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Rooftop Solar Development Market Growth Fundamentals

USAID - ICED II

Jakarta, August 31st 2018

Outline

1. **Market drivers**
2. **Market evolution**
3. **LCoE impact**
4. **Technical impact**

1. Market Drivers. Precedents.

Political

- Energy security
- Utility & market transformation
- Subsidies cost evaluation
- Environmental awareness

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Financial

- Lifting of subsidies
- Real cost fossil energy
- Environmental costs
- Investment constrains
- Partial transfer of old subsidies to RE incentives

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Incentives

- FiT’s
- RPO’s
- Regulatory easing

1. Market Drivers. Precedents. Political.

- Most of developed countries:
  - Consecutive and unprecedent instability in the international energy markets during 70's and 80's. These market instabilities continues today.
  - Energy is fully cross-subsidized (direct & indirect subsidies), with little to no overall cost aggregation.
  - There is no awareness of the collateral costs derived from environmental impact of the fossil based generation.
  - The utilities are understood as a governmental infrastructure operation, not a commercially oriented service to customers.
  - Utilities struggle financially to attend the increased and changing demand.
- The present model is no longer suited to meet the changing demand of the customers nor the country.
- The whole energy sector is subject to a detailed review and transformation process is started.

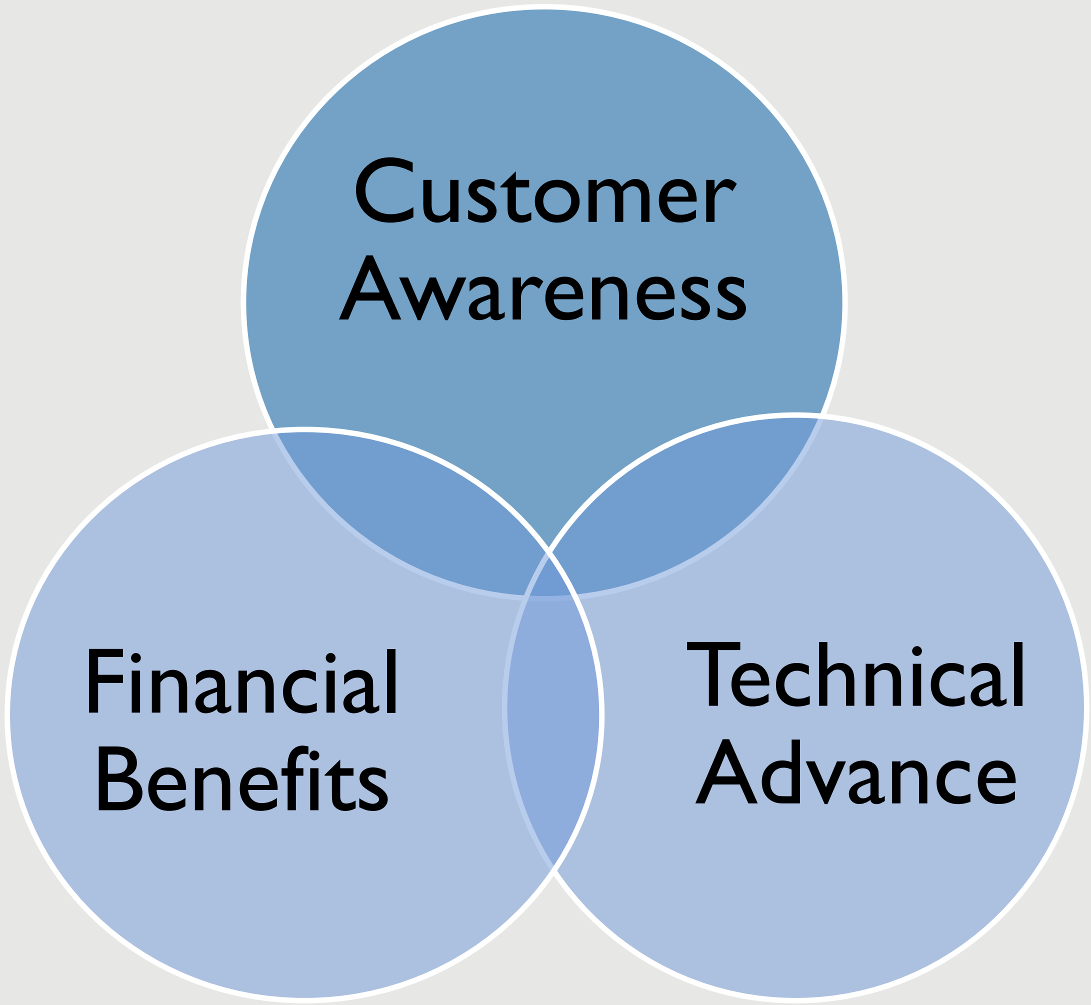
1. Market Drivers. Precedents. Financial.

- Aggregation of all cross-subsidies, hidden, collateral and indirect costs:
  - Realization of the real cost per kWh delivered for the country.
  - Accounting for the long terms costs of environmental damages.
  - Investments required to assure cost stability and energy security.
- The traditional energy model is not financially sustainable.
- Removal of subsidies and change of energy model become the only viable options.
- Renewable energies become the clear candidate:
  - No fuel costs and no environmental impact. Jobs creation.
  - Highly scalable, with flexible & quick installation.
  - Suitable for private or institutional investors. Cost diversion.
- Drawbacks, still expensive (90's and 2000's).
  - Some incentives are needed.

1. Market Drivers. Precedents. Incentives.

- To kick start the market:
  - FiT's (Feed in Tariff):
    - Full export
    - Excess export
    - FiT's are financed by a % of the national aggregated cost avoided.
  - RPO's (Renewable Purchase Obligation):
    - Utilities are required to have a certain % of his generation mix or energy mix sourced from renewable sources, mainly solar and wind.
  - Creation of the CO_2 world market.
    - Created to help those countries which could not afford FiT's.
    - Each country has allocated a certain number of CO_2 credits, which he can trade against clean kWh produced by IPP's.
  - Simplification and standardization of permitting and interconnections.

1. Market Drivers. Today.



1. Market Drivers. Today.

- Customer awareness :
  - Environmental impacts.
    - Air quality & CO_2 levels.
    - Natural preservation.
    - Health damages.
  - Social impacts.
    - Social responsibility & corporate image.
    - Quality job creation.
    - Environment improvement.
  - Energy independence.
    - Reduce dependence from utility.
    - Improve country's energy stability.
  - Financial benefits.
    - Systems cost reduction.
    - kWh savings.
    - Increase competitivity.
    - CO_2 credits & ratings.
    - Increase export capacity.
  - Technical advances.
    - Systems availability.
    - Power quality.
    - Power stability.
    - Power scalability.
    - Supply security & resilience.

1. Market Drivers. Today.

- Financial benefits.
  - Savings in kWh vs grid and/or other fuel based generation.
  - Could have full control over energy cost, supply and stability.
  - Predictable and stable cost of energy.
  - Reduced overhead.
  - Increase product or service competitivity.
  - Increase sales options.
  - Access to more export options (upcoming EU CO_2 tax ratings).
  - Net metering, specially beneficial with solar (100% energy coverage).
  - Multiple ownership options without CAPEX:
    - Private PPA's.
    - ESCO contracts.
    - Lease with BOT options.

1. Market Drivers. Today.

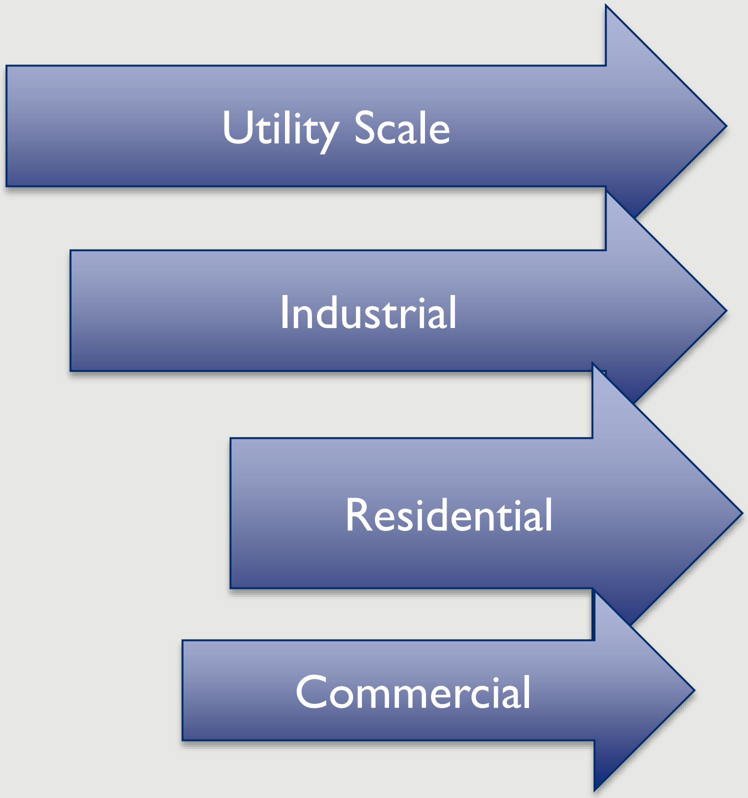
- Technical Advances:
  - Systems available in all sizes.
  - Configurations possible to match any power supply requirements.
  - Automated interoperation with almost any other form of generation.
  - Perfect power quality.
  - Scalable installation.
  - Extended lifetimes (>30 years).
  - Almost no maintenance.
  - Simple installation & ease of interconnection.
  - Remote management and monitoring.
  - Programmable automated responses to multiple power situations (VRTH)
  - Automated management of multiple integrated energy sources.

1. Market Drivers. Resume.

- Historically (1,980 – 2,000) Kickstarting policies were used, mainly:
  - FiT's (rebates for exported energy, either total or balance).
  - RPS / ROC / RPO (Utilities required to have a % of RE in energy mix).
- Presently, consumers drive the market mostly without incentives, because:
  - Energy efficiency and consumer education.
  - Environmental awareness.
  - kWh cost from distributed systems has become cheaper than grid supply for both utility and consumer.
  - Generation technology evolution in grid and power management.
  - Change of client behavior and decentralization.
- Utilities support this acceleration because:
  - Reduces operation costs and improves generation mix fuel efficiency.
  - Energy management by the grid becomes an added value service, generating profits instead of cost.
  - Reduces direct operation risks and CAPEX requirements.
  - Advanced technology based generation mix provides better quality & stability.

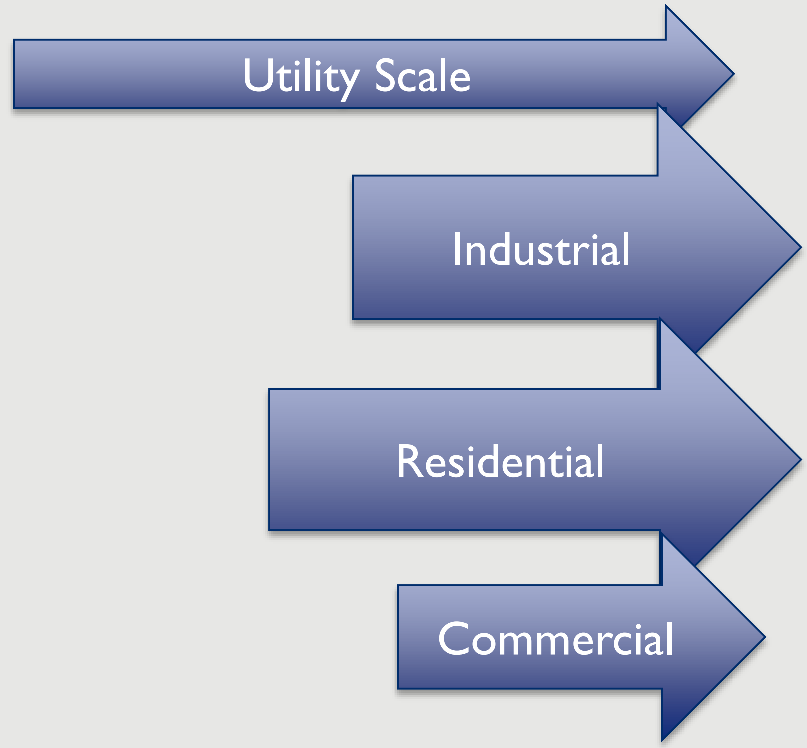
2. Market evolution. Type.

World



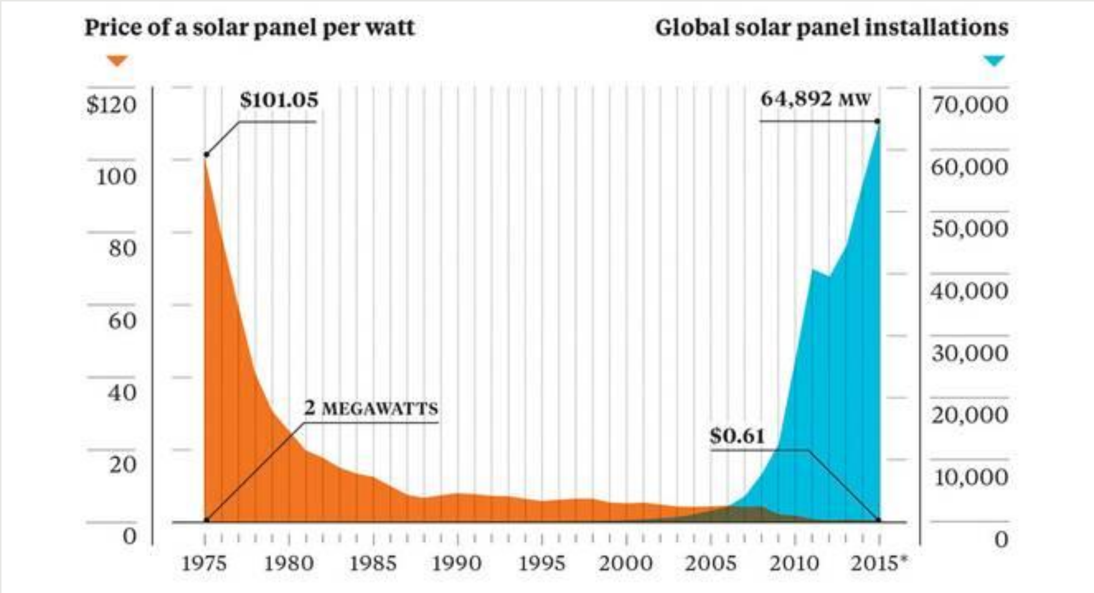
- Financial benefits.
- Corporate benefits.
- Awareness and education.

Indonesia



- Energy independence / reduced dependence.
- Technology evolution.

2. Market evolution. Cost of systems.

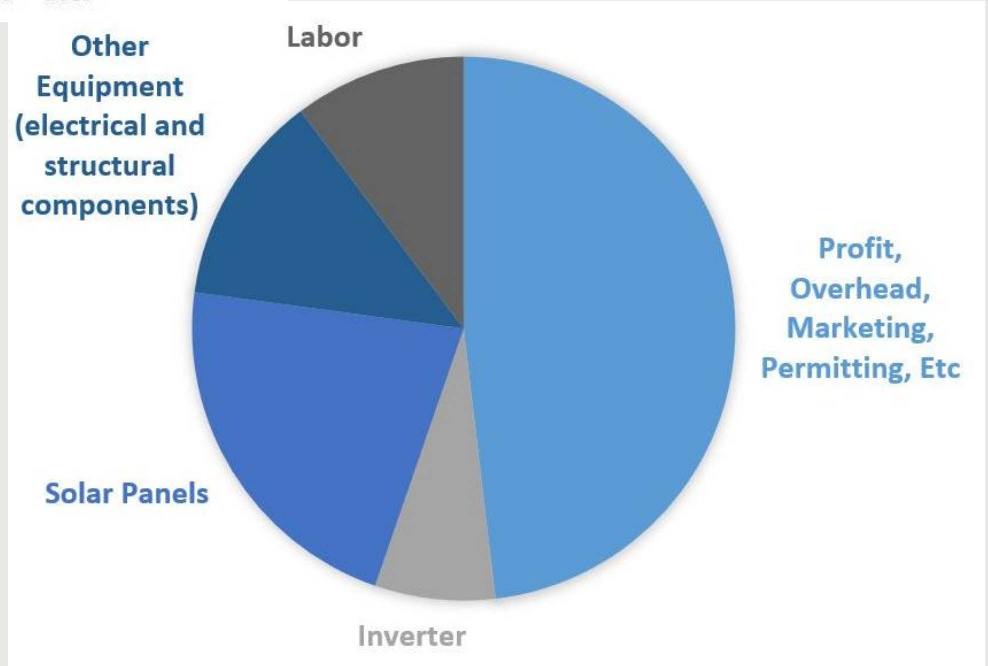


Today's biggest cost drivers are labor cost and Permitting.

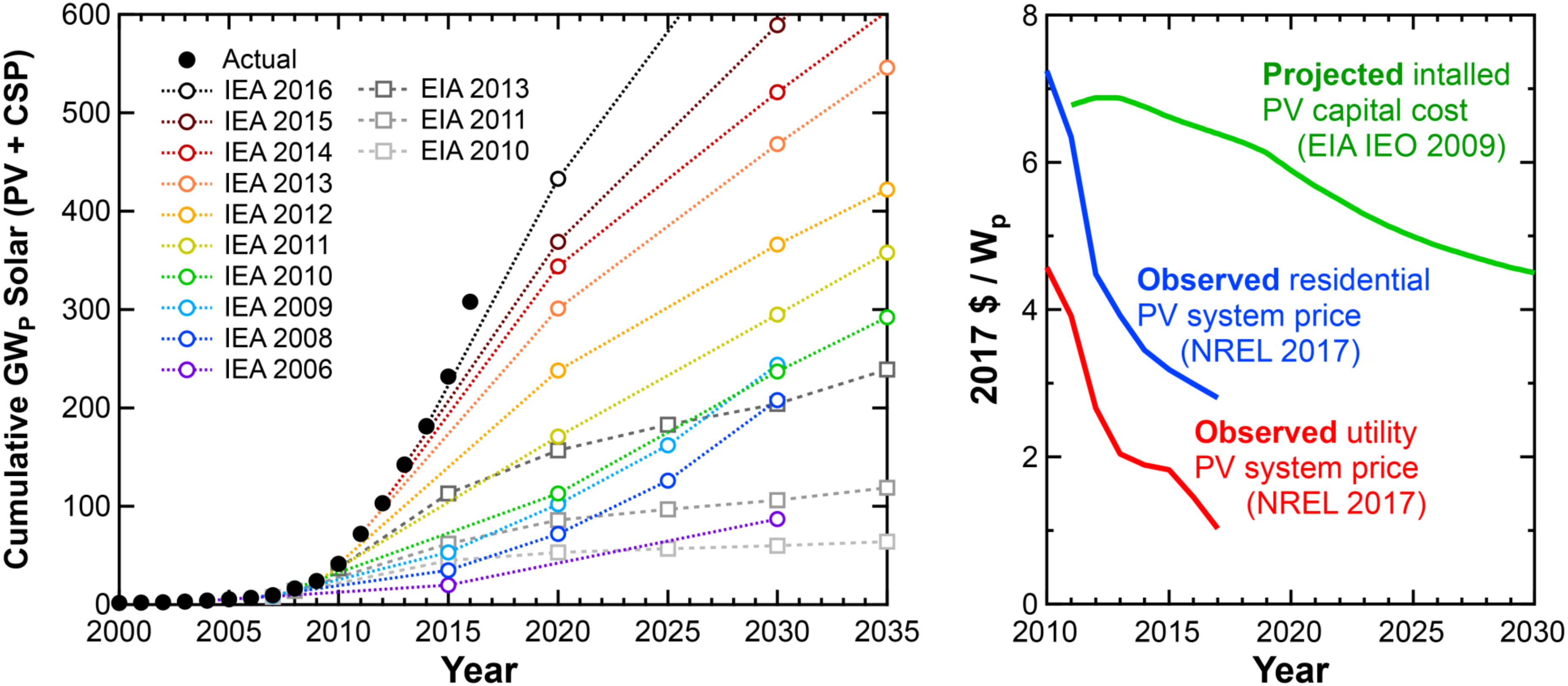
Indonesia's new regulation for residential and commercial systems shall be able to provide a relevant cost reduction by simplifying the permitting.

Combination of FiT's and commercial manufacturing readiness drove exponential growth and cost reduction.

Systems have reduced his costs by more than 85% in less tan 10 years.



2. Market evolution. Cost of systems.

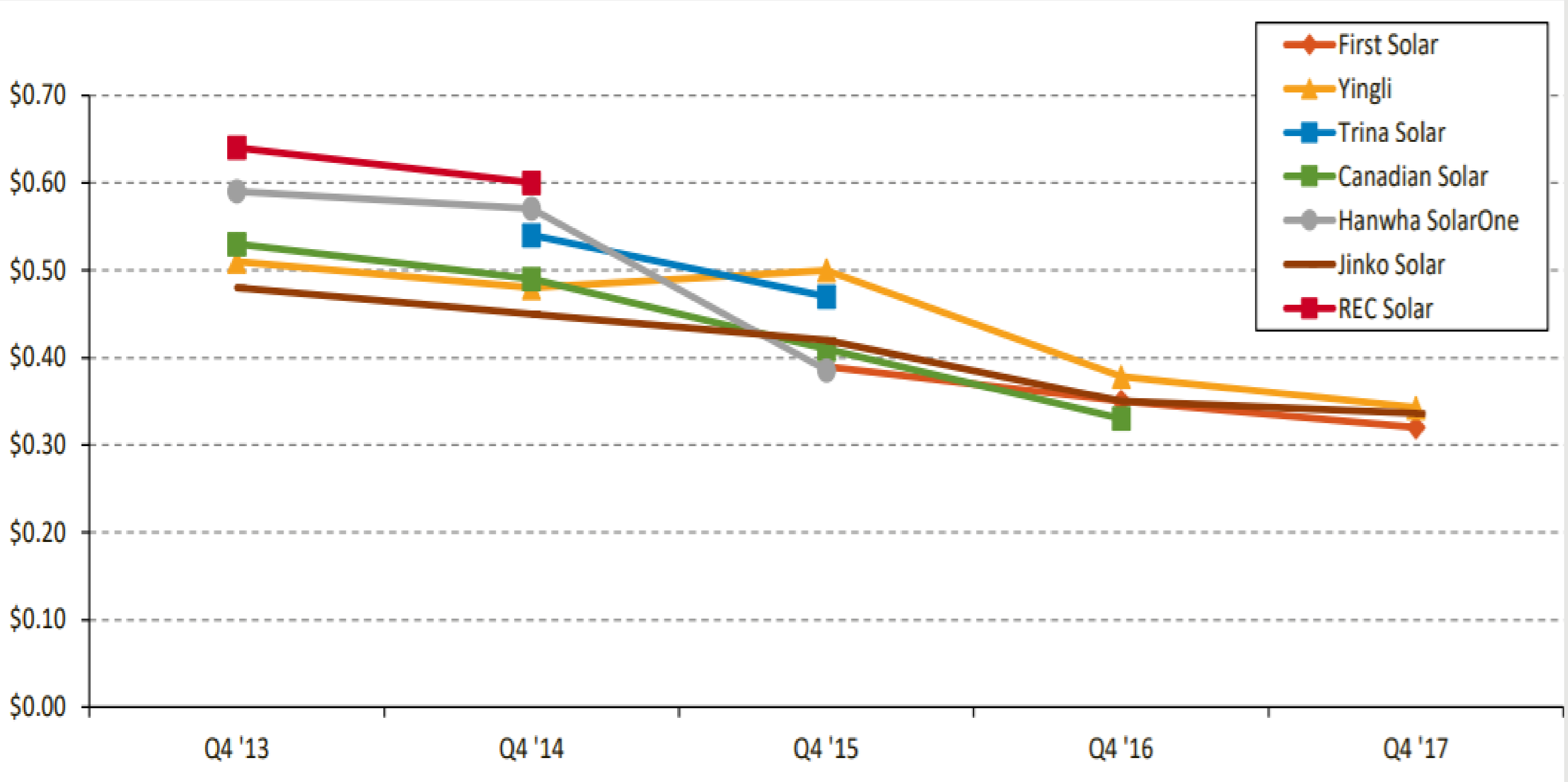


World's market, by his own organic growth and cost reduction, has proven to outpace any projections, both on volume and cost.

This cost reduction has a direct effect on the LCoE, which is how much each kWh costs to the user of the system. Today's average is below 0.05 $/kWh for Indonesia Residential.

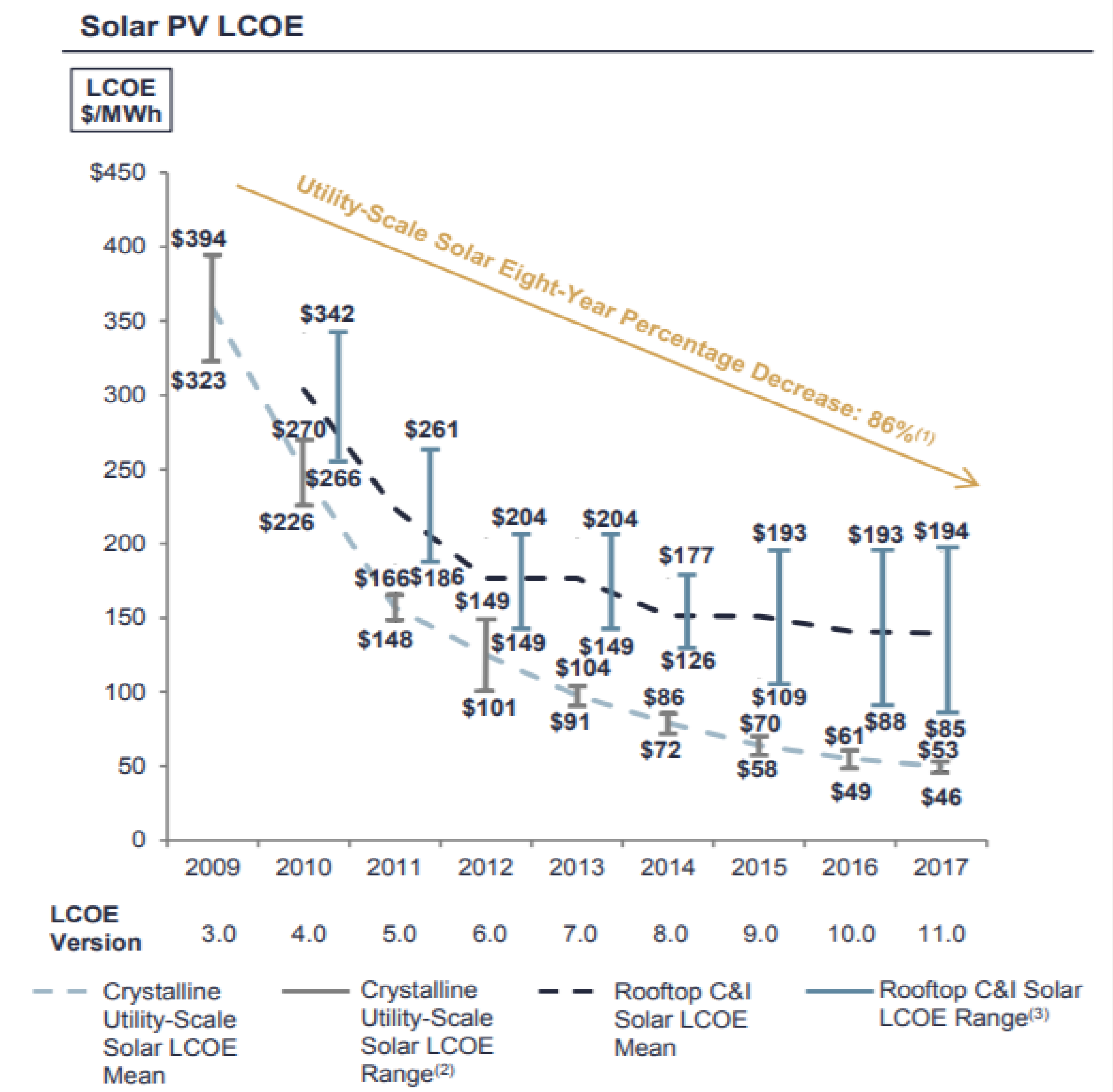
3. LCoE Impact.

Year	Cost Wp*	LCoE*	World Capacity
2010	4.39 USD	0.40	30 MWp
2017	1.38 USD	0.07	415 GWp



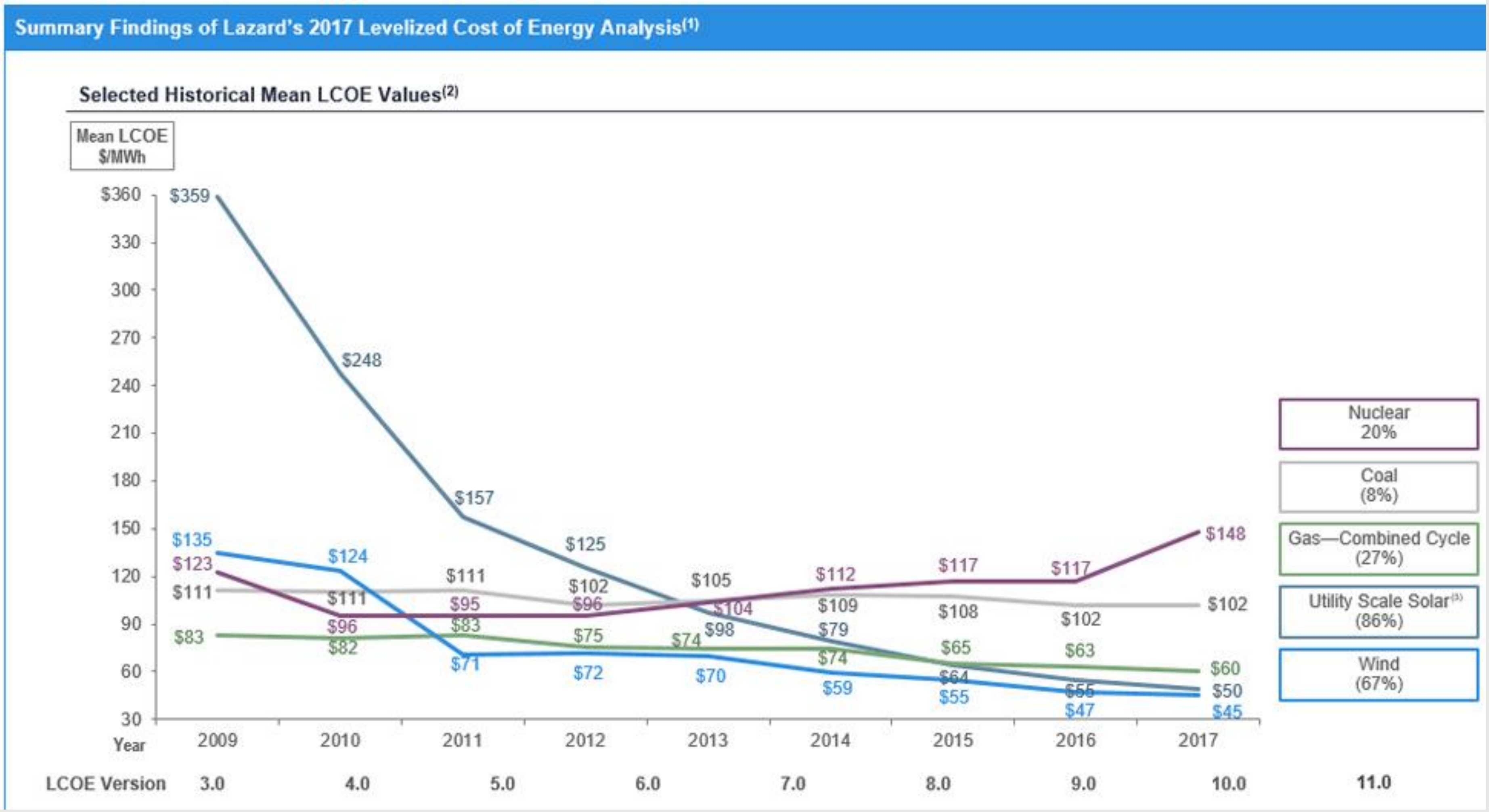
* World averages for residential and small commercial systems (< 100 kWp)

3. LCoE Impact.



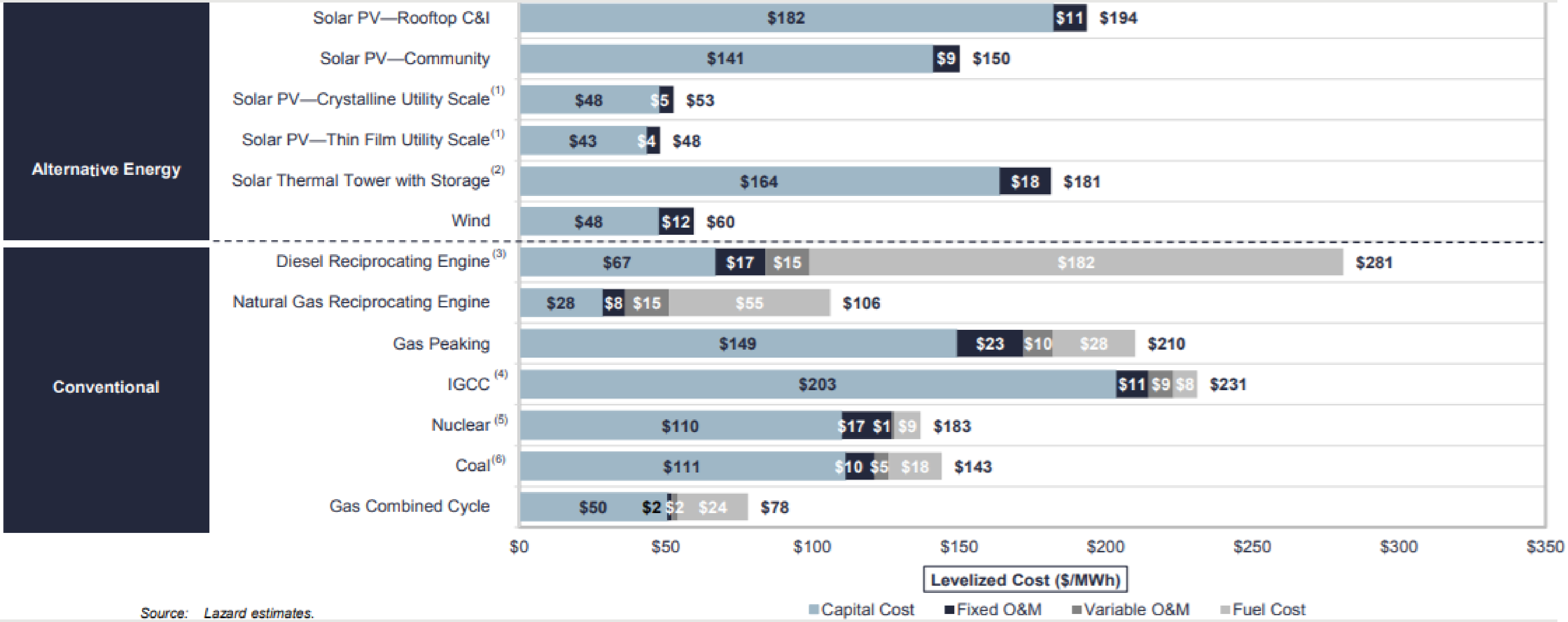
Cost systems is in a self-supported downdraft spiral, fueled by an increase in demand, which drives an increase in production capacity, which drives costs down which drive an increase in demand.

3. LCoE Impact.



Average unsubsidized LCoE by generation technology

3. LCoE Impact.



Source: Lazard estimates.

Once all subsidies are removed, even with some fuels sourced locally, is clear to see the why Solar + Wind + Gas Combined Cycle is the generation mix of choice for most countries.

4. Technical Impact.

Given the actual inverters are capable of:

- Generate reactive power.
- Compensate for frequency deviations.
- Compensate for voltage deviations.
- Restrict harmonics.
- Compensate phase imbalances.
- Provide Transient Events Ride Through capacity.
- Ramped up or down at any rate (within the availability of the resource).
- Remotely and automatically managed and programmed.

They do not create any negative impacts on any average distribution grid with adequate management, furthermore, they can provide high value ancillary services.

Grid operators must understand that distributed imbedded solar rooftops do represent an active source of load reduction, versus an increased generation capacity. This circumstance is not likely to represent any challenge, but many benefits, for the average grid, which already accounts for the liberty of the customer's load needs.

Once the participation of solar rooftops in the energy mix exceeds the 30%, distribution grids based on inflexible thermal generation without dynamic dispatching capabilities many need to reduce the fixed blocks dispatched and increase the participation of load followers.

4. Technical Impact.

Arguments about Solar rooftops:

Variability will destabilize the grid.
Overload the consumer transformers.
Grids will have to expand his capacity to accommodate more power.

Fact: Distribution of a high amount of small generators over a large geographical area reduces the weather induced variability of solar, becoming almost imperceptible for the grid.

Fact: Most of rooftops will not be big enough to create excess power, but even when excess power is generated, it is likely consumed downstream the consumer transformer by other users without solar systems, reducing the active load on consumer transformers and distribution grids.

Fact: On weak distribution grids Solar rooftops reduce technical losses and power fluctuations, adding quality to the grid power.

Fact: Solar reduces the active loads on utility's equipment and infrastructures have an extended lifespan and investments in grid capacity expansion. Saves CAPEX & OPEX.

4. Technical Impact.

Arguments about Solar rooftops:

Utility grid can't manage excess power.

Fact: This can be true in poorly managed and underperforming grids.
Solution: Activation of the 0 export option in many inverters or installation of a 0 export controller.

Fact: Most of rooftops will not be big enough to create excess power, but even when excess power is generated, it is likely consumed downstream the consumer transformer by other users without solar systems, reducing the active load on consumer transformers and distribution grids.

4. Technical Impact.

Arguments about Solar rooftops:

Utility will lose revenues.

Fact: Solar rooftops increase utility's net cash flow and/or reduce the financial losses.

Fact: When utility operations are subsidized every kWh they produce is a loss, but the kWh produced from solar rooftop is totally free for the utility.

Fact: Even when a subsidized utility gives a compensation for the kWh generated by a rooftop, that compensation is at the subsidized tariff, therefore it reduces the financial losses of the utility and the country.

Fact: Each kWh generated by solar within a subsidized utility reduces the kWh served by the utility, therefore, reducing the kWh provided by the utility reduces the losses for the utility and increases the net cash flow.

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