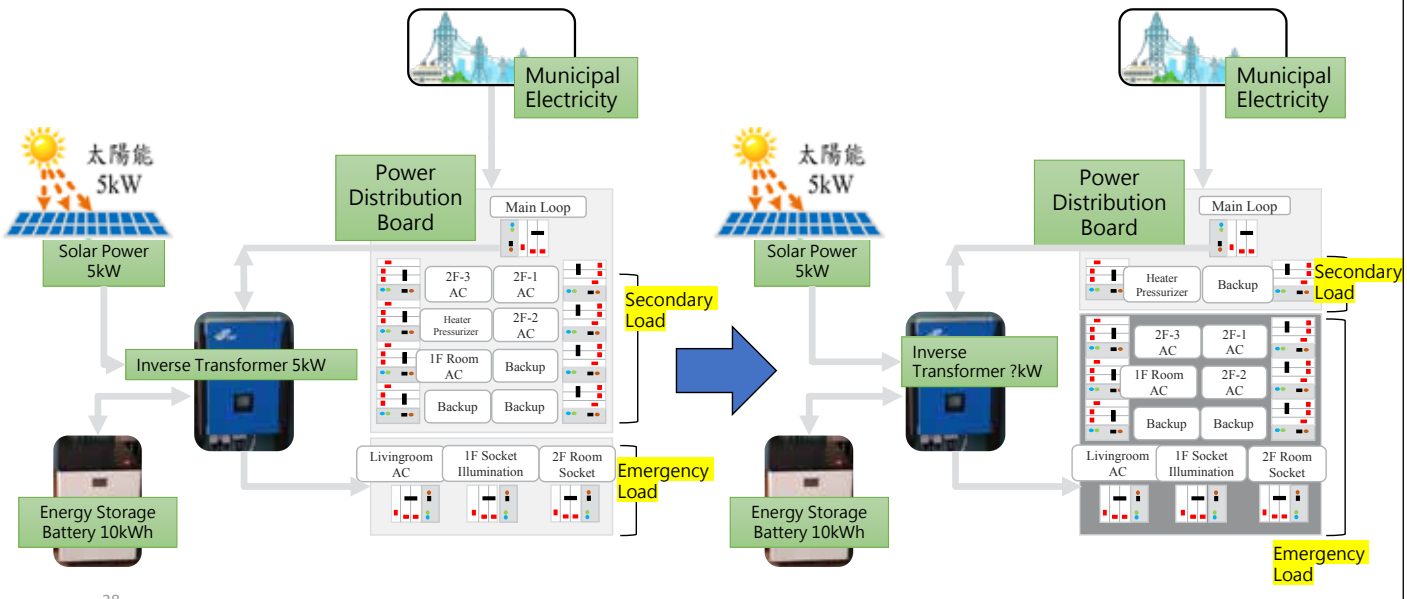
Function 3：OpenADR VEN

- Use our own OpenADR VEN module
- Receiving demand events and scheduling of planned island shipments

Function 4：TaiSEIA

- Co-development of TaiSEIA module with research team
- Supports smart home appliance smart context, as well as web and voice remote control

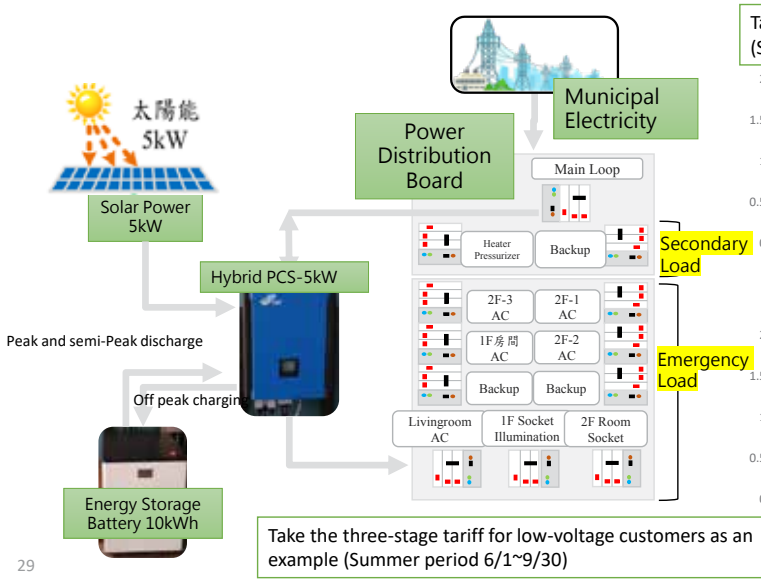
Outage- island operation to keep power



28

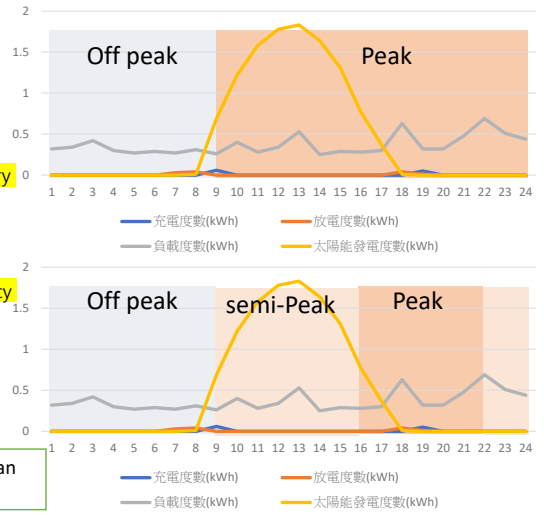
Two-way charging and discharging time setting for energy storage equipment.

Time-of-use tariff for low-voltage electricity (applicable from 01/01/112)



Take the three-stage tariff for low-voltage customers as an example (Summer period 6/1~9/30)

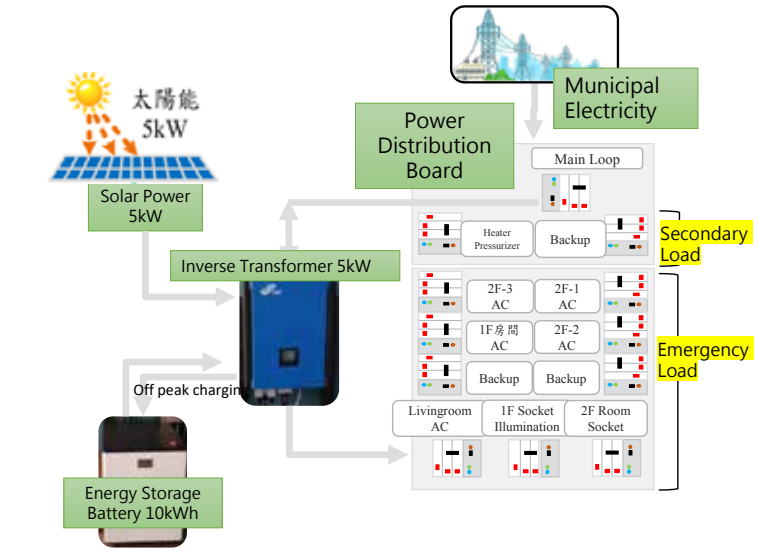
Take the two-stage tariff for low-voltage customers as an example (Summer period 6/1~9/30)

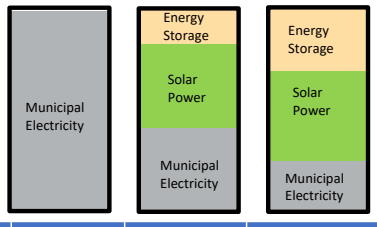


29

Two-way charging and discharging time setting for energy storage equipment.

Time-of-use tariff for low-voltage electricity (applicable from 01/01/112)

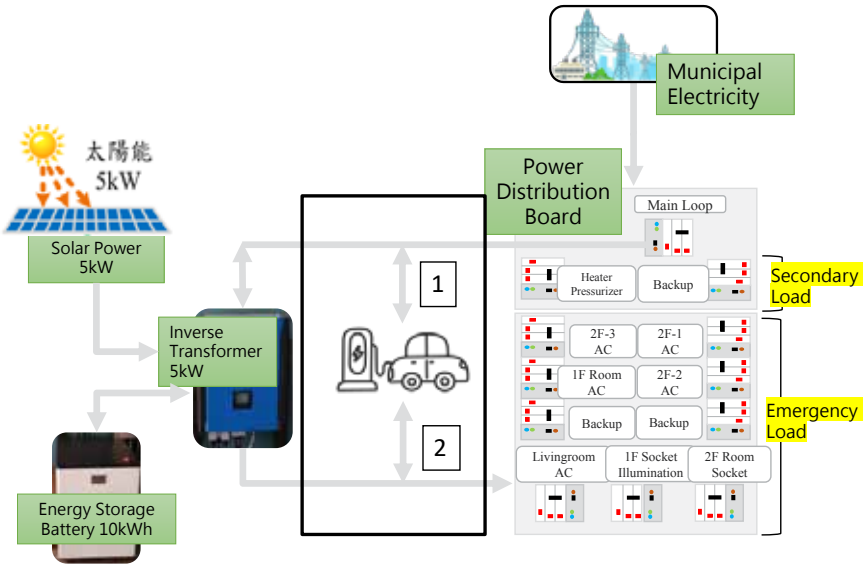




	Case I	Case 2	Case 3
Load	V	V	V
PV		V	V
ESS		V	V
EMS (zero energy consumption)		V	V
EMS (zero energy consumption &Participation Time Tariff)			V

One Day Electricity Composition Analysis of the Show house

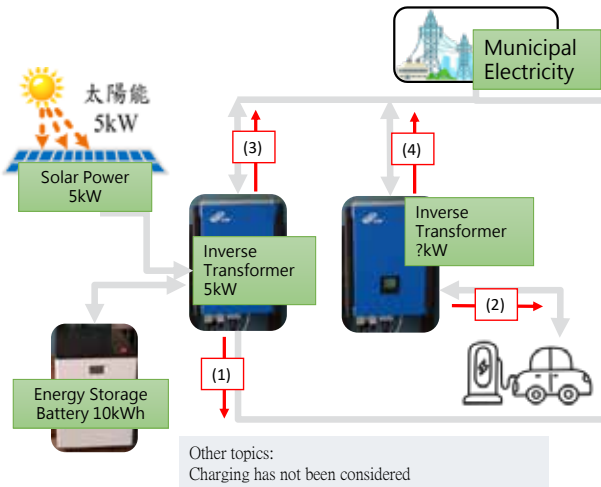
Solar power, Energy storage, and Charging pile energy integration in Demo house.



1. In the case of 5kwp solar energy and 5kw inverter equipment, solar energy can be sent backwards and energy storage cannot be sent backwards.
2. Changing the output power of the inverter may result in the solar energy not being fed back to the distribution panel.
3. New power architecture to be developed?

31

Energy storage, and Charging pile energy integration in Demo house.



Definition of 0 and 1
- PV：MPPT Critical point
- ESS：Voltage Critical point
- EVSE：Range of SOC Whether the car is powered up.

situation	PV	ESS	EVSE	緊急負載供電源	一般負載供電源
1	0	0	0	(5) Municipal Electricity	(5) Municipal Electricity
2	0	0	1	(2)EVSE	(5)Municipal Electricity
3	0	1	0	(1)ESS	(5)Municipal Electricity
4	0	1	1	(1)ESS	(4)EVSE
5	1	0	0	(1)PV	(5)Municipal Electricity
6	1	0	1	(1)PV	(4)EVSE
7	1	1	0	(1)PV	(5)Municipal Electricity
8	1	1	1	(1)PV	(4)EVSE

Other topics:
Charging has not been considered
- Possibility of PV charging EVSE
- EVSE has Municipal Electricity reference voltage, frequency
- No-load scenario is not yet considered (you can add the emergency load power state to the truth table)

Instructions:
- When out of Municipal Electricity, Emergency load only scenario 1 can not isolate the island to run the power supply
- Daytime: 1-8 scenarios (poor sunlight 1-4 scenarios)
- Nighttime: Scenarios 1-4
- Programmable control of inverter

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Conclusions

- Hardware construction of power grid strengthening is necessary but not fully solution
- Software techniques + AI + IoT needs to integrate to play keyrole
- Advance distribution management system can improve the performance of distribution operation with shorter outage time for customers
- Smart micro grid which integrates solar PV, battery system, and charging system with V2G function can support better solution for high power quality

Q&A

Thank you for Listening

SAMAIDEN

EVOLUTION AND INNOVATION OF SOLAR PV & BATTEY ENERGY STORAGE SYSTEM : DRIVING ENERGY SUSTAINABILITY

Samaiden Group Berhad

Presented by Ir Chow Pui Hee

OVERVIEW

SAMAIDEN

This presentation explores the journey of solar photovoltaic (PV) technology and battery energy storage systems (BESS) in shaping sustainable energy generation.

Solar PV has emerged as a vital source of clean and sustainable energy due to increased efficiency, reduced costs, and scalability.

BESS technologies have revolutionized renewable energy integration into the grid, enhancing stability and enabling efficient energy management.

Together, solar PV and BESS form a cohesive framework for a sustainable energy ecosystem.

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DEVELOPMENT OF SOLAR PV

- **Solar PV evolution:** Significant evolvement, from niche technology to a global renewable energy giant.
- **Harnessing solar energy:** The fundamental concept is to capture the sun's energy and convert it into electricity with minimal environmental impact.
- **Advancements:** Advances in materials, manufacturing, and system design led to increased efficiency, reduced costs, and improved accessibility.
- **Challenges:** Solar PV's intermittent nature poses challenges for grid stability and energy reliability.
- **Ongoing research:** Solar PV's reliability and robustness enhancement

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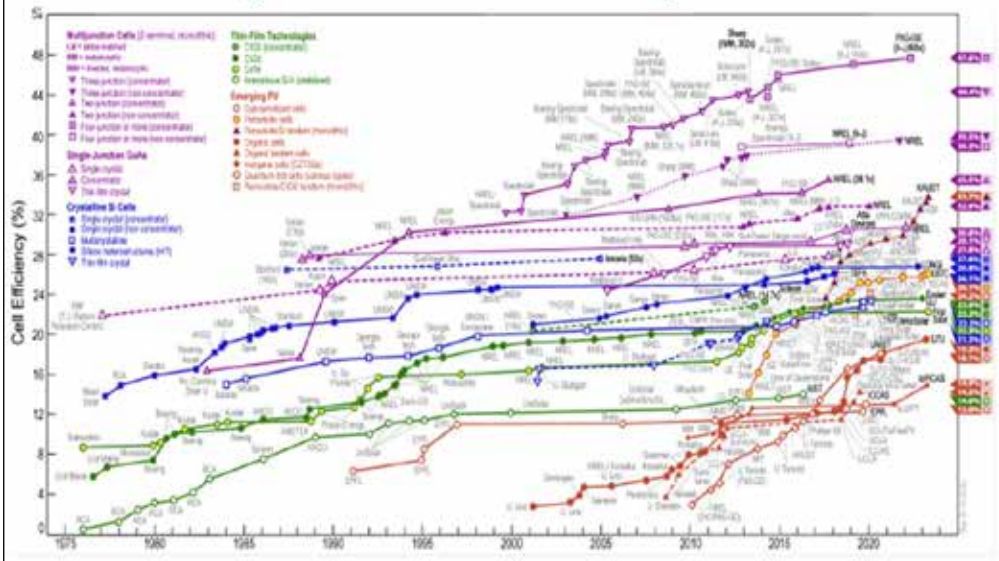
SOLAR PV EFFICIENCY

Solar PV Efficiency Trends Best Research-Cell Efficiency Chart



- The trend in past 2 decades indicates a steady increase, with some innovations achieving over 20% efficiency in lab settings
- Result in higher energy generation and reduced land usage for solar installations, boosting sustainability

Source: National Renewable Energy Laboratory (NREL)

SOLAR PV EFFICIENCY

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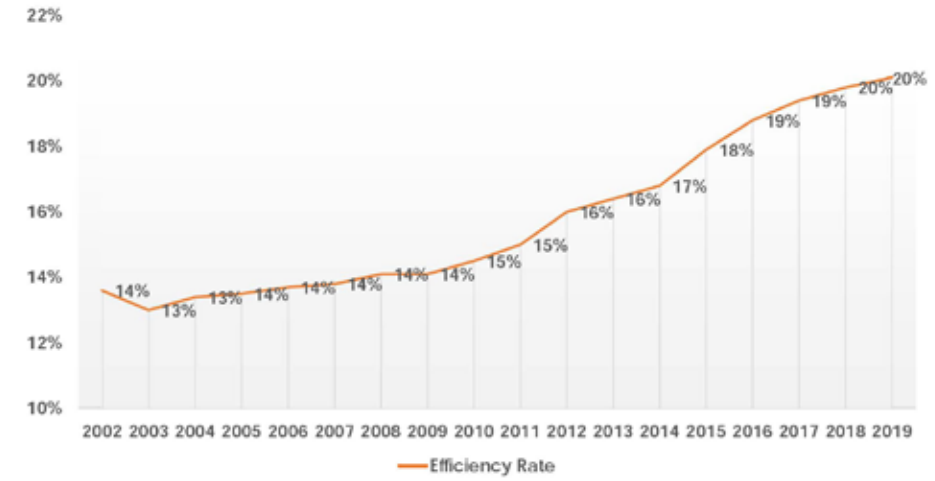
Median Solar Panel Efficiency Rate Over Time



Source: 2022 LBNL Tracking the Sun Report

- Consistent upward trend of solar panel efficiency rates from 2002 to 2019.
- In 2002, the median efficiency was 14%, relatively modest.
- By 2019, the median efficiency reached 20%, a nearly 6% improvement over the period.
- Technological advancements and research led to a significant increase in efficiency.
- Latest production in 2023 has achieved 23%

More space efficient !!!

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WHAT IS THE DRAWBACK OF SOLAR PV ?

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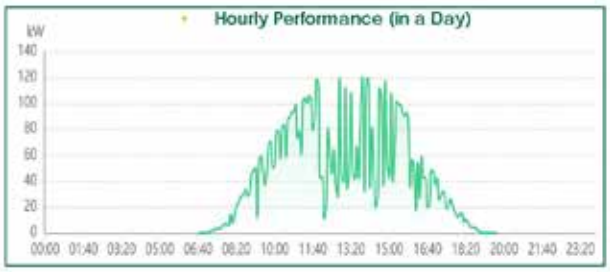
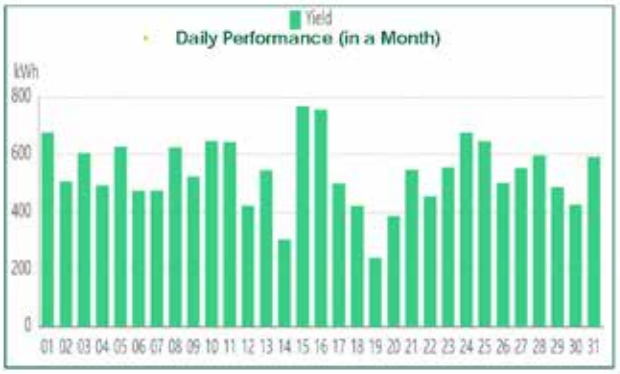
- Energy from the sun is "Intermittent". Only available in daytime but not available at night
- Energy generation is unpredictable and can only be harnessed in the presence of sunlight.
- Power generated gets reduced during cloudy weather.
- Battery Storage is the solution of "Intermittency"





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BATTERY ENERGY STORAGE SYSTEM DEPLOYMENT

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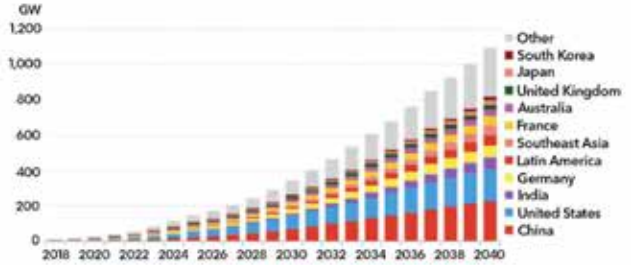
Global Cumulative Energy Storage Installations Projection

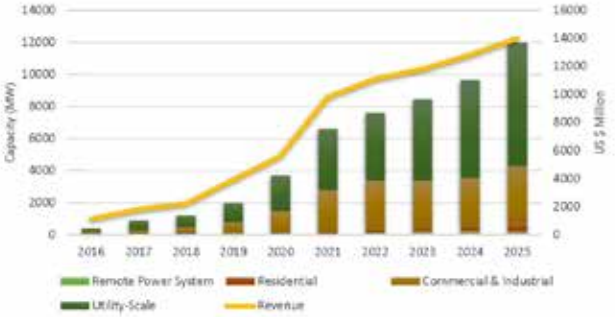


Source: Bloomberg NEF

Global energy storage installations are expected to increase significantly until 2040 due to growing demand for green energy and countries' commitments to achieving net-zero emissions.

Energy storage installations could surpass 1000GWh by 2040.

Projected annual stationary energy storage deployments, power capacity & revenue by market segment



Source: World Bank

Exponential growth of grid-connected BESS installations in the past decade.

Key drivers: regulatory support, declining battery costs, and demand for reliable energy storage in renewable-rich areas.

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GLOBAL TREND OF SOLAR AND BESS (2022 PROJECTION)

86% Estimated proportion of power generated by renewable energy in 2050

58 GWh Global installed capacity of BESS in 202

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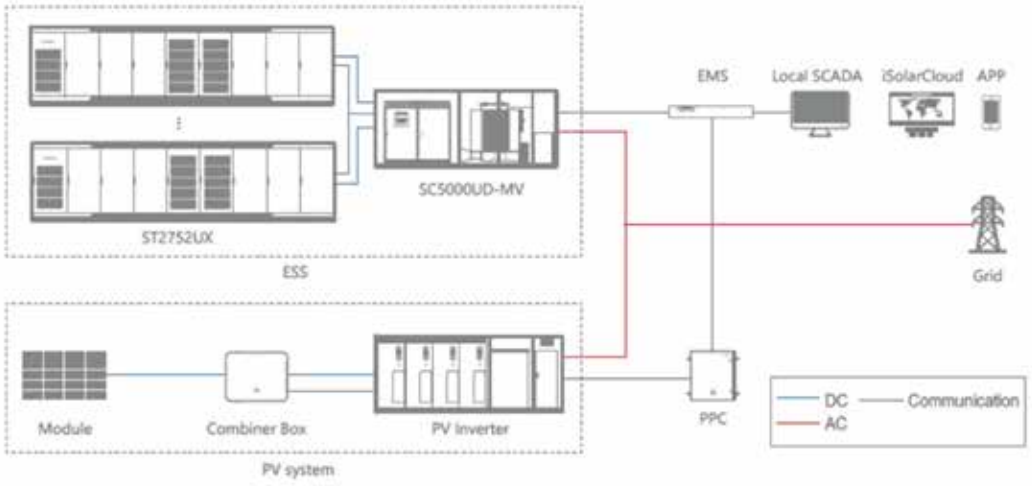
THE COMPOSITION OF BESS

Having the smart combination of Battery Management System (BMS) Energy Management System (EMS) is critically important because it can improve the overall safety and efficiency level



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INTERNAL COMPPONENTS OF BESS (CONTAINERISED)




1 PCS

2 Liquid Cooling System

3 Cluster Controller

4 Module

BESS SOLUTIONS : SMART STRING ESS

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Smart String ESS hardware architecture (200kWh)

- Dimensions: 2570 mm x 2100 mm x 950 mm
- LFP battery
- Capacity: 193.5 kWh
- Weight: ≤2950 kg
- Installation environment: Outdoor

1 - Door-mounted distributed air conditioner
- 2 for each cabinet

2 - Battery pack + optimizer
- With 16 320Ah batteries in one pack
- Built-in Battery Optimizer

3 - Battery rack
- 12 packs per rack
- 1 rack for each cabinet

4 - Intelligent battery rack controller
- 1 DC/DC module in each system

5 - Intelligent energy storage controller
- 100kW, 400V

6 - Emergency stop switch

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POTENTIAL CHALLENGES FOR BESS DEPLOYMENT

High Upfront Cost

Technology

Durability

Regulatory Framework (Grid Connection Requirements

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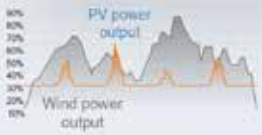
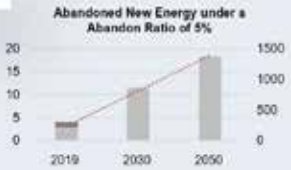
GRID CONNECTION REQUIREMENT IN BESS

Innovative Power Systems Have Higher Requirements for Grid-connection of ESS

Power Generation Side



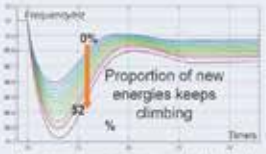
The unpredictability and fluctuation of new energies bring **challenges to the power balance and safety of electricity systems.**



Increasing proportion of new energies is **making power consumption more and more challenging.**

Grid Side

Increasing gap of peak and valley load **requires higher current-carrying capacity and adds to the peak regulation pressure of grids.**



New energies are causing **greater fluctuation to the grid voltage and frequency.**

Meet Requirements of Innovative Power Systems

1 High grid adaptability
- LVRT, HVRT, without disconnecting from the grid
- Stable operation in weak power grids with an SCR less than 1.018

2 Active Support for Grid
- 20 ms quick response
- VSG technology

3 Off-grid Independent Support
- MWh-level black start

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CHALLENGES LED INNOVATION IN BESS

High LCOE

Conventional ESS

Large **area**, high installation **cost**

High thermal management **power consumption**, short battery **service life**

Inconsistent **charge and discharge**

Difficult **O&M**

Innovative Integration, LCOS Down by 20%

PowerTitan

Occupied area down by 32% ▼

Smaller area

Single door and open from front
Support back-to-back and side-by-side layout

Service life up by 10% ▲
Consumption down by 40% ▼

Lower consumption, longer service life

Intelligent liquid-cooling temperature control
Extreme even heat dissipation

Discharge capacity up by 7% ▲
RTE up by 3% ▲

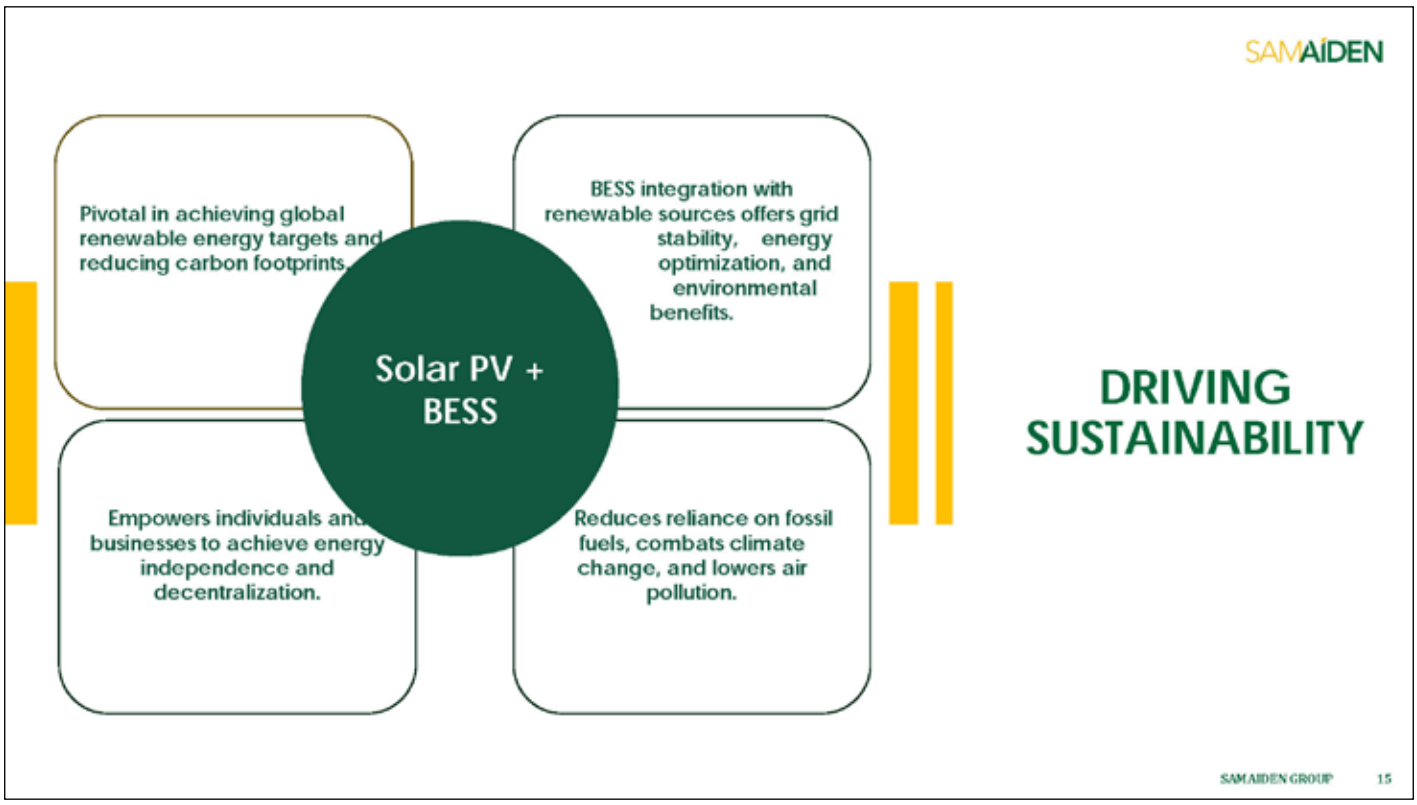
High discharge capacity

Intelligent cluster-level management
Energy efficiency optimization with MEPT

O&M cost Down by 1 million/year ▼

Smart O&M

SOC auto balancing
Easy system upgrade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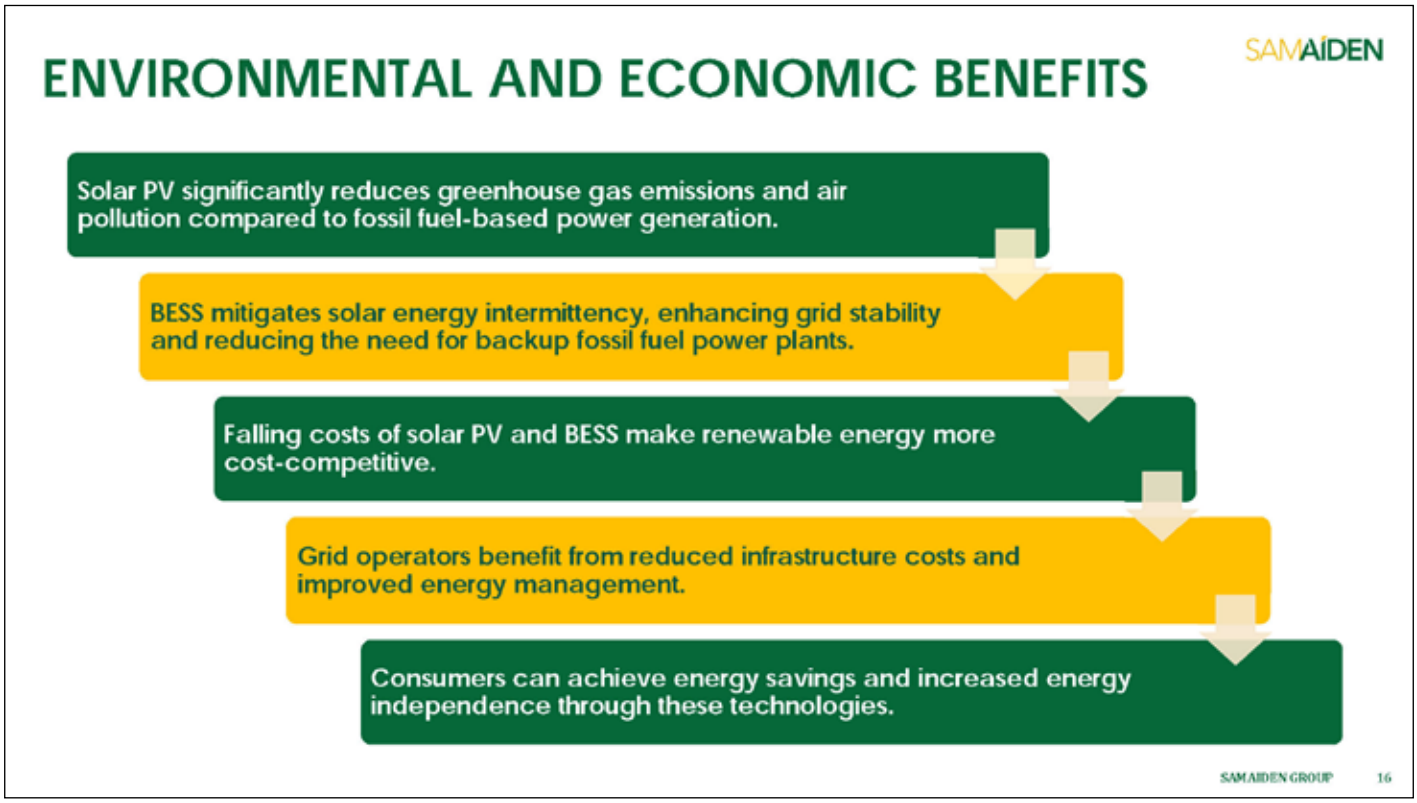
Pivotal in achieving global renewable energy targets and reducing carbon footprints.
BESS integration with renewable sources offers grid stability, energy optimization, and environmental benefits.
Solar PV + BESS
Empowers individuals and businesses to achieve energy independence and decentralization.
Reduces reliance on fossil fuels, combats climate change, and lowers air pollution.
DRIVING SUSTAINABILITY
SAM AIDEN GROUP 15


ENVIRONMENTAL AND ECONOMIC BENEFITS
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Solar PV significantly reduces greenhouse gas emissions and air pollution compared to fossil fuel-based power generation.
BESS mitigates solar energy intermittency, enhancing grid stability and reducing the need for backup fossil fuel power plants.
Falling costs of solar PV and BESS make renewable energy more cost-competitive.
Grid operators benefit from reduced infrastructure costs and improved energy management.
Consumers can achieve energy savings and increased energy independence through these technologies.
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Taman Sains Selangor 1,
Kota Damansara,
47810 Petaling Jaya,
Selangor.
Sustainability for Our Future
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The Evolution of Solar PV and Battery Energy Storage Systems and its Innovations: Driving Energy Sustainability

Corresponding Author
Ir. Chow Pui Hee, Samaiden Group

Abstract

This paper explores the transformative journey of solar photovoltaic (PV) technology and battery energy storage systems (BESS) in shaping the landscape of sustainable energy generation. Since the advent of renewable energy, solar power has emerged as a vital source of clean and sustainable energy. Solar PV systems have played an important role in harnessing the transition towards renewable energy, owing to their increasing efficiency, declining costs, and scalable nature. This has led to their widespread adoption across various sectors, including residential, commercial, and utility-scale applications. Today, the deployment of solar PV system has successfully led to the significant reduction of carbon emissions, fostering energy independence, and driving the transition towards a clean energy future. However, due to numerous supply issues from solar sources, innovative advancements in BESS have emerged, which have revolutionized the integration of renewable energy sources into the grid. The existence of transformative impact of BESS technologies has been proven in enhancing grid stability, enabling energy management, and facilitating the widespread deployment of intermittent renewable energy resources. In addition to that, the introduction of BESS has exerted the full potential of solar PV systems, allowing for energy storage, demand response, and load shifting capabilities. The synergistic relationship between solar PV and battery energy storage systems demonstrated that the integration of these technologies promotes a sustainable energy eco-system that maximizes energy generation and its efficiency while minimizes reliance on fossil fuels, and further foster grid resilience. As for the recommendation of this paper, the significant technological enhancement in both solar PV and BESS symbolizes the need for policy makers to roll out the policies in the affirmative to the development of these industries. Solar PV and BESS are inherently interdependent catalysts in the pursuit of energy sustainability. These technologies rely on a symbiotic relationship, wherein solar PV systems provide renewable energy generation, while BESS ensures efficient energy utilization and management. Together, they form a cohesive framework that drives the transition towards a sustainable energy future.

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1. Introduction

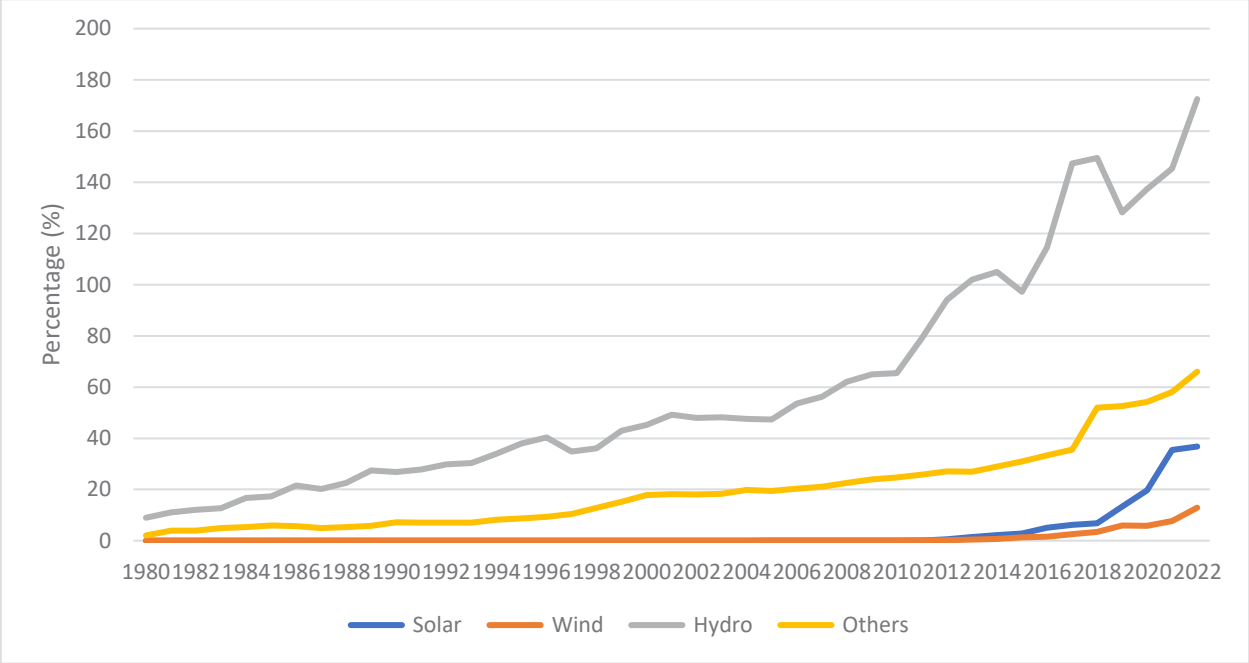
The global energy landscape is currently undergoing dramatic change primarily driven by the immediate need for sustainability in the context of climate change and the dwindling reserves of fossil fuels. Energy sustainability has risen to the forefront as one of the most formidable challenges of our time. Heavy dependence on fossil fuels for power generation has given rise to escalating levels of greenhouse gas emissions, air pollution, and the degradation of our ecosystems (Frederica, 2017; Lazarus & van Asselt, 2019). These environmental consequences pose an immediate and severe threat to the delicate balance of our planet and the well-being of both present and future generations. The transition to sustainable energy will not be easy, but it is essential. We need to make a concerted effort to invest in sustainable energy technologies and to make them more affordable.

The need for energy sustainability is one of the most pressing challenges of our time. Our reliance on fossil fuels for power generation has led to climate change, air pollution, and environmental degradation. These consequences pose an immediate threat to the planet and its inhabitants. The transition to sustainable energy sources is no longer a choice, but a moral, environmental, and economic imperative. In this context, solar photovoltaic (PV) systems and battery energy storage systems (BESS) have emerged as key players in the quest for a cleaner, more sustainable future. This paper explores the evolution of PV and BESS technologies and their innovations, highlighting their essential role in advancing global energy sustainability.

In recent years, Southeast Asia has witnessed a dynamic and multifaceted energy trend marked by a discernible transition towards greater sustainability and energy diversification. This transformation is characterized by a notable surge in renewable energy development, such as solar, biomass, biogas, wind, and hydro which is primarily driven by concerns over environmental sustainability and a desire to reduce carbon emissions. As a result of that, governments and industries in the region are escalating their efforts to enhance energy efficiency and grid reliability, aiming to meet the growing energy demands of their rapidly urbanizing populations while reducing energy wastage. However, Southeast Asia's energy landscape remains complex and multifaceted, as many countries in the region continue to rely heavily on fossil fuels, particularly coal and natural gas as the core resources for power generation, to meet their immediate energy needs. The growth of renewable energy in Southeast Asia is challenging the region's reliance on fossil fuels, forcing governments and industries to strike a delicate balance between economic development, energy security, and environmental sustainability.

Figure 1 depicted the composition of renewable energy generation in Southeast Asia, hydropower stood at the highest amongst all, indicating the proportion of the other renewable energies remains relatively low. Overall, the increasing trend of the composition of renewable energy implies that the progress of energy transition held significant development.

Figure 1: Southeast Asia Electricity Generation by Sources



Source: ourworldindata.org

*The country selected consists of Malaysia, Singapore, Thailand, Vietnam, Indonesia and The Philippines

2. The Development of Solar Photovoltaic (PV)

Solar PV technology has captured the imagination of public alike. The fundamental concept is elegantly simple which is to harness the boundless energy radiating from the sun and convert it into electricity with minimal environmental impact. Over the past decades, solar PV has evolved from a niche technology to a global energy giant. Advances in materials, manufacturing processes, and system design have led to increased efficiency, reduced costs, and greater accessibility, making solar PV a pivotal player in the quest for sustainable energy solutions. While solar PV offers a renewable energy source, its intermittent nature presents challenges for grid stability and energy reliability. As such, there are many researchers who have proposed methods to deal with this common issue and enhance its robustness (Thomas et. Al., 2013; Jeroen et. Al., 2013).

The revolution of Solar PV is a testament to human ingenuity. From the early explorations of the photovoltaic effect to the sophisticated multi-junction solar cells capable of capturing sunlight with remarkable efficiency, the journey has been nothing short of astonishing. Over the decades, solar PV has evolved from a curiosity to a cornerstone of global renewable energy initiatives. Advancements in materials science, manufacturing techniques, and system design have led to efficiency improvement, cost reduction, and broader accessibility. Today, solar PV installations span continents, harnessing the Sun's abundant energy to power homes, industries, and entire regions.

3. The Evolution of Solar Photovoltaic (PV) and BESS Technology

The evolution of solar photovoltaic (PV) technology and battery energy storage systems (BESS) has been a subject of extensive research and innovation over the past few decades (Lingling et. al., 2023; Neelakantha et. al., 2023; Kokchang, et al., 2023). Solar PV technology traces its roots back to the mid-20th century, with the discovery of the photovoltaic effect. Notable milestones in its evolution include:

- 1954: Bell Labs scientists Gerald Pearson, Calvin Fuller, and Daryl Chapin developed the first practical solar cell which the achievement of 6% efficiency rate
- 1970s: The development of monocrystalline and polycrystalline silicon solar cells led to the cost reduction and improvement in efficiency
- 1990s: Thin-film solar technologies, such as amorphous silicon and cadmium telluride, emerge as alternatives, further diversifying the PV landscape
- 2000s: Innovations like bifacial solar panels, concentrated solar photovoltaics (CPV), and tandem solar cells contribute to higher efficiency and energy capture

These advancements have collectively propelled solar PV into a prominent position as a clean and renewable energy source. Battery energy storage systems have undergone remarkable developments, enabling the efficient capture and storage of electricity generated from renewable sources. Key development in BESS technology include:

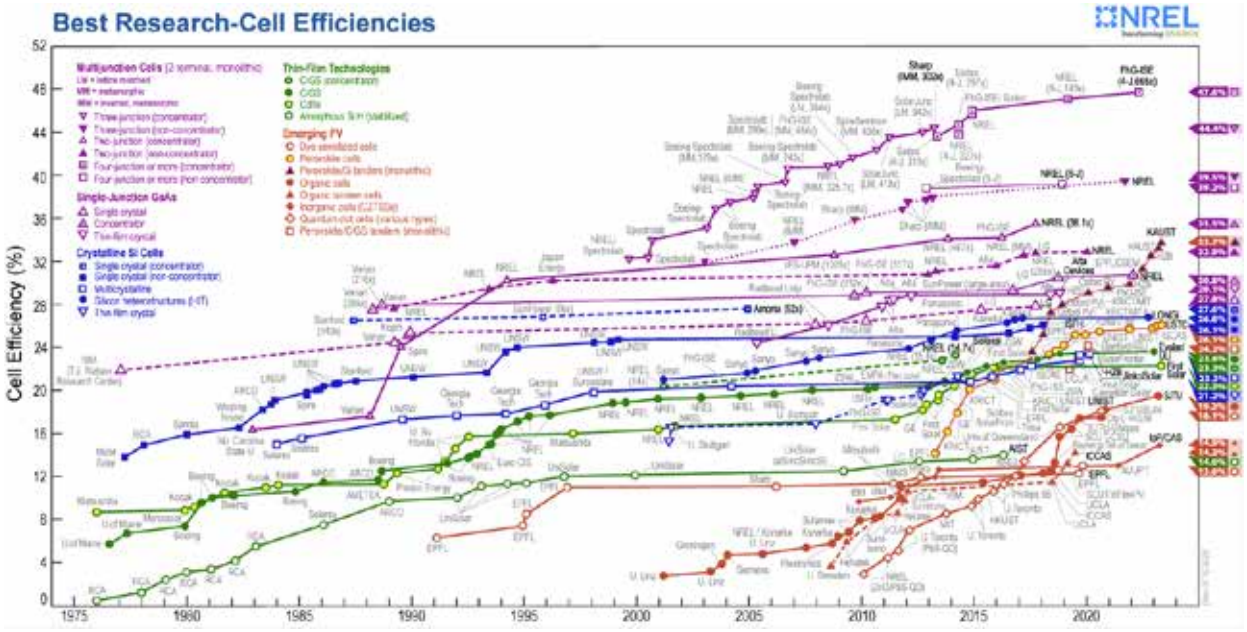
- 1970s-1980s: Early BESS technologies emerge with applications in remote power systems and satellites.
- 2000s: Advancements in lithium-ion battery technology led to higher energy density, longer cycle life, and lower costs, making BESS more commercially practical for various applications.
- 2010s: Grid-scale BESS installations become more prevalent, offering solutions for peak load management, grid stabilization, and renewable energy integration.

Recent Innovations such as solid-state batteries, flow batteries, and advanced energy management systems are opening new frontiers for BESS. These developments in BESS technology have unlocked the potential to store excess energy from intermittent renewable sources and ensure a stable and reliable energy supply.

4. Solar PV Efficiency

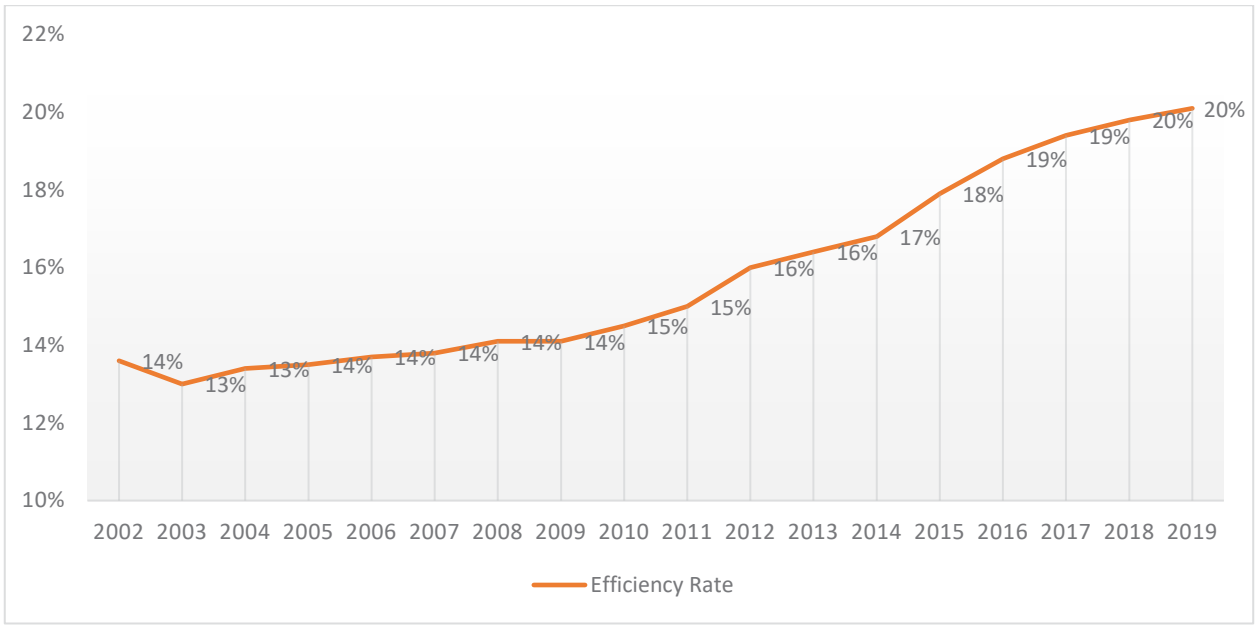
In recent years, there have been significant enhancements in solar PV efficiency, rendering this technology increasingly appealing for a diverse array of applications. Figure 2 illustrates the increase in solar PV efficiency over the past two decades. As shown in Figure 2, the efficiency of solar PV panels has steadily improved, with recent innovations pushing beyond 20% efficiency in laboratory settings. These advancements translate into increased energy capture and reduced land requirements for solar installations, further enhancing their sustainability.

Figure 2: Solar PV Efficiency Trends Best Research-Cell Efficiency Chart



Source: National Renewable Energy Laboratory (NREL)

Figure 3: Median Solar Panel Efficiency Rate Over Time



Source: 2022 LBNL Tracking the Sun Report

Figure 3 indicated the trend of solar panel efficiency rate from 2002 to 2019, the data published demonstrated a remarkable and consistent upward trajectory. In 2002, the median efficiency of solar panels was relatively modest, with an average efficiency rate of 14%. However, as technological advancements and research in photovoltaics flourished, the efficiency of solar panels experienced a

significant increase. By 2019, the median efficiency had soared to 20%, signifying a nearly 6% improvement over the examined period. This substantial enhancement in solar panel efficiency can be attributed to a multitude of factors, including breakthroughs in materials science, the development of more sophisticated manufacturing processes, and the refinement of solar cell designs. These advancements have not only made solar energy more accessible and affordable but have also contributed significantly to the global shift towards renewable energy sources and a reduced carbon footprint. As a result, the solar industry has become a pivotal player in the sustainable energy landscape, offering a cleaner and more efficient energy solution for a greener future.

5. Battery Energy Storage Systems (BESS) Deployment

BESS technology has witnessed remarkable growth, enabling the efficient capture and storage of excess solar energy for later use, even when the sun is not shining. BESS enhances the resilience and reliability of renewable energy sources, making them viable alternatives to conventional fossil fuel-based power generation. Researchers, engineers, and entrepreneurs continuously seek novel solutions to enhance efficiency, reduce costs, and expand the scope of applications for these technologies. These innovations are not only fostering the growth of renewable energy but also reshaping entire energy ecosystems, offering new opportunities for decentralization, grid modernization, and increased energy independence.

Battery Energy Storage Systems (BESS) have found a multitude of applications across various sectors, revolutionizing the way we harness and manage energy in storage. As presented in Table 1, application of BESS has been found to exist in numerous sectors such as grid related utility, grid related residential and C&I. Within the framework of environmentally friendly energy sources, BESS plays a vital role in stabilizing the intermittent output of sources like solar and wind, providing grid operators with greater flexibility and reliability. Furthermore, BESS systems are instrumental in peak shaving, helping commercial and industrial facilities reduce their electricity bills by storing excess energy during low-demand periods and discharging it during high-demand hours. Beyond the energy sector, BESS finds use in enhancing resilience during power outages, serving as backup power sources for critical infrastructure such as hospitals and data centers. Additionally, BESS can help integrate electric vehicles into the grid by enabling efficient charging and discharging of EV batteries. As the technology continues to develop, BESS applications are expected to expand even further, contributing to a more resilient, efficient, and sustainable energy system.

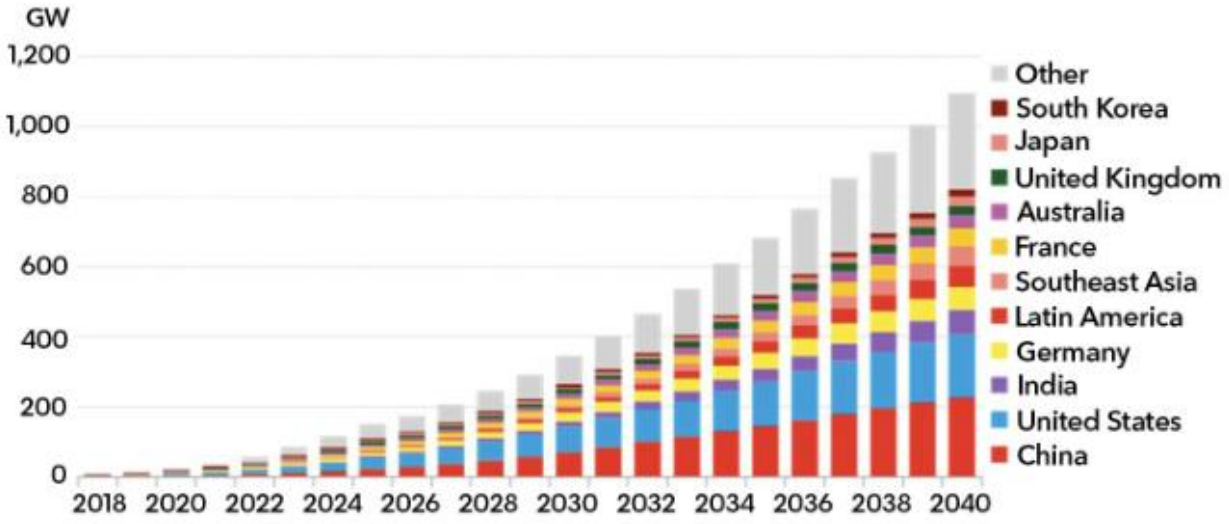
Table 1: Application of BESS

Sector Category	Application	Description
Grid-related – utility	Ancillary services	Provision or absorption of short bursts of power to maintain supply and demand and thus the frequency of the grid; frequency regulation and reserves
	Peaking capacity	Provision of capacity to meet system maximum demand
	Energy shifting	Driven by increasing system flexibility needs. Energy storage is charged during low prices and surplus supply

		and discharged to meet demand. Batteries can be charged from surplus renewable energy or from assets that, along with battery, become dispatchable
	Transmission-level	Use of an energy storage system as an alternative to traditional network reinforcement, such as to meet an incremental increase in transmission capacity instead of an expensive transmission line upgrade
	Distribution-level	Use of an energy storage system as an alternative to traditional network reinforcement such as to meet an incremental increase in distribution capacity instead of an expensive distribution line upgrade
Grid-related – residential	C&I energy storage	Energy storage that is used to increase the rate of self-consumption of a PV system from a commercial or industrial customer
Grid-related – utility/residential and C&I	EV charging infrastructure	

Source: U.S. Department of Energy (Energy Storage Grand Challenge: Energy Storage Market Report, 2020)

Figure 3: Global Cumulative Energy Storage Installations Projection

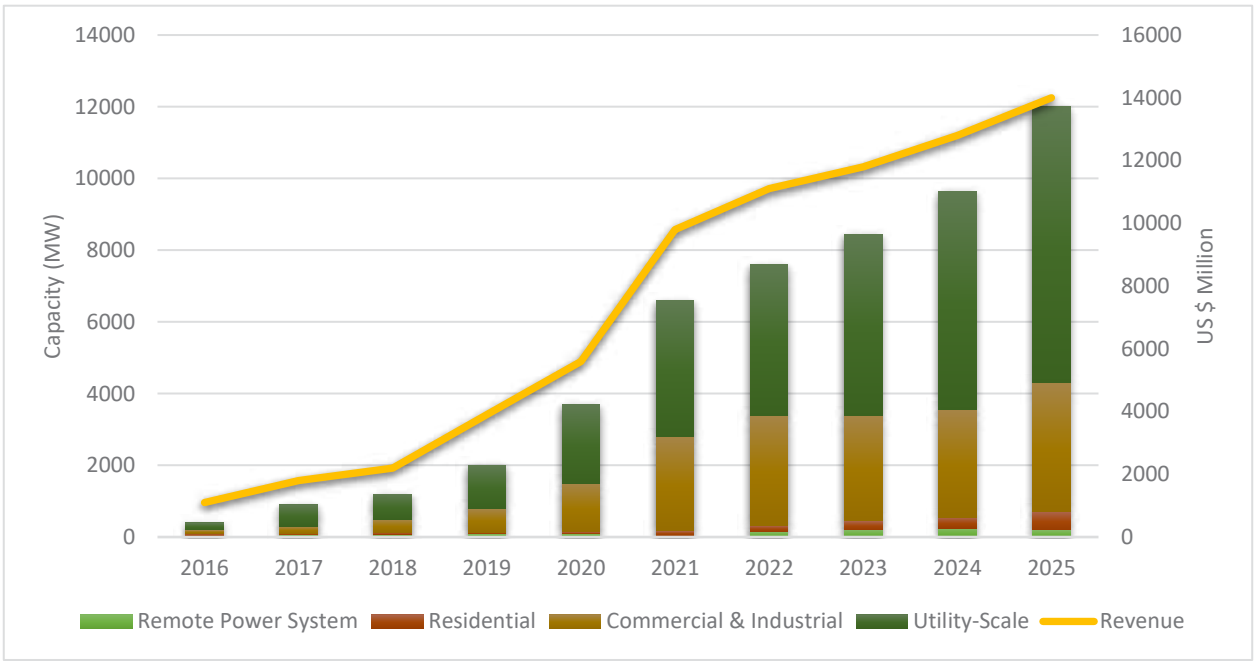


Source: Bloomberg NEF

Based on the data published by Bloomberg NEF, global energy storage installation is projected to increase tremendously till 2040 due to the rapid change in the demand of green energy as well as the commitment towards net zero by majority of the countries around the World. Figure 3 reveals the energy storage installation could exceed 1000GWh by 2040. As commented by Logan Goldie-Scot, head of energy storage at BNEF renewables-plus-storage, especially solar-plus-storage, has become a major driver for battery build in the near term.

Battery energy storage is considered as a critical technology in the transition towards sustainable energy. The declining price and increasing use of lithium-ion batteries is proven by the declining price especially in electric vehicles and renewable projects within the region. In the next three years, the World Bank forecasts that approximately 10 GW storage capacity might be realized. Although most of the projected 10 GW capacity would probably be contributed by pumped hydro storage, it deemed battery technologies are beginning to make impacts. But for this to happen, there must be an energy storage target as most countries in ASEAN do not have rules regarding the storage or fundamental commercial structures to support such emerging technologies (The ASEAN Post). Government support in terms of policies, regulations, and laws are now in the spotlight as the push for the adoption of energy storage takes place. The regulatory uncertainties pose an obstacle to equity investors and debt funders regarding deploying these essential technologies.

Figure 4: Projected annual stationary energy storage deployments, power capacity and revenue by market segment



Source: World Bank

Figure 4 illustrates the exponential growth of grid-connected BESS installations over the past decade. This expansion is driven by regulatory support, falling battery costs, and the need for reliable energy storage solutions in renewable-rich regions. The driving factors behind the deployment of BESS facilitate since 2016 is projected to continue its upward trend, energy transition associated with the reliable energy supply is a must to ensure there is no intermittency for the electricity supply.

6. Driving Sustainability: Solar and Battery Energy Storage System (BESS)

Understanding the evolution and innovations in solar PV and BESS is crucial in a global context. Nations worldwide are setting ambitious renewable energy targets and actively seeking ways to reduce their carbon footprints. Solar PV and BESS play a central role in accelerating the transition, offering scalable and adaptable solutions that can be tailored to the specific needs of diverse regions and communities. While in the on-going search for eco-friendly energy options, the domains of Solar Photovoltaic (PV) and Battery Energy Storage Systems (BESS) have emerged as transformative forces, rewriting the narrative of global energy production and consumption. The urgent need to address climate change, dwindling fossil fuel resources, and the imperative of achieving the United Nations Sustainable Development Goal 7 (SDG 7) - ensuring access to affordable, reliable, sustainable, and modern energy for all - has propelled solar PV and BESS to the forefront of technological innovation.

Integrating Battery Energy Storage Systems (BESS) with renewable energy sources, such as solar and wind, offers multifaceted advantages. BESS plays a pivotal role in enhancing grid stability and reliability, maximizing energy utilization, promoting energy independence and decentralization, and delivering significant environmental and economic benefits. One of the most notable benefits of combining BESS with solar photovoltaic (PV) systems is the substantial improvement in grid stability and reliability. Solar power generation is inherently intermittent, relying on weather conditions and daylight hours. By coupling solar arrays with BESS, excess energy can be captured during sunny periods and released during low or no sunlight, effectively mitigating fluctuations and providing a consistent energy supply to the grid. This stability benefits utility companies, ensuring uninterrupted power supply for homes and businesses, reducing the risk of blackouts, and enhancing overall energy resilience.

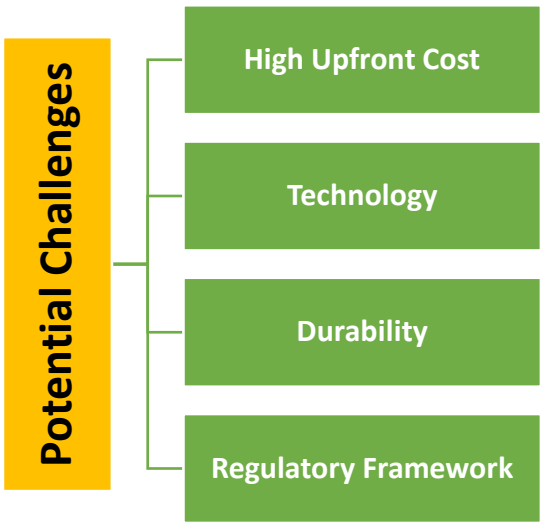
BESS serves as an energy buffer, enabling efficient utilization of solar-generated power. Solar PV systems often produce surplus energy during peak sunlight hours when electricity demand may be low. Without storage, this excess energy is typically wasted. BESS, on the other hand, captures and stores surplus energy for later use, optimizing the use of clean, renewable resources. Homeowners and businesses can rely on stored solar energy during nighttime or cloudy days, reducing their dependence on conventional grid power and lowering electricity costs. The integration of solar PV and BESS empowers individuals, communities, and businesses to achieve greater energy independence and decentralization. A well-designed system enables users to generate, store, and consume their renewable energy, reducing reliance on centralized fossil fuel-based power generation. This not only contributes to a greener planet but also enhances energy security by reducing vulnerability to disruptions in the central grid.

The economic benefits are substantial as well; BESS smooths out energy supply and demand variations, potentially lowering electricity costs for consumers while creating opportunities for revenue generation through grid services such as peak shaving and frequency regulation. In summary, Battery Energy Storage Systems complement solar power in numerous ways, including grid stability, energy utilization, energy independence, and environmental and economic benefits. This synergy not only advances sustainability goals but also positions these technologies as essential components of a cleaner, more resilient energy future.

7. Potential Challenges for BESS Deployment

Notwithstanding there are numerous benefits of having integrated Solar PV and Battery Energy Storage System but still there are challenges for the dissemination of BESS within Southeast Asia. First and foremost, the cost to be incurred for BESS remains relatively high given that the technology involved is new in the region. This can make it difficult for businesses and governments to justify the investment, especially in countries with limited financial resources. Apart from that, the lifespan of BESS batteries is typically shorter than other power generation technologies, such as solar and wind. This implies that BESS needs to be replaced more often, which can increase the overall long-term investment cost. Due to the BESS system are relatively complex involving Energy Management System (EMS) and Battery Management System (BMS), therefore expertise in this industry might be scarce. For instance, BESS needs to be able to efficiently store and discharge energy, and they need to be able to withstand harsh weather conditions. More importantly, the evolving regulatory framework can make it difficult for businesses and governments to plan and invest in BESS projects.

Figure 5: Potential Challenges for BESS Deployment



Despite these challenges, there are several reasons to be optimistic about the future of BESS in Southeast Asia. The region is home to a growing population and economy, which is driving demand for energy. Renewable energy is also becoming more affordable and accessible, which is creating an opportunity for BESS to play a role in the region's energy mix. As technology continues to develop and the costs are exhibited downward trend, BESS are likely to become more widespread in Southeast Asia.

8. Environmental and Economic Benefits of Solar PV and BESS Integration

Extensive research has consistently highlighted the compelling environmental and economic advantages of seamlessly integrating solar photovoltaic (PV) systems and Battery Energy Storage Systems (BESS) into

modern energy systems. A wealth of key findings underscores the remarkable Environmental Benefits of this integration. Solar PV, for instance, has been demonstrated to significantly reduce greenhouse gas emissions, curbing the impact of climate change. Additionally, it helps mitigate air pollution and conserves precious water resources, particularly when compared to conventional fossil fuel-based power generation methods. It has been demonstrated that BESS helps mitigate the intermittent of solar energy, enhancing grid stability and reducing the need for backup fossil fuel power plants (MA, et al., 2021; Chaffee, 2023). The falling costs of solar PV and BESS technologies are making renewable energy more cost competitive. Grid operators benefit from reduced infrastructure costs and improved energy management, while consumers can achieve energy savings and increased energy independence.

9. Conclusion and Implications

The exploration of the evolution of solar photovoltaic (PV) technology and battery energy storage systems (BESS) reveals a promising trajectory toward a more sustainable energy future. The innovations discussed in this paper showcase the potential for these technologies to revolutionize the way we generate, store, and utilize energy. As we continue to confront the challenges of climate change and finite fossil fuel resources, the importance of renewable energy sources cannot be overstated. Solar PV and BESS, with their growing efficiencies, declining costs, and increasing accessibility, are poised to play a pivotal role in reducing greenhouse gas emissions and enhancing energy resilience.

The journey from the early days of solar PV to the sophisticated battery energy storage systems of today underscores the remarkable progress made in harnessing clean and abundant energy from the sun. Additionally, ongoing research and development efforts promise even greater advancements in future, making these technologies increasingly practical and economically viable from the investor perspective. It is crucial that we continue to invest in research, development, and policy initiatives that support the widespread adoption of solar PV and BESS. By doing so, we can accelerate the transition to a more sustainable, clean energy landscape and contribute to a brighter and more environmentally responsible future for generations to come.

In order to facilitate the growth of Solar PV and BESS, it is deemed crucial for governments to provide financial incentives to businesses or relevant government bodies to invest in new BESS technology. By having this in place, it can help to reduce the upfront costs and make BESS more affordable. Additionally, governments can work to secure a reliable supply of raw materials for BESS. This can help to reduce the risk of supply disruptions and make BESS more sustainable. Moreover, R&D can be conducted to improve the performance and lifespan of BESS batteries. This can help to reduce the overall cost of BESS and make them more attractive to businesses and governments. Standards and regulations can be developed to create a more favorable environment for BESS deployment. This can help to reduce uncertainty and make it easier for businesses and governments to invest in BESS projects. By addressing these challenges, Southeast Asia can position itself as a leader in the development and deployment of BESS. This can help the region to meet its energy needs in a sustainable and affordable way.

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Sustainable Smart, Safety and Green Technology for Building and Industry: Environmental, Social and Governance in Practice

Dr. Werachet Khan-ngern,
Kumwell Corporation PLC, TEMCA, Thailand

1

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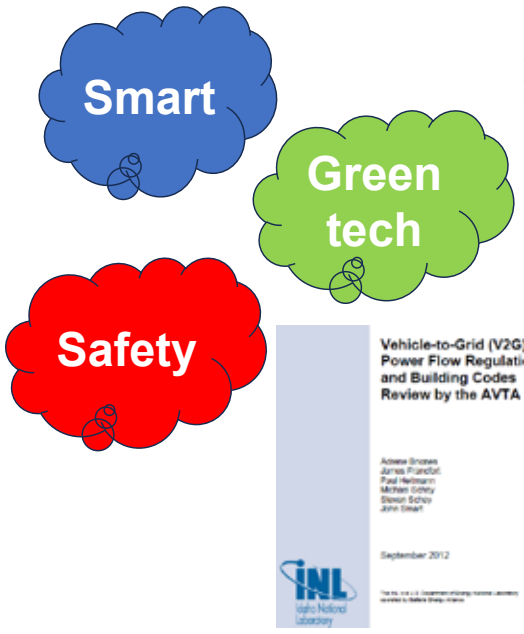

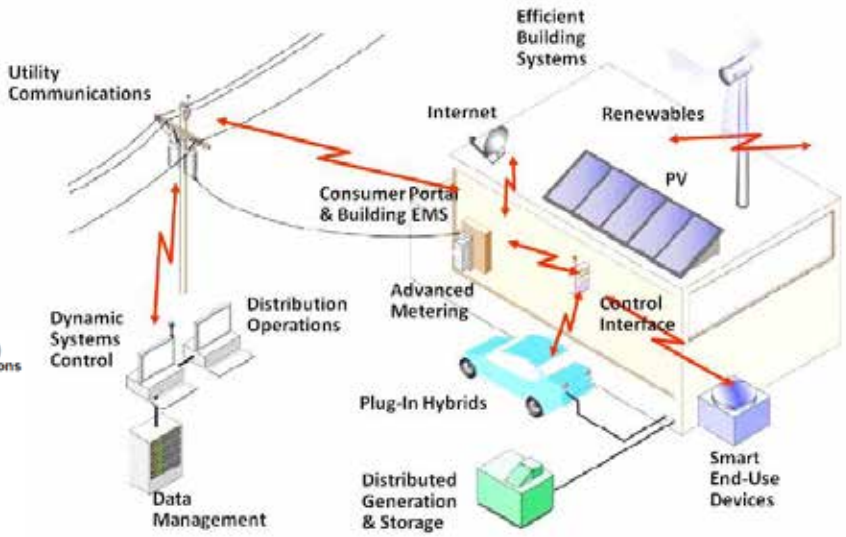

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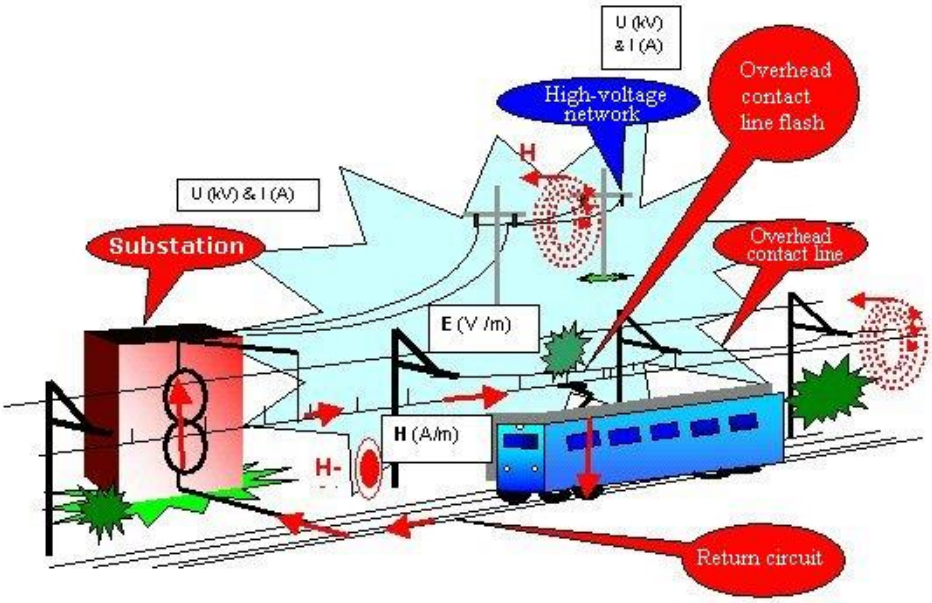

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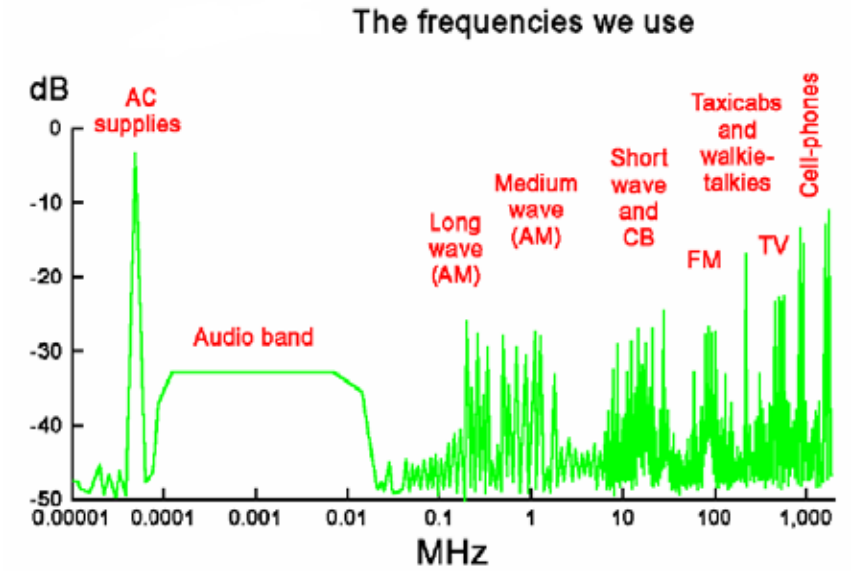
Used frequency



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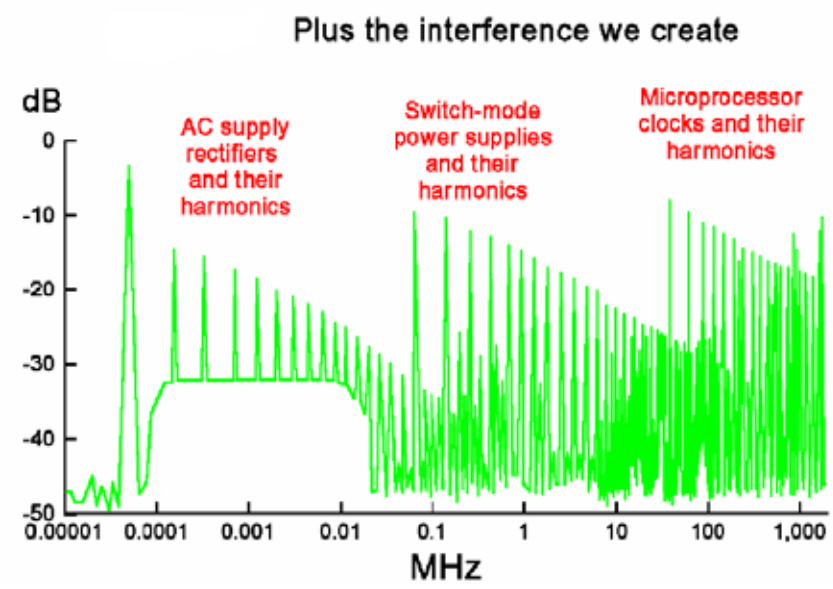

6

Damage due to lightning and EMI

Source and Type of Damage	Human Life D1	Physical Damage D2	System Failure D3
	R_A: Human Life	R_B: Fire/Explosion	R_C: LEMP
	-	-	R_M: LEMP
	R_U: Human Life	R_V: Fire/Explosion	R_W: Overvoltage
	-	-	R_Z: Overvoltage

EMI may cause 5G smart system problem

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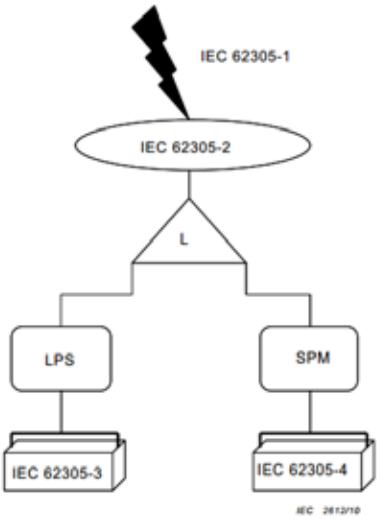
The Connection between the part of IEC 62305

Lightning Threat

Lightning Risk

Lightning Protection

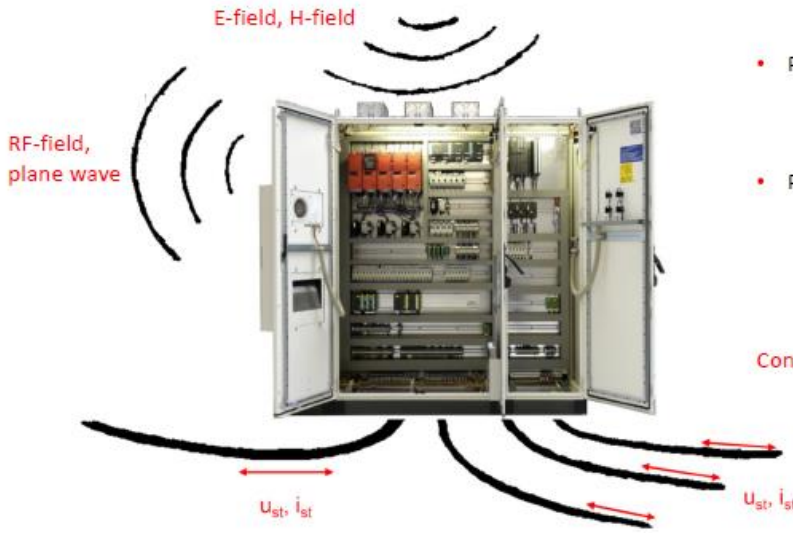
Protection Measure



LPS: Lightning Protection System

SPM: Surge Protection Measures

- Risk assessment in EMC, how to start?



- Product boundaries
  - Interfaces > Cables
  - Enclosures (Fields)
- Phenomena
  - interference voltages
  - currents on lines
  - interference fields

Consideration of the environment !

EMC in large industrial areas – Dr. Heinz Zenkner, Jan. 2022

9

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Lightning Protection Grounding, Electrical Grounding and Signal/Instrument Grounding

The fundamental goals of earthing and bonding are:

Safety

By limiting the touch voltage and the return path of fault currents

EMC

By avoiding differences in potential and providing a screening effect

10

Earthing and grounding

Purposes of Earth connection

1. **Safety earth**
2. **Functional earth**
3. **Lightning protection earth**
4. **EMC earth**
   1. Equipotential area/plane as system reference
   2. Low impedance path for currents to return to source
   3. Low transfer impedance path to prevent CM current converting to DM

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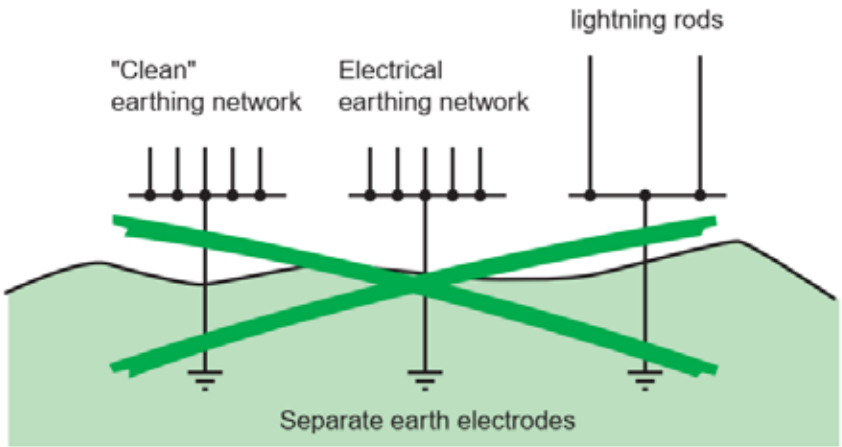
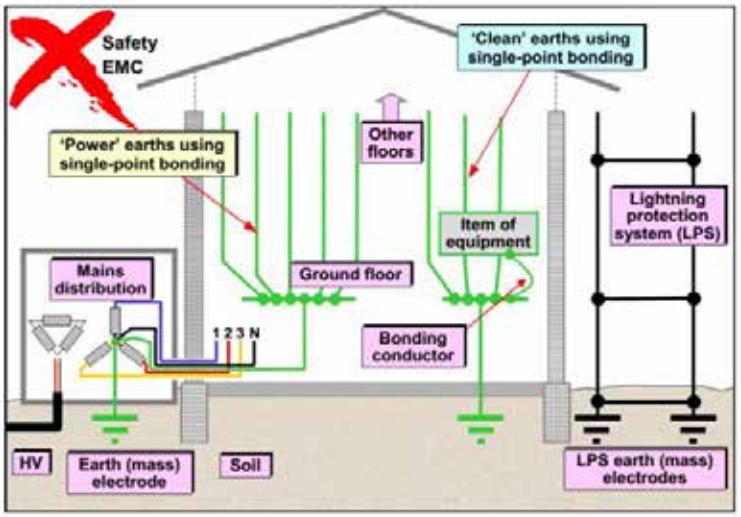
Independent grounding

Not Good for Safety and EMC



Independent grounding

Not Good for Safety and EMC



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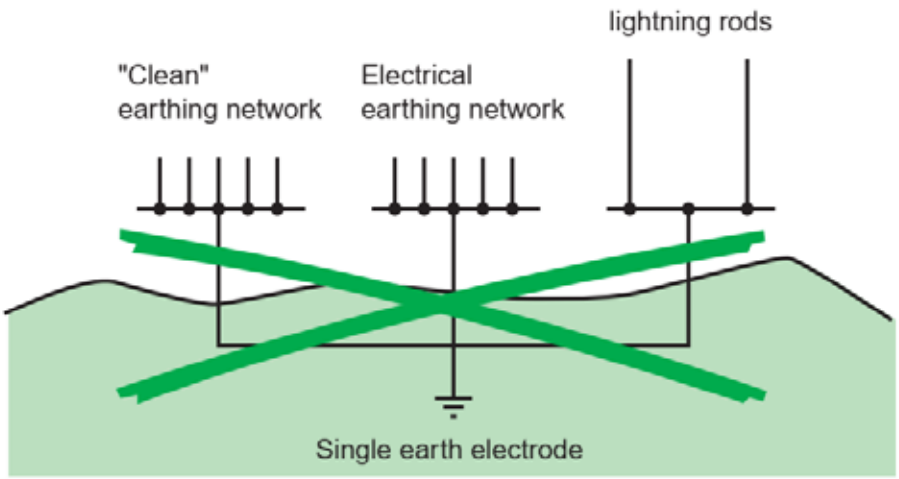
Single-Point grounding

Good for Safety, but no good for EMC



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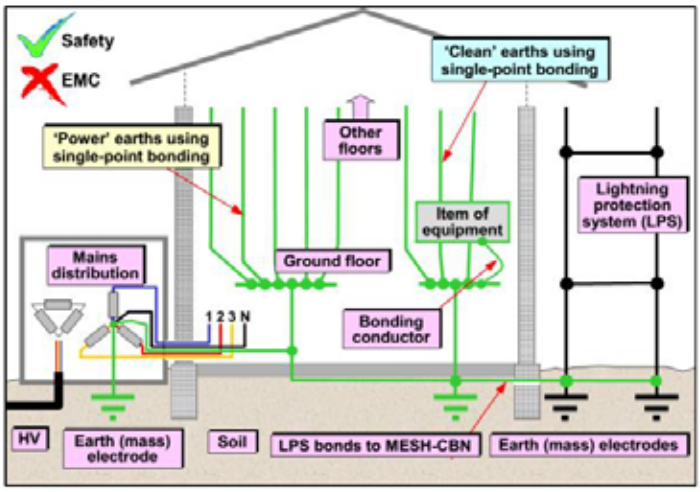
Single-Point grounding

Good for Safety, but no good for EMC



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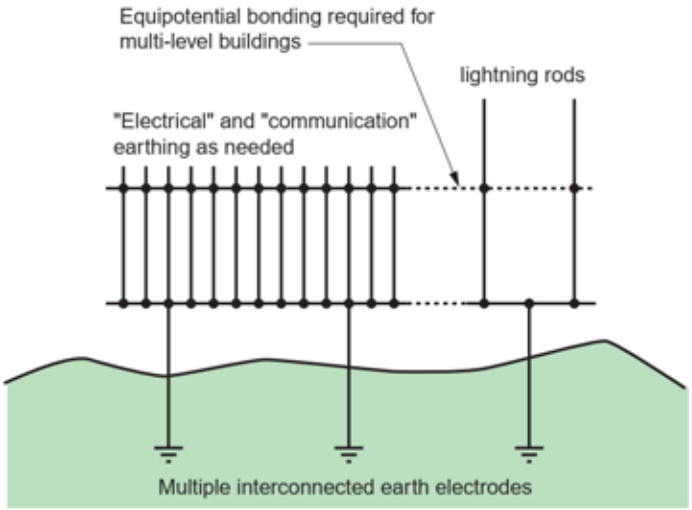
Grounding network

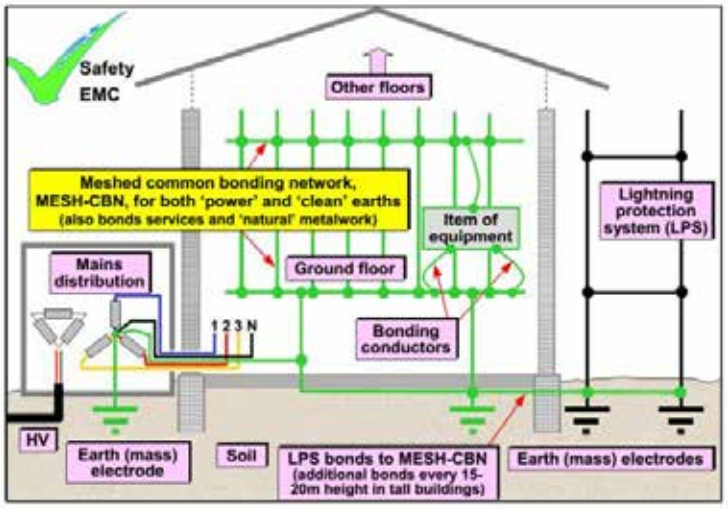
Good for safety for and EMC



16

Grounding network

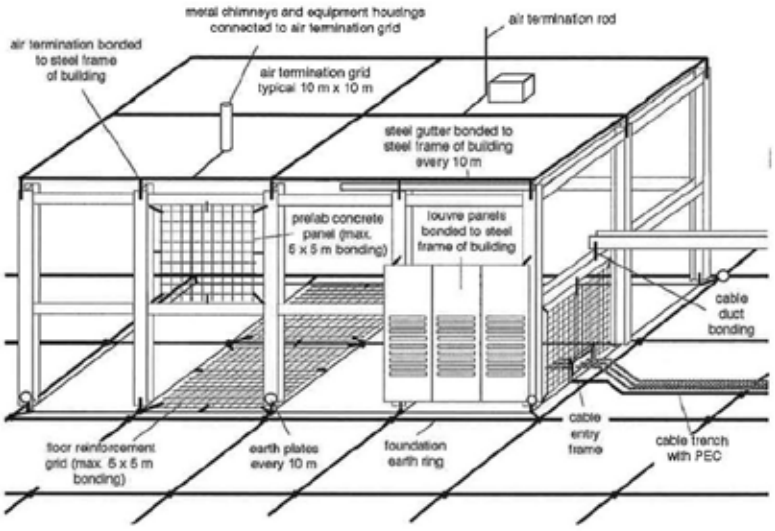
Good for safety for and EMC



17

Grounding network

Good for safety for and EMC



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EMC management and EPCC

Engineering

- EMC management plan
- EM site survey report
- EM matrix evaluation
- EM zone plan
- Risk assessment

Procurement

- Equipment Specification EMC
- Installation guide
- EMC test report

Construction

- Diagram of all EMC parts
- Installation check list

Commissioning

- EMC site acceptance test report
- Maintenance management

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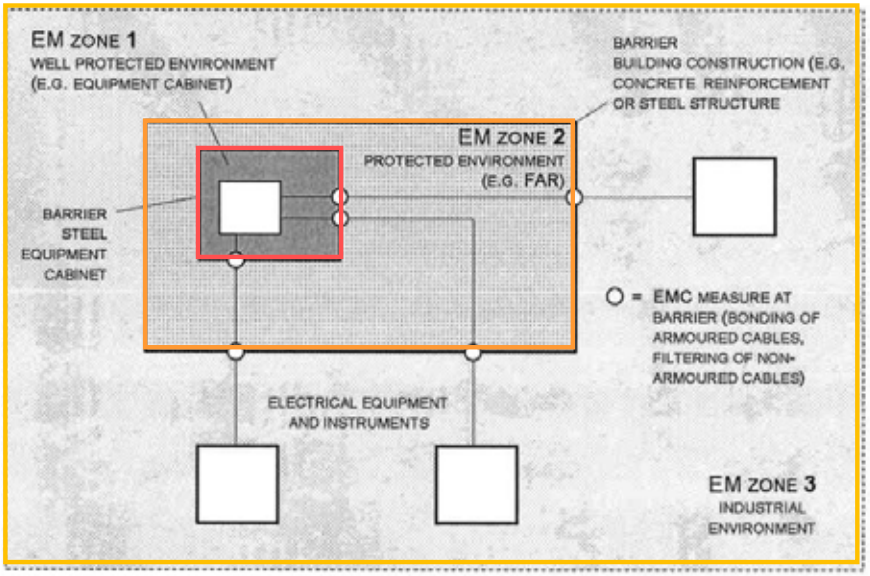
EM zoning and Location of EMC measures at EM zone barriers



EMC management

Check list

EMC	Sky deck	Office area	Data center	Residence zone	Play ground	Electrical room
Sky deck						
Office area						
Data center						
Residence zone						
Play ground						
Electrical room						

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EMC management

EMC

Not EMC

Check list step 1 EMC improvement

EMC	Sky deck	Office area	Data center	Residence zone	Play ground	Electrical room
Sky deck						
Office area						
Data center						
Residence zone						
Play ground						
Electrical room						

22

EMC management

EMC

Not EMC

Check list step 2 EMC improvement

EMC	Sky deck	Office area	Data center	Residence zone	Play ground	Electrical room
Sky deck						
Office area						
Data center						
Residence zone						
Play ground						
Electrical room						

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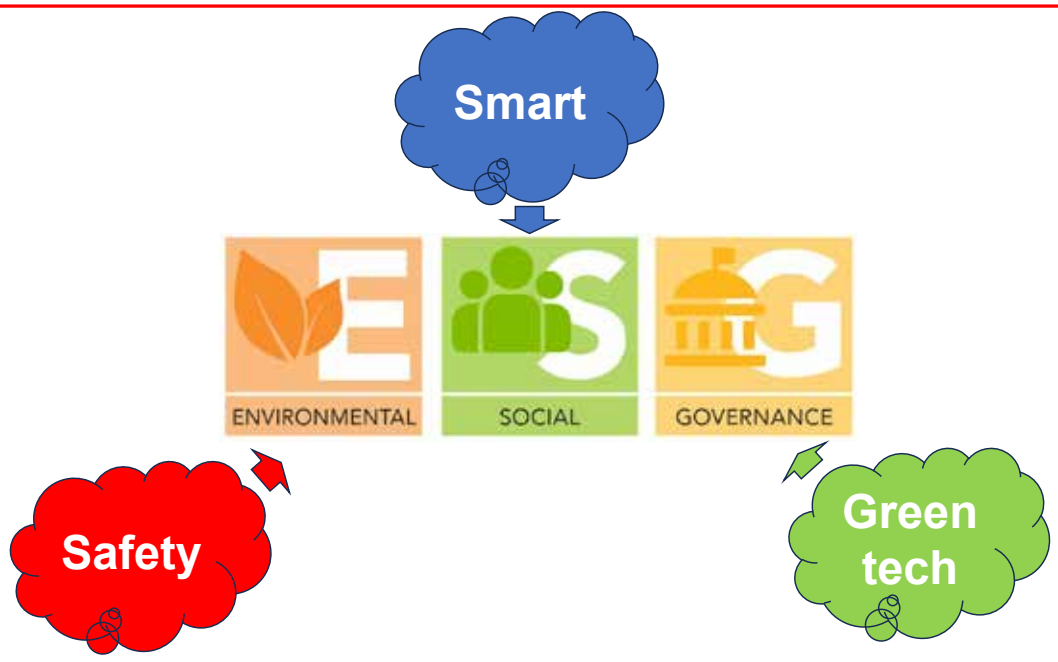


Thank you

Battery Comparison

Natron's Sodium Ion Battery

BRIDEX Fuji Electric Innovating Energy Technology

Why Sodium Ion Battery?

BRIDEX Fuji Electric Innovating Energy Technology

2

Why Sodium-Ion?

BRIDEX Fuji Electric Innovating Energy Technology

Natron's Prussian Blue Sodium-ion technology is perfectly aligned for quick energy and an extensive cycle life.

Natron's patented Prussian blue electrodes store and transfer sodium-ions faster, more often, and with lower internal resistance than any other commercial battery. With zero strain during charge / discharge, 10x faster cycling, and an over 50,000 cycle-life Natron's sodium-ion batteries represent the future of industrial mobility.

3

BlueTray® 4000

BRIDEX Fuji Electric Innovating Energy Technology

Introducing BlueTray® 4000

Reliable Performance & Uncompromising Safety

BlueTray 4000 is a standard 1U 19" rackmount configuration delivers 4kW at 48VDC over 2-minute discharge with a 6kW peak power rating. Fast recharges in 8-minutes and can cycle potentially >50k times.

Based on Natron's core Prussian Blue Battery technology, the Battery is UL listed.

Ultra Safe, High Sustained Power.

4

BlueRack® 500

BRIDEX | Fuji Electric Innovating Energy Technology

Introducing BlueRack® 500

Scalable Power Platform From kW to multi-MW

- Breakthrough sodium-ion cells based on Prussian blue electrodes
- Full recharge in 15 minutes, ready immediately
- No settling or thermal waiting required
- UL9540A 'Champion' rated nonflammable with no thermal runaway under any condition
- >10,000 deep discharge cycles
- Wide temperature operating range
- Twice the power of lithium
- Designed for Data Centers, behind-the-meter grid storage, and mission critical applications
- Round-trip efficiency >97%

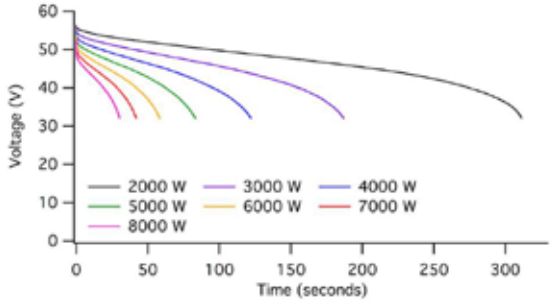
5

High Power Output and Input

BRIDEX | Fuji Electric Innovating Energy Technology

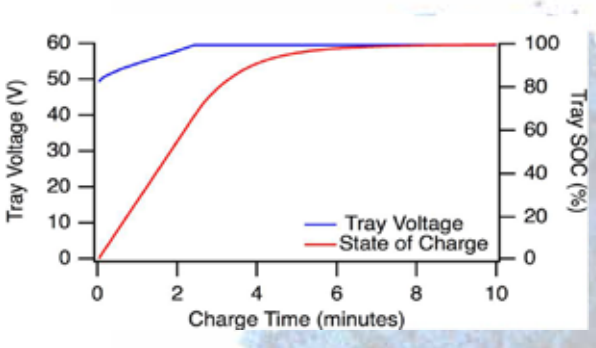
Full Discharge As Fast As 30s

- Natron's battery has half the internal resistance per energy of lead acid.
- This allows a much higher fraction of total energy to be delivered during rapid discharge.
- 70% of rated energy is delivered during 2-minute discharge at 4kW.
- 33% of rated energy is delivered during 30 second discharge at 8kW.



Full Recharge As Fast As 8 mins

- Natron's tray has unique charge acceptance ability: 0-99% SOC in 8 minutes.
  - ✓ 0-70% SOC during 16C recharge lasting 2.5 minutes.
  - ✓ 70-99% SOC during constant voltage hold lasting 6 minutes.



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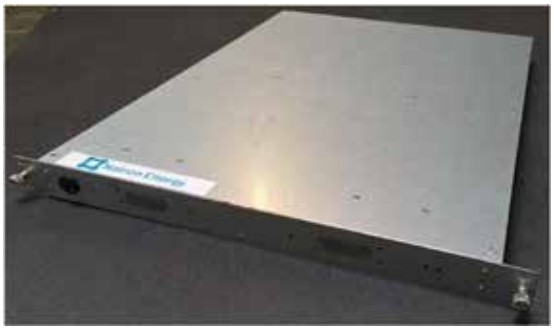
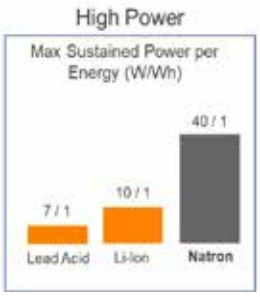
High Power, Long Life, Safe

BRIDEX Fuji Electric Innovating Energy Technology



Natron UPS Tray – 50VDC / 4.6Ah



For a 10MW Data Center:	Natron Energy	Lead Acid
Trays	2,500	5,000
Tray Power 2 minutes, end-of-life	4 kW	2 kW
Service life	5 years+	1-2 years
Safety Hazards	Nonflammable No lead or acid	Lead, acid Risk of fire during faults

- ✓ No Thermal Runaway!
- ✓ UL9540, 1973 991 Listed
- ✓ 2x Power of Lead Acid
- ✓ 6 successful customer demonstrations

7

Comparison

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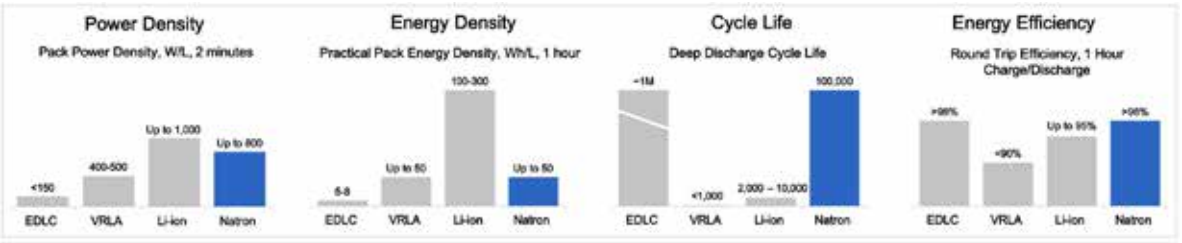

VRLA: Valve Regulated Lead Acid. EDLC: ultracapacitors. Note: for all technologies, products designed for high power have a higher price-per-energy than products designed for high energy, by an approximate factor of 2. Example: energy optimized Li-ion = $125/kWh, but power-optimized Li-ion = $250/kWh.

8

Comparison

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Natron Energy

Battery Type	Natron Sodium Ion (Dry Type)	Lithium NCM	Nickel Cadmium	Sealed Lead Acid	VRLA
Thermal Runaway	NIL	High	Moderate	Low	Low
Toxicity	NIL	Mid	Very High	Very High	High
Power	High	High	Low	Low	Low
Density	High, Lower than Lithium	High	Mid	Low	Low
Cycle Life	>10,000	>4,000	>2,000	Less than 1,000	Less than 1,000
Operating Temp	-30 to +50	-20 to +60	-20 to +45	-20 to +50	+20 to +25
Depth of Discharge	96%	70%	70%	50%	50%
Cost	High	High	Mid	Low	Low
Air Transport Restrictions	No	Yes	Yes	Yes	No
Maintenance	Low	Low	High	Low	Low

Source: https://bridex.fujielectric.com/sodium-ion-battery-dry
https://natron.energy/technology/
https://batteryuniversity.com/article/bu-704a-shipping-lithium-based-batteries-by-air
https://batteryuniversity.com/article/bu-107-comparison-table-of-secondary-batteries

10

Summary

BRIDEX | Fuji Electric Innovating Energy Technology

Sodium Ion Batteries

- UL1973 & 9540A approved
- 480VDC Version available in 2023
- 480VDC discharge 500kW in 2 mins & 250kW in 5 mins ~ LFP possible 250kW from 2 to 5 mins
- 16C Charge Rate ~ recharges in 15 mins
- 50,000 cycles with 100% DOD
- Single Phase UPS solution available

Current Progress

- Establishing position with SCDF Clause 10.3
- Discharged 12kW (403A) from 6 x Natron BT4000 (1.56kWh @1C) for >5 minutes
- Charging only 5 mins back to 100%
- 480VDC BluePack to arrive in Apr 2023
- Ongoing BlueRack design

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Thank You.

Corporate Website

bridex.fujielectric.com

Contact Number

+65 6756 0833

Email Address

sales@bridex.fujielectric.com

BRIDEX Fuji Electric Innovating Energy Technology

Participating Associations

AKLI, INDONESIA

HKECA, HONG KONG

KECA, KOREA

SPECS, PHILLIPINES

TECA, TAIWAN

TEEAM, MALAYSIA

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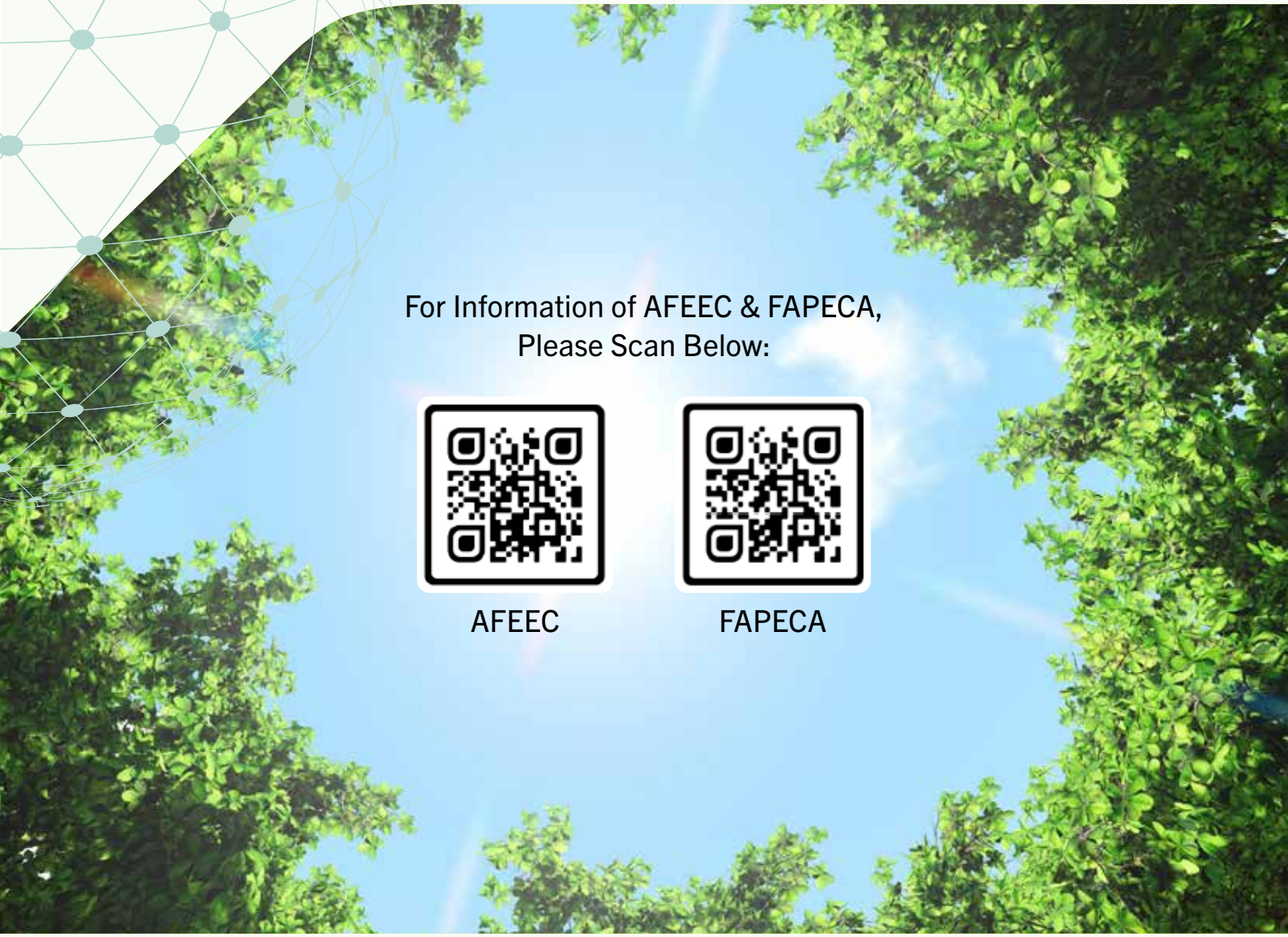

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