HOW SOLAR ENERGY BECAME CHEAP
A MODEL FOR LOW-CARBON INNOVATION

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LONG TERM COST REDUCTIONS

PV

Wind

Batteries

($2016/W)

($2016/MWh)

($2016/kWh)
PROJECT INDEPENDENCE 1ST PV LEARNING CURVE

1958 → 1974
2 x 6 CM CELLS
$7000/MWh
2" DIA CELLS
10% learning rate
20% learning rate
30% learning rate

2018
$10-20 B

Industry Accumulated Volume (MW)
POTENTIAL FOR SOLAR HAS BEEN UNDERESTIMATED

IEA Forecasts

Actual

Simon Evans, Carbon Brief
Potentially for solar has been underestimated.

Historical growth rates

50%

New IAM runs w/learning

30%

HOW DID SOLAR GET CHEAP?

**Creating Technology**
- Scientific Understanding
- Evolving R&D Foci
- Knowledge Spillovers

**Building a Market**
- Niche Markets
- Modular Scale
- Robust Policy Support

**Making it Cheap**
- Learning by Doing
- Iterative Upscaling
- Delayed System Integration
## HOW TO ACCELERATE LOW-CARBON INNOVATION

### WE NEED MULTIPLE MODELS

<table>
<thead>
<tr>
<th>Technology type</th>
<th>Innovation model</th>
<th>Low-carbon target</th>
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</thead>
<tbody>
<tr>
<td>1. High-tech, iterative, disruptive</td>
<td>Solar PV</td>
<td>Direct air capture</td>
</tr>
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<td>2. Low-tech, small, distributed</td>
<td>Green revolution</td>
<td>Soils</td>
</tr>
<tr>
<td>3. Large, system integration intensive</td>
<td>Chemical plants</td>
<td>BECCS</td>
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<tr>
<td>4. General purpose</td>
<td>Micro-processors</td>
<td>Artificial intelligence</td>
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