



# REC GROUP SOLAR MARKET INSIGHT

H1 2018



SOLAR'S MOST TRUSTED

August 14, 2018

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# REC H1 2018 Highlights



- Launch of **world's first n-type mono solar panel** with **half-cut cells** and a **twin design**, starting a new era for the company
- Very strong operational performance
  - **Module production +39%** in H1 2018 vs. H1 2017
- Active **growth of customer base globally**, with the Americas showing the biggest growth of 83% compared to H1 2017
- REC escalates innovations along the full value chain, in particular **silicon kerf recycling**
- REC completed transition to **diamond wire slicing** and new texturizing methods
- For the **3<sup>rd</sup> year in a row**, REC has been named a **Top Performer** by **DNV GL**
- REC achieves an **industry-leading energy payback time** thanks to its fully integrated solar value chain and silicon production in Norway
- REC Group's Norwegian entity, "Elkem Solar", changed its name to "**REC Solar Norway**", completing the integration into REC Group
- REC breaks ground for **one of Singapore's largest rooftop solar installations** at its Tuas manufacturing plant, attended by Singapore's Senior Minister of State for the Environment and Water Resources, Dr. Amy Khor
- Roll out and **expansion of REC's Channel Programs** in APAC





573 kW, Dubai, UAE


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# REC Highlights – H1 2018



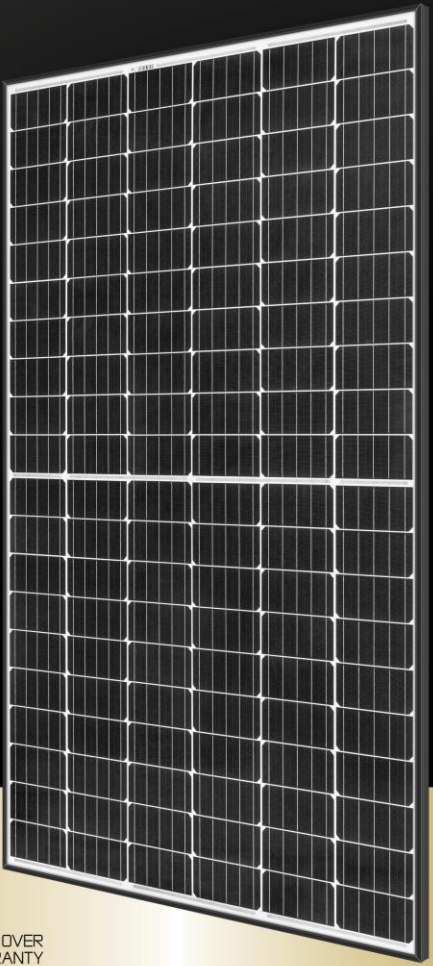
# Launch of new flagship product: REC N-Peak









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## REC N-PEAK SERIES

PREMIUM MONO N-TYPE SOLAR PANELS WITH WORLD-CLASS PERFORMANCE



-  MONO N-TYPE: THE MOST EFFICIENT C-SI TECHNOLOGY
-  NO LIGHT INDUCED DEGRADATION
-  SUPER-STRONG FRAME UP TO 7000 PA SNOW LOAD
-  FLEXIBLE INSTALLATION OPTIONS
-  IMPROVED PERFORMANCE IN SHADED CONDITIONS
-  GUARANTEED HIGH POWER OVER LIFETIME

**330 W<sub>P</sub>** POWER

**12** YEAR PRODUCT WARRANTY

**0.5%** ANNUAL DEGRADATION OVER 25-YEAR POWER WARRANTY

- REC entered into a new era with its N-Peak Series, a solar panel with **n-type mono half-cut cells** and a **twin design** – the **1<sup>st</sup> of its kind**
- Successfully launched at Intersolar Europe in June 2018
- Most powerful 60-cell product ever by REC with power output of up to **330 watt peak**
- Unique combination of value adding features
  - Mono n-type: the most efficient crystalline silicon technology
  - No Light Induced Degradation
  - Super-strong frame design up to 7000 Pa snow load
  - Flexible installation options
  - Improved performance in shaded conditions
  - Long-term high power for lasting performance
- Industry leading 25-year power warranty, with 0.5% degradation per year; 12-year product warranty
- Manufactured in REC's brand-new 'Industry 4.0' cell building at REC's Singapore plant
- Distinct energy yield advantage over competitive p-mono products, shown by initial field test carried out by SERIS<sup>1</sup>

<sup>1</sup> SERIS = Solar Energy Research Institute of Singapore

# Industry-leading energy payback time achieved



- REC solar panels achieve an **energy payback time of around 1 year**, which is class-leading
- One year of energy payback time refers to the time a panel needs to generate the amount of electricity which was required to produce the panel itself
- The company's efforts throughout its entire value chain are leading the way in **sustainable panel production**
- As the most energy intensive phase of the entire production process is the silicon production, REC benefits from its **proprietary silicon process by REC Solar Norway**
- In combination with hydro as the main energy source for REC Solar Norway operations, this leads to **one of the lowest carbon footprints in the industry**
- More insights available in REC's recent published [whitepapers](#)

Location	Annual GHI (kWh/m <sup>2</sup> )	Yield/Year (kWh/kWp)	EPBT <sup>1</sup> (years)
Munich, Germany	1,183	1,182	1.7
Barcelona, Spain	1,635	1,651	1.2
Phoenix, Arizona, U.S.	2,093	1,319	1.0
New Delhi, India	1,973	1,939	1.1
Tuas, Singapore	1,623	1,804	1.5
Perth, Australia	1,938	1,830	1.1

<sup>1</sup> EPBT = Energy Payback Time; Data based on an 290Wp solar module and calculated using PVsyst simulation software

# REC Group again Top Performer in PV Module Reliability Scorecard by DNV GL

- REC has been named a **Top Performer by DNV GL** in its PV Scorecard – for **3<sup>rd</sup> year in a row**
- This rating acknowledges REC's continuous efforts and ambition to **deliver highest quality to its customers**
- REC demonstrates an **industry leading low claims rate** of far below 100 parts per million (ppm), an outstanding results if one considers that in 2017, REC Group manufactured 4.3 million solar panels in its integrated and automated production plant in Singapore
- REC earned Top Performer status for its award-winning TwinPeak 2 panels in all test categories:
  - **Potential induced degradation (PID) tests** (power output losses caused by voltage, heat and humidity)
  - **Thermal cycling tests** (resilience to fluctuations in temperature)
  - **Damp heat tests** (use high temperature and high humidity to evaluate panel construction)
  - **Dynamic mechanical load tests** (load effect of snow and wind to measure a panel's resilience to degradation)



# REC breaks ground for one of Singapore's largest rooftop solar installations at its own Tuas plant



- REC held a ground-breaking and contract-signing ceremony for **one of Singapore's largest-ever rooftop solar installations**
- The new installation, located on the rooftops of REC's integrated factory in Tuas
  - Built in collaboration with Singapore-based power company [PacificLight Energy](#); to be operational by August 2018
  - Will generate around 2.6 million kWh annually = enough to power 550 HDB four-room apartments
  - Will **save 1,400 tons of CO<sub>2</sub> emissions** every year = equivalent of planting 64,000 trees or taking almost 300 cars off the road
  - Further reduces already low carbon footprint of REC solar panels
- As guest of honor, REC welcomed Singapore's Senior Minister of State for the Environment and Water Resources, Dr Amy Khor
- By installing solar on its own roof, REC shows its support to **Singapore's Year of Climate Action**





# Roll out and expansion of REC's Channel Programs in APAC



## REC Partner Program

- REC added **seven new partners in APAC** to the REC Partner Program in Q2 2018
  - New Partners are in Australia, Taiwan, Japan, New Zealand, Thailand and Indonesia
- REC Partner Program builds and maintains alliances with distributors by offering partners a range of technical and marketing services, tools and benefits to grow business profitably with REC products
- Launched in 2011, the REC Global Partner Program now numbers 45 Platinum Partners and Authorized Distributors worldwide



## REC Solar Professional Program

- REC organized together with its partners 12 certification trainings in APAC H1 2018
- **237 new installers in APAC** are now REC Solar Professionals (Australia, India, Taiwan)
- To date, the REC Solar Professional Program comprises over **1,500 certified installers globally with 500+ in APAC**
- The Program gives installers unique training and skill-building to ensure global best practice in system installation
- Certified REC Solar Professionals benefit from an extended product warranty of additional 2 years and a range of sales and marketing tools





573 kW, Dubai, UAE

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# REC Operations

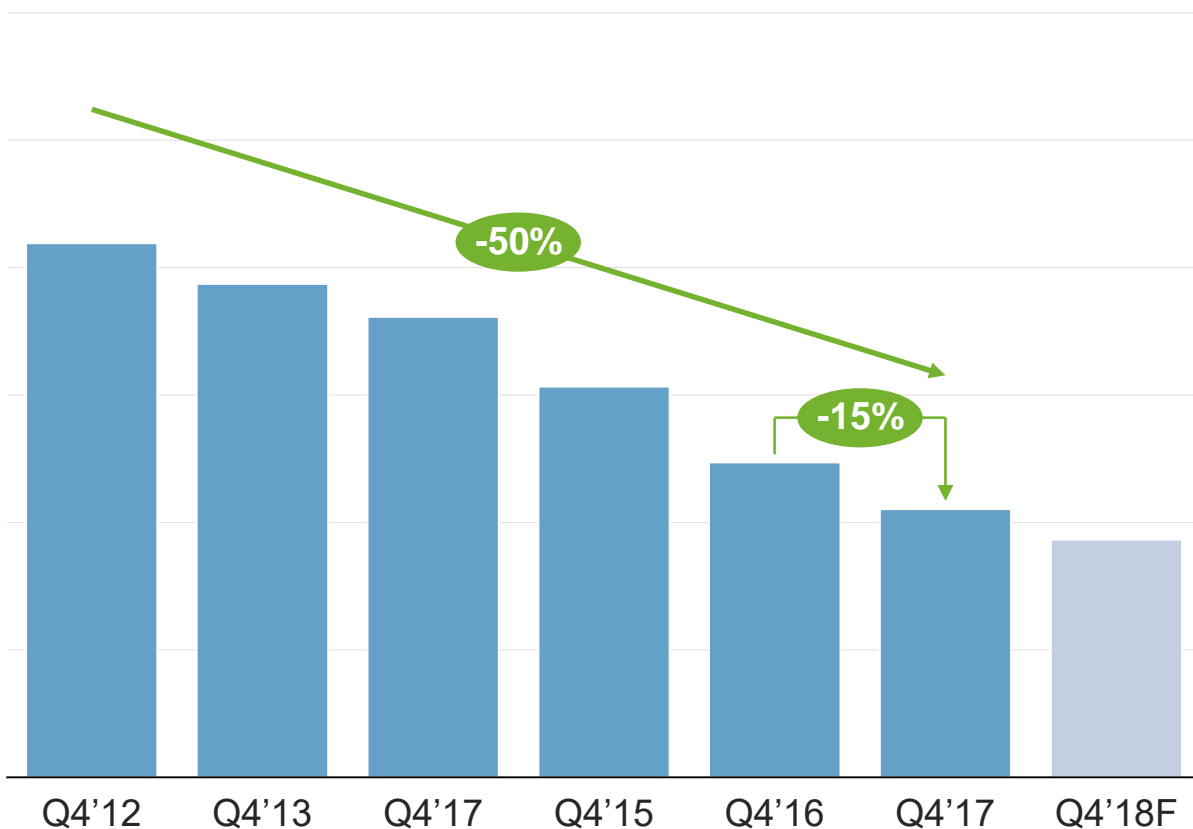
## Performance highlights



# REC achieved 50% cost reduction from 2012 to 2017



Total Cost<sup>1</sup> Development – Actual and Projection from 2012 to 2018



- REC was highly successful in reducing its total cost per watt over the last six years – achieving a 50% cost decline
- While most peers struggled to bring down cost during 2017 due to higher input prices especially in H2 2017 (i.e. polysilicon), REC managed a cost reduction of ~15%, thanks to its continuous efforts to invest in new technology and achieving efficiency gains

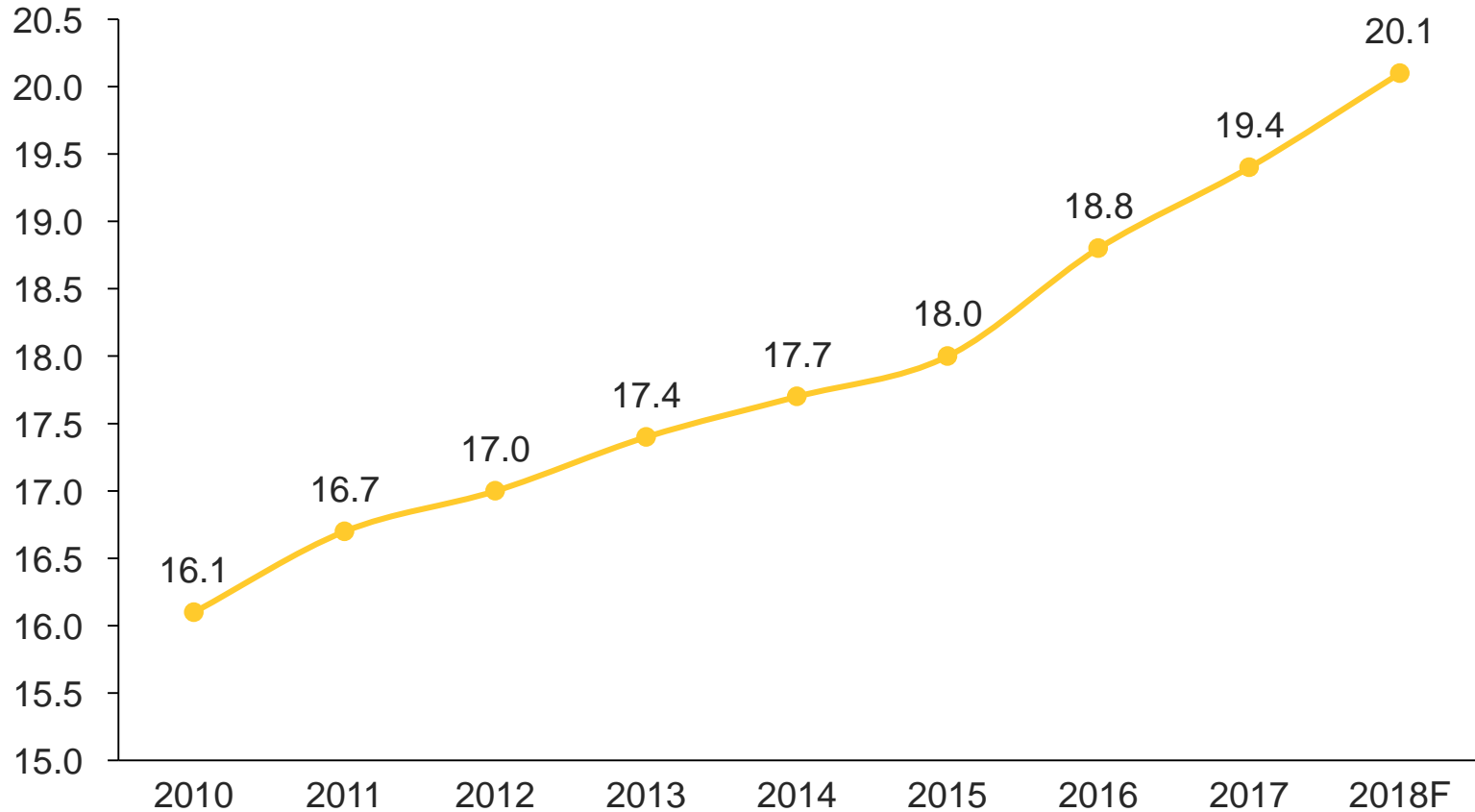
<sup>1</sup> Total Cost including silicon + raw material, wafer, cell module cost

# Thanks to its technology focus, REC enjoys continuous improvement in cell efficiency

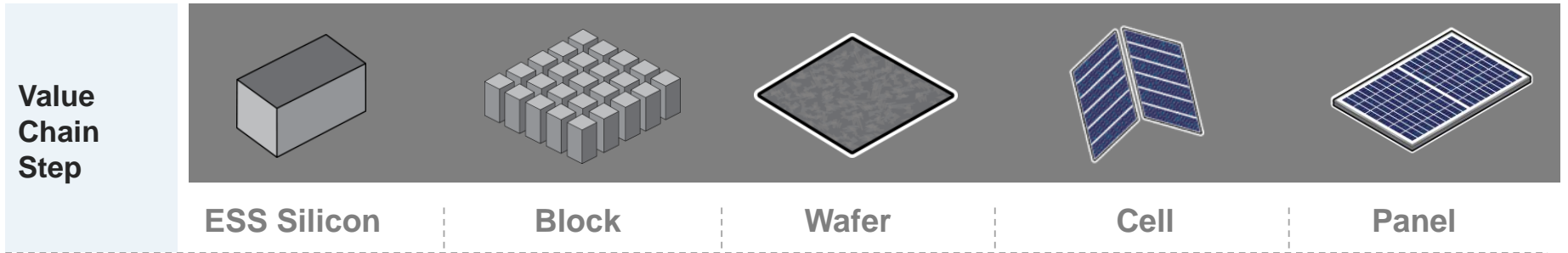


**REC Average Cell Efficiency Trend**

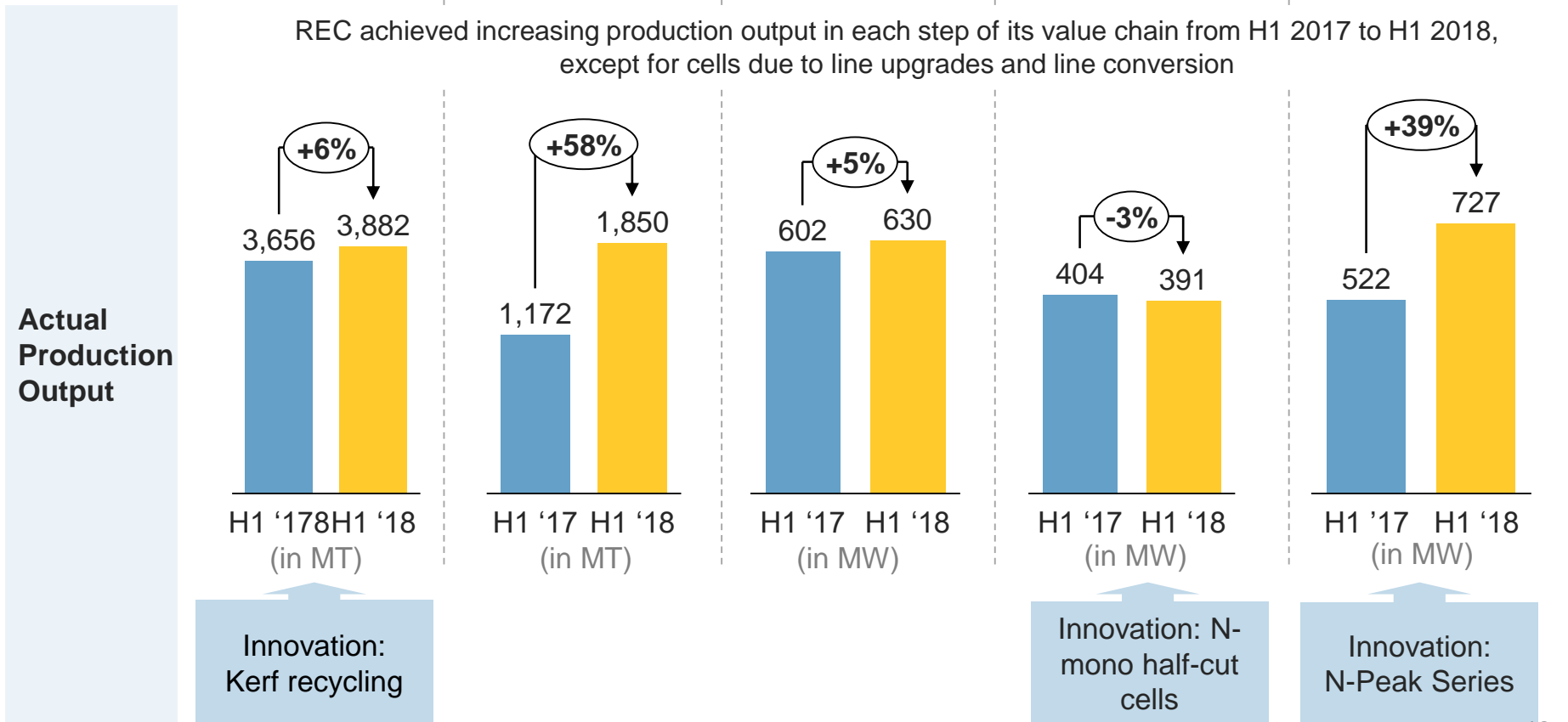
Cell Efficiency  
(average, in %)

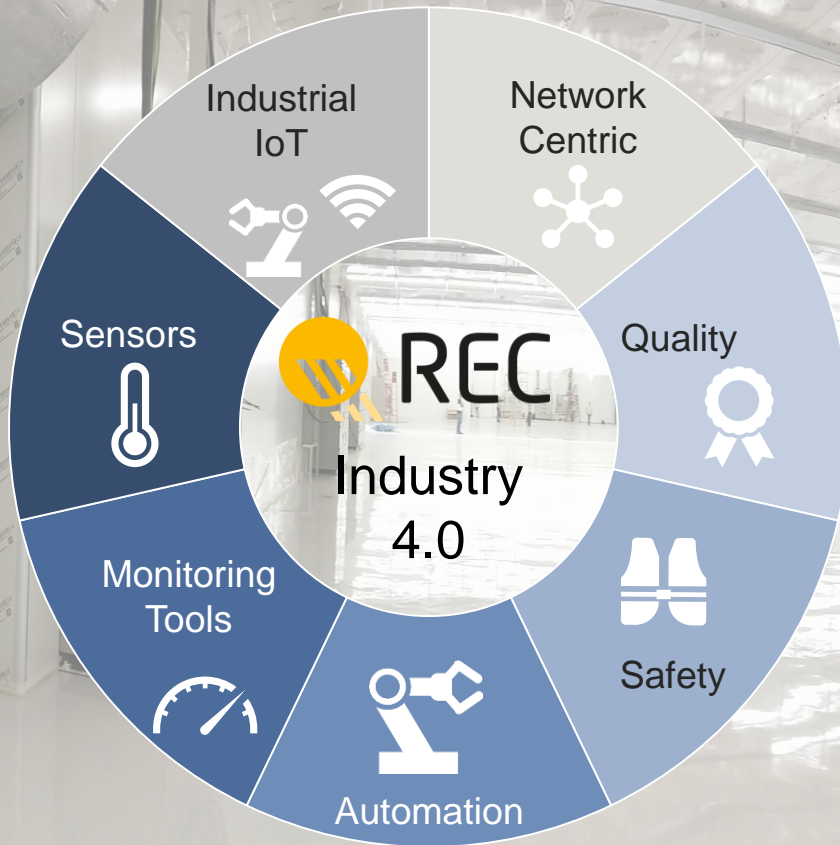


# REC innovates along the value chain while pushing its production output to new records



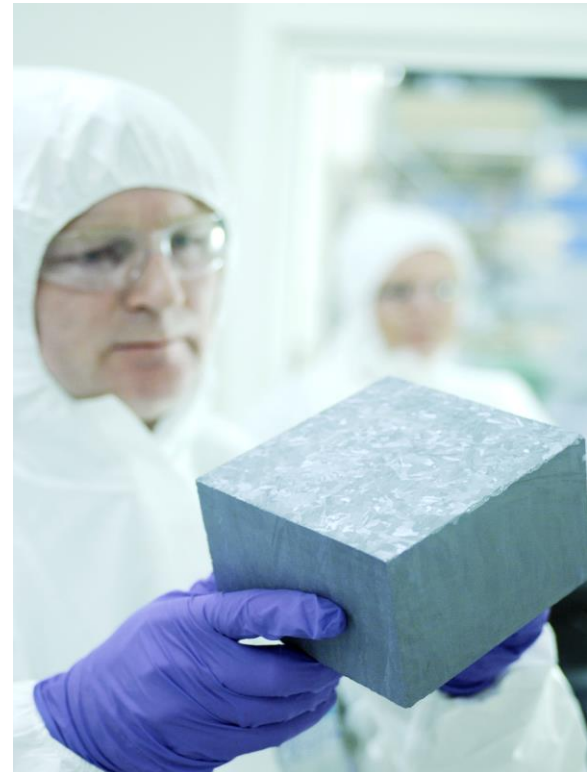
REC achieved increasing production output in each step of its value chain from H1 2017 to H1 2018, except for cells due to line upgrades and line conversion





- For its brand-new flagship product, N-Peak, REC Group built a **new 'Industry 4.0' cell building** at its integrated production plant in Singapore
- This expansion adds the 'Internet of Things' idea to REC's already highly automated production
- In this so called 'Cyber-physical System', machines communicate and cooperate with each other and with humans in real time across the full value chain
- By using advanced sensors, software and data, machines are moving around along dedicated paths and fulfilling tasks stand-alone, resulting in efficiency improvements, economic benefits, and reduced human exertions

- With the planned implementation of REC's inimitable "**Silicone Kerf Recycling**" process, the already low carbon footprint of REC's silicon and solar panels will even further improve
- For the very first time, REC was able to upgrade fines from the wafer process to solar grade silicon in a test phase – this is not only recycling but **true upcycling**
- **REC is the only solar company who has demonstrated the capability to upcycle silicon** fines into high-quality solar grade silicon
- In Q1 2018, REC Solar Norway has successfully finalized the concept study, and received grant approval from Enova for next steps to demonstrate feasibility of mass production





15.53 MW, Kaua'i, USA

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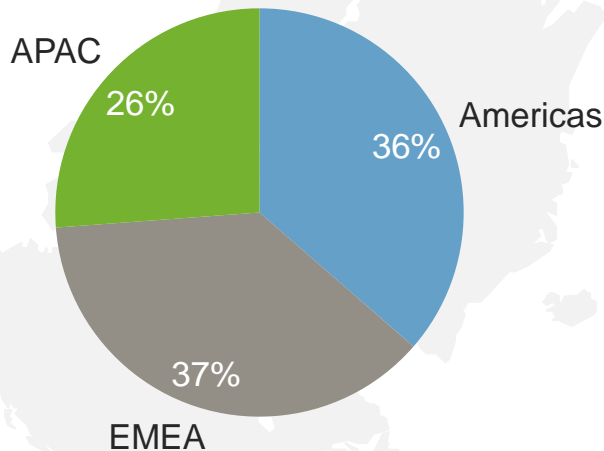
## Global Performance – H1 2018



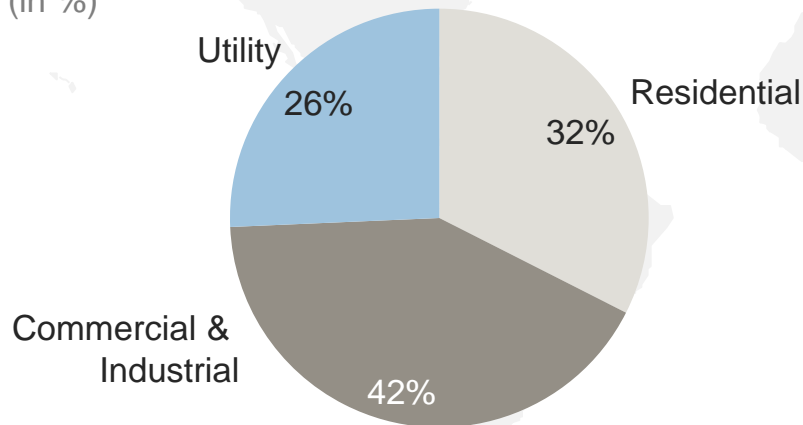


# REC's H1 2018 shipments were balanced segments with Americas and EMEA as strongest regions

**H1 2018 Module Shipments by Region**  
(in MW)



**H1 2018 Module Shipments by Segment**  
(in %)



- **Balanced** shipments among all **key segments**
- **Americas** and **EMEA** **equally** account for the **largest portion** of REC shipments
- **Americas**
  - Shipments increased by 23% y-o-y and customer base grew by 83% y-o-y
  - REC ranks amongst the **Top 5 most popular panel brands** for **residential** installations in the **entire U.S.** in Q1 2018<sup>2</sup>
- **EMEA:**
  - Top 5 markets were Germany, France, the Netherlands, Turkey and Belgium
  - REC enjoyed strong growth rates from H1 2017 to H1 2018 in **France with +183%**, having achieved **CRE3 and CRE4 methodology certification** for its TwinPeak products as well as in **Belgium (+115%)** strengthening its brand position
- **APAC**
  - Top markets were India, Japan, Australia, Thailand and Singapore
  - Strong demand for REC products in rooftop applications, esp. C&I, a key segment of REC

<sup>1</sup> REC market segment module shipment volume splits are best estimates; <sup>2</sup> Based on Q1 2018 data by GTM, published June 2018

Source: REC; GTM Research US PV Leaderboard Q2 2018, IHS Markit



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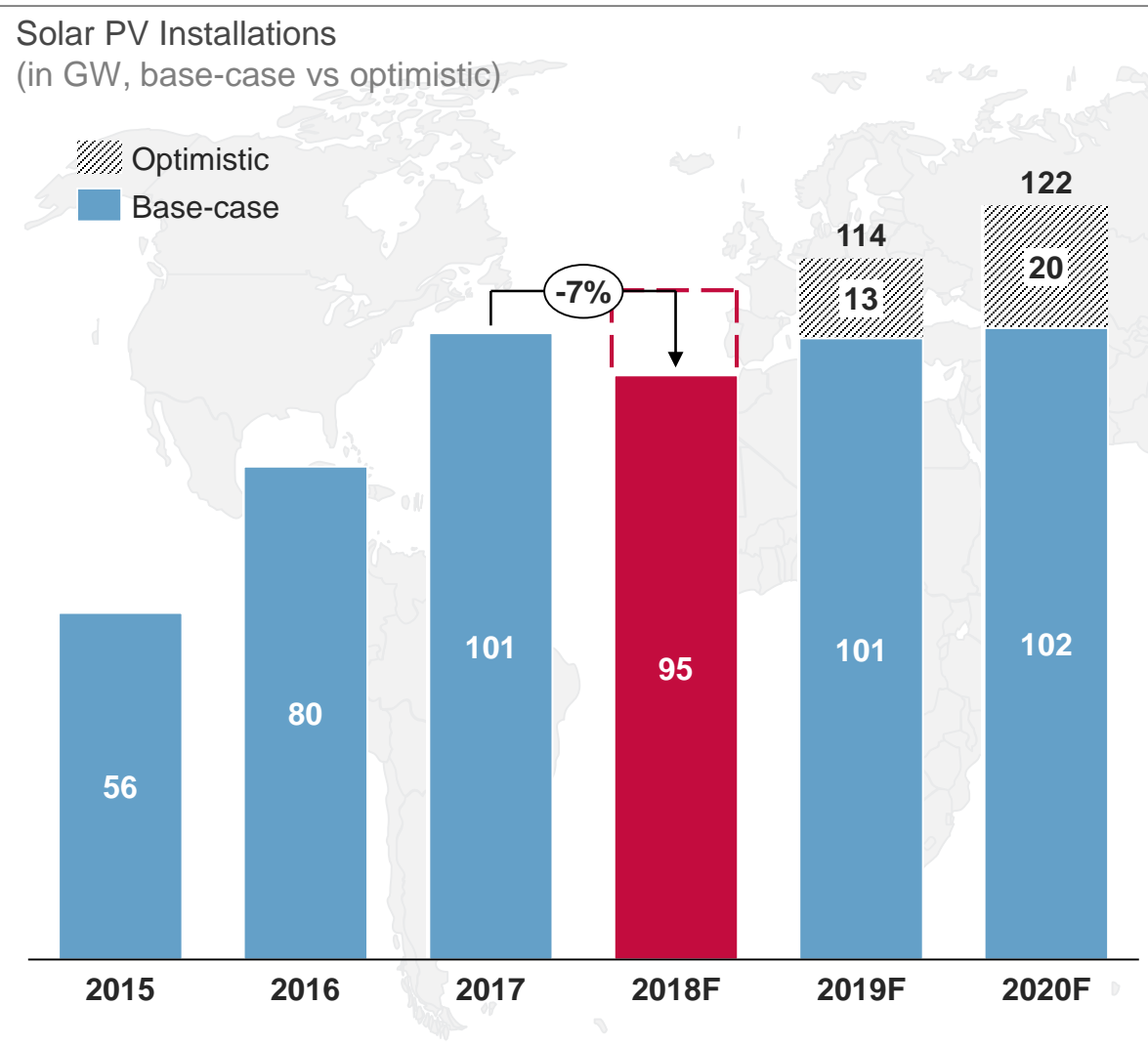
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2.2 MW, Singapore

# REC Global Outlook 2018



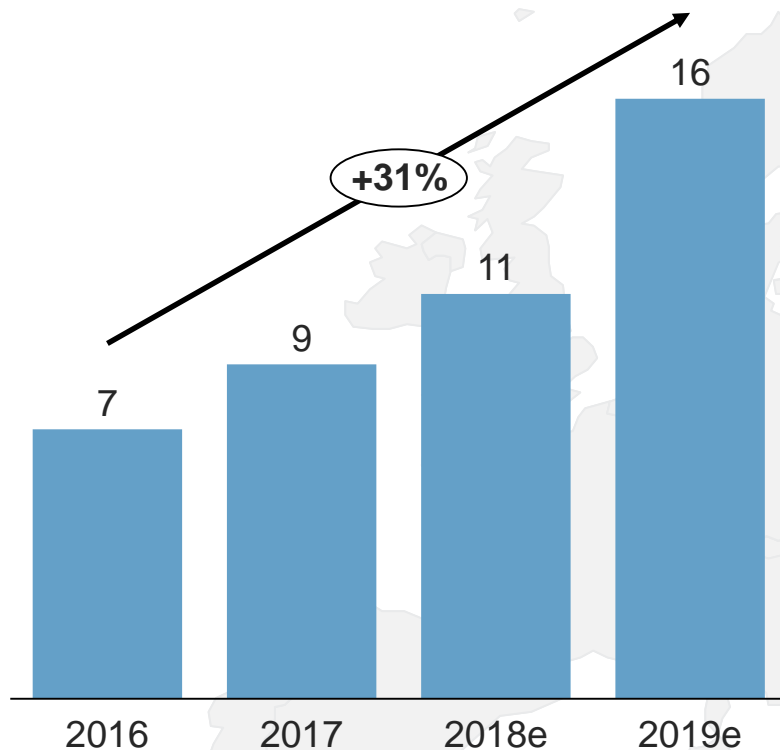
# Expected reduced Chinese PV demand in 2018 could cut global installations to ~95GW



- The **Chinese policy change** has **turned** an expected global PV market **growth** of 8-10% in 2018 **into a demand drop of 7%** (in total -14 GW)
- But the overall market outlook is still bright: **more than 30 countries are expected to grow** in 2018, with China tending for a surprise
- The global PV market will benefit from **increasing demand diversification** – more **markets** to achieve **1+ GW installation** mark, hence **increasing** the overall PV market **resilience** against individual market changes
- Rather than being active in China, REC's core markets are expected to grow
- In the mid- and long-term, **solid fundamentals for solar PV will continue to improve worldwide**
- Global benchmark **levelized cost of electricity for PV** has fallen 19% to **\$70/MWh**, from \$86/MWh in H1 2017

# The European PV market returned to growth with auctions and self-consumption being strong facilitators

Europe PV Installations  
(In GW, 2016-2019e)

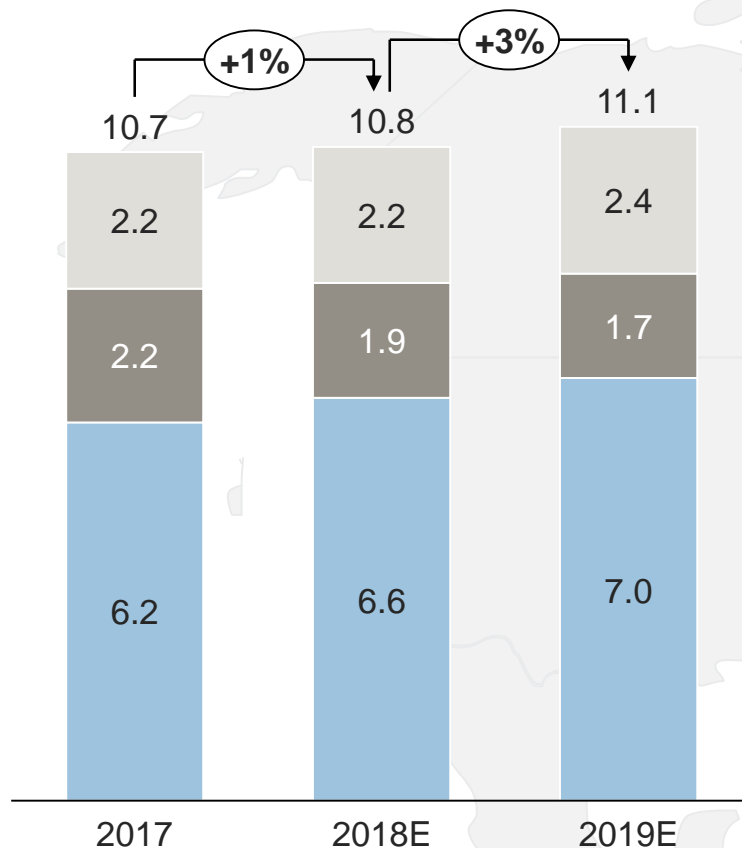


- European PV demand continues its recovery path
- Revised **RE target of 32%** (increased from 27%) by 2030, requires roughly almost a doubling of the annual 2017 installations
- The “**Top Six**” markets will grow at **42% CAGR** from 2017 to 2019 (Germany, France, Netherlands, Italy, Turkey, Spain); with the Netherlands set to become a 1 GW+ market
- **Former heavyweights** are expected to make their comeback
- European **demand picture** is set to **increasingly diversify**
- Rooftop PV<sup>1</sup> is **growing by ~22%** from 2017 to 2019
- Due to expected ongoing **PV cost decline**, there is the potential for a growing number of **LCOE driven large-scale projects**

# Despite Section 201 trade case, the U.S. PV market demand for 2018 is expected to remain rather flat

Annual U.S. PV Installed Capacity and Forecasts 2017 - 2019E, (GW)

Residential Non-Residential Utility

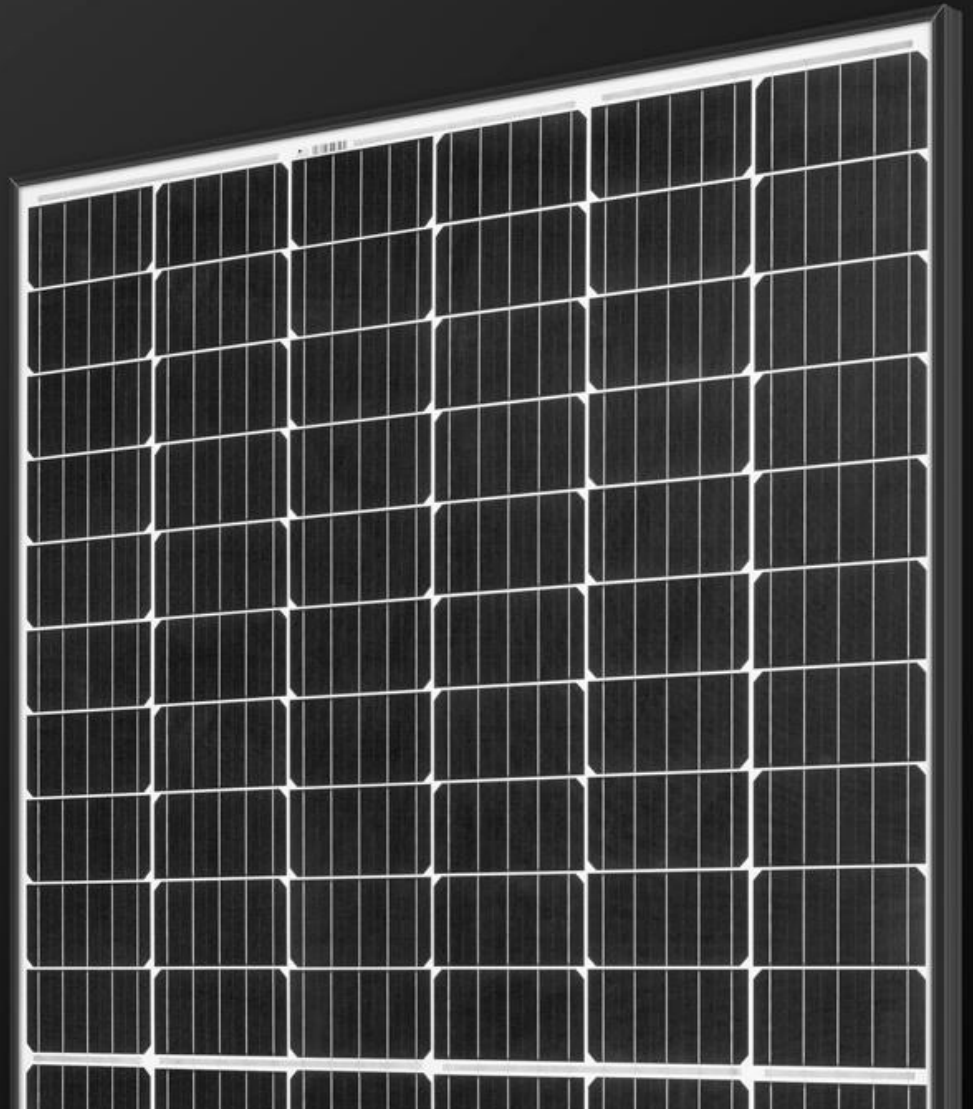


- After a muted H1 2018, shipments are expected to pick up around end of Q3 2018 as tariff-free inventory will be cleared
- Current total market estimates at ~10-11 GW for 2018, forecasting:
  - Relatively stable residential market
  - Non-residential faces some headwinds due to policy changes, yet enjoys community solar growth
  - Robust performance of utility segment
- REC **won several** large U.S. deals in the last weeks of H1 2018 for its multi-award-winning TwinPeak 2 solar panels, reinforcing its position as one of the **U.S.'s top five panel brands for residential installations**
- REC **signed its 1<sup>st</sup> N-Peak deal** – just days after the U.S. unveiling with a long-standing distribution partner

**Brand-new REC N-Peak Series**

**Thank you!**

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