

5TH ASEAN SMART GRID CONGRESS (ASGC 5)

**December 3rd 2019 - Updates of Development
on Smart Grid in ASEAN (SINGAPORE)**

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4 Main Switches to Power Singapore's Future

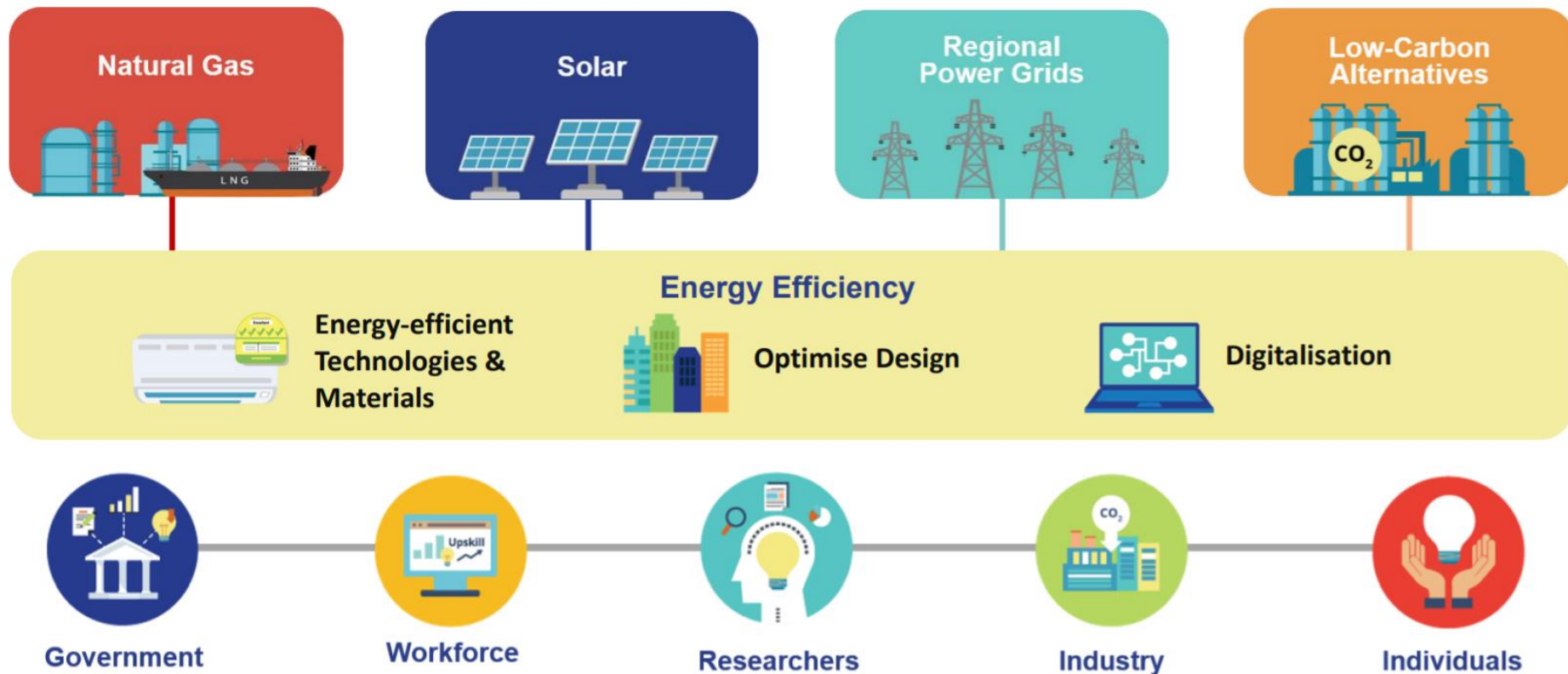


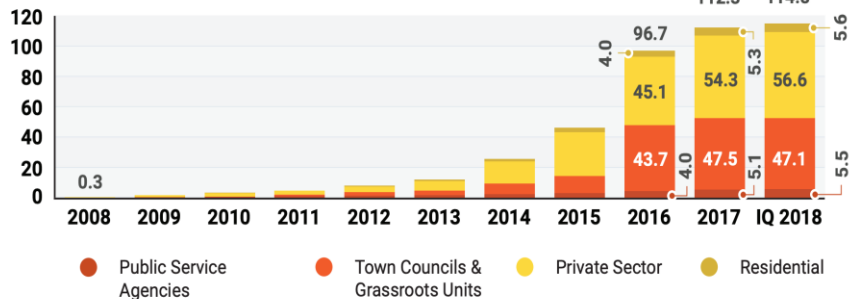
Photo credit: SIEW Opening Remarks by Minister for Trade and Industry (Chan Chun Sing)

Singapore Solar PV Market Update, Drivers & Challenges

Total Installed Capacity as of Q1 2018: 114.8MW

Unit: MWac

Installed Capacity



Grid-connected installed capacity grew sharply from 7.7 MWac in 2012 to 96.7 MWac in 2016, its growth had moderated recently and total installed capacity stood at 114.8 MWac in 1Q 2018.

Market Challenge:

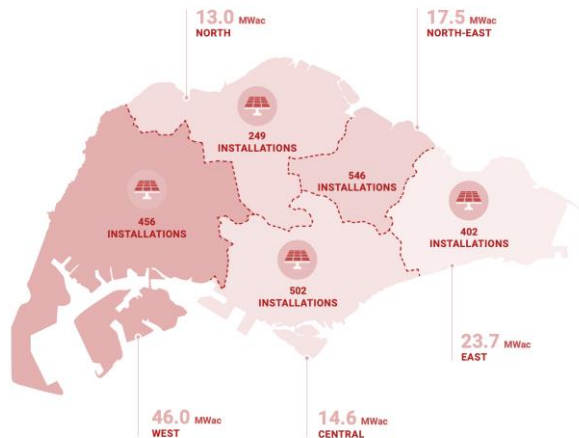
There are two limitations to deploying solar energy on a large scale to generate electricity reliably.

- **Singapore's small physical size** (716.1 km²), high population density and land scarcity limit the amount of available space to install solar panels.
- Any power system with significant penetration of solar energy for electricity generation must manage **intermittency** appropriately, so as not to compromise grid stability and reliability.

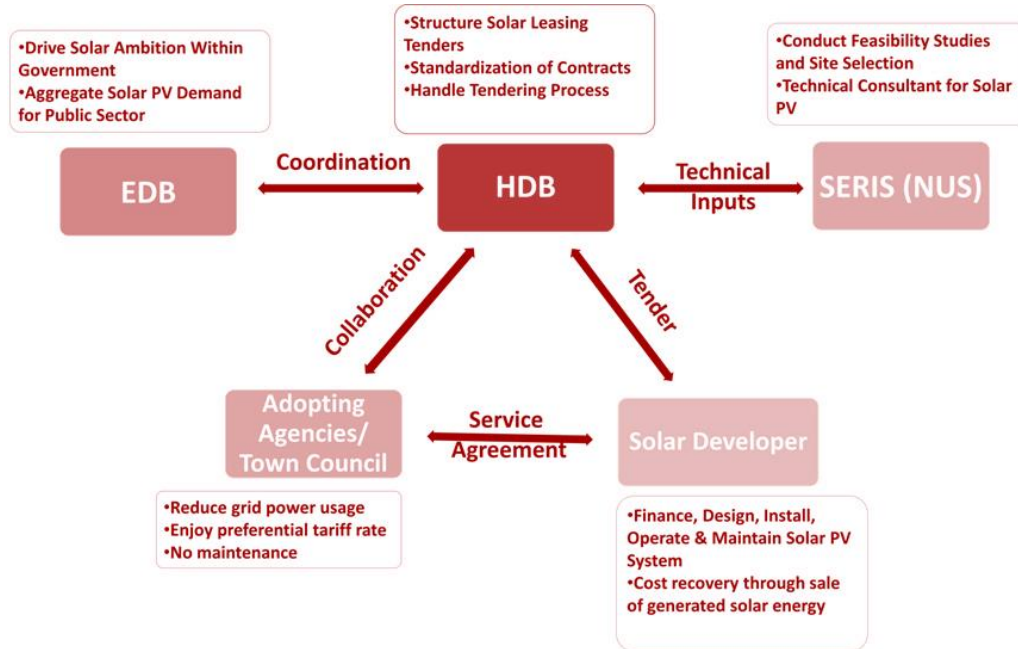
Market Driver:

1. **The Housing & Development Board (HDB)** and the Economic Development Board (EDB) are jointly spearheading the acceleration of the deployment of solar PV systems in Singapore through the SolarNova project, which was launched in 2014. As part of this effort, three solar leasing tenders have been called to-date. **Singapore is expected to reach the committed solar PV capacity of 350 MWp via this project by 2020.**
2. **The Public Utilities Board (PUB)** pursues large-scale floating solar deployment at Tengeh Reservoir while EDB explores potential for 100MWp system. PUB will be deploying a **50 megawatt-peak (MWp) floating solar PV system** at Tengeh Reservoir by 2021. Tender submission is closed last end September 2019. Another tender has been awarded in September 2019 for 1.5MW + 1.5MW at Bedok & Lower Seletar Reservoirs.

DISTRIBUTION OF SOLAR INSTALLATIONS IN SINGAPORE, 1Q 2018



Singapore Current Scheme/Program in Solar PV



Launched in 2014, the **SolarNova programme** is a Whole-Of-Government effort led by the Economic Development Board (EDB) and HDB to accelerate the deployment of solar photovoltaic (PV) systems in Singapore. This programme helps to promote and aggregate demand for solar PV across government agencies to achieve economies of scale, as well as drive the growth of Singapore's solar industry. This scheme will align with Singapore's plans to generate 350MWp of solar power by 2020.

Singapore Number of Grid-Connected Solar Photovoltaic (PV) Installations by User Type

Number of Grid-Connected Solar Photovoltaic (PV) Installations by User Type, 2008 - 2019

	2008	2009				2010				2011				2012				2013				2014				2015				2016				2017				2018				2019	
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Total	30	34	42	49	59	71	79	90	106	120	141	160	169	192	220	258	294	324	341	362	388	464	526	562	635	689	757	840	941	1,138	1,444	1,647	1,831	1,905	1,966	2,060	2,131	2,183	2,321	2,501	2,721	2,894	3,173
Residential	6	7	9	11	12	12	14	15	16	22	28	31	33	37	48	63	76	84	92	106	118	143	166	179	203	232	264	303	338	373	390	422	525	563	592	661	699	738	782	881	928	960	1,073
Non-Residential	24	27	33	38	47	59	65	75	90	98	113	129	136	155	172	195	218	240	249	256	270	321	360	383	432	457	493	537	603	765	1,054	1,225	1,306	1,342	1,374	1,399	1,432	1,445	1,539	1,620	1,793	1,934	2,100
Public Service																																											
Agencies	15	16	19	19	22	27	27	28	29	31	33	35	39	49	51	54	58	61	64	67	68	70	71	74	76	78	79	82	84	84	86	87	89	93	95	96	101	105	108	111	115	118	121
Town Councils &																																											
Grassroots Units	2	2	3	3	3	3	3	7	16	16	23	35	37	42	49	68	80	91	91	91	98	140	169	173	199	203	232	246	292	438	723	882	951	975	995	1,006	1,022	1,021	1,091	1,154	1,301	1,426	1,573
Private Sector	7	9	11	16	22	29	35	40	45	51	57	59	60	64	72	73	80	88	94	98	104	111	120	136	157	176	182	209	227	243	245	256	266	274	284	297	309	319	340	355	377	390	406

Source: SP PowerGrid Ltd (SPPG)

Last updated on 20 September 2019

Source: EMA website

Canadian Solar Inc.

Singapore Installed Capacity of Grid-Connected Solar Photovoltaic (PV) Systems by User Type

Installed Capacity of Grid-Connected Solar Photovoltaic (PV) Systems by User Type, 2008 - 2019

	2008	Unit: MWp																																									
		2009				2010				2011				2012				2013				2014				2015				2016				2017				2018				2019	
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2				
Total	0.4	0.4	0.7	1.0	1.9	2.9	3.0	3.3	3.8	4.0	4.8	5.5	5.9	6.8	7.6	8.8	10.1	12.0	12.6	14.0	15.3	18.7	22.5	24.8	32.9	36.9	40.3	48.5	59.3	73.4	102.6	118.0	125.5	132.4	140.3	144.2	150.6	155.4	169.7	184.7	205.7	229.5	262.4
Residential	-	-	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.4	1.6	1.8	2.0	2.3	2.8	3.2	3.6	4.1	4.3	4.6	5.2	5.6	5.9	6.4	6.9	7.4	7.9	8.6	9.3	9.7	10.6
Non-Residential	0.3	0.4	0.6	0.9	1.9	2.8	2.9	3.2	3.7	3.8	4.6	5.3	5.7	6.5	7.2	8.3	9.4	11.2	11.7	13.0	14.2	17.3	20.9	23.1	30.9	34.6	37.5	45.3	55.7	69.3	98.3	113.4	120.3	126.8	134.4	137.8	143.7	148.1	161.8	176.1	196.4	219.8	251.8
Public Service Agencies	0.2	0.2	0.4	0.4	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	1.0	1.2	1.5	1.5	1.8	2.0	2.0	2.1	2.1	2.3	2.3	2.4	3.1	3.2	3.5	3.9	4.0	4.0	4.9	4.9	5.3	6.2	6.2	6.2	6.6	7.1	7.2	8.7	10.0	10.2	11.7
Town Councils & Grassroots Units	-	-	-	-	-	-	-	0.2	0.5	0.5	0.9	1.4	1.5	1.7	2.0	2.9	3.6	4.1	4.1	4.1	4.4	6.5	7.9	8.1	9.5	9.7	11.1	12.0	15.1	23.4	40.8	52.3	57.0	58.8	60.5	61.4	62.4	62.5	67.5	71.8	82.8	93.2	103.2
Private Sector	0.1	0.1	0.2	0.5	1.4	2.2	2.3	2.5	2.6	2.7	3.0	3.1	3.1	3.6	3.8	3.8	4.1	5.2	5.7	6.8	7.7	8.6	10.6	12.6	18.3	21.6	22.8	29.4	36.7	42.0	52.5	56.1	58.0	61.9	67.6	70.2	74.7	78.5	87.0	95.6	103.6	116.4	136.9

Source: SP PowerGrid Ltd (SPPG)

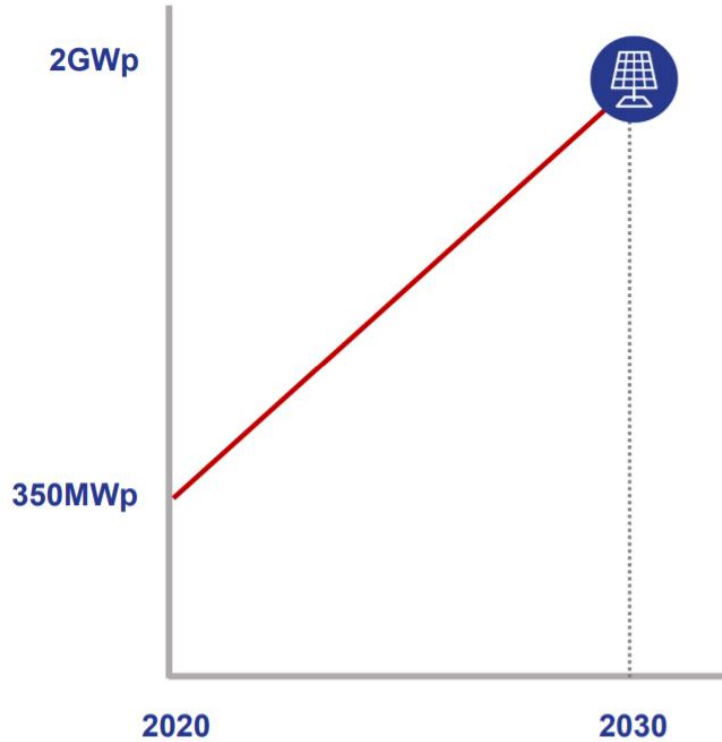
	2008	2009				2010				2011				2012				2013				2014				2015				2016				2017				2018				2019		Unit: MWac
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2									
Total	0.3	0.3	0.5	0.8	1.5	2.2	2.3	2.6	2.9	3.1	3.7	4.3	4.6	5.2	5.8	6.8	7.7	9.2	9.7	10.7	11.8	14.4	17.3	19.1	25.3	28.4	31.0	37.3	45.7	56.5	79.0	90.9	96.6	101.9	108.0	111.1	115.9	119.7	130.7	142.2	158.4	176.7	202.0	
Residential	-	-	-	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.4	0.5	0.6	0.6	0.8	0.9	1.1	1.3	1.4	1.5	1.8	2.1	2.5	2.8	3.1	3.3	3.5	4.0	4.3	4.5	4.9	5.3	5.7	6.1	6.6	7.1	7.5	7.9	
Non-Residential	0.2	0.3	0.5	0.7	1.4	2.2	2.3	2.5	2.9	3.0	3.5	4.1	4.4	5.0	5.6	6.4	7.3	8.7	9.0	10.0	10.9	13.3	16.1	17.8	23.8	26.6	28.9	34.9	42.9	53.4	75.7	87.3	92.6	97.7	103.5	106.1	110.6	114.0	124.6	135.6	151.2	169.2	193.9	
Public Service Agencies	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.8	0.9	1.1	1.1	1.4	1.5	1.6	1.6	1.6	1.7	1.8	1.9	2.4	2.5	2.7	3.0	3.0	3.0	3.8	3.8	4.1	4.8	4.8	4.8	5.1	5.4	5.6	6.7	7.7	7.9	7.9	
Town Councils & Grassroots Units	-	-	-	-	-	-	-	0.1	0.4	0.4	0.7	1.1	1.2	1.3	1.5	2.3	2.8	3.1	3.1	3.1	3.4	5.0	6.1	6.2	7.3	7.5	8.6	9.2	11.6	18.0	31.4	40.3	43.9	45.2	46.6	47.3	48.1	48.1	52.0	55.3	63.7	71.7	79.5	
Private Sector	0.1	0.1	0.1	0.4	1.1	1.7	1.8	1.9	2.0	2.1	2.3	2.4	2.4	2.8	2.9	3.0	3.1	4.0	4.4	5.3	5.9	6.6	8.2	9.7	14.1	16.6	17.6	22.7	28.2	32.3	40.4	43.2	44.7	47.7	52.1	54.0	57.5	60.4	67.0	73.6	79.8	89.6	103.4	

Source: SP PowerGrid Ltd (SPPG) & Energy Market Authority (EMA)

Source: EMA website

Singapore – Accelerating Adoption of Solar Energy

Solar



**At least 2 Gigawatt-peak (GWp)
of solar by 2030 which can power
around 350,000 households**



Singapore – Accelerating Adoption of Solar Energy – Cont'd

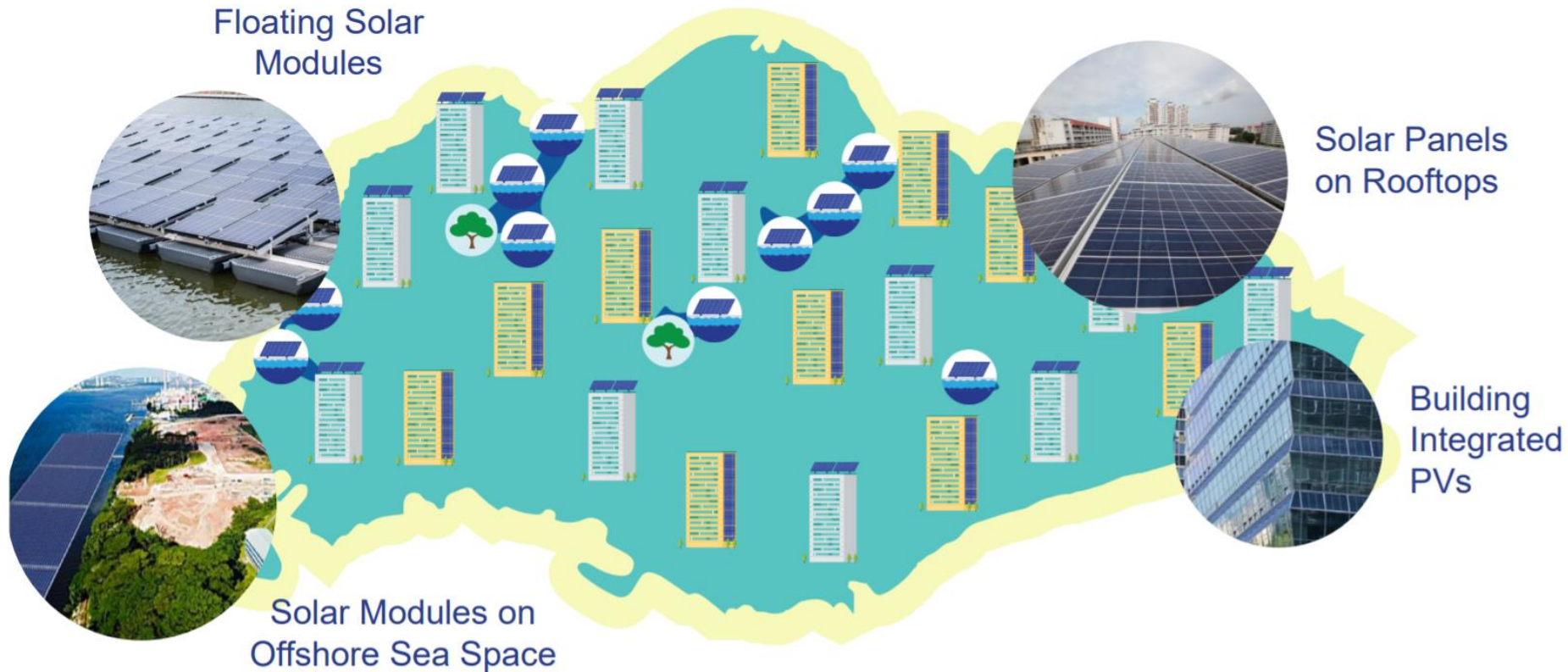


Photo credit: SIEW Opening Remarks by Minister for Trade and Industry (Chan Chun Sing)

Singapore – Tapping on Regional Power Grid

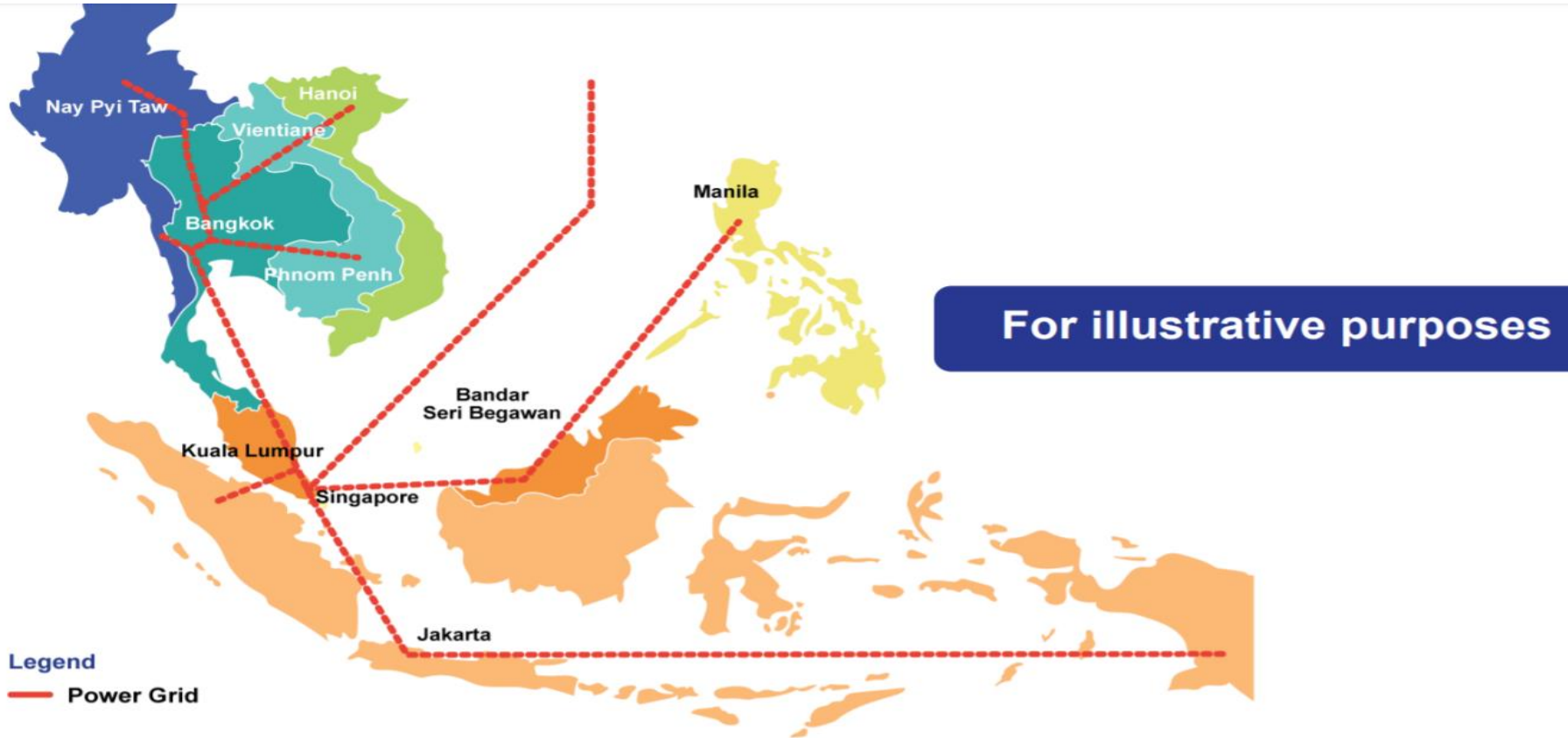
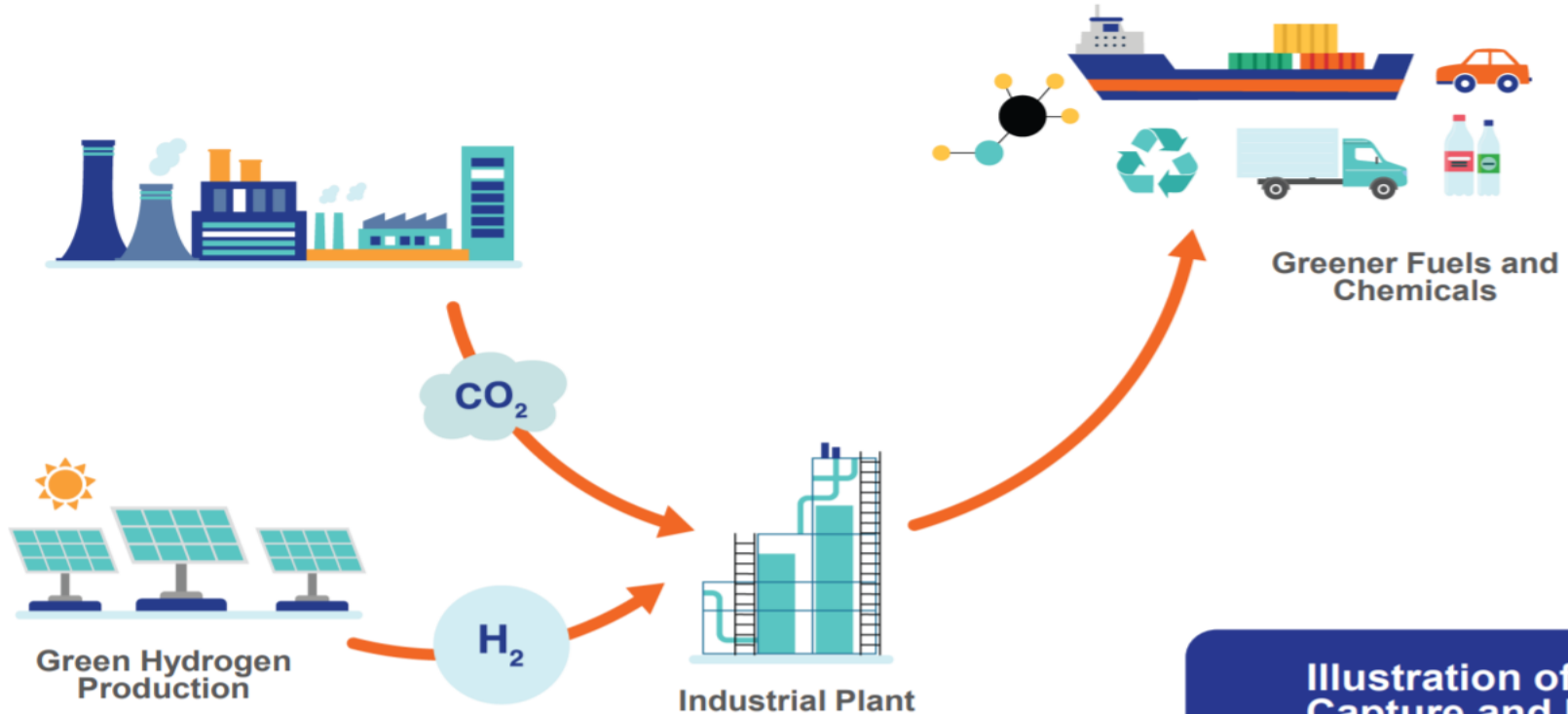


Photo credit: SIEW Opening Remarks by Minister for Trade and Industry (Chan Chun Sing)

Singapore – Investing in Emerging Low-Carbon Alternatives



**Illustration of a Carbon
Capture and Utilisation
Process**

Photo credit: SIEW Opening Remarks by Minister for Trade and Industry (Chan Chun Sing)

Canadian Solar Inc.

Improving Energy Efficiency (EE)



Energy-efficient Technologies & Materials

- Home appliances with thick mark
- Power Saver Devices with Integrated Circuits (ICs)



Optimise Design

- Building Integrated with Smart Home / Smart Office design optimization



Digitalisation

- Artificial Intelligent (AI) in Energy
- Blockchain
- Cryptocurrency

W.H.O.



Government

Lead and support
energy
transformation



Workforce

Upskill for a new
energy future



Researchers

Research and
develop innovative
energy solutions



Industry

Deploy clean and
energy-efficient
technologies



Individuals

Adopt energy-efficient
practices

New Opportunities by Government

1) EMA-PSA Joint Grant Call 2019

- Proposals in smart grid and energy storage to reduce overall energy usage, costs and carbon footprint
- Use PSA's Pasir Panjang Terminal as a living lab to test-bed potential solutions

2) EMA-KETEP Joint Grant Call 2019

- Collaboration to pursue and promote partnerships in the areas of smart grids and energy technologies
- To develop innovative solutions in energy storage systems or solar photovoltaics

3) EMA-Shell Partnership 2019

- MOU to formalise a partnership to nurture local start-ups in the energy sector and help them build capacity in areas such as renewable energy, distributed power generation, and energy storage systems
- To incubate promising local start-ups, and help translate their solutions to meet market needs.



Human Capital Development

Develop an “Attraction, Retention and Development” Framework; Embark on a sector-wide branding exercise; and Adopt a coordinated approach to drive manpower efforts

- 1) Sembcorp - EMA Energy Challenge (SEEC)
- 2) Energy-Industry Scholarship (EIS)
- 3) Singapore-Industry Scholarship (SgIS)
- 4) Dedicated Degree Programme in Electrical Power Engineering
- 5) SkillsFuture Study Awards for Power Sector



Energy Research and Development

- 1) Accelerating Energy Storage for Singapore (ACCESS)
- 2) Exploiting Distributed Generation Programme (EDGE)
- 3) Electric Vehicles Test-Bed
- 4) Sembcorp-EMA Energy Technology Partnership (SEETP)
- 5) Energy Storage Systems Test-bed
- 6) Pulau Ubin Micro-Grid Test-Bid / Experimental Urban Micro-Grid
- 7) Enterprise Development



Industry

- 1) The manufacturers, EPCCs, Project/Building Developer deploy energy-efficient technologies, for example the smart PV module with optimizer, smart inverter, smart meter, smart home integrated accessories with ICs, smart energy monitoring system, etc.
- 2) The factories or power plants practice high level of recycling program

Individuals

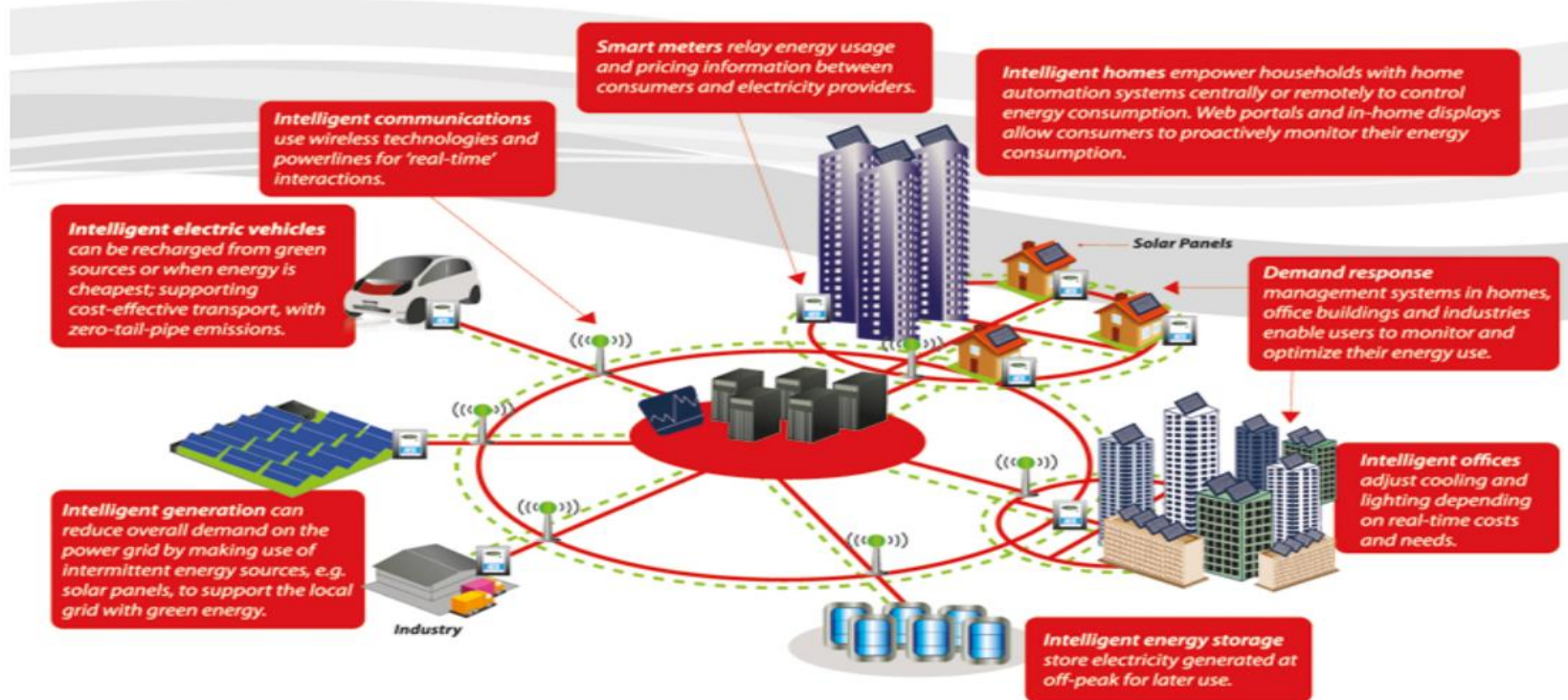
- 1) Consumers adopt smart power saver devices, smart home plug with designated mobile application, electric vehicle, electric scooter, etc.
- 2) Being educated the importance of climate change, reduce carbon footprint on the planet, saving electric consumptions as population increases



SMART GRIDS - The Intelligent Energy System (IES) Pilot

The Intelligent Energy System (IES) Pilot Project Conceptual Overview

An energy ecosystem connecting intelligent homes, vehicles, communities, electricity network sensors and sources of green generation to promote reliability, sustainability and energy efficiency.



THANK YOU!

