

With the support of the PV Market Alliance

The PV Market Alliance



# APVIA Q2 2019 Market Report



# Introduction



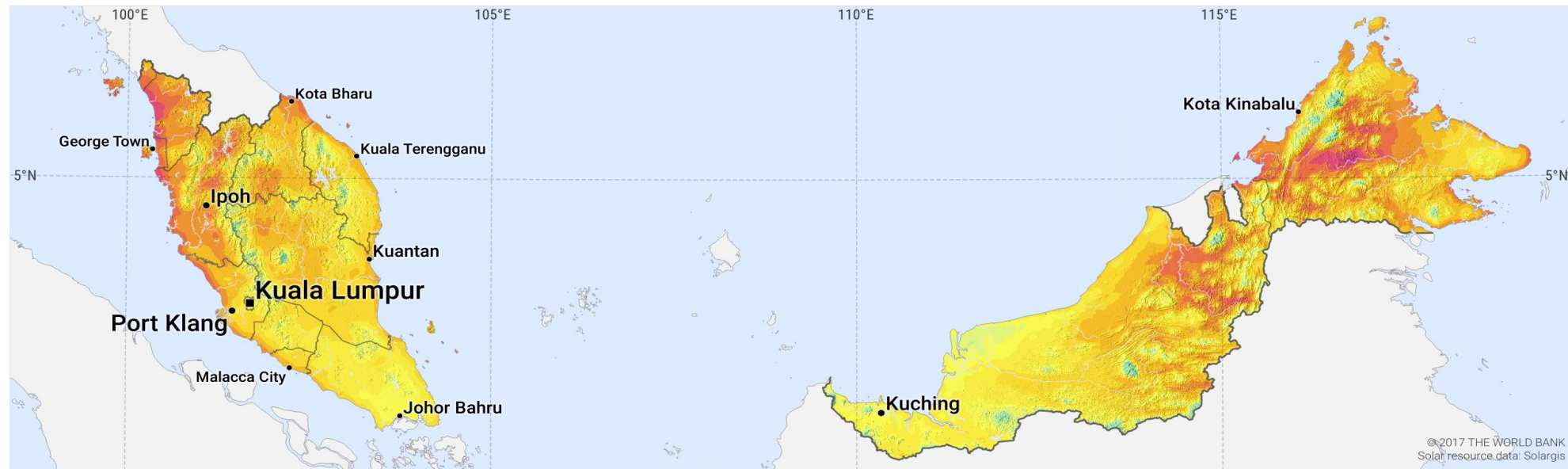
- Launched in 2017, this 10<sup>th</sup> edition of APVIA's quarterly PV market report focus on 'Malaysia, the Philippines and South-Korea's PV market developments
- This report has been prepared with information provided by the PV Market Alliance and especially Asia Europe Clean Energy (Solar) Advisory Co. Ltd. (AECEA) as well the Malaysian PV Industry Association (MPIA) and the Philippine Solar and Storage Energy Alliance (PSSEA)
- All information collected are valid at the time of publication. The data published do not engage the responsibility of APVIA or AECEA and should be considered with all due caution and are for informational purposes only



# Malaysia's - Solar Resource Maps

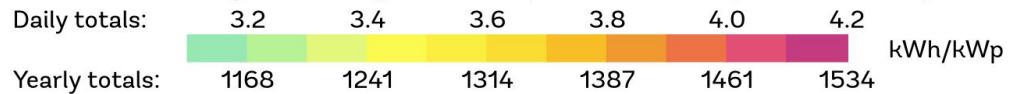
SOLAR RESOURCE MAP

## PHOTOVOLTAIC POWER POTENTIAL MALAYSIA



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Solar resource data: Solargis

Long term average of PVOUT, period from 1999 (2007 in the East) to 2015

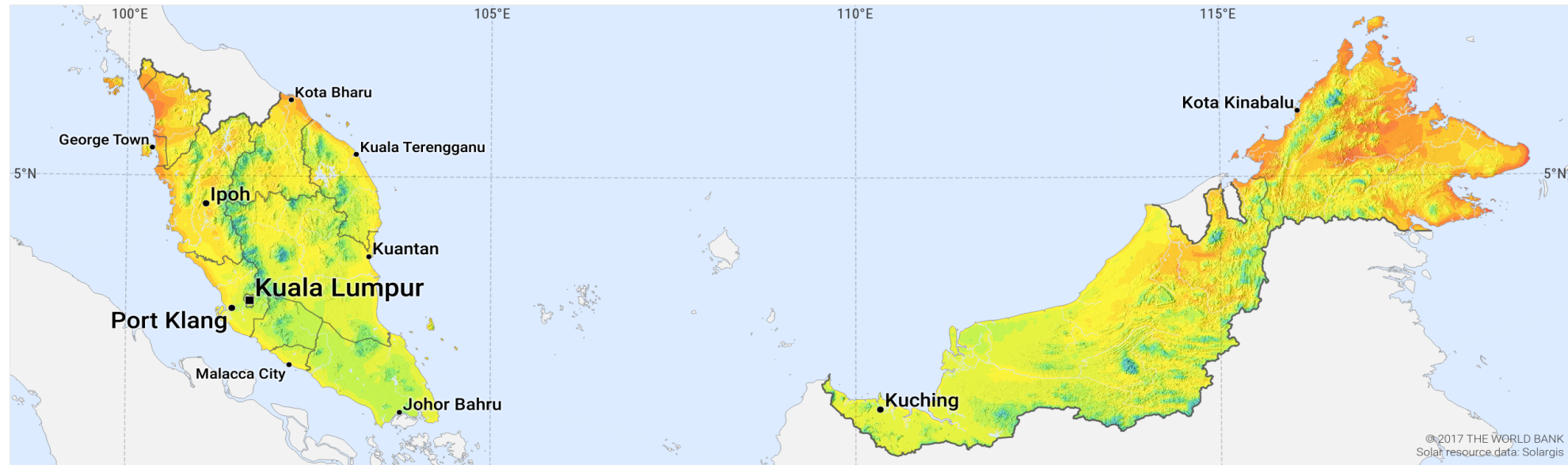


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# Malaysia's - Solar Resource Maps

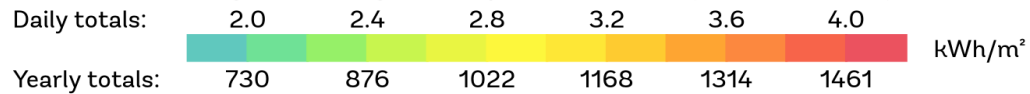
SOLAR RESOURCE MAP

## DIRECT NORMAL IRRADIATION MALAYSIA



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Solar resource data: Solargis

Long term average of DNI, period from 1999 (2007 in the East) to 2015



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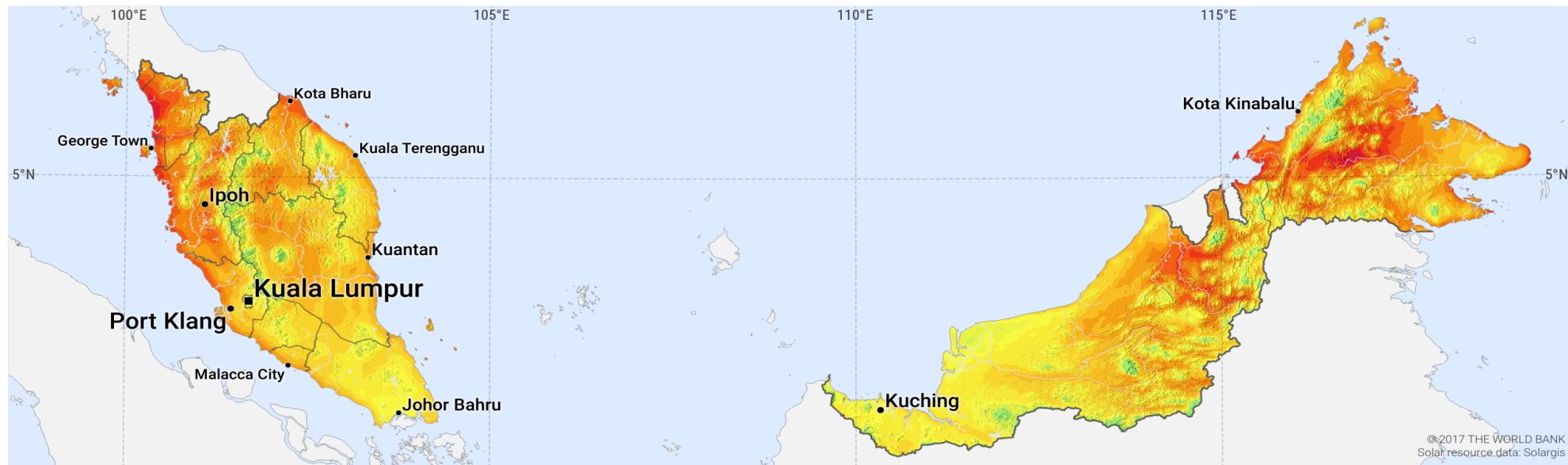


# Malaysia's - Solar Resource Maps

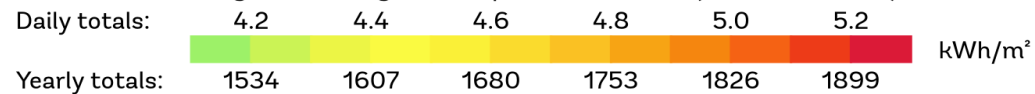
SOLAR RESOURCE MAP

## GLOBAL HORIZONTAL IRRADIATION

### MALAYSIA



Long term average of GHI, period from 1999 (2007 in the East) to 2015



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# Malaysia - A Decade of RE Promotion



- **9<sup>th</sup> Malaysia Plan (2006 - 2010)**
  - Target RE: 300 MW - Peninsular Malaysia plus 50 MW - Sabah (East Malaysia)
  - 61.2MW (17% from 9<sup>th</sup> MP target through Small Renewable Energy Programme (SREP))
  - Cabinet approved National RE Policy & Action Plan (October 2010)
- **10<sup>th</sup> Malaysia Plan (2011-2015)**
  - Enactment of RE Act 2011 & SEDA Act 2011 (27 & 28 April 2011)
  - Establishment of SEDA, implemented Feed-in Tariff (FIT)
  - 2015: Energy mix 43% coal, 40% gas, 14% large hydro, 2% RE, 1% oil
- **11<sup>th</sup> Malaysia Plan (2016-2020)**
  - Target energy mix of 53% coal, 29% gas, 15% large hydro, 3% RE (now increased to 20% by 2025)
  - Target RE (FIT) capacity of 2,080 MW
  - Introduce Net Energy Metering (NEM), Self-Consumption (Selco), Large-Scale-Solar (LSS), SARE, etc.



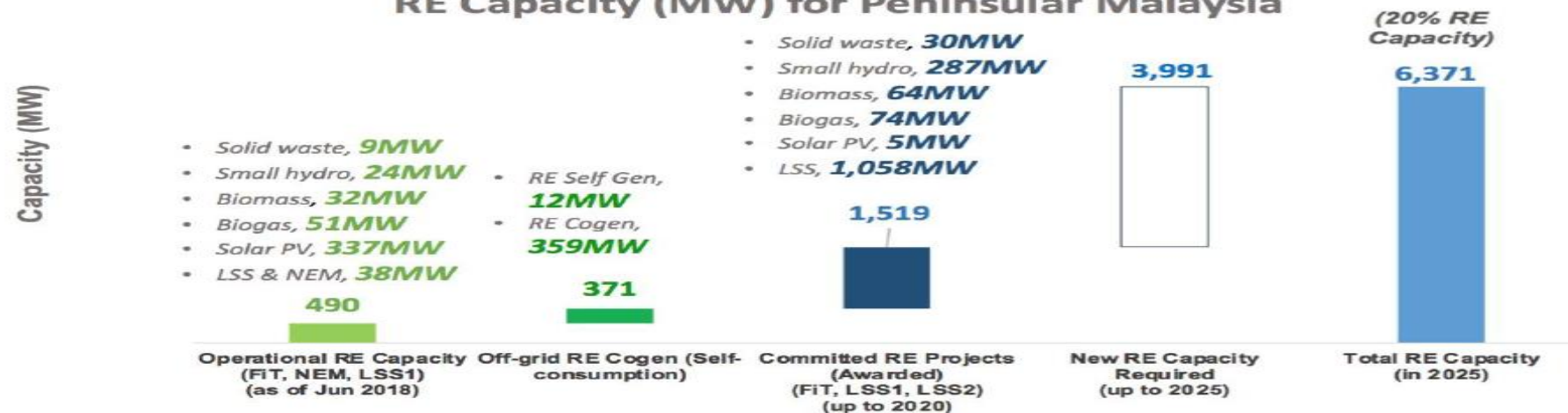
# Malaysia - 20% RE Share Target by 2025

## 20% RE TARGET BY 2025

In meeting the set target of 20% RE capacity mix, 3,991MW RE is required in the Peninsula system.

- More LSS?
- Solar Leasing?
- New NEM scheme?
- Large hydro as RE?
- Pricing of biomass?
- Limitation of solar integration into the grid system?

### RE Capacity (MW) for Peninsular Malaysia



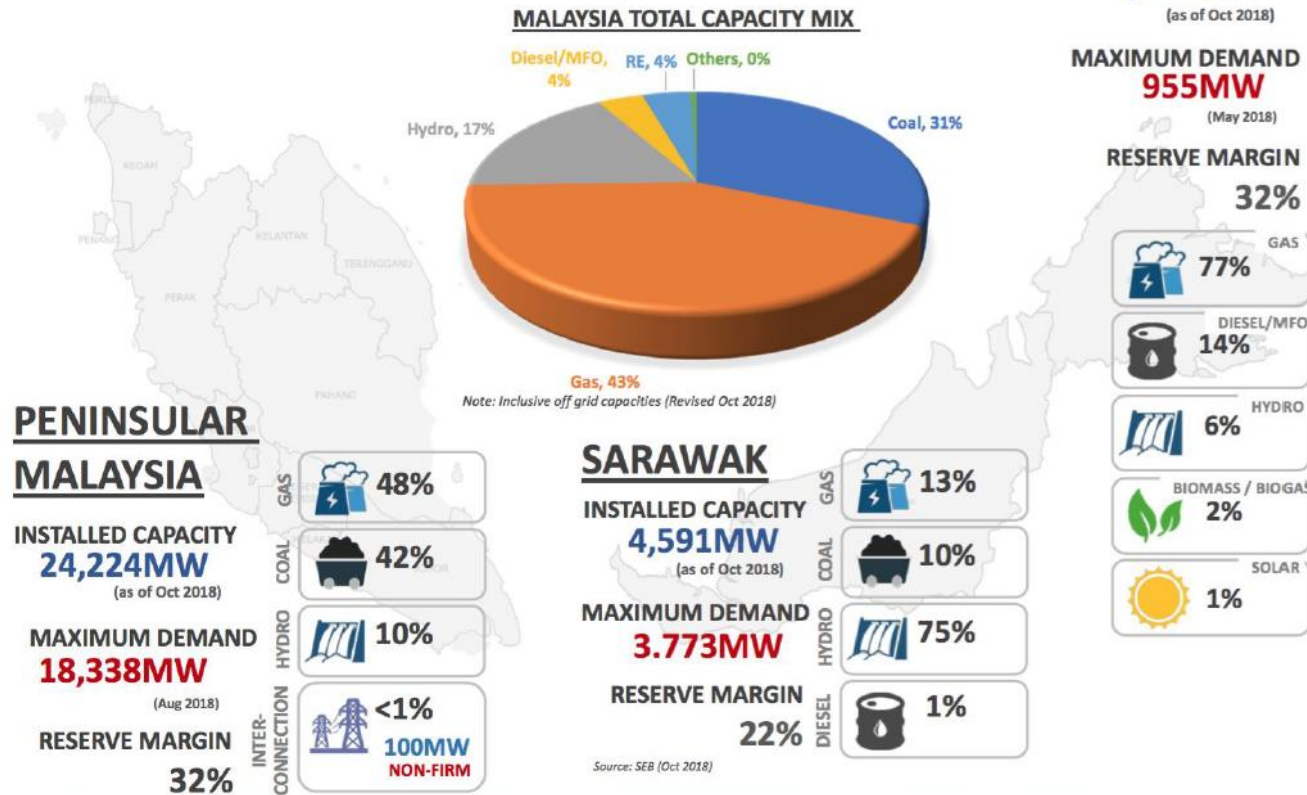
#### Notes:

1. "Operational RE Capacity" is based on FIT, NEM & LSS (source : SEDA)
2. "Committed RE Projects" is based on awarded FIT, LSS 1 & LSS 2 up to 2020 (source: SEDA & ST)
3. "New RE Capacity Required" is the RE capacity to be developed to meet 20% RE Capacity Target by 2025
4. "Total RE Capacity" in 2025 is the RE Capacity target in MW to meet the 20% RE Target (without large hydro)

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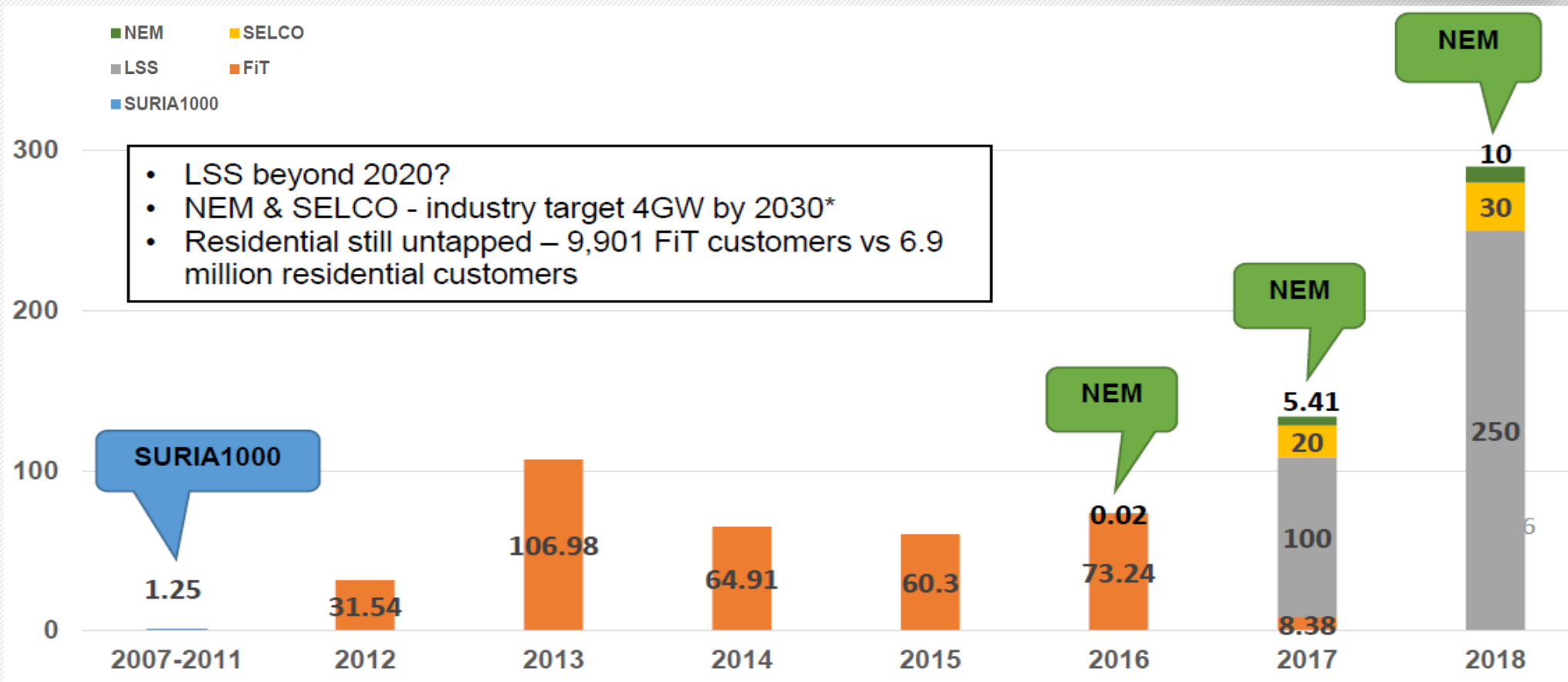
# Malaysia - Power Sector Overview

## SUPPLY AND DEMAND (as at Oct 2018)



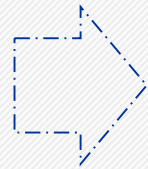


# Malaysia - PV Market Development



# Malaysia - PV Market Development Stages (1)

**2006 – 2010**  
**SURIA1000**



**2011 – 2016**  
**Feed-in Tariff**  
**(FIT)**



**2016 - Present**  
**- Large Scale Solar (LSS)**  
**- Net Energy Metering (NEM)**  
**- Self-consumption (SELCO)**

## Installed Capacities

SURIA1000 program	: 1.25MWp
FIT program	: 380MWp (2012 - 2017)
Net-Energy-Metering (NEM)	: 45MWac (~ 60MWp) (Total quota 500MWac by 2020)
Self-Consumption (Selco)	: 60MWac (~ 80MWp)
Large-Scale-Solar (LSS)	: 1250MW (Target by 2020)



# Malaysia - PV Market Development Stages (2)



## Large-Scale-Solar (LSS): 1250MW (Target by 2020)

Direct Awarded Capacity:	250MWac (200MWac completed)
LSS 1: Awarded Capacity:	400.9MWac (310.5 MWac completed)
LSS 2: Awarded Capacity:	556.98 MWac (on-going)
LSS3: Target Capacity:	500MWac (bid closing on August 19, 2019)

To date, cumulative installed capacity commissioned: 615.5 MWac (~ 830MWp) + 380MWp

As of June 1, 2019 - Malaysia is home to approx. 1.21 GWp of installed PV power generation

**Malaysia's PV Industry Association is targeting 5.6 GWp by 2025**

# Malaysia - Large-Scale-Solar (1<sup>st</sup> Bidding)

Category	Peninsular Malaysia			Sabah			Total Submissions
	No of Submissions /MW	Lowest Bid Price RM/kWh	Highest Bid Price RM/kWh	No of Submissions /MW	Lowest Bid Price RM/kWh	Highest Bid Price RM/kWh	
P1 (1-5.99 MW <sub>ac</sub> )	25 (72.3MW)	0.375	0.47	19 (78.8MW)	0.371	0.53	44
P2 (6-9.99 MW <sub>ac</sub> )	18 (171.9MW)	0.37	0.46	12 (111MW)	0.39	0.49	30
P3 (10-30 MW <sub>ac</sub> )	42 (1198MW)	0.3398	0.5	na	na	na	42
<b>Total</b>	85 (1442.2MW)			31 (189.8MW)			116 (1632MW)

- Available Quota: 360MW<sub>ac</sub> (x 4) in Peninsular Malaysia
- 100MW<sub>ac</sub> (x 2) in Sabah (commercially operational by 2019-2020);
- Exchange rate: US\$1 = RM4.21



# Malaysia - Large-Scale-Solar (2<sup>nd</sup> Bidding)

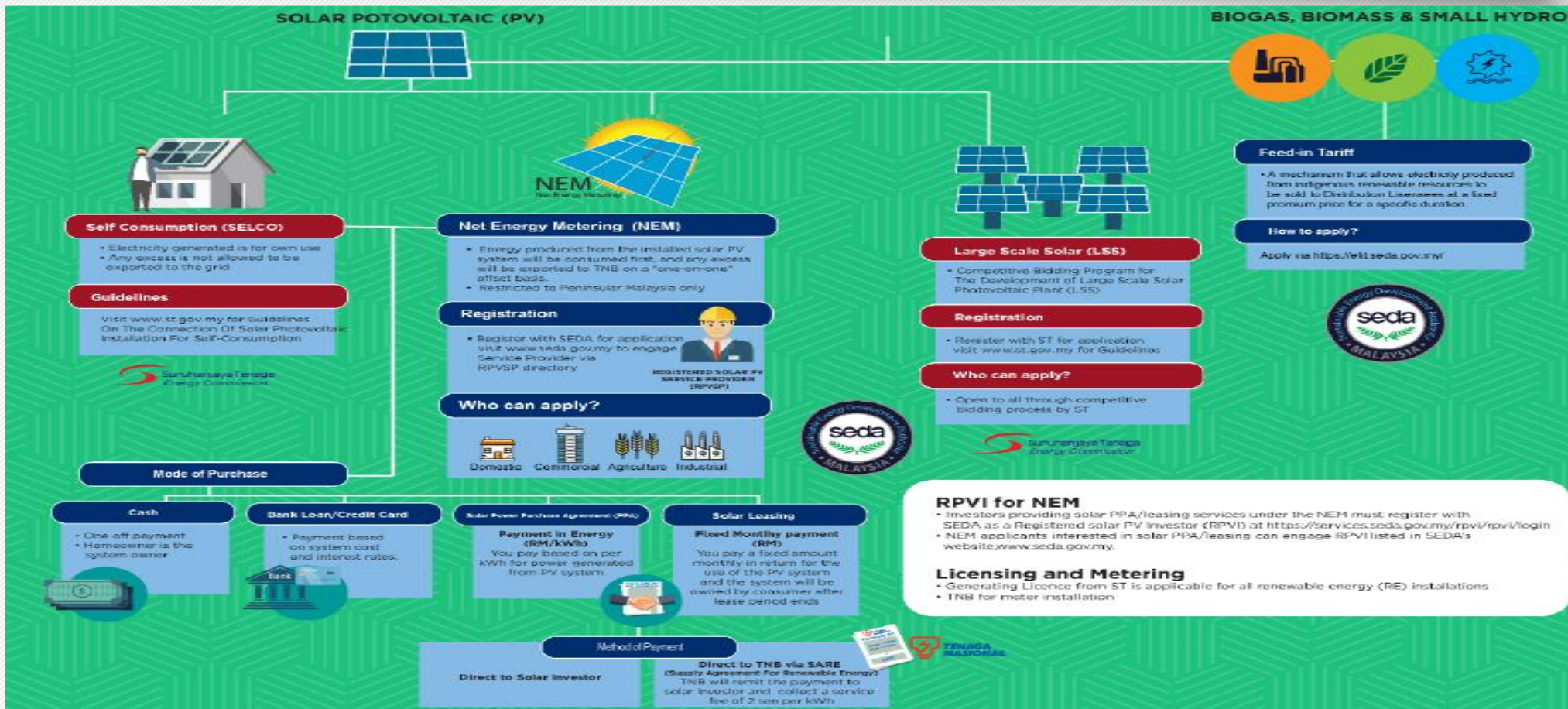
	'Raw' offer prices (RM/kWh) / No. of bids	No. of Shortlisted Bids
<b>Peninsular Malaysia</b>		
Package P1: 1.00MWac to 5.99MWac	0.3750 - 0.4700 / (25 bids)	6 bids
Package P2: 6.00MWac to 9.99MWac	0.3700 - 0.4600 / (18 bids)	11 bids
Package P3: 10.00MWac to 30.00MWac	0.3398 - 0.5000 / (43 bids)	13 bids
<b>Sabah / Labuan</b>		
Package S1: 1.00MWac to 5.99MWac	0.3710 - 0.5300 / (19 bids)	8 bids
Package S2: 6.00MWac to 10.00MWac	0.3900 - 0.4900 / (12 bids)	3 bids

# Malaysia - Current FIT Structure

## FiT Rates for Solar PV (Community) (21 years from FiT Commencement Date)

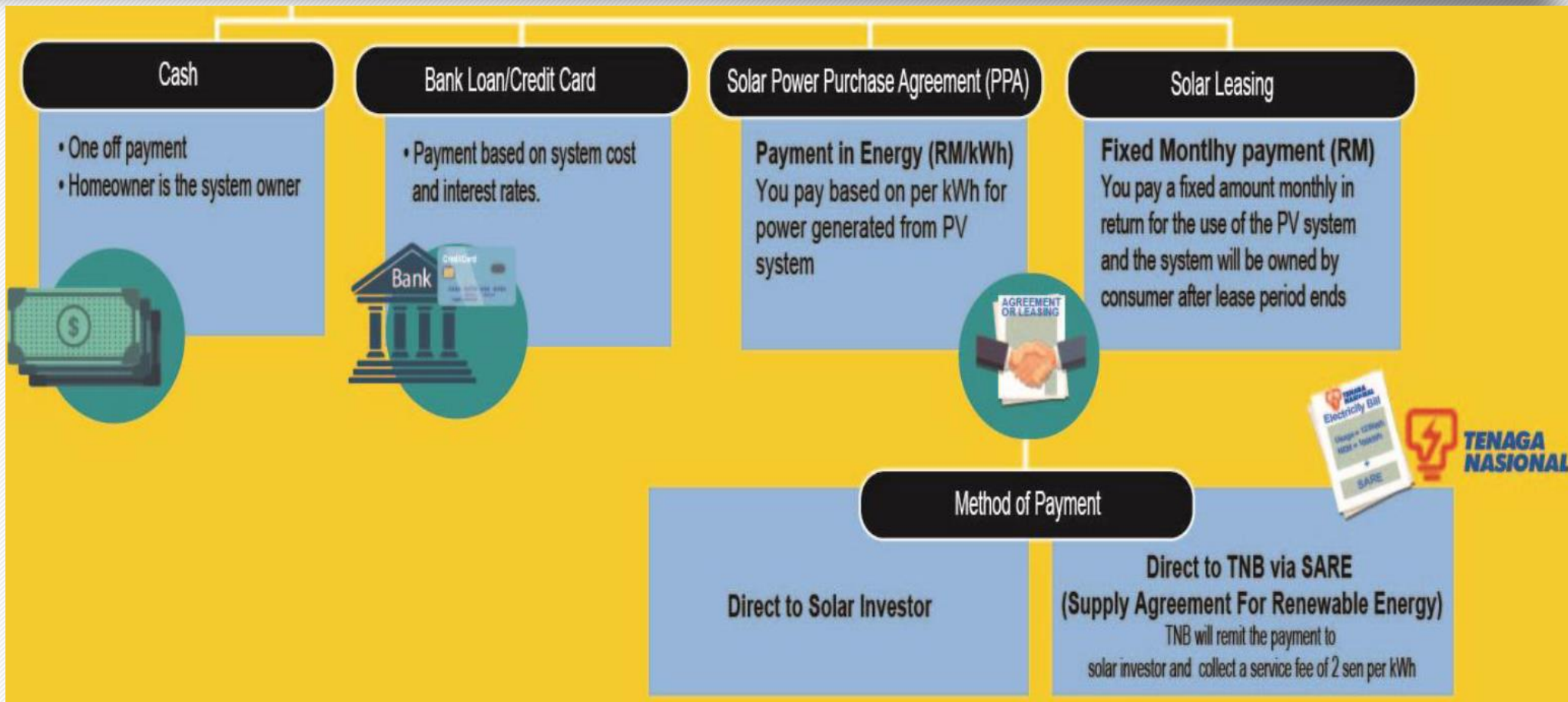
Description of Qualifying Renewable Energy Installation	FiT Rates (RM per kWh)
	01-JAN-2019 <input type="button" value="v"/>
<b>(a) Basic FiT rates having installed capacity of :</b>	
(i) up to and including 4kW	0.6014
(ii) above 4kW and up to and including 24kW	0.5867
(iii) above 24kW and up to and including 72kW	0.3770
<b>(b) Bonus FiT rates having the following criteria (one or more) :</b>	
(i) use as installation in buildings or building structures	+0.1130
(ii) use as building materials	+0.0678
(iii) use of locally manufactured or assembled solar PV modules	+0.0500
(iv) use of locally manufactured or assembled solar inverters	+0.0500

# Malaysia - Renewable Energy Programmes





# Malaysia - Solar Purchase Options (NEM or Selco Programme)



# Malaysia - Improved NEM Scheme

NEM is a mechanism which allows electricity consumers in Peninsular Malaysia and Sabah to sell excess electricity generated from their solar PV systems back to the grid. This scheme is applicable to all consumers in the domestic, commercial and industrial sectors who are customers of Tenaga Nasional Berhad (“**TNB**”) or Sabah Electricity Sdn. Bhd. Among its benefits is that it allows consumers to import less energy from the grid, save on electricity bills, and export excess electricity back to the grid for credit to reduce electricity bills even further.

The government has announced several initiatives to improve the NEM scheme which had, until recently, experienced a low take-up rate of approximately 4% of the 500MW quota allocated for the period of 2016 - 2020. This was due to the lower selling price of RM0.31/kWh compared to the tariffs charged by the utilities ranging from RM0.218/kWh to RM0.571/kWh. Beginning 1 January 2019, excess electricity will be exported back to the grid on a one-to-one basis, i.e. there will be no difference between the selling and buying price of the electricity. However, this new NEM scheme is only applicable to Peninsular Malaysia and only to TNB customers.



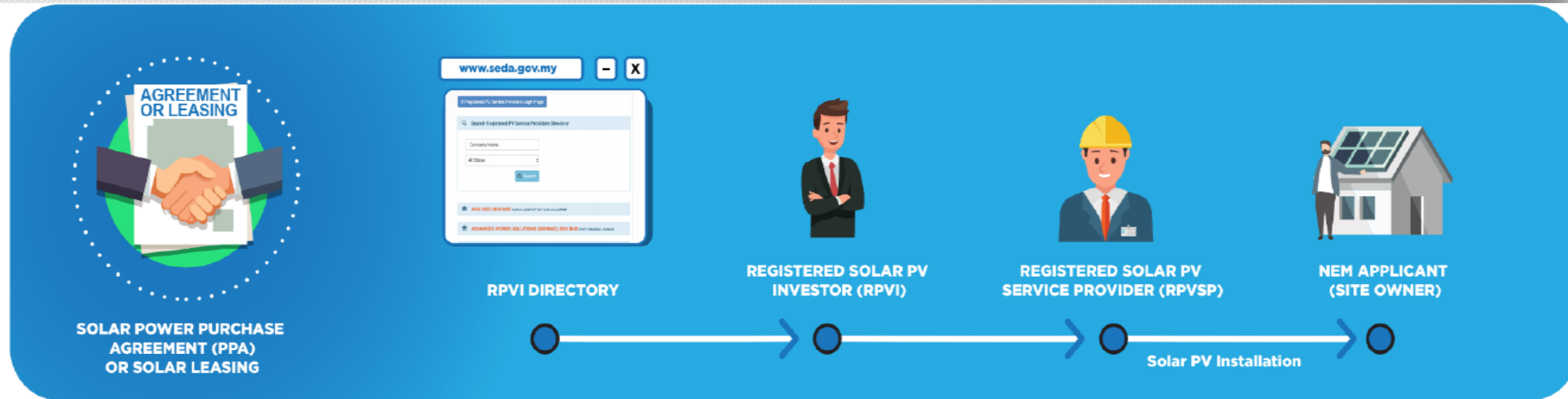
# Malaysia - Investors in NEM

Foreign Company	Local Company
<p><b>Solar PV projects of <u>above 250kW only</u></b></p>	<p><b>Solar PV projects of <u>all Capacity</u></b></p>
<ul style="list-style-type: none"> <li>• Companies must be incorporated in Malaysia;</li> <li>• Companies must have minimum paid-up capital of at least <b>RM10 million</b>;</li> <li>• A minimum of 80% local employment is required. To submit company's organization chart reflecting the min 80% of local employment;</li> <li>• <b>Companies are required to have 100% local Engineering, Procurement and Construction (EPC) by engaging Registered PV Service Providers with SEDA;</b></li> <li>• <b>Leasing company is not allow to register as a PV Service Provider;</b></li> <li>• Must be a Registered Solar PV Investor with SEDA.</li> </ul>	<ul style="list-style-type: none"> <li>• Companies must be incorporated in Malaysia;</li> <li>• Companies must have minimum paid-up capital of at least <b>RM1million</b>;</li> <li>• Project EPC can be carried out by themselves or awarded to the Registered PV Service Provider with SEDA;</li> <li>• Leasing company can be a Registered PV Service Provider with SEDA;</li> <li>• Must be a Registered Solar PV Investor with SEDA.</li> </ul>

Source: MPIA



# Malaysia - Solar PPA or Leasing



SOLAR PPA	<p>Payment in Energy (RM/kWh)</p> <p>Customers pay based on per kWh for power generated from PV system</p>
SOLAR LEASING/HIRE PURCHASE	<p>Fixed Monthly payment (RM)</p> <p>Customers pay a fixed amount monthly in return for the use of the PV system and the system will be owned by consumer after lease period ends</p>

# Malaysia - Launch of Supply Agreement for Renewable Energy (SARE) programme (1)



- The “Supply Agreement for Renewable Energy (SARE) programme is essentially a solar leasing arrangement in which asset owners/investors will finance and install the solar PV systems and lease it to homeowners or commercial customers
- This new programme came into play early 2019. Homeowners and commercial customers would benefit greatly from this programme, due to the savings in electricity cost while ensuring a return on investment for the developers
- This is a bold and a most welcomed step forward in opening up the market to investors and create a new pool of players known as 'prosumers' - where the public is able to be producers and consumers of electricity at the same time, in addition to filling in a gap to the current non-existent framework in relation to solar leasing in Malaysia

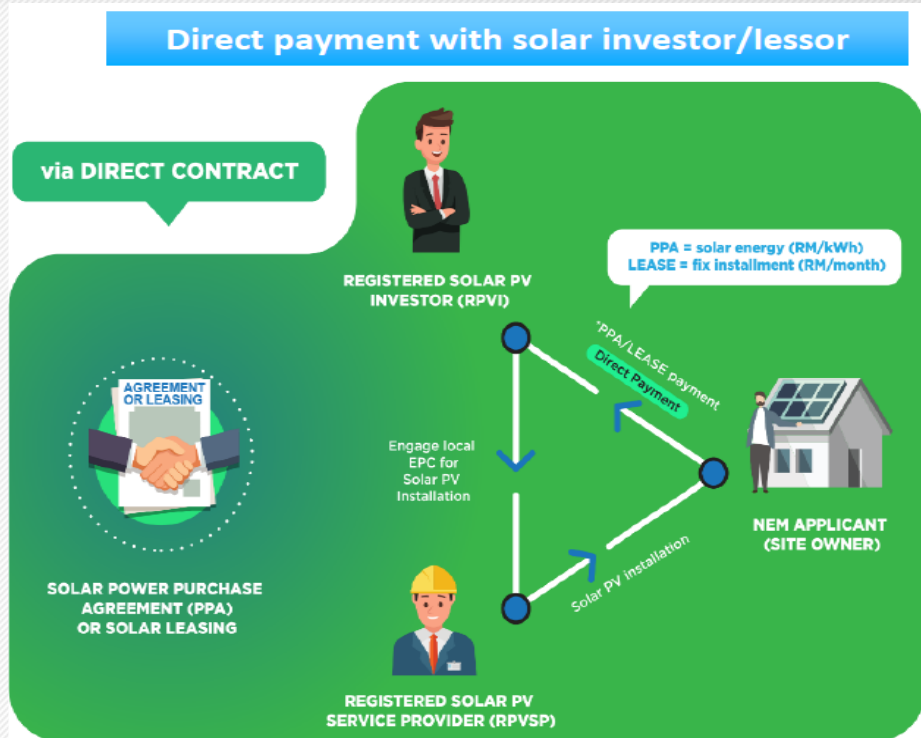
# Malaysia - Launch of Supply Agreement for Renewable Energy (SARE) programme (2)

The government has also recently introduced the SARE programme as one of the improvements to the NEM scheme. The main thrust of the programme is that it makes participation in the NEM scheme more affordable as consumers need not incur substantial upfront cost to install the solar PV system. Instead, the SARE programme allows the consumer (as the lessee), the investor/owner (i.e. the company which owns and leases the solar PV system to the consumer) and the utility (such as TNB) to agree on the arrangement in which the leasing fee may be paid to the investor/owner via electricity bills. Generally, this arrangement will see the investor/owner earning its profit from a portion of savings that the consumer enjoys from participating in the NEM scheme.

Companies that wish to participate as an investor in the programme must first be registered with the Sustainable Energy Development Authority Malaysia (“**SEDA**”). Applicants must be Malaysia-incorporated companies, with Malaysian-controlled companies (“**Local Companies**”) required to have a minimum paid-up capital of RM1,000,000 while foreign -controlled companies (“**Foreign Companies**”) are required to have a minimum paid-up capital of RM10,000,000. Local Companies are required to have 100% local engineering, procurement and construction capabilities by appointing SEDA-registered service providers, while not only are Foreign Companies subject to that same condition, they can only participate in projects with a capacity exceeding 250 kWac and must also ensure that at least 80% of the company’s employees are local workers.

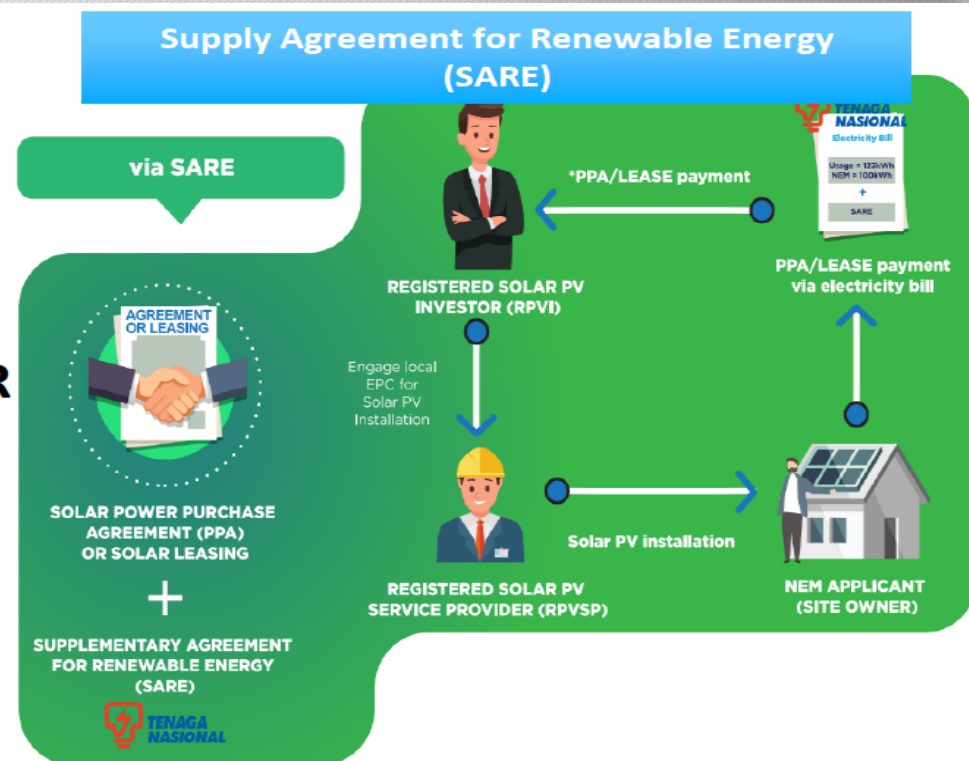


# Malaysia - Payment Methods (SARE)



RPVI receive payment from customer directly

OR



TNB does the billing, collection & remittance of payment by customers to RPVI in return for a service fee (2sen/kWh).

# Malaysia - Launch of a National Solar PV Monitoring System (PVMS)



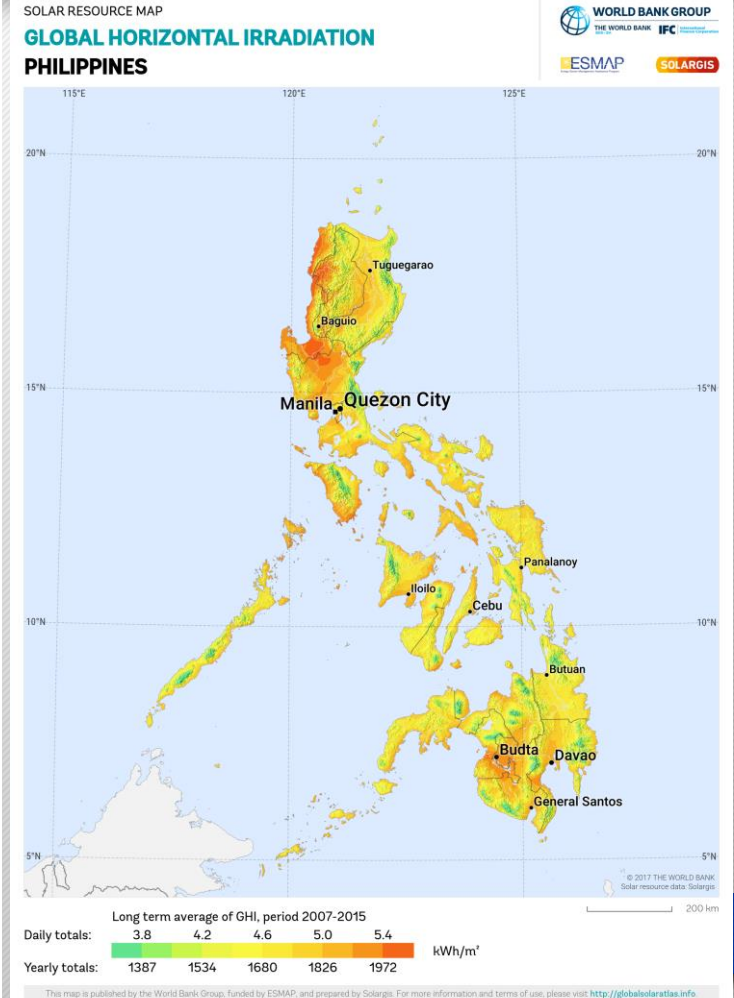
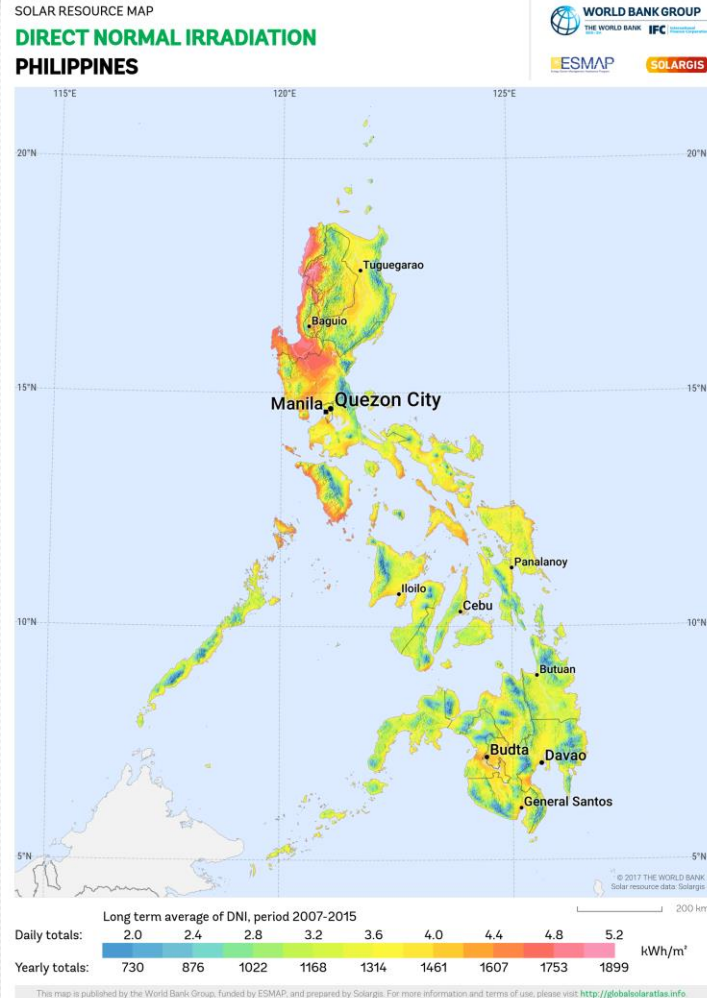
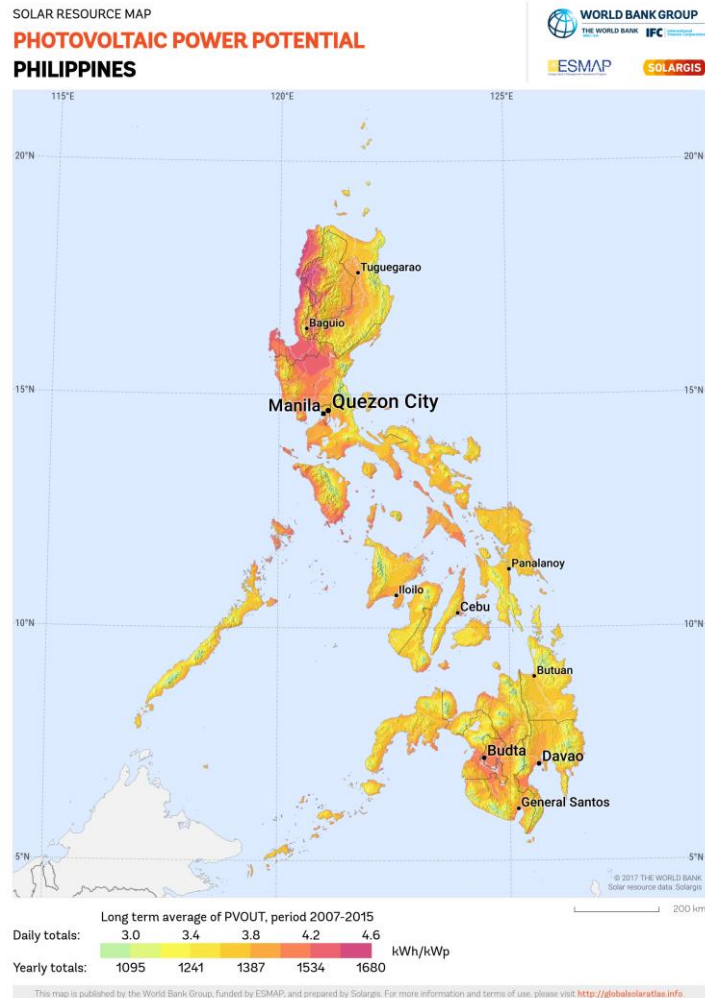
- A single platform to be established
- Allowing real-time data monitoring of key components of solar photovoltaic (PV) systems such as PV modules and inverters
- The PVMS will also be able to provide information in relation to solar PV in Malaysia to the public
- At least 120 grid-connected solar PV systems (up to 1MW in capacity) are being monitored by the PVMS
- Anticipated that more systems will be added in the future

# The Philippines

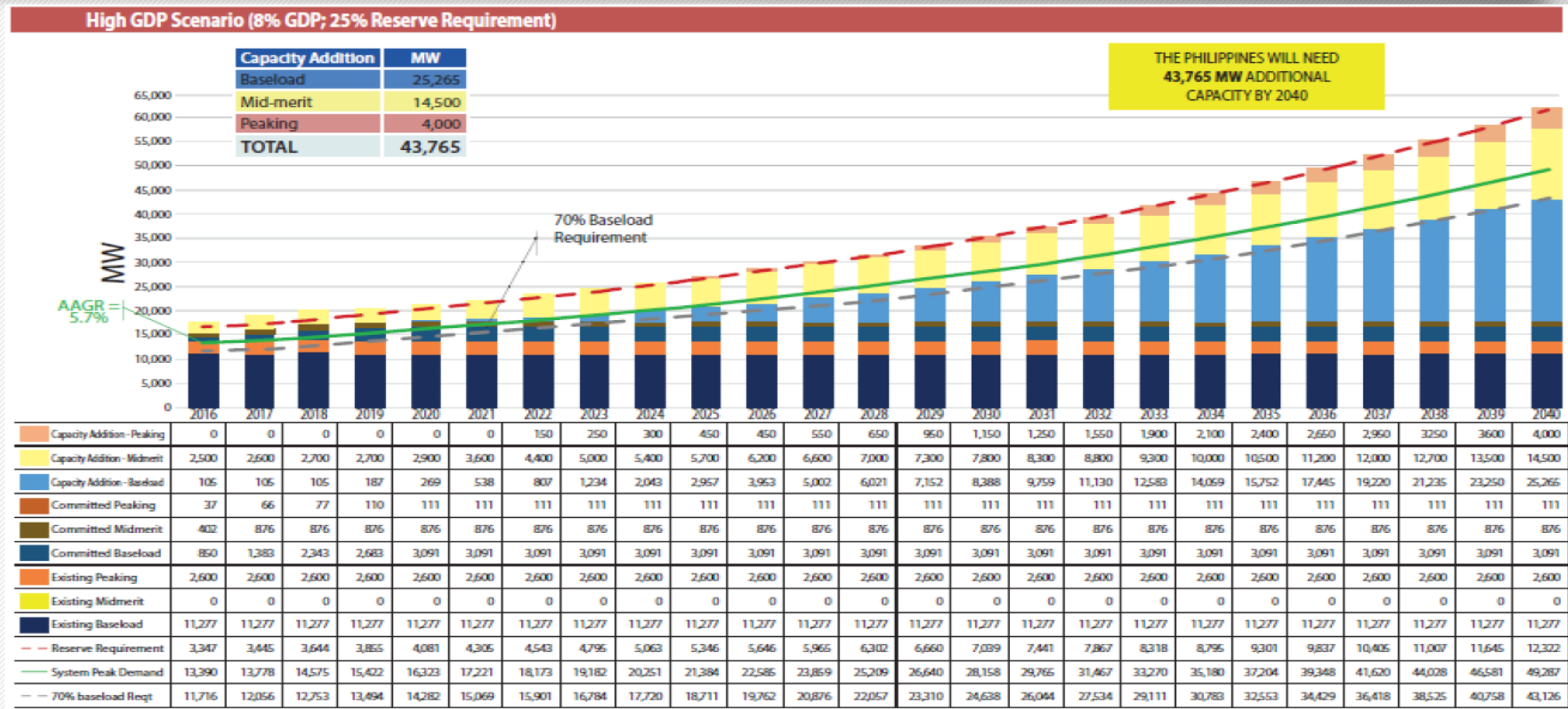




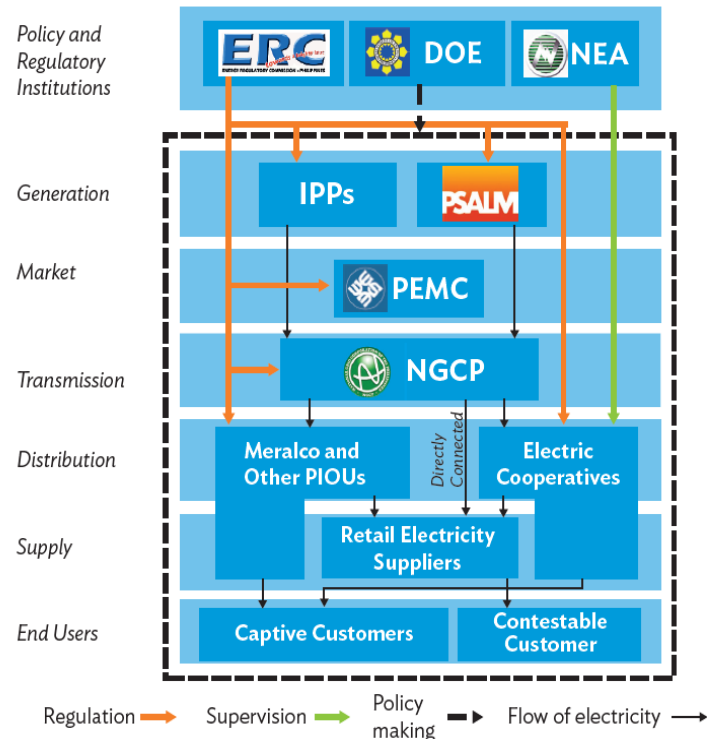
# The Philippines' - Solar Resource Maps



# The Philippines - Power Dev Plan (2016-2030)



# The Philippines - Power Industry Structure & Energy Supply Projections for 2040



DOE = Department of Energy; ERC = Energy Regulatory Commission; IPP = independent power producer; NEA = National Electrification Administration; NGCP = National Grid Corporation of the Philippines; PEMC = Philippines Electricity Market Corporation; PIOW = private investor-owned utility; PSALM = Public Sector Assets and Liabilities Management Corporation.

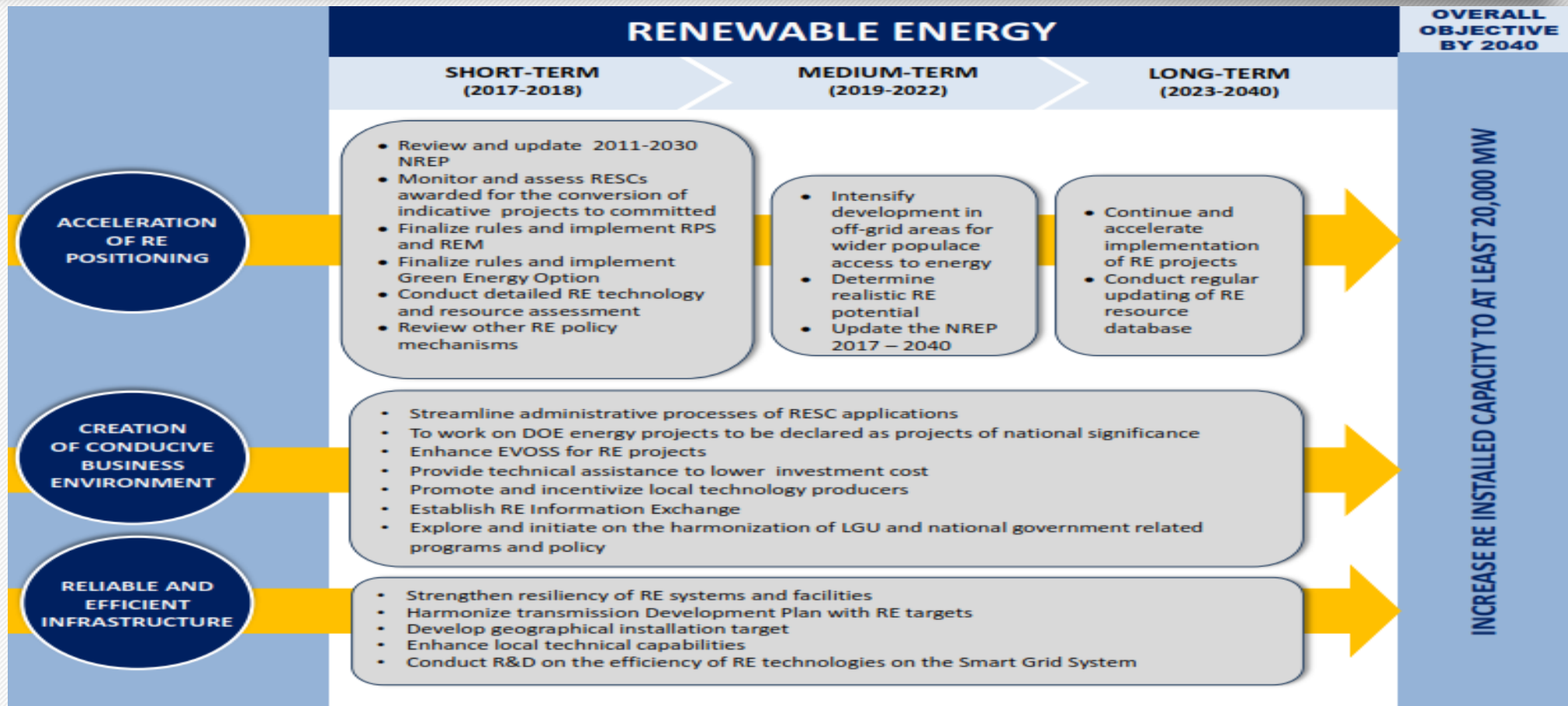
Source: Asian Development Bank.

Source: ADB, DOE

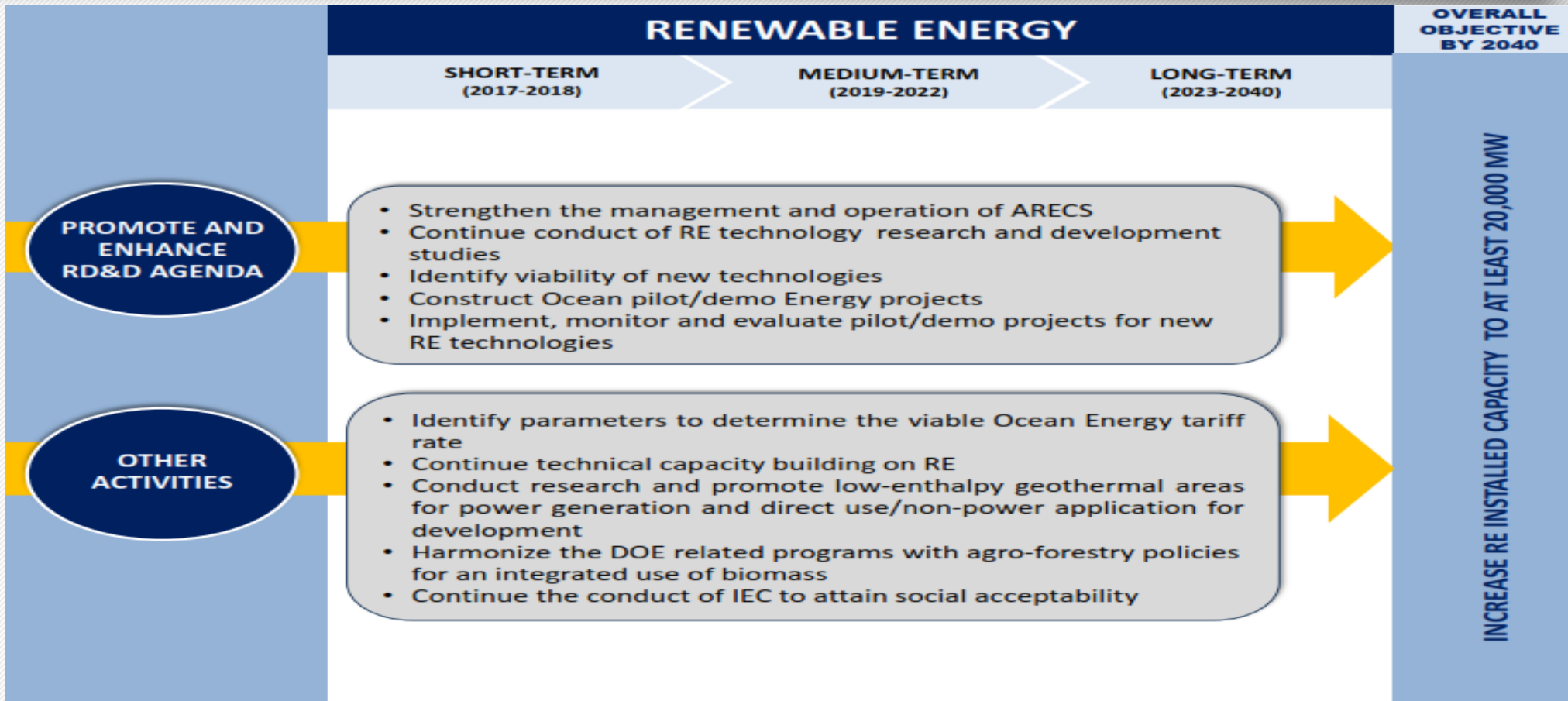
	Business-as-Usual Scenario		Clean Energy Scenario	
	Supply (million tons of oil equivalent)	Average Growth from 2016-2040 (%)	Supply (million tons of oil equivalent)	Average Growth from 2016-2040 (%)
<b>Fossil Fuels</b>				
Oil	53.1	4.5	48.8	4.1
Coal	51.3	6.4	40.7	5.3
Natural gas	15.7	6.7	17.1	7.1
<b>Renewables</b>				
Geothermal	10.5	0.4	11.7	0.9
Hydropower	3.1	1.9	2.9	1.5
Solar and wind	0.2	0.2	0.4	3.5
Biomass	12.5	2.2	12.3	2.1



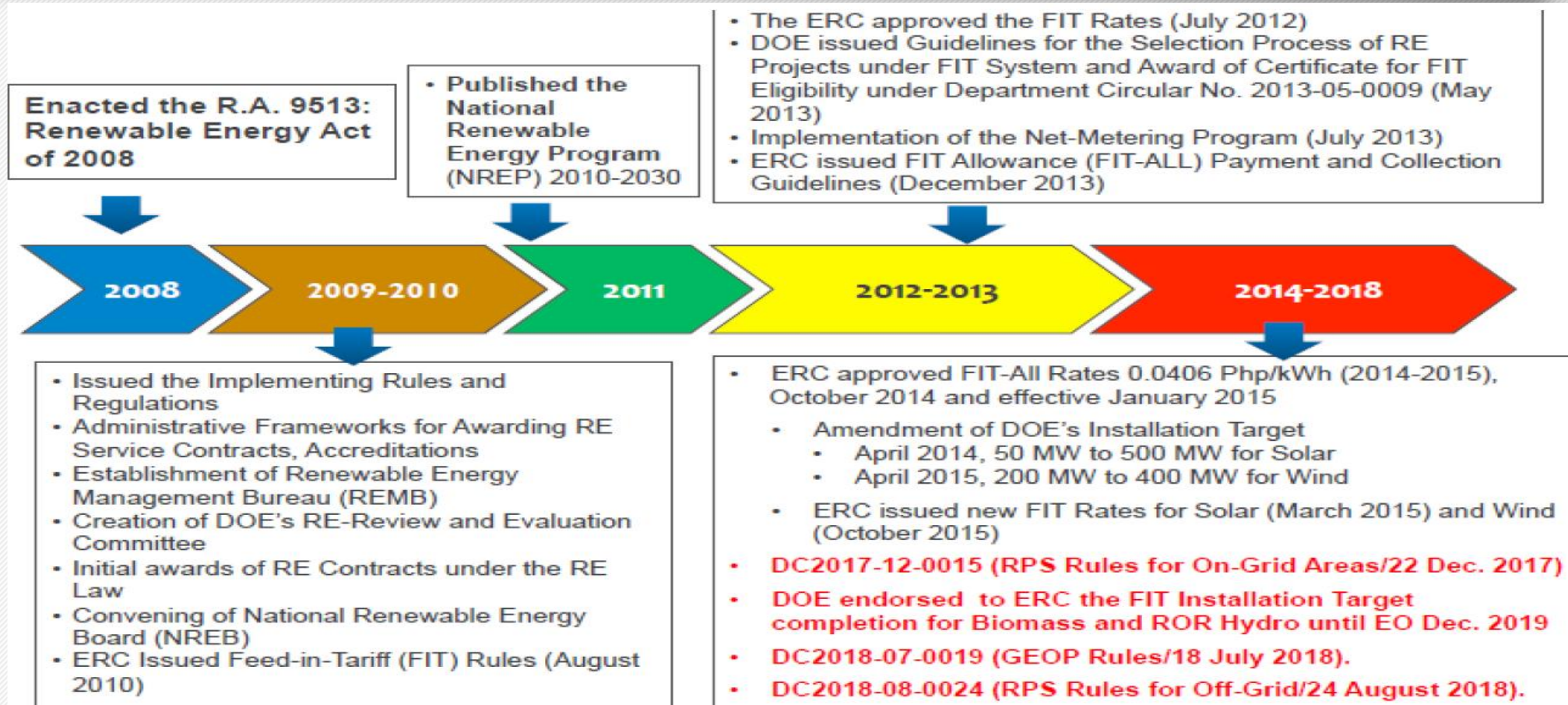
# The Philippines - RE Roadmap 2017-2040 (1)



# The Philippines - RE Roadmap 2017-2040 (2)



# The Philippines - Milestones of RE Law





# The Philippines - Updates of the RE Law (1)

Gov't Policy	Description	Status
FIT	Fiscal Incentives for Utility Scale RE Projects	<ul style="list-style-type: none"><li>- DOE Extended the FIT only for Biomass and Hydro until end of 2019</li></ul>
Net Metering	Interconnection Rules for Grid Export	<ul style="list-style-type: none"><li>- Implemented</li><li>- Senate Bill 1719 is pending; issues tackled include the removal of 100 kWp cap</li><li>- ERC discussing rate impacts &amp; utility revenue, technical impacts</li></ul>

# The Philippines - Updates of the RE Law (2)

## RPS On-Grid

- Minimum Percentage of 1% incremental generation from eligible RE sources to the total supply of electricity for on grid areas
- Eligible RE facilities are those started CODs after effectivity of RE Act
- Establishment of RE Market and Registrar to govern trading of RECs
- IEC Rollout Program
- Data gathering for determination of RPS requirements
- Consolidation of data gathered from mandated participants
- Next step: Operationalized RPS Composite Team

# The Philippines - Updates of the RE Law (3)

## RPS Off-Grid

- Sourcing a minimum percentage of the total annual generation by NPC, NPP, QTP, from available RE resources
  - All DUs shall incorporate the calculations of the minimum requirements
  - In case there are no viable RE in the area, mandated participants shall still comply with the RPS
  - GenCos, NPC SPUG, NPPs, QTPs, DUs
- Department Circular effective 29 September 2018
  - IEC Rollout Program
  - Data gathering
  - Next steps: operationalize RPS composit team and hand out training for mandated participants



# The Philippines - Updates of the RE Law (4)

Gov't Policy	Description	Status
Green Energy Option	<ul style="list-style-type: none"> <li>- A voluntary and non-regulated mechanism to empower consumers to choose RE source at 100 kWp load</li> <li>- Sets rules to guide end-users, RE suppliers, service providers in facilitating the option taken by consumers to choose RE as their source</li> <li>- Network service providers will still continue to wheel power and provide open and non-discriminatory access</li> </ul>	<ul style="list-style-type: none"> <li>- Effective 22 August 2018</li> <li>- Service Contract Template drafted</li> <li>- Guidelines for issuance and operating permit drafted</li> <li>- Next steps conduct public consultation; Conduct of IECs and FGDs</li> </ul>

# The Philippines - Updates of the RE Law (5)

RE Trust Fund		For establishment to DOE
RE Market	<ul style="list-style-type: none"><li>- Market for RE Certificates for compliance to RPS</li><li>- PEMC to establish RE Registrar to issue, keep and verify RE Certificates</li></ul>	For promulgation

# The Philippines - FIT as of Dec 2016

Technology	Base FiT Rate (P/kWh)	Adjusted FiT* for 2017	Quota (MW)	Approved for FIT (MW)	Degression Rate (from effectivity of FiT)
Biomass	6.63	7.25	250	105.1 (42.0%)	0.5% (from Y+2)
Hydro (RoR)	5.90	6.64	250	26.6 (10.6%)	0.5% (from Y+2)
Solar PV (FiT1)	9.68	n/a	50	526.0 (105.2%)	6.0% (from Y+1)
Solar PV (FiT2)	8.69	n/a	450		6.0% (from Y+1)
Wind (FiT1)	8.53	n/a	250	393.9 (98.5%)	0.5% (from Y+2)
Wind (FiT2)	7.40	7.61	150		0.5% (from Y+2)

FiT = feed-in tariff, kWh = kilowatt-hour, MW = megawatt, PV = photovoltaic, RoR = run-of-river.

Note: FiT rates for installed capacity are subject to annual adjustments for local inflation and foreign exchange. Approved FiT capacity is that which has received a certificate of endorsement. Two years (1 year for solar) after the effectiveness of the prevailing FiT rate, a new rate (reduced by the degression rate) becomes applicable.

Source: Government of the Philippines, Department of Energy. 2012–2015. *Energy Regulatory Commission (case no. 2011-006M, 27 July 2012; case no. 2014-004RM, 27 March 2015, resolution N° 14, 6 October 2015)*. Manila.



# The Philippines - PV Market Development

Year	Capacity in MW Utility Scale	Capacity in MW Rooftop Scale *	Total Capacity in MW
2010	2		3
2014	22		68
2015	142		142
2016	600	2.95	602.95
2017	120	6.05	126.05
2018	11	19.66	30.66
2019	189.96		189.96
	<b>1086.96</b>	<b>28.66</b>	<b>1162.62</b>

\*\*

- Registered under Net Metering under the Energy Regulatory Commission

\*\* 2019 Utility Scale Figures are based on Prospective Installation as per Issuance of Certificate of Commerciality  
2019 Industry Count of Rooftop C&I installation is at 75.58 MW

# South-Korea



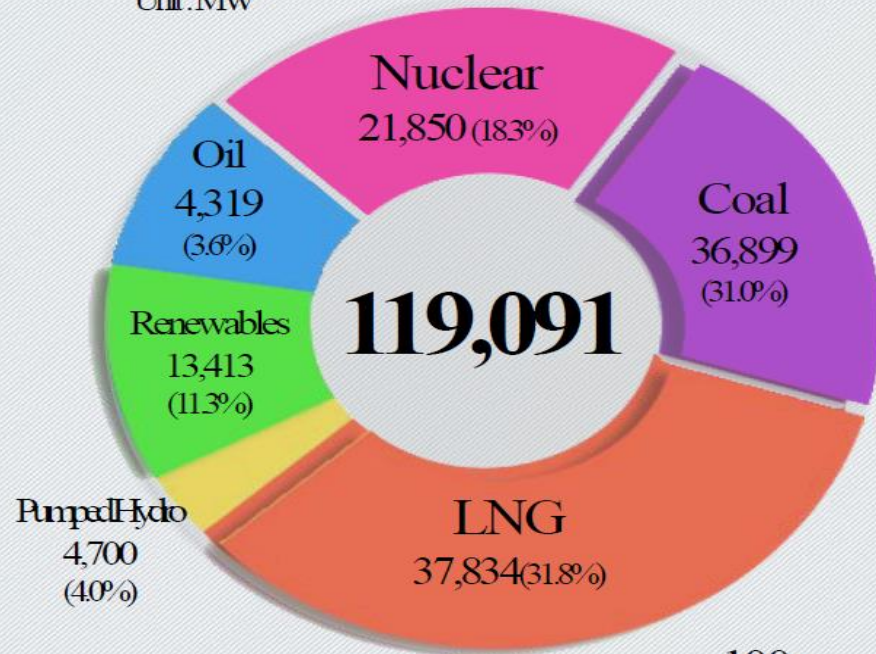
# South-Korea - Power Sector Overview

Total Capacity : 119,091 MW

※ As of Dec 2018

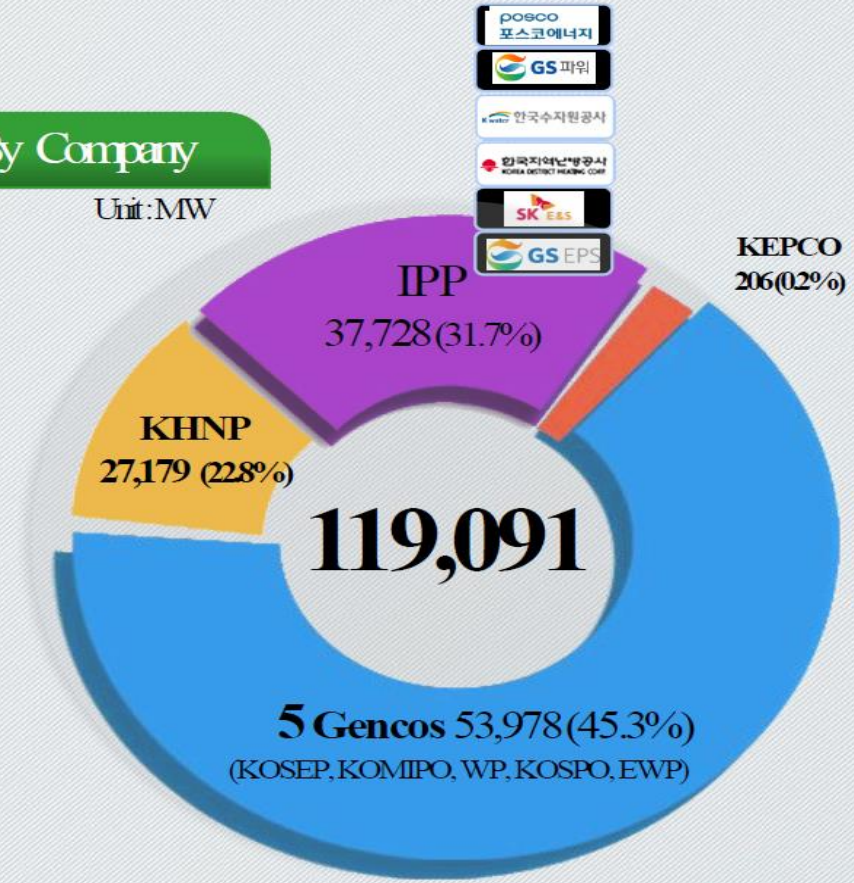
## By Fuel Type

Unit: MW



## By Company

Unit: MW



Source: Korea Power Exchange, April 2019



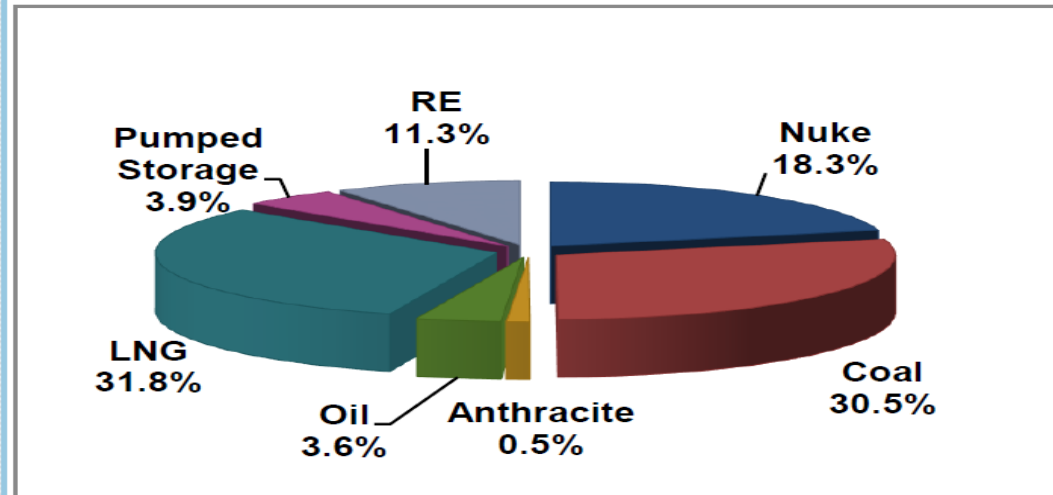
# South-Korea - RE Current Status

Total RE capacity : 13,413MW (11.3% share)

PV capacity is 7,130MW (53.2% share), comprising the biggest share among renewables.

\* Total installed capacity : 119,092MW

## Renewables Status of Korea Electricity Industry (as of Dec. 2018)

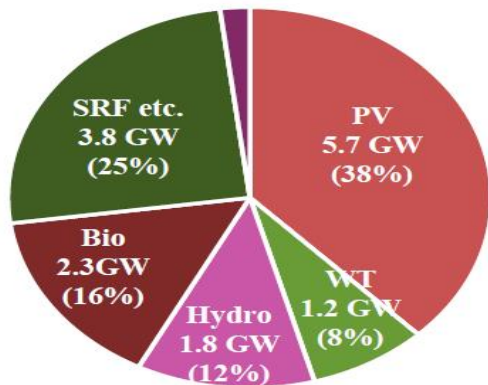


Classification	MW	Shares
PV	7,130	53.2%
Hydro	1,790	13.4%
Wind	1,420	10.6%
LFG	67	0.5%
By-product gas	1,356	10.1%
Waste	234	1.7%
Fuel Cell	344	2.6%
Tidal	346	2.6%
IGCC	255	1.9%
Bio	470	3.5%
<b>Total</b>	<b>13,413</b>	<b>100%</b>

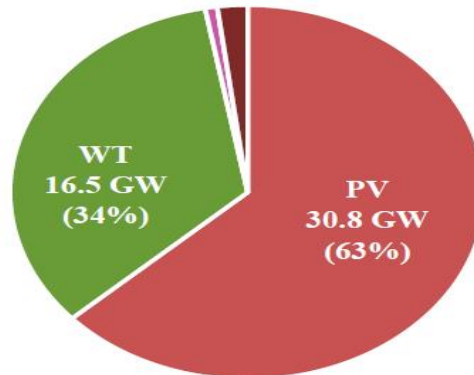
# South-Korea - 20% RE Share by 2030



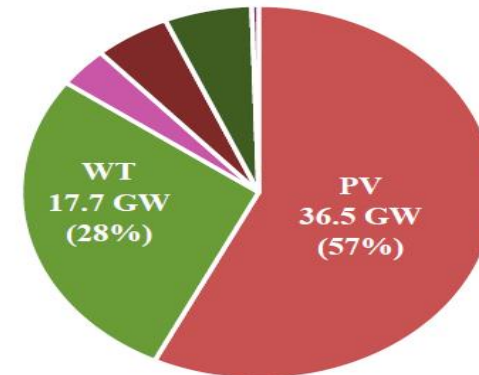
< 2017 (15.1GW) >



< Projected Installed Capacity (48.7GW) >



< 2030 (63.8GW) >



# South-Korea - Implementation for New Vision of 3020

Achieve **25% share of renewable energy** by 2030

– Achieve 20% share of renewable energy by 2030, the government's target –

➤ Year-by-year Implementation Plan [Unit: Facility Capacity (MW), Power Generation Amount (GWh), and Share (%)]

Year	'17	'18	'19	'20	'21	'22	'23	'24	'25	~'30
Facility Capacity	300	367	754	2,540	3,557	4,622	5,022	6,002	6,302	7,952
Facility Share	2.8	3.5	7.1	20.4	28.8	34.5	36.4	40.6	41.8	47.4
Power Generation Amount	1,354	1,407	1,856	5,026	6,523	8,660	10,840	12,853	14,017	18,129
Power Generation Share	2.0	2.2	2.9	7.4	10.4	13.4	16.3	18.8	20.0	25.0

➤ Roadmap for Business Implementation

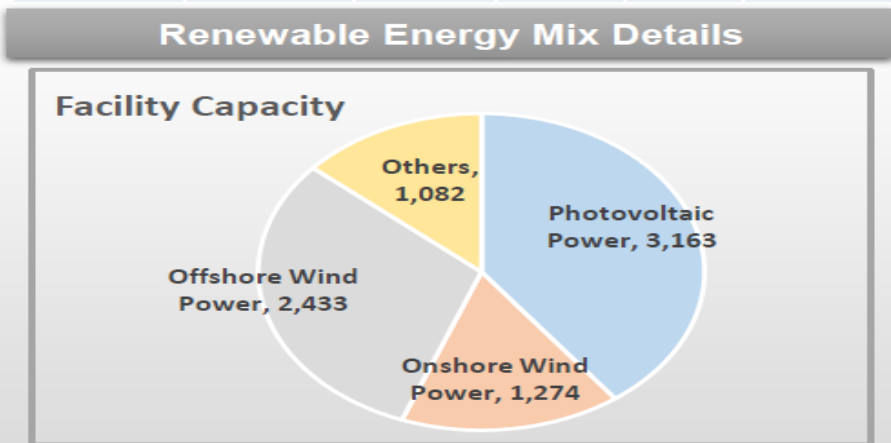
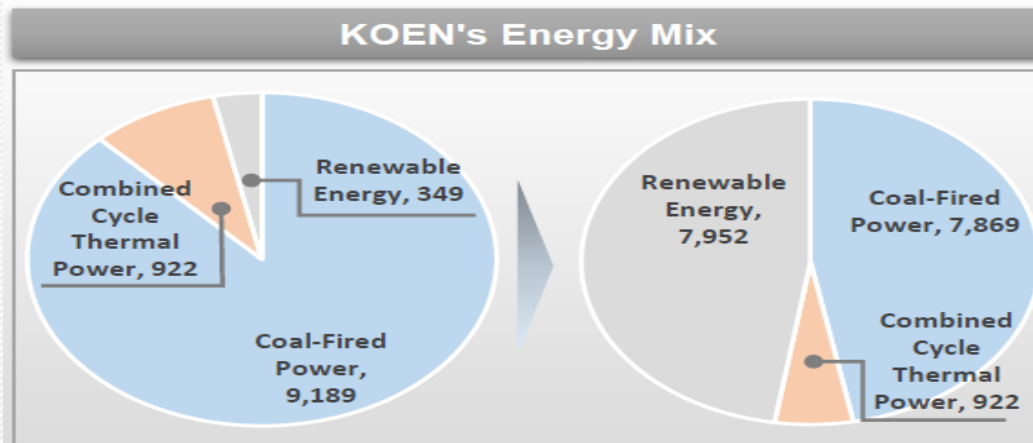
Category	Implementation Strategy	Implementation Details
Short-term Strategy (- 2022)	<ul style="list-style-type: none"> <li>➤ Establishment of Stable Foundation for RPS Implementation</li> <li>➤ Establishment of Foundation for Large-scale Business Implementation</li> </ul>	<ul style="list-style-type: none"> <li>✓ Business Development Centered on Onshore and Offshore PV Power, Fuel Cell, and Biomass Power</li> <li>✓ Establishment of Foundation for Large-scale Energy Source Business Implementation (Offshore Wind Farms and Complexes)</li> </ul>
Mid- and Long-term Strategy (2023 - 2030)	<ul style="list-style-type: none"> <li>➤ Making Tangible Achievements in Offshore Wind Power Generation</li> <li>➤ Establishment of More Renewable Energy Complexes</li> </ul>	<ul style="list-style-type: none"> <li>✓ Commencement of a Large-scale 3GW Offshore Wind Power Project</li> <li>✓ Commencement of a Renewable Energy Complexes (340MW Complex in Haenam and 1GW Complex in Shinan)</li> </ul>



# South-Korea - RE Portfolio by 2030

KOEN's Energy Mix				
Category	2018		2030	
	Facility Capacity	Facility Share	Facility Capacity	Facility Share
Coal-Fired Power	9,189	88%	7,869	47%
Combined Cycle Thermal Power	922	9%	922	6%
Renewable Energy	349	3%	7,952	47%
Total	10,460	100%	16,743	100%

Renewable Energy Mix Details					
Category	Photovoltaic Power	Onshore Wind Power	Offshore Wind Power	Others	Total
Facility Capacity	3,163	1,274	2,433	1,082	7,952
Facility Share	40%	16%	31%	13%	100%
Power Generation Amount	3,655	2,730	6,263	5,481	18,129
Power Generation Share	20%	15%	35%	30%	100%



# South-Korea - RE & Rate Targets by 2030

## ◆ Installing Targets

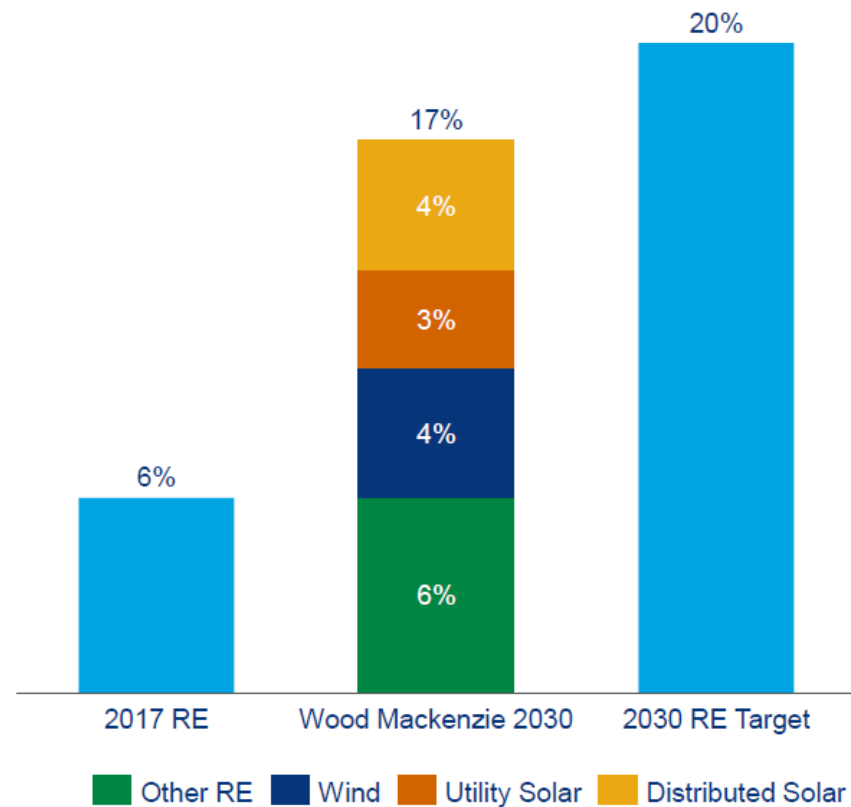
Year	2017	2022	2030
GW	11.3	23.3	58.5

## ◆ Rate of Generation and Facilities

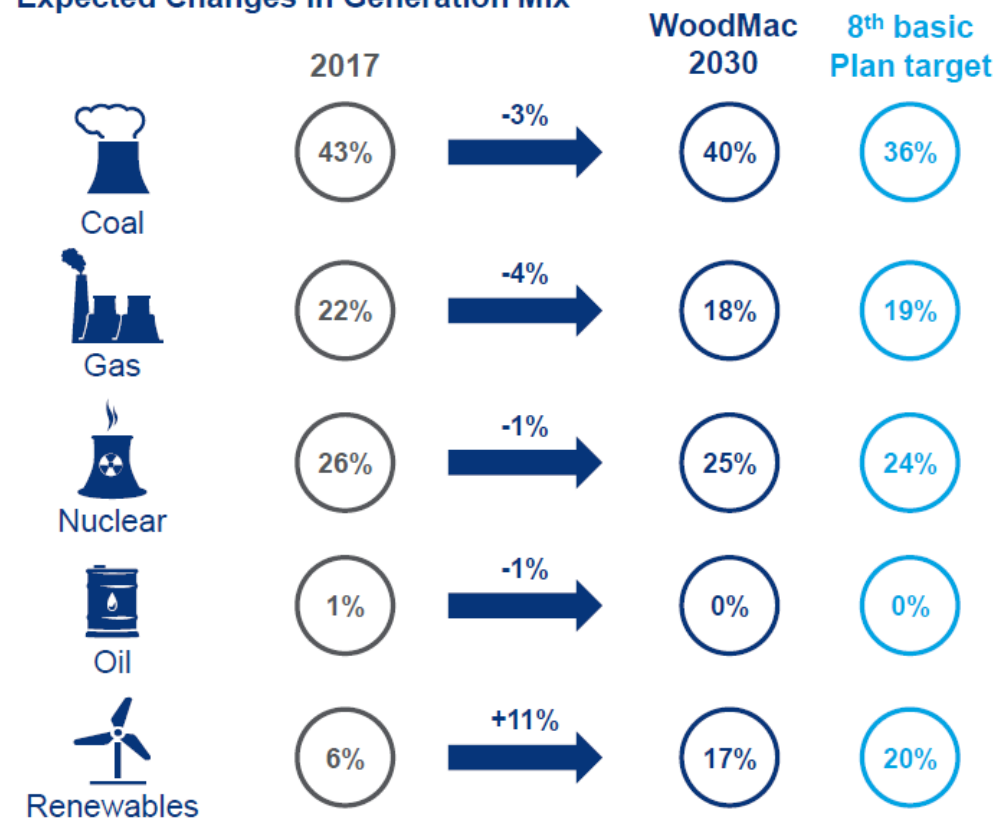
Year	2017	2022	2026	2030	2031
Generation (Twh/%)	34.4 (6.2)	58.3 (9.6)	89.5 (14.4)	125.8 (20.0)	126 (19.9)
Generating Facilities (GW/%)	11.3 (9.7)	23.3 (16.4)	38.8 (25.4)	58.5 (33.7)	58.6 (33.6)

# South-Korea - RE3020 Plan - Prospects

South Korea's 2030 Renewables Generation Mix



Expected Changes in Generation Mix

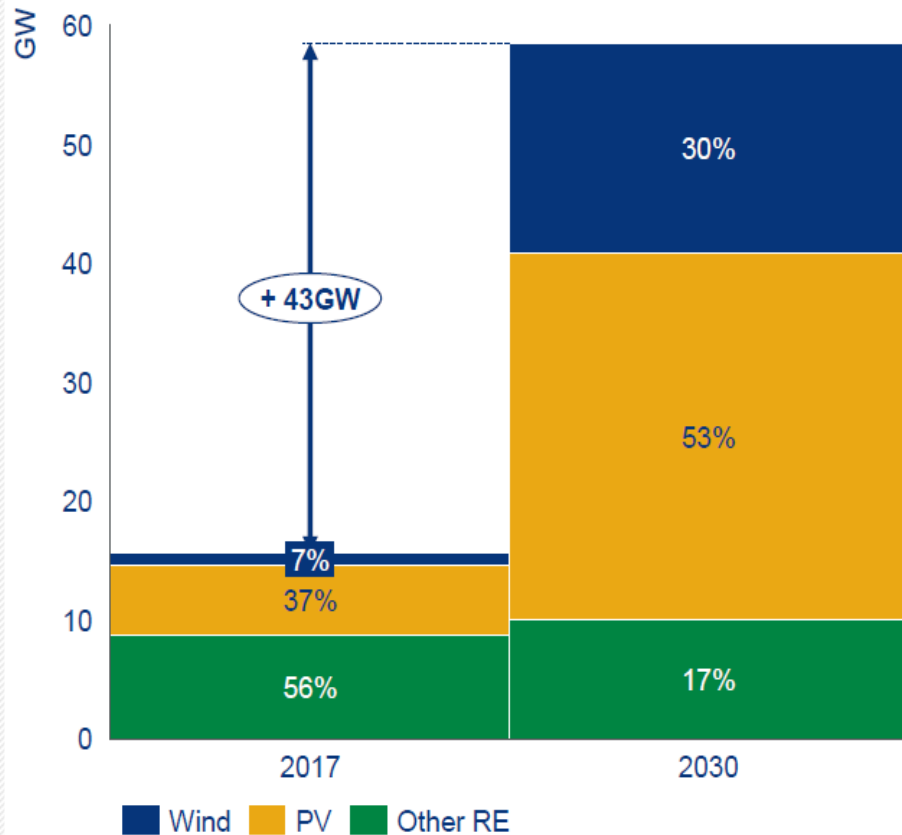


Source: Wood Mackenzie, April 2019

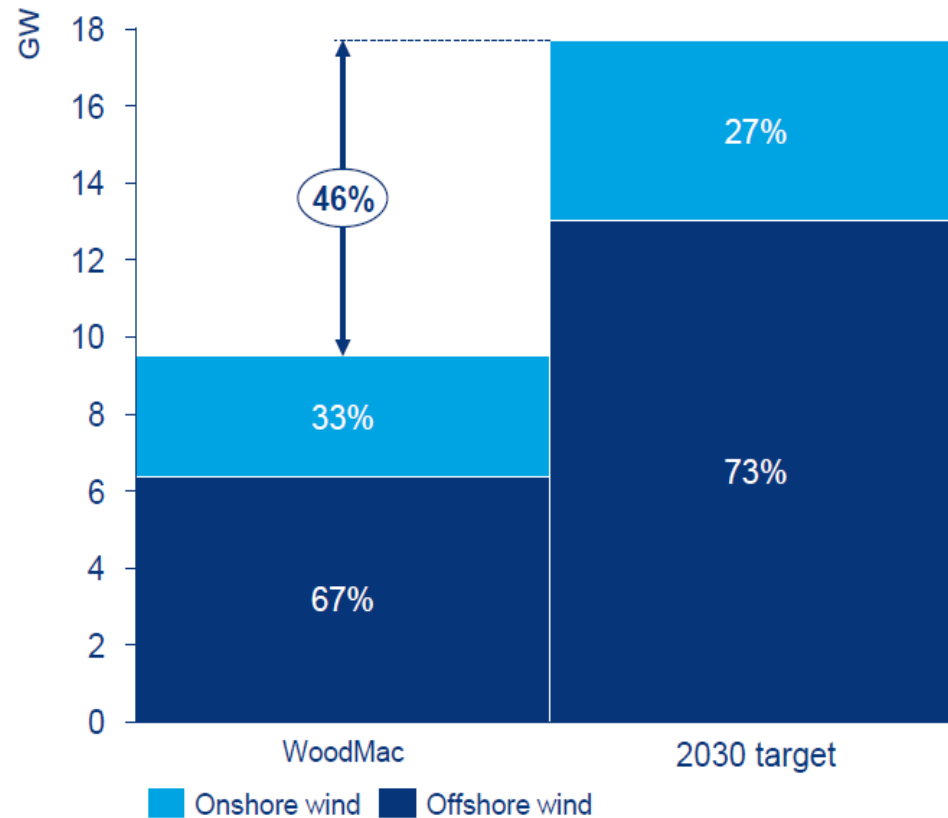


# South-Korea - RE3020 Plan - Prospects

South Korea renewable energy capacity mix, 2017 and 2030 target



Wind gap between WoodMac view and 2030 target



Source: Wood Mackenzie, April 2019

# South-Korea - RPS Development

- RPS enforces power producers to supply a certain amount of the total power generation by renewables.
- Starting from the 2% at the beginning in 2012.

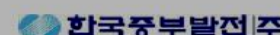
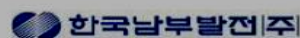
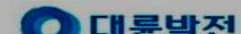
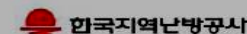
## < Renewable Portfolio Compliance Rate >

Year	12	13	14	15	16	17	18	19	20	21	22	23
Ratio(%)	2.0	2.5	3.0	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0

## < RPS Obligations >

▶ Those with 500MW or generating capacity are obligors for RPS

- Pertinent Gencos : 6 KEPCO subsidiaries, 13 Private and 2 Public companies



# South-Korea - Renewable Energy Credit (1)

- ▶ RPS compliance in restructured markets typically occurs through “unbundled” RECs sold separately from the underlying electricity, often via spot market transactions or relatively short-term contracts.
  - Long-term contracting programs in many restructured countries have migrated some REC volume into longer-term, bundled PPAs.
- ▶ REC pricing can be viewed from several perspectives
  - A potentially important source of revenues for RE generators
  - The direct cost of compliance to entities with RPS obligations
  - Signals whether REC supply and demand are in balance
- ▶ REC issue :  $REC = MWh \times multiplier$ 
  - 2 MWh generation, multiplier 1.5  $\Rightarrow 2 MWh \times 1.5 = 3$  RECs issued
  - Expiration Date : within 3 years of issue
  - Time limit for application : within 90 days after the end of the generating month
  - Issuing & Transaction fee : 0.04\$/REC



# South-Korea - Renewable Energy Credit (2)

- ▶ Implementation Method : Self construction, self contract and in-kind trade
- ▶ Operate banking and borrowing system to secure flexibility
- ▶ Penalty : impose penalty up to 1.5 time of market avg. price

## < RPS Implementation Method >

### Contract Markets

- ◆ Sign the contract between the two parties
- ◆ The contract is being made throughout the year
- ◆ Long-term fixed price for 20 years

### Spot Markets

- ◆ Based on the law of supply and demand
- ◆ Market opens 2 times per week
  - REC is sold in 1 REC unit

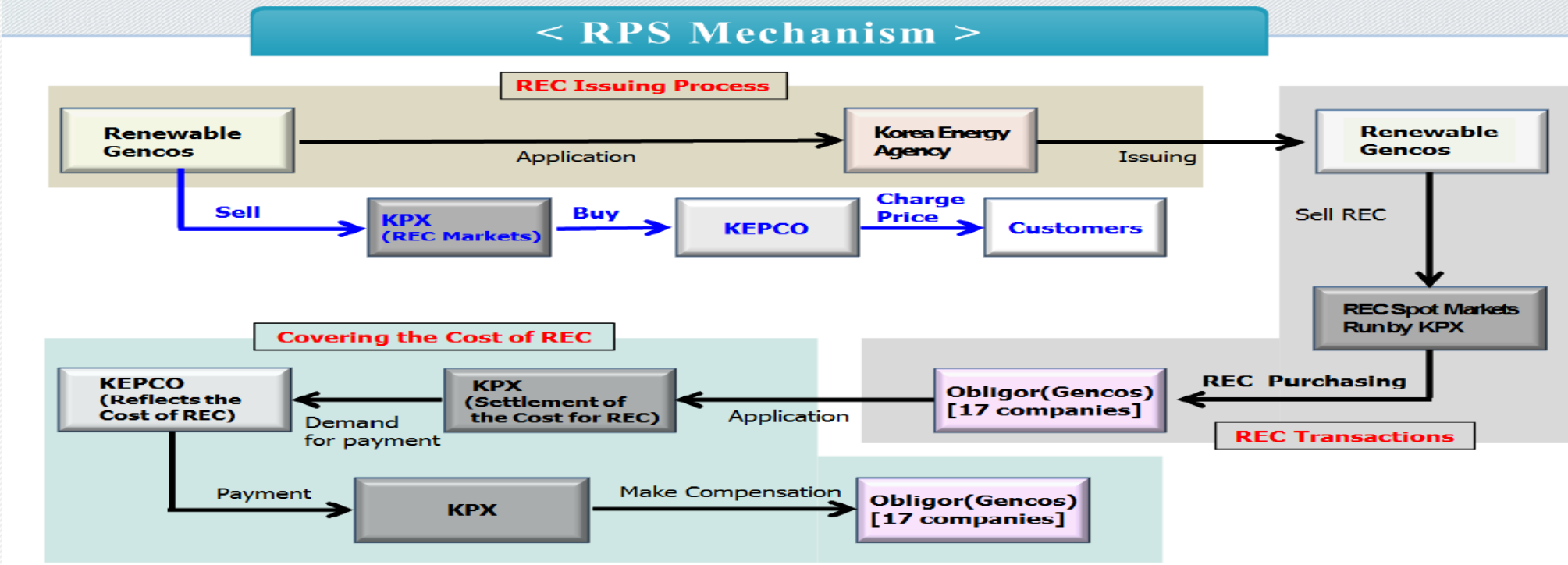
### Two-Way Bidding Markets

- ◆ Matching price and quantity according to order
- ◆ Order of priority for buying & selling
  - Firstly, price matching
  - Secondly, quantity matching

# South-Korea - Renewable Energy Credit (3)

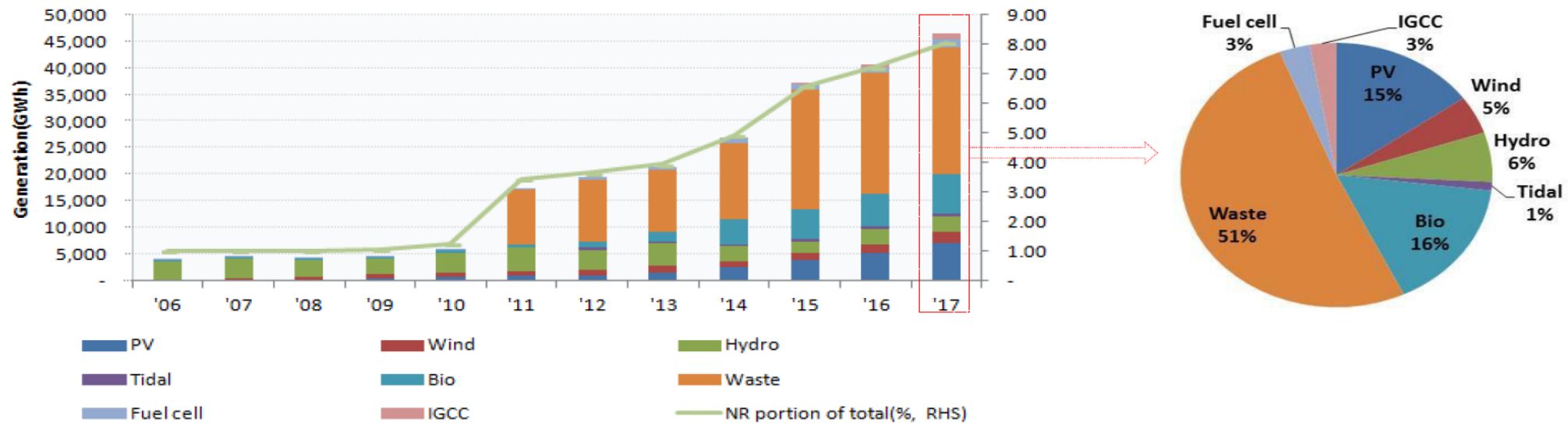
KPX : Trade RECs and Settle REC cost

KEA : Issue RECs and run Fixed Price Contract



# South-Korea - Supply / Demand of RE Certificates

## New and Renewable(NR) energy generated



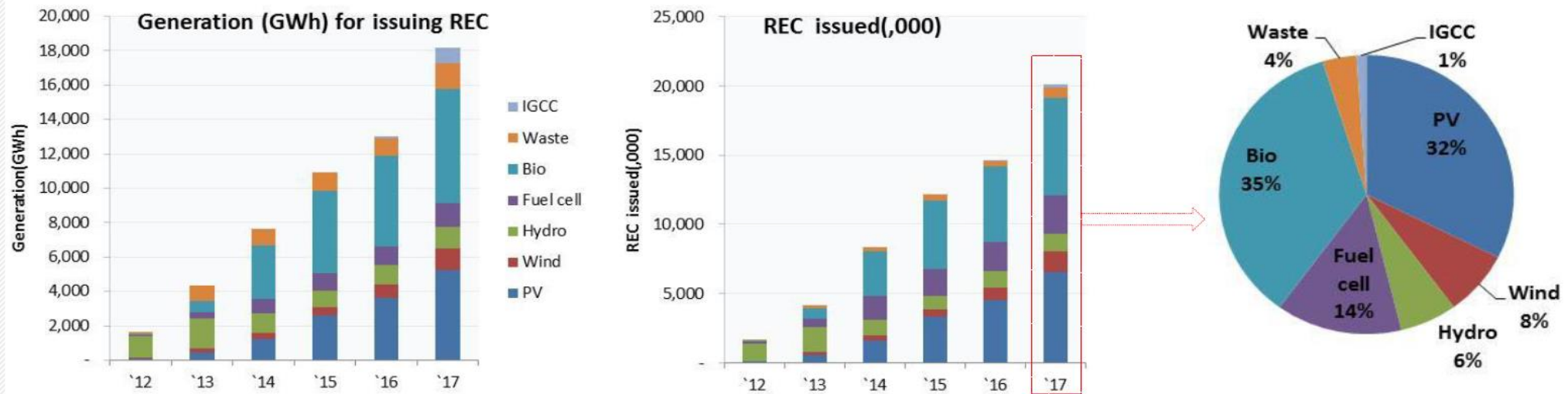
Source: KEA, 2018, "Statistics of power generation from new and renewable energy in 2017"

- NR contribution to power generation is 8.1% of the total power production (Y2017)
- PV and wind are only 1.6% of the total power production

Source: Korea Development Bank, April 2019



# South-Korea - Quantity of RE Certificates issued



Source: KEA, 2018.10.15, "Statistics of New and Renewable Facility and REC Issuance 2018.9.30"

- Unlike the NR contribution to power production, REC was supplied by biomass, PV, fuel cell (the order of REC quantity)
- NR that needs feedstock consists more than half of the REC supply

Source: Korea Development Bank, April 2019

# South-Korea - Renewable GenCo's Revenue

**GenCo's Revenue = Energy Markets (SMP) + REC Markets (REC)**

**< GenCo's Revenue >**

**Energy market Revenue** = Generation(kWh) × Energy market selling price(SMP)

**REC market Revenue** = REC quantity × REC transaction price

REC quantity = Generation(MWh) × Weighted value

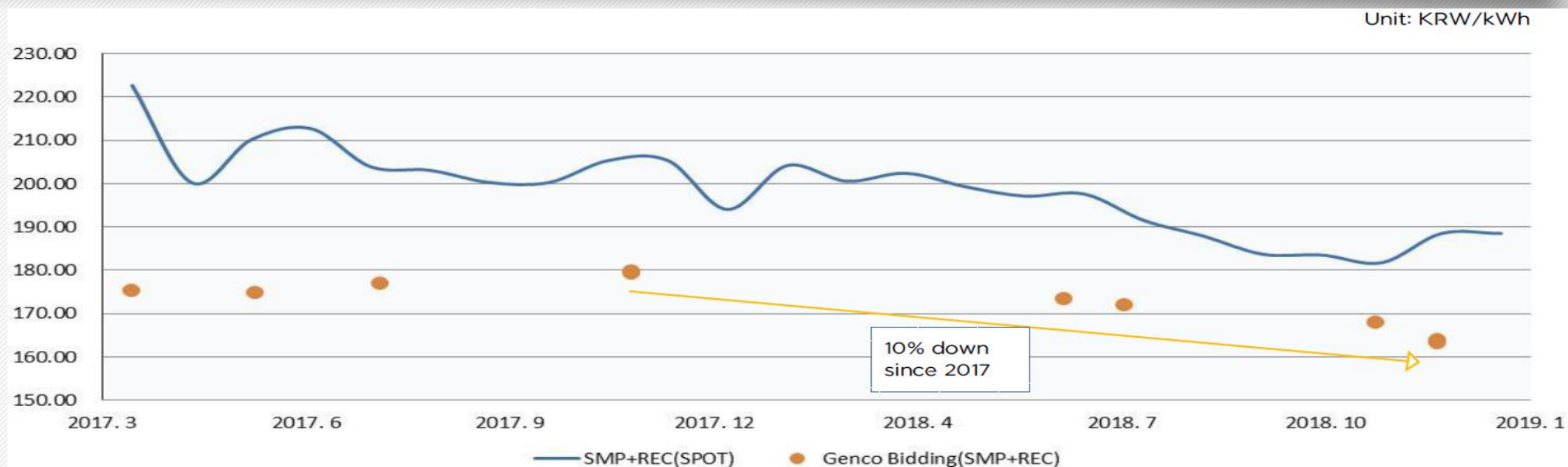
ex.) 100kW PV (solar) on land – REC quantity yearly?

REC = [Capacity(kW) × Annual time(h) × Capacity factor × Weighted value]/1,000

= [100 × 8,760(365days\*24h) × 0.15 × 1.0]/1,000 [MWh conversion]

≒ 131 [Units]

# South-Korea - Tariff Bidding by Genco's since 2017



Source: Collected from announcements of bidding result from Korea South-East Power, Korea Midland Power, Korea Western Power, Korea East-West Power, Korea Southern Power

- Gencos' Tariff(SMP + REC fixed price) bidding (PV and Wind only) initiated in Y2017
- As new renewable energy sources (mainly biomass) came into the market, the spot and the contract price of REC steadily declined

Source: Korea Development Bank, April 2019



# South-Korea - Key Features of Electricity Market

## Transmission and Distribution Industry run by KEPCO exclusively

- No chance for private entities to operate or invest in transmission or distribution assets other than through holding shares in KEPCO
- Heavily regulated market, the retail price of which is subject to the MOTIE's approval

## Clear distinction between the wholesale and the retail market.

- Generated electricity shall be traded only in the wholesale market. Generated electricity may not be acquired directly in the retail market.
- Kepco is an only utility company in the retail market and an only offtaker in the wholesale market – sale of electricity to KEPCO is either through participation in the pooled market or by execution of PPA with KEPCO, however, PPAs are only available for certain projects (e.g. (i) sales from an island region that is not connected to the power grid operated by KEPCO, and (ii) sales from a new or renewable energy generation project with an output capacity below 1MW)

## Pooled market and SMP

- Two components make up wholesale electricity prices: (1) the system marginal price ("SMP"), being the variable unit cost of the most expensive generating unit entitled to be dispatched in a day-ahead, hourly competitive bidding and (2) the capacity payment representing fixed cost of generation.
- Renewable energy generators are not required to participate in bidding. Instead, they are entitled to sell the entire amount of their generated electricity to KEPCO at the hourly SMP. Also, no capacity payments are payable to renewable energy generators.

# South-Korea - Key Features of RE Projects (1)

## Two separate source of revenues: SMP and REC

- SMP as discussed in the previous slide.
- Sale of RECs (renewable energy credits) granted to electricity from eligible and certified renewable generators under RPS scheme where conventional generators (the "Required Generators") with installed capacity over 500MW shall either (i) generate a minimum proportion of their power through renewable energy source or (ii) purchase RECs equivalent to such minimum proportion. Taking into account the REC weighting factor applicable for each renewable energy generator, the revenue from REC sale will be calculated as [amount of generated electricity(kWh) entitled to receive RECs] x [price of REC (KRW/kWh)] x [REC weighting factor].

## Eligibility and certification of REC

- Application for certification shall be submitted within one month of the pre-use inspection. The lead-time for certification is around 1 month from the application.
- REC weighting factor (a.k.a REC multiplier) shall be confirmed at the time of the facility certification, thereafter will not be subject to change as long as the project in question remains in operation.
- **RISK associated with REC multiplier being less than what had been expected at the construction commencement.**

## Trading of RECs

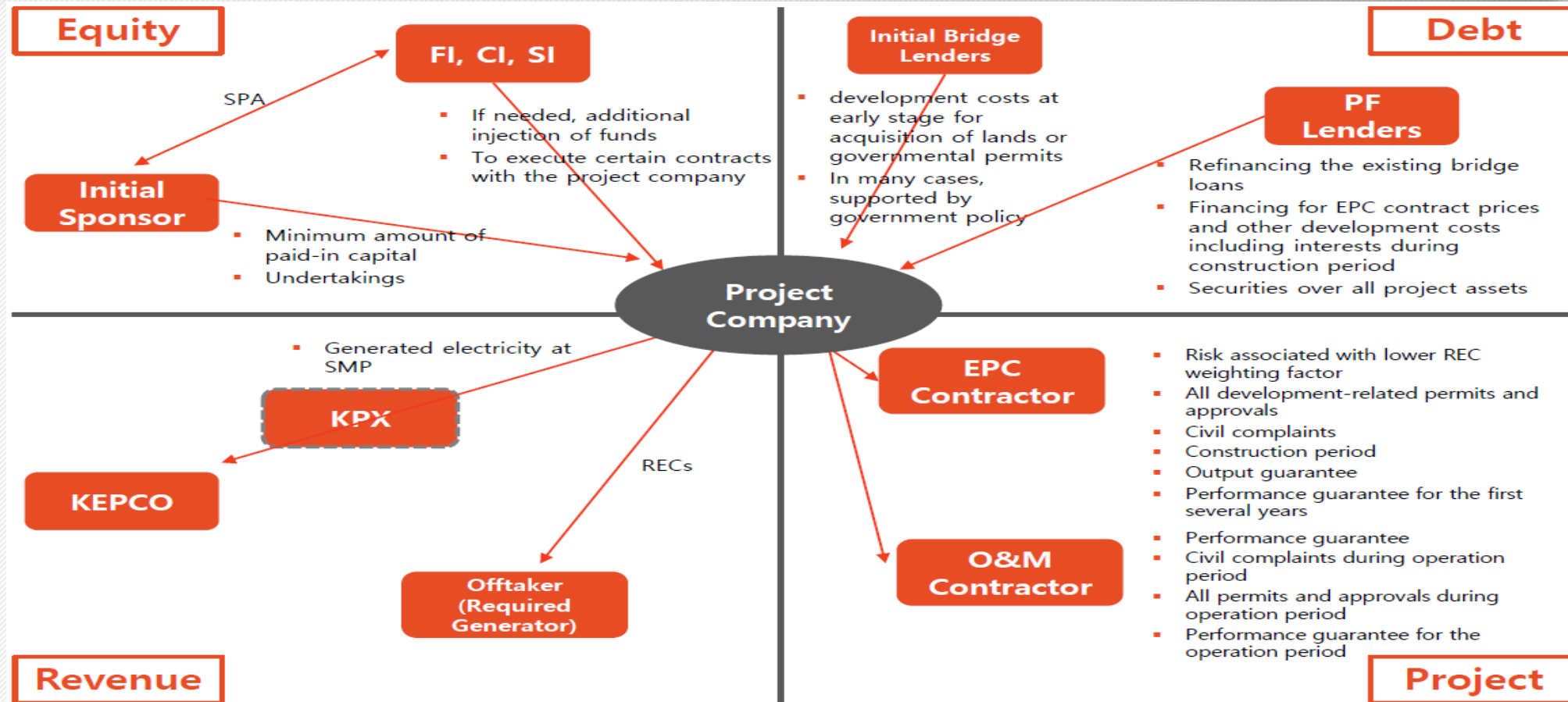
- Offtaker: Required Generators through (1) spot market; (2) bilateral contracts, and (3) fixed price arrangement system.
- Spot Market operated by KPX, involving two-way bidding system which takes place twice a week and seeks to match willing renewable energy generators with RECs to Required Generators.
- Bilateral Contract, where parties are free to determine the price of RECs and other terms and conditions.
- **Fixed Price Arrangement System for 20 years**, where [SMP + REC] is fixed or [SMP + REC x weighing factor] is fixed. Mandatory for Required Generators with the capacity of 5MW or more.
- **Risk associated with the change of REC price (in case of Spot Market trade) or the failure to sell RECs.**

# South-Korea - Dev Process of RE Projects (1)

Phase	Implications / Remarks
Electricity Generation Business License	<ul style="list-style-type: none"> <li>▪ Grid capacity in the region to be considered.</li> <li>▪ Prior clearance of the environment impact assessment may be required at this stage.</li> </ul>
Environmental Impact Assessment	<ul style="list-style-type: none"> <li>▪ Regular EIA required for projects with capacity exceeding 10MW.</li> <li>▪ Small projects may be eligible for expedited and simplified EIA process.</li> </ul>
Development Permit	<ul style="list-style-type: none"> <li>▪ Upon obtaining the development permit, certain ancillary permits shall be deemed to be obtained.</li> </ul>
Approval of Construction Plan	<ul style="list-style-type: none"> <li>▪ Required prior to the commence works of construction</li> </ul>
Pre-Use Inspection	<ul style="list-style-type: none"> <li>▪ Carried out by KESCO, who should issue a certificate upon satisfactory completion of the inspection</li> </ul>
Obtaining Membership in KPX	<ul style="list-style-type: none"> <li>▪ Key steps for the eligibility to sell generated electricity and collect SMP</li> </ul>
Business Commencement Report	<ul style="list-style-type: none"> <li>▪ Key steps for the eligibility to be issued RECs</li> </ul>
Facility Certification	<ul style="list-style-type: none"> <li>▪ Key steps for the eligibility to be issued RECs</li> </ul>



# South-Korea - Transaction Structure of RE Projects



# South-Korea - Risks and Mitigation of RE Projects

## Eligibility of REC sale and its weighting factor

- From the equity investor's perspective, they may recover loss of profits from the initial sponsor, however the last resort would be the EPC contractor, for failures to satisfy the eligibility resulting from causes attributable to deficiencies in construction.
- From the lender's perspective, they may pursue the EPC contractor as well as shareholders through credit support undertakings from them.
- Not able to be mitigated through conditions precedent, since the eligibility and its weighting factors are to be confirmed around COD.

## Tradability of RECs

- Bilateral agreement (whether or not fixed-price-arrangement system) recommended.
- Prior to making an investment, advisable to make sure that a REC offtake agreement is in place and to include such in conditions precedent in loan agreements or equity subscription agreements.
- Gencos are subject to mandatory tender process in order to enter into REC offtake agreements, and being a shareholder to the SPC doesn't relieve such mandatory tender requirement.

## Government approvals or permits/ land acquisition.

- Challenging for financial investors, lenders or foreign investors to bear the risk of obtaining permits and securing lands.
- Advisable to require them prior to making an investment decision.
- To the extent not practically possible to have them prior to committing to an investment, the following measures are to be considered:
  - Undertakings by initial sponsors regarding obtainment of generation business license and securing requisite lands through shareholders agreements
  - Undertakings by EPC contractors with respect to permits and approvals during and for the construction period whether in the name of the SPC or the EPC contractor, for example, through relevant covenants and obligations the arrangement built into the loan agreements and the direct agreements.

# South-Korea - Market Access for Foreign Investors

## Model Hypothetical Case of an Equity Investment by a Foreign Investor

- The project company has been established by a Korean sponsor.
- The project company has obtained the generation business license and secured land use rights.
- During the construction period, the sponsor and a foreign investor executed a share sale and purchase agreement for the majority of the outstanding shares, where the closing is conditional on the satisfaction of certain key permits and the execution of key project documents (including REC offtake agreement) and the sponsor granted a put option exercisable by the foreign investor in case of certain events such as non eligibility for REC and its expected weighting factor.
- Further, civil complaints or other project related issues shall be resolved at the responsibility and expense of the local sponsor.

## No restrictions on foreigners or foreign entities' ownership of the project company as a IPP.

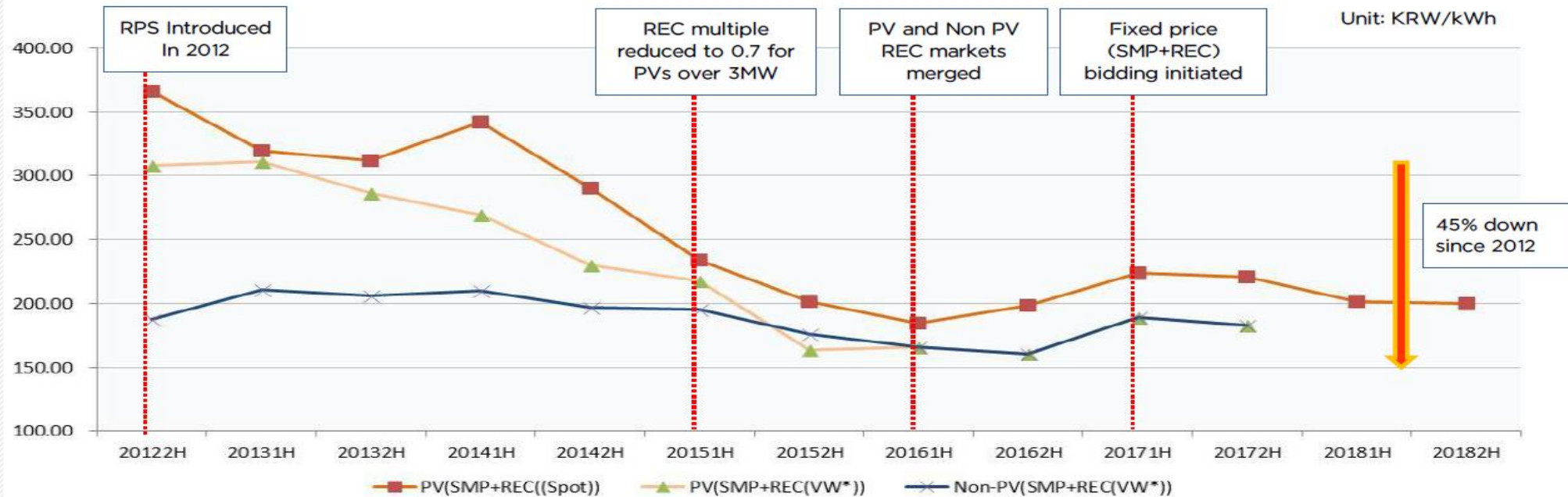
- Change of control through share sale and purchase agreements may be subject to the MOTIE's approval, if the capacity is no less than 20MW. However, as this is equally applicable to both domestic entities and foreign entities, this is not a particular restriction on foreign investment.

## Licenses required for construction works.

- Have not seen a case where a foreign entity directly obtained construction related licenses. A Korean subsidiary is typically incorporated to obtain same.
- Requirements (e.g. the minimum amount of paid-in capital, the number of licensed employees) vary depending on the nature of construction to be carried out.



# South-Korea - Trends of RE Tariffs (SMP+RPS)



Source: KEA New and Renewable Energy Center(KNREC), Korea Power Exchange(KPX)

\* VW: volume weighted average price (excluding fixed price contract since 2017) which applies for reimbursing the REC obligor for the RPS costs incurred

- PV tariff has fallen steeply, whereas non-PV has been relatively stable
- PV tariff with long-term contract hovered around KRW180/kWh since 2015

# South-Korea - LCOE of PV and Wind

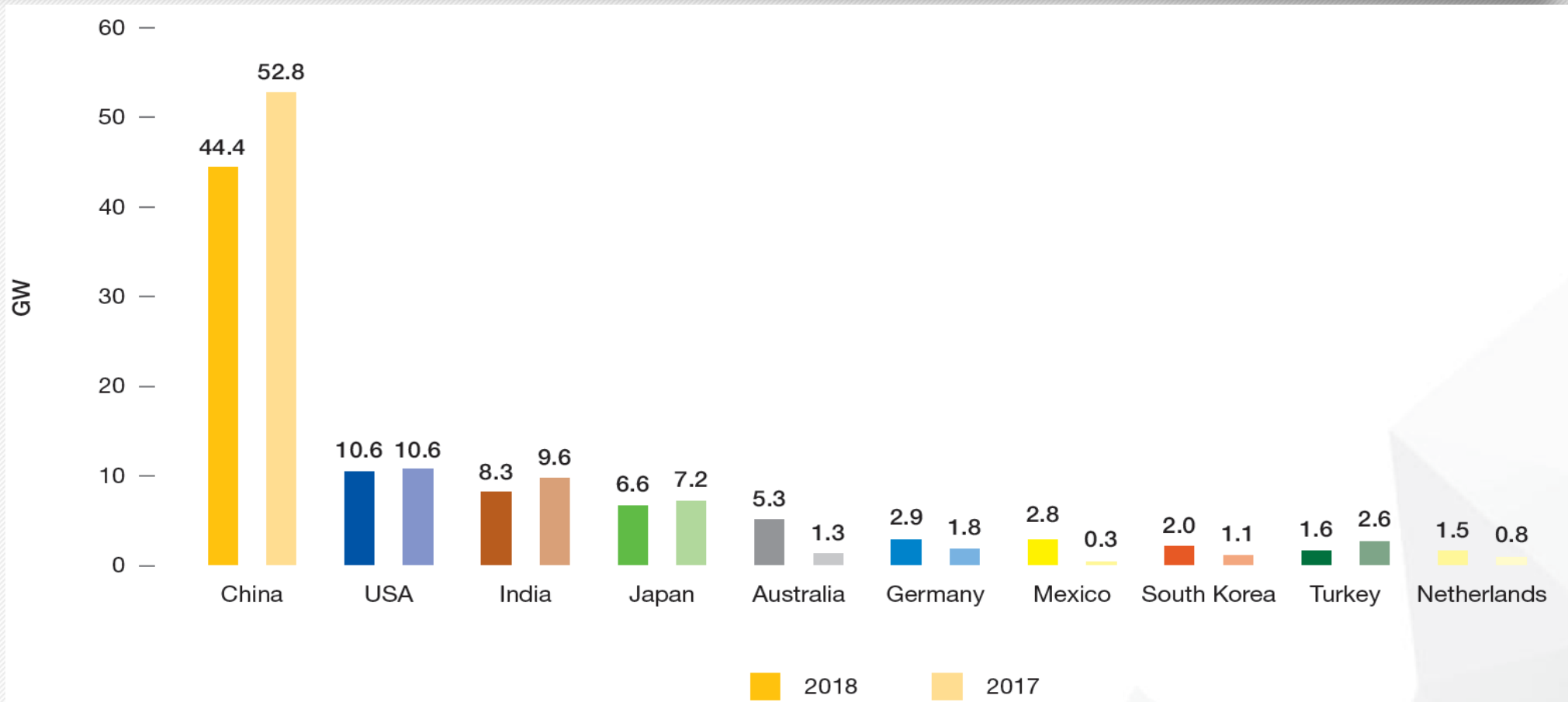
Unit: KRW/kWh	PV			Wind
	<100kW	100kW-3MW	>3MW	Onshore
Land	15	15	15	
Module	42	42	42	94
BoS	68	63	56	
O&M	21	20	19	30
Decomm.	2	2	2	N/A
LCOE	148	142	133	124

Source: KPX, 2018.2.28, A study on the estimation of levelized cost of electricity by generation source

- Limitation on economy of scale and 'other' high costs entails the domestic RE projects to be expensive compared to large global projects

Source: Korea Development Bank, April 2019

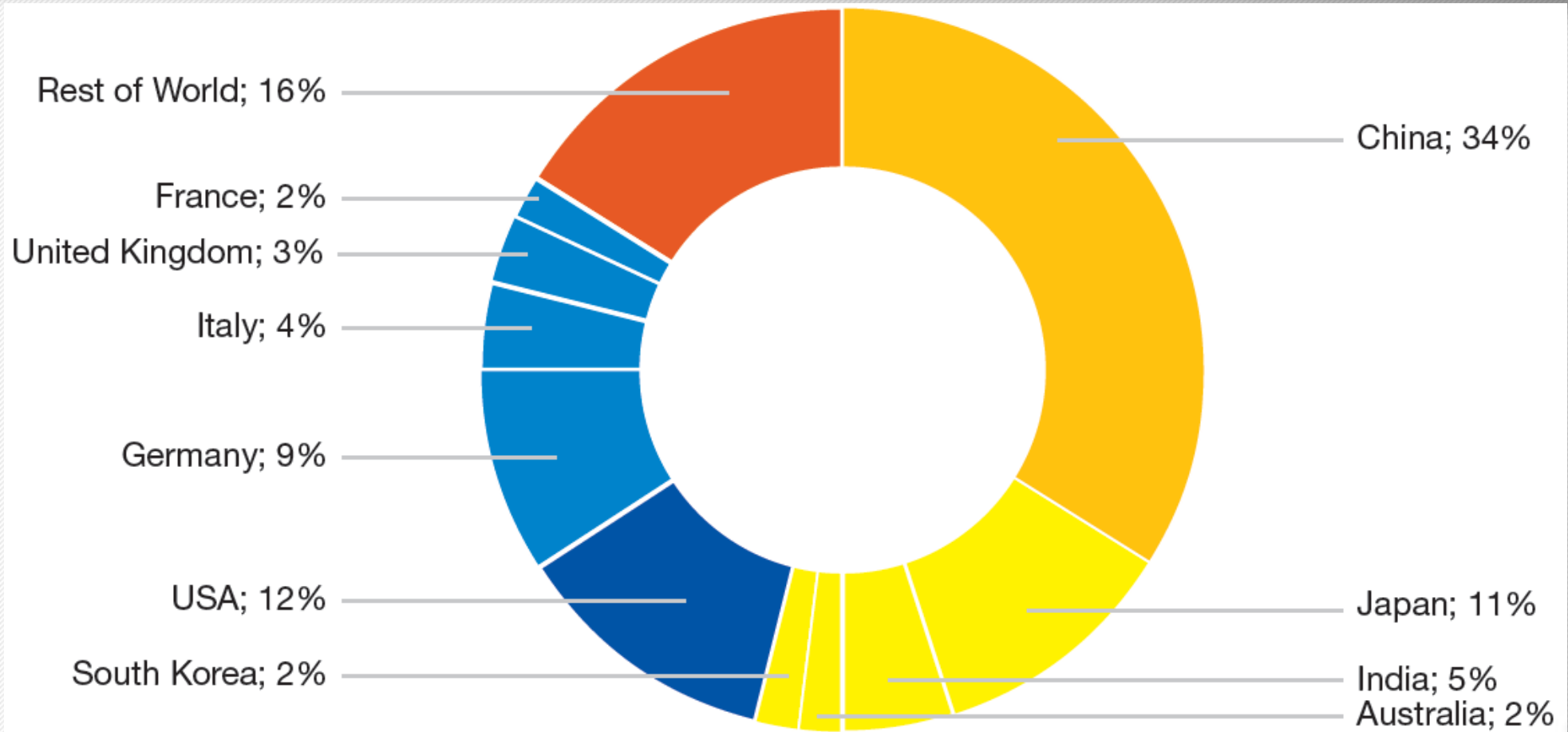
# South-Korea - Among Top 10 PV Markets 2018



Source: SolarPower Europe, May 2019

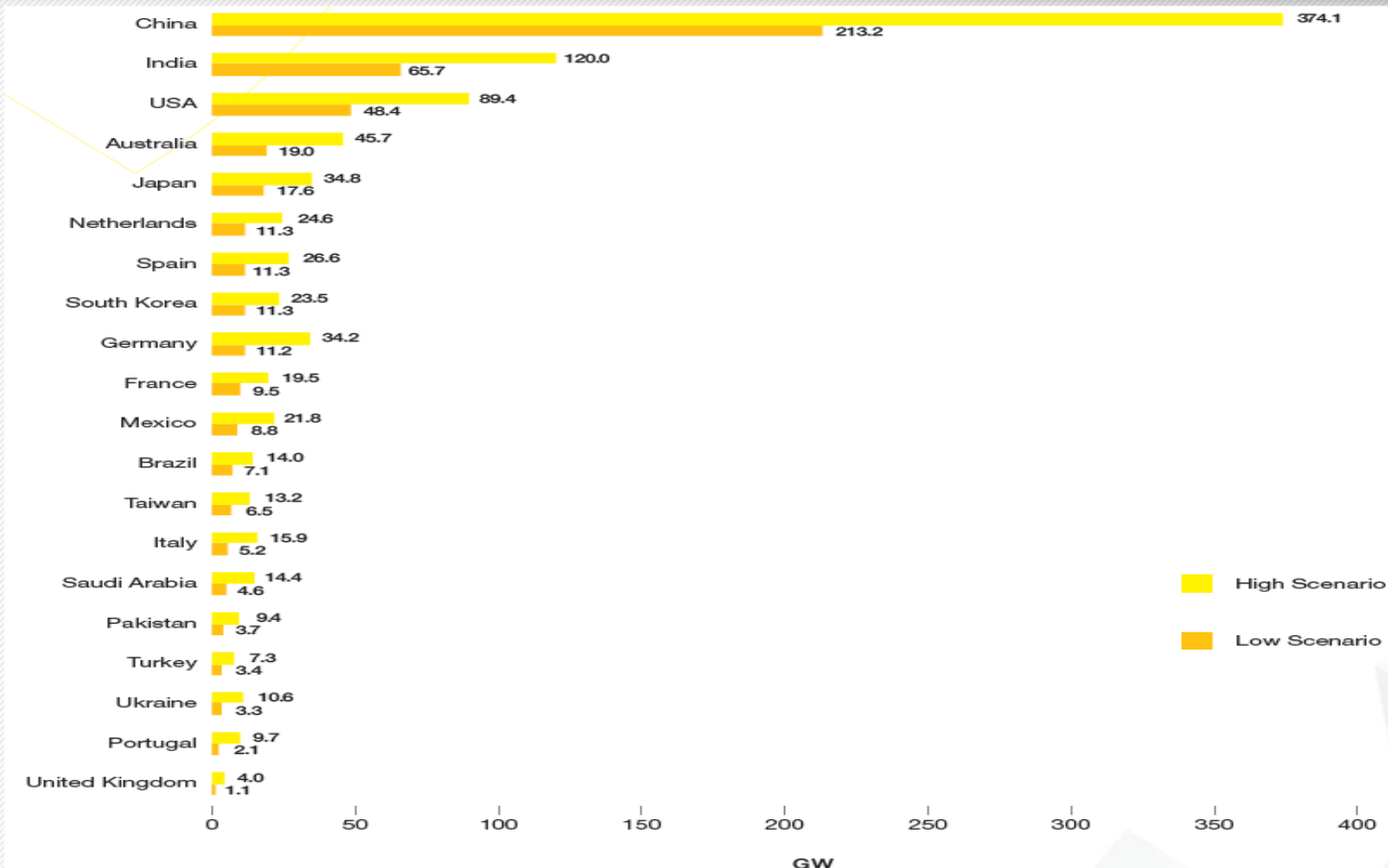


# South-Korea - Global Top 10 Markets By Total Installed PV Capacity (2018)



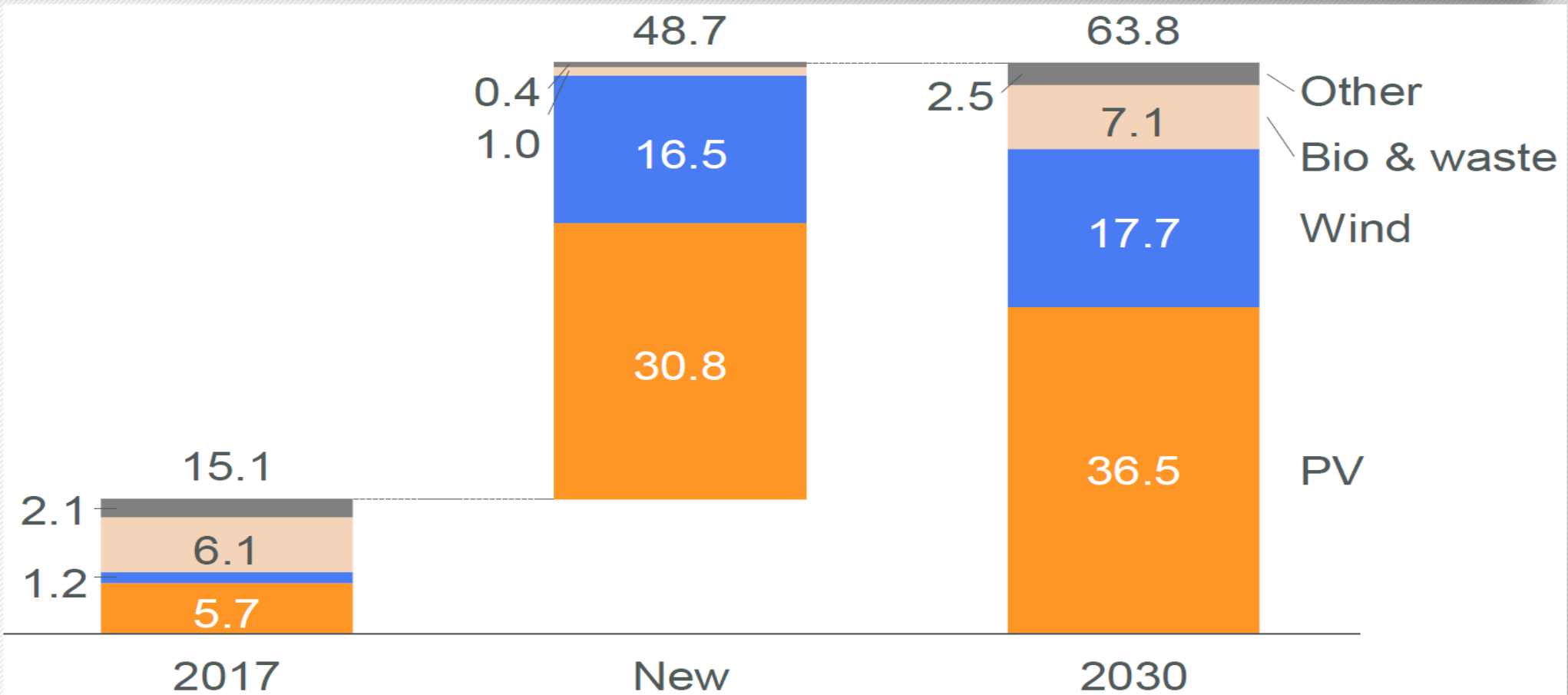
Source: SolarPower Europe, May 2019

# South-Korea - Top 20 Markets for PV Capacity Additions till 2023



Source: Korea Development Bank, April 2019

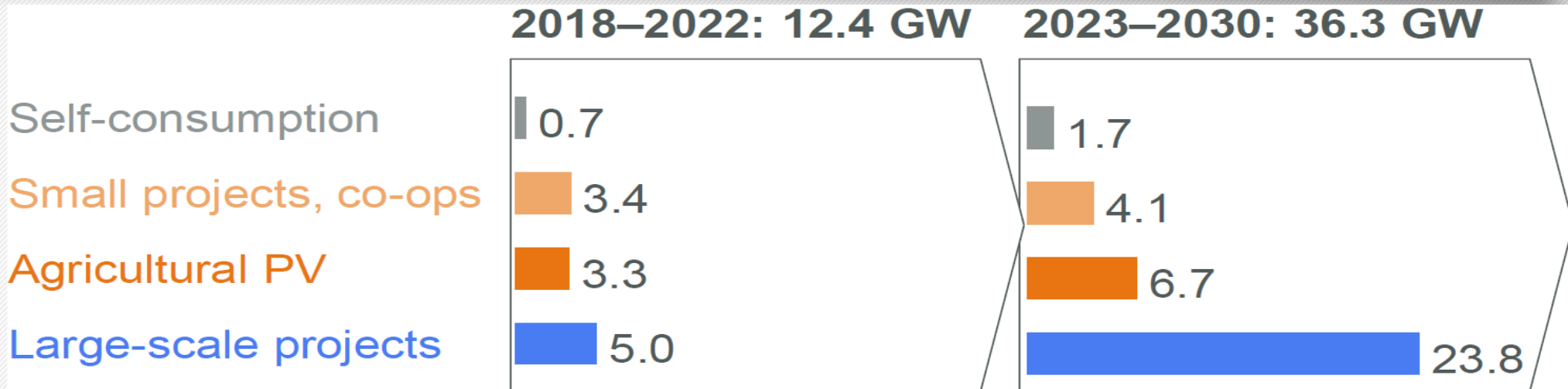
# South-Korea - RE3020 Plan: ~ 50 GW new RE Capacity by 2030



Source: Ministry of Trade, Industry and Energy, April 2019



# South-Korea - RE3020 - Implications for PV



- RE buildout timed to exploit future competitiveness improvements
- Emergence of new business models, especially downstream
- Significant new home market for Korean energy industry
- Increasing price pressure for component suppliers

# Courtesy



- Market data have been collected and analysed by members of the PV Market Alliance.
- Special thanks to the Malaysian PV Industry Association (MPIA) and The Philippines Solar and Storage Energy Alliance (PSSEA)
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## The PV Market Alliance

