

## BP TECHNOLOGY OUTLOOK

# Focus on Solar

May 2019

BP's Technology Futures team collaborated with external industry experts

LuxResearch  
Bloomberg NEF  
Curation  
RBS  
Deutsche Bank

start-up

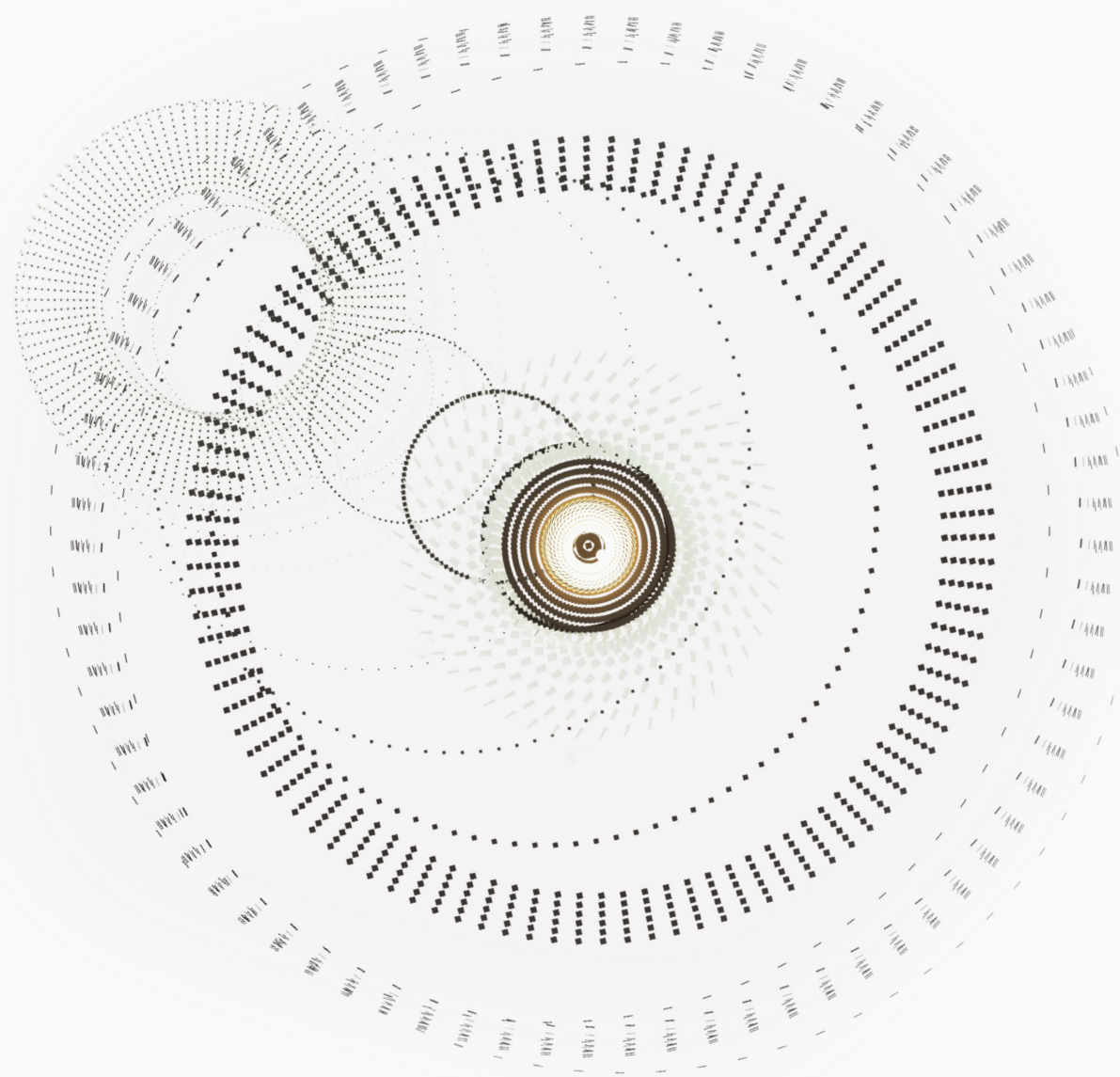
Oxford PV

and key BP groups including

LightsourceBP

to review and analyse key emerging technologies and trends within the solar photovoltaics area.

Below are some of our insights and observations:



## 01

Solar PV sector is the fastest growing power generation technology and is on track to meet or exceed the IEA Sustainable Development Scenario target

- Cumulative global installed solar photovoltaics (PV) capacity grew from 6.1 GW at the end of 2006 to 486 GW by the end of 2018; more than ~100 additional GW was installed in 2018 alone and \$131bn annual investment.
- If current growth rate (~10% pa) is maintained, the solar PV sector would meet the IEA Sustainable Development Scenario target for 2040.
- Key drivers for developing countries are likely to be energy security and reduced cost, rather than reduction in GHG emissions.

## 02

Strong innovation pipeline (>50 technologies) enables cost reductions across the whole solar PV supply chain

- Bifacial modules and single-axis trackers can significantly increase energy output for little additional cost.
- Smart inverters will enable solar plants to provide ancillary grid services and reduce integration costs.
- Digital tools will enable cost benefits in operation and maintenance.
- Among 'beyond silicon' technologies, perovskites are currently showing the greatest potential with impressive efficiency gains in the last 5 years.

## 03

Solar PV sector continues to dominate, with further significant cost reductions expected by 2025

- With 95% market share today, silicon PV technologies will continue to dominate the sector.
- Advances in materials and cell/module design will see silicon PV pushing close to theoretical efficiency limits (expected to reach at least 25% efficiency by 2030, from today's industry average of 17%).
- 'Beyond silicon' technologies will likely have a hard time keeping up with this rapid pace of improvement.

## 04

Solar PV sector can grow for decades before intermittency challenges would become material

- Intermittency challenges are not expected to be material until solar PV reaches ~30% adoption (currently solar PV is ~2%).
- It is likely that solar PV intermittency will be largely addressed through a combination of storage, demand side management, digital tools and back-up baseload generation capacity.

## 05

The levelised cost of energy (LCOE) for solar PV will be competitive against traditional generating technologies across most regions by early 2020s

- Between 2009 and 2017 the benchmark LCOE for solar PV fell from \$304/MWh to just \$70/MWh.
- Record low auction prices, below \$30/MWh, have been announced for solar PV for projects in Dubai, Mexico, Peru, Chile, Abu Dhabi and Saudi Arabia.

## 06

Lower costs of renewable energy start to unlock other synergistic energy applications

- Solar PV plus storage is viewed as a potential game changer for managing the intermittent electricity generated by solar PV.
- Solar PV plus batteries is already technically and economically attractive for distributed systems as alternative to diesel generators and, at utility scale, solar plus storage is starting to compete with gas peaker plants.
- "Green hydrogen" refers to hydrogen produced via electrolysis using renewable power. In areas where co-location of wind and solar PV could provide electricity at or below \$30/MWh with ~50% capacity factor, "green hydrogen" would be price competitive with traditional industrial hydrogen production, using fossil fuels.

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### Sources

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