1 February 2017

MARKET TRENDS IN RENEWABLE ENERGY AND ENERGY ACCESS

SREP Pilot Countries Meeting

Takehiro Kawahara

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Solar	Wind	Other Renewables	Gas	Energy Smart Technologies	Advanced Transport	Carbon & RECs Markets

Americas

Europe, Middle East & Africa

Asia Pacific

TABLE OF CONTENTS

1. RENEWABLE ENERGY MARKET TREND IN EMERGING COUNTRIES

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KEY FINDINGS FROM CLIMATE SCOPE PROJECT

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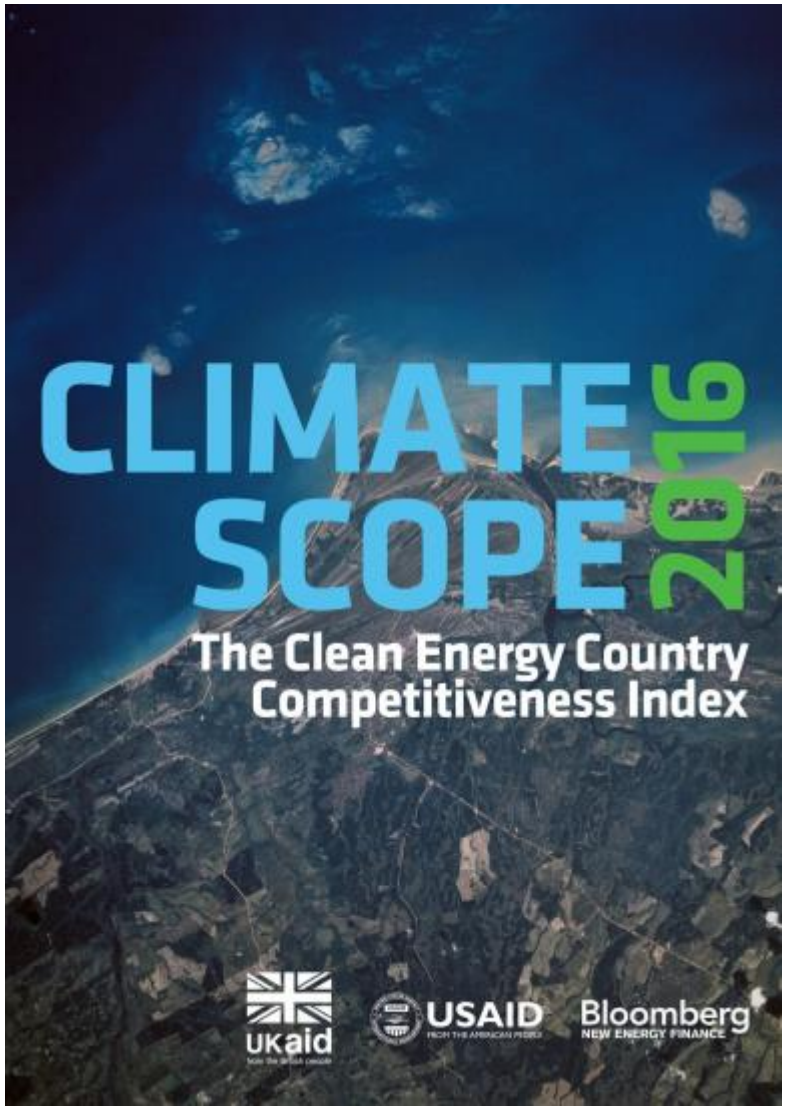
CLIMATESCOPE 2016 - OVERVIEW



FOUR PARAMETERS – Enabling framework, investment, low carbon business, GHG management

UDPATED OFF-GRID METHODOLOGY AND QUARTERLY OFF-GRID MARKET UPDATES

UDPATED WEBSITE

26 COUNTRIES IN LATIN AMERICA AND THE CARIBBEAN

19 COUNTRIES IN SUB-SAHARAN AFRICA

10 COUNTRIES IN ASIA, 6 INDIAN STATES

3 COUNTRIES IN THE MIDDELA EAST AND NORTH AFRICA

CLIMATESCOPE COUNTRY COVERAGE

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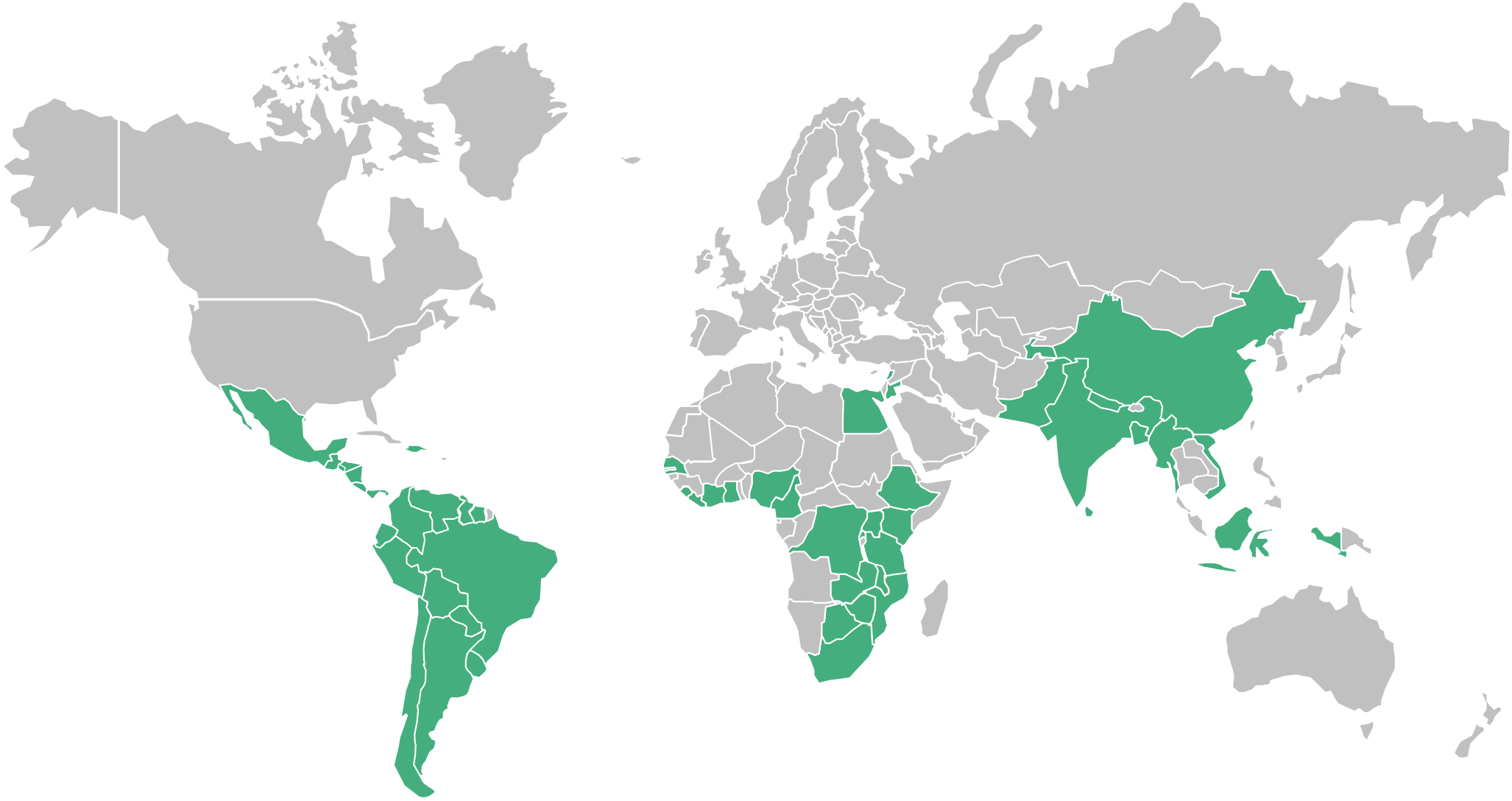
58 developing nations and 6 Indian states



ANNUAL CLEAN ENERGY CAPACITY ADDITIONS, CLIMATESCOPE VS OECD COUNTRIES (GW), 2011-2015

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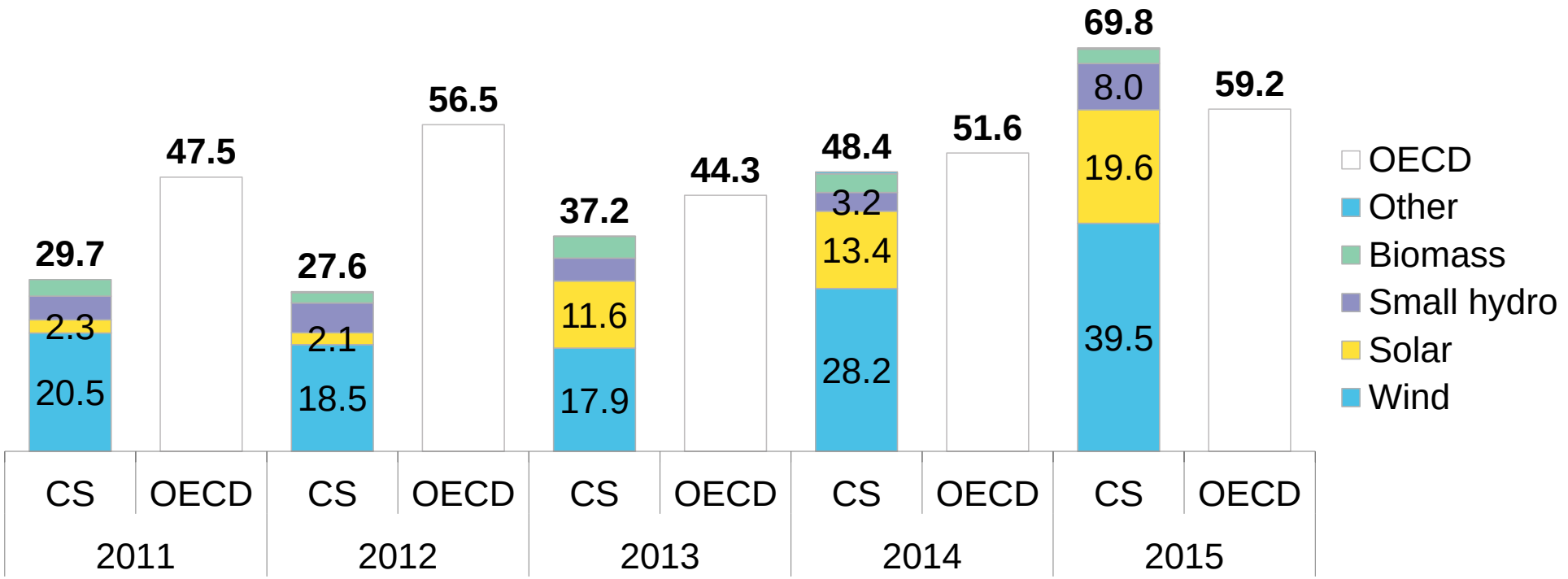
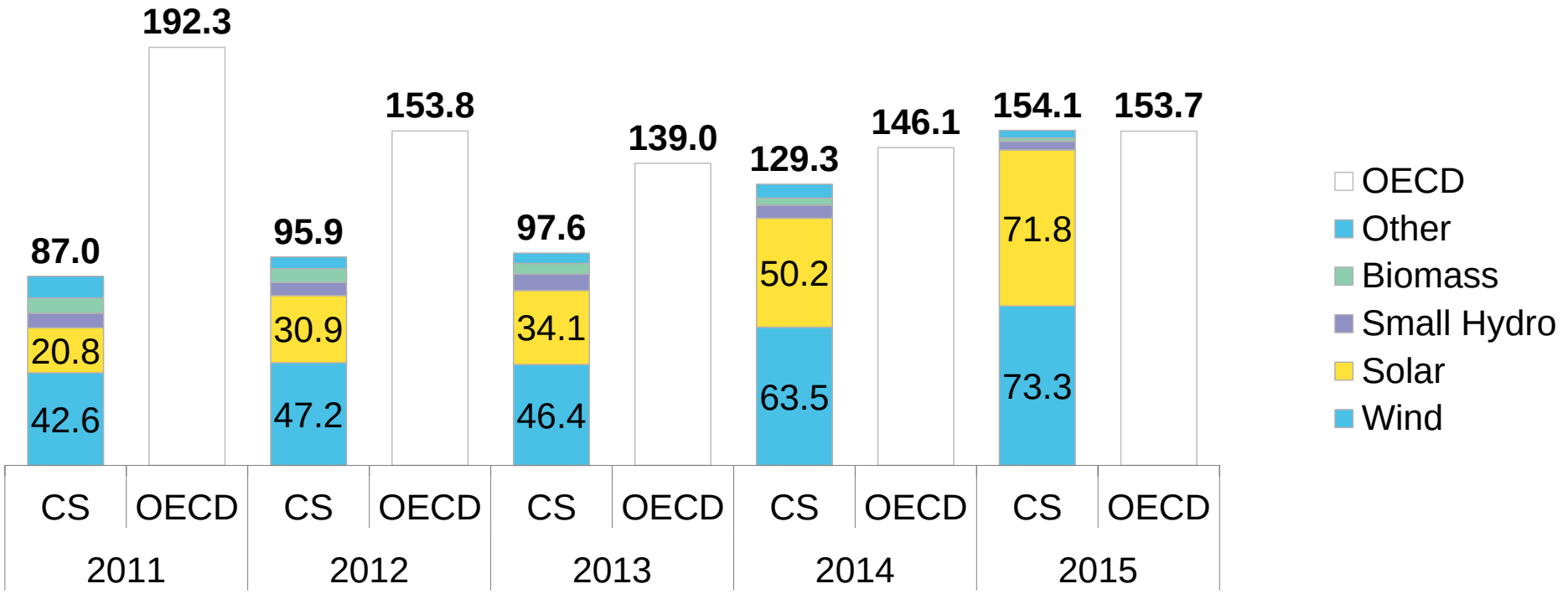


Note: Climatescope and OECD countries account for more than 95% of global annual

Source: Climatescope 2016

ANNUAL CLEAN ENERGY INVESTMENT, CLIMATESCOPE VS OECD COUNTRIES ($BN), 2011-2015

Bloomberg NEW ENERGY FINANCE



Note: Climatescope and OECD countries account for more than 95% of global new clean energy investment over 2011-2015. Climatescope figures include three new MENA states added in Climatescope 2016. Projects smaller than 1MW are not included. Chile and Mexico are included in both OECD and Climatescope.

Source: Climatescope 2016

NON-OECD VS OECD SHARE OF CLEAN ENERGY INVESTMENT INTO CLIMATESCOPE COUNTRIES (%), EXCLUDES INVESTMENT IN CHINA), 2010-2015

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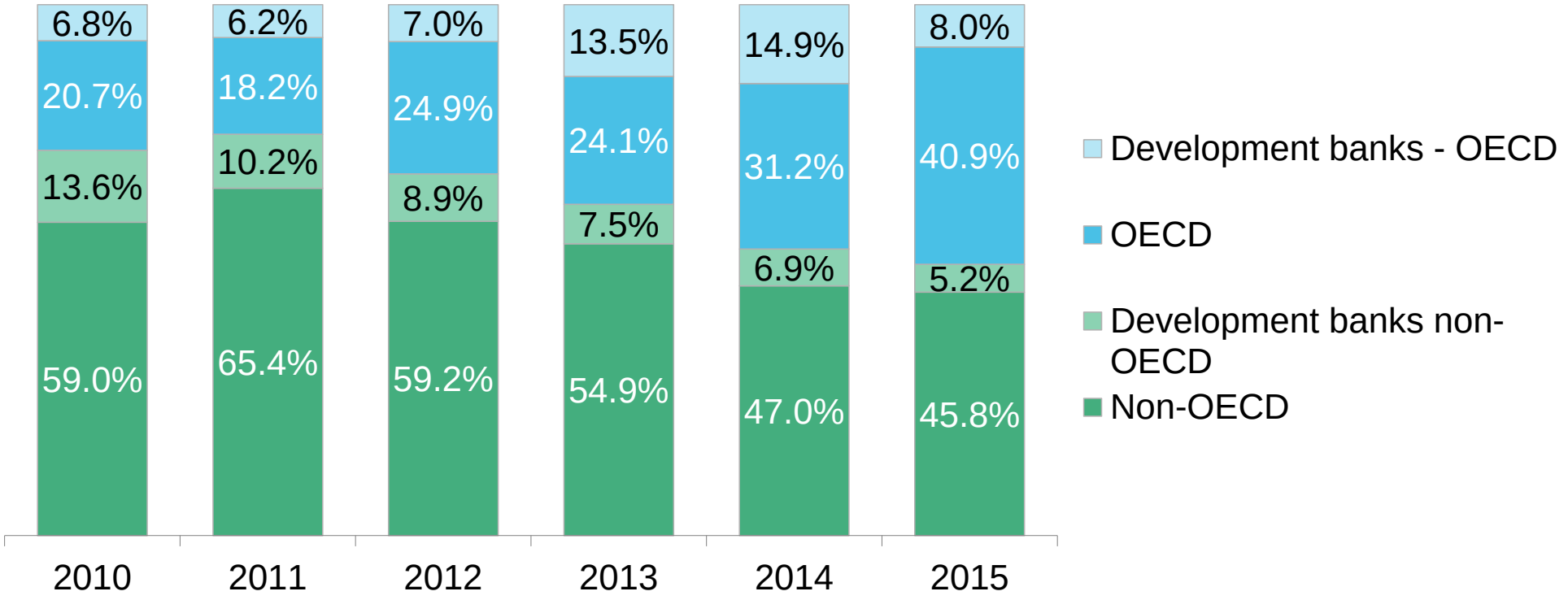
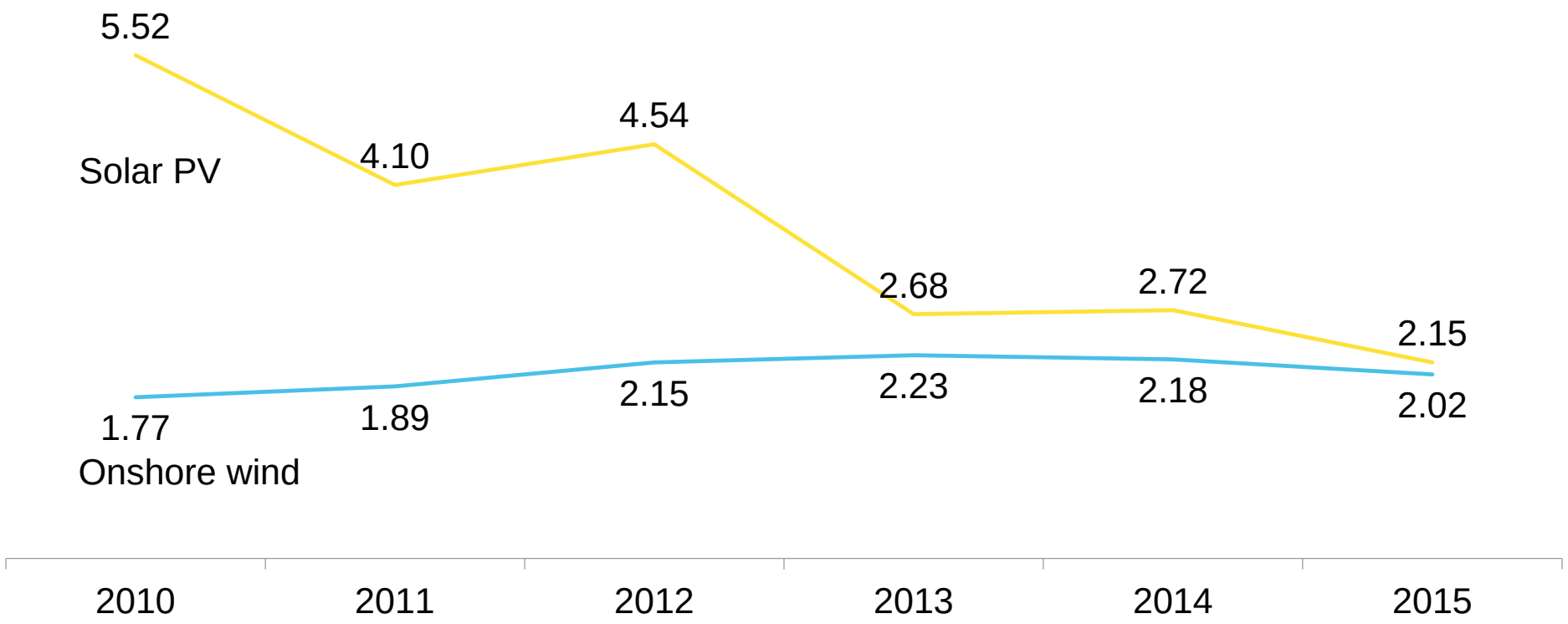


Source: Climatescope 2016

AVERAGE DISCLOSED CAPEX FOR ONSHORE WIND AND PV PROJECTS IN CLIMATESCOPE COUNTRIES ($M/MW)

Bloomberg NEW ENERGY FINANCE



Source: Climatescope 2016

COST OF RENEWABLES

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LEVELISED COST OF ELECTRICITY (LCOE): DEFINITION

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$$\text{LCOE} = \frac{\text{Total life cycle costs}}{\text{Total lifetime energy production}}$$

SOLAR AND WIND EXPERIENCE CURVES

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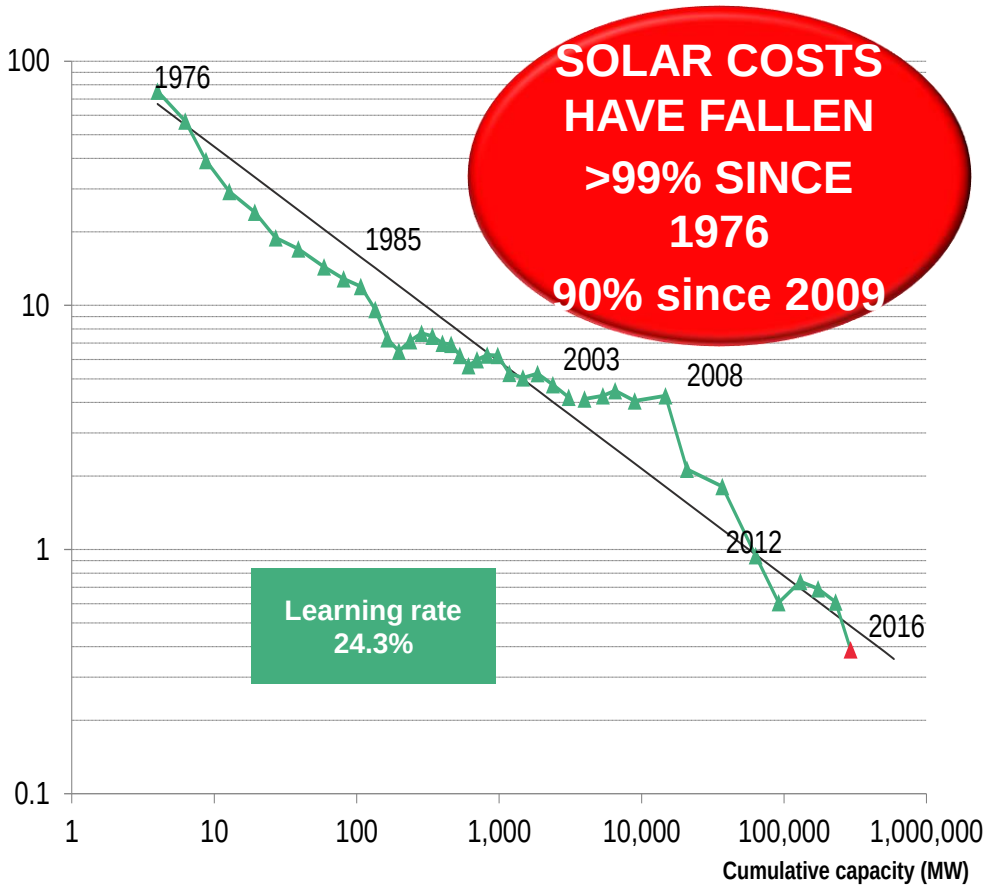
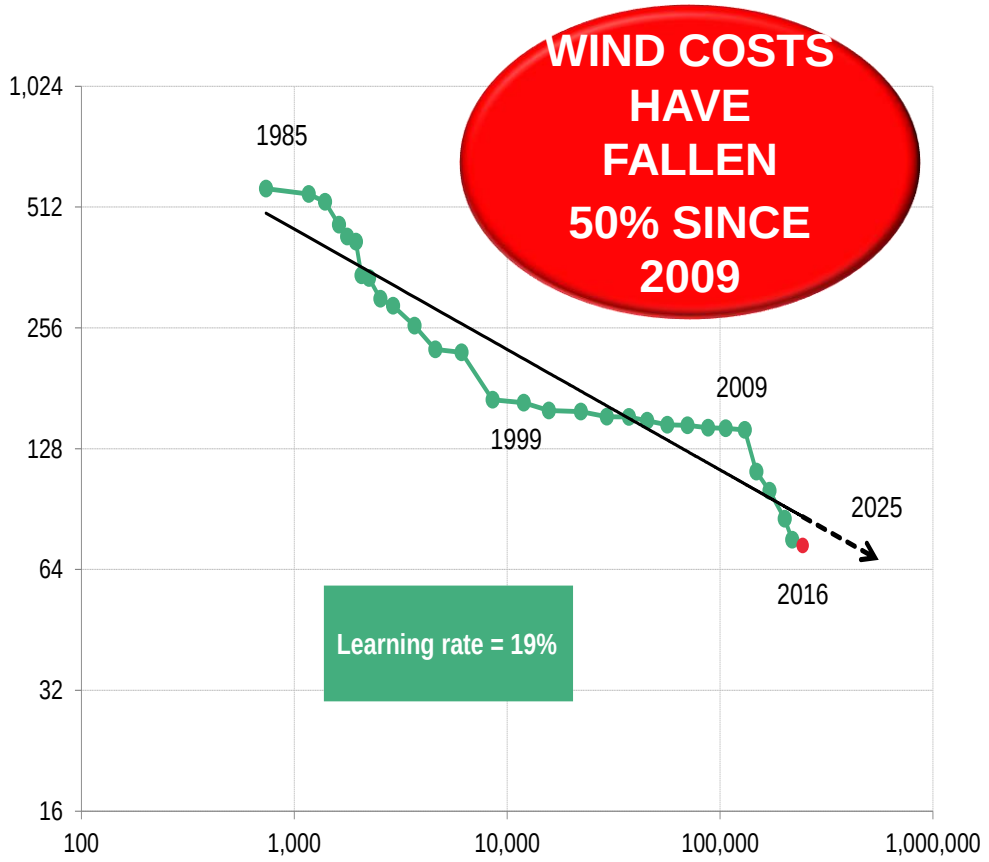
SOLAR PV MODULE COST ($/W)



Note: Prices are in real (2015) USD. 'Current price' is $0.4/W

Source: Bloomberg New Energy Finance, Maycock

ONSHORE WIND LEVELISED COST* ($/MWH)

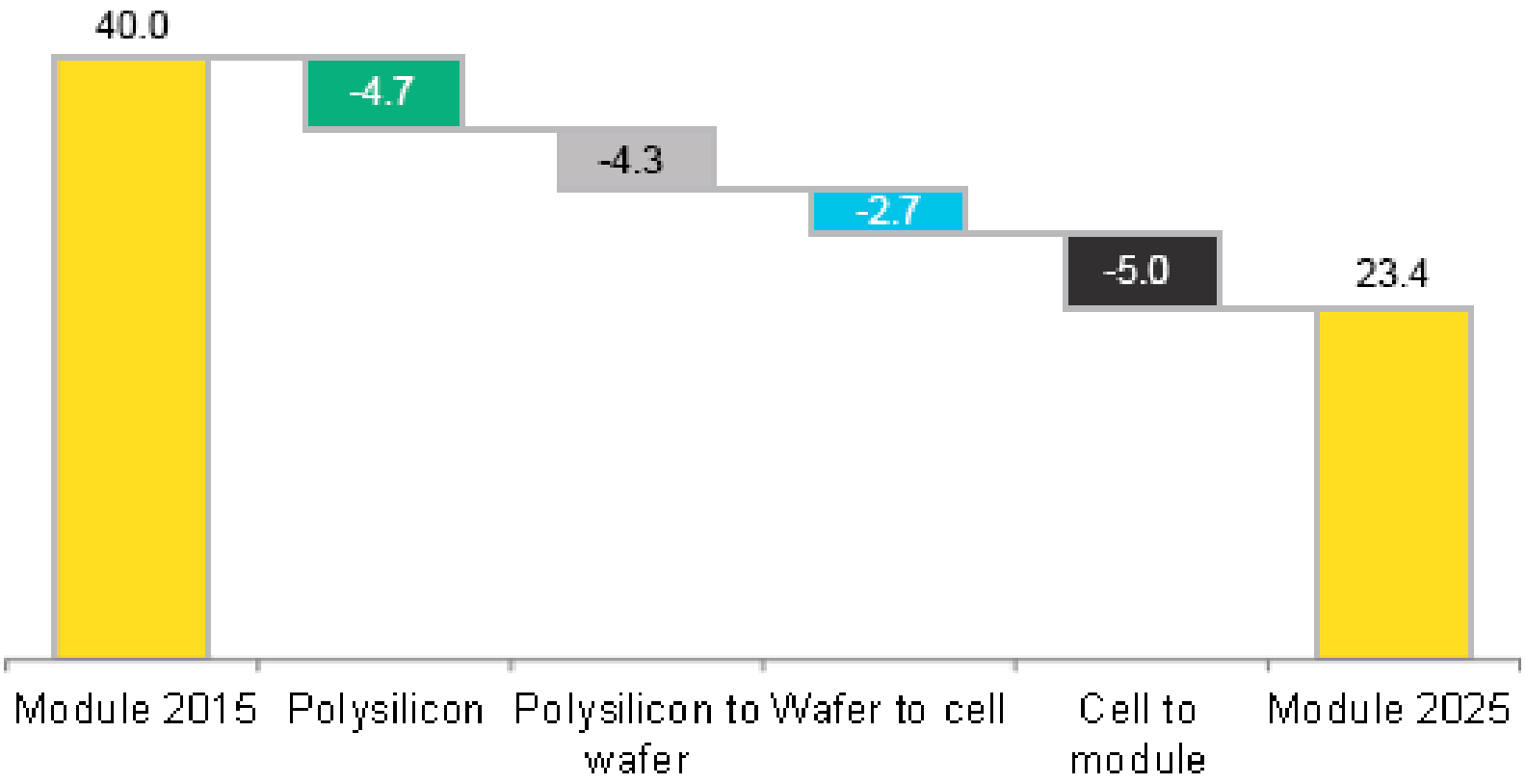


Note: Pricing data has been inflation corrected to 2014. We assume the debt ratio of 70%, cost of debt (bps to LIBOR) of 175, cost of equity of 8%. *Data is for Northern Europe.

Source: Bloomberg New Energy Finance

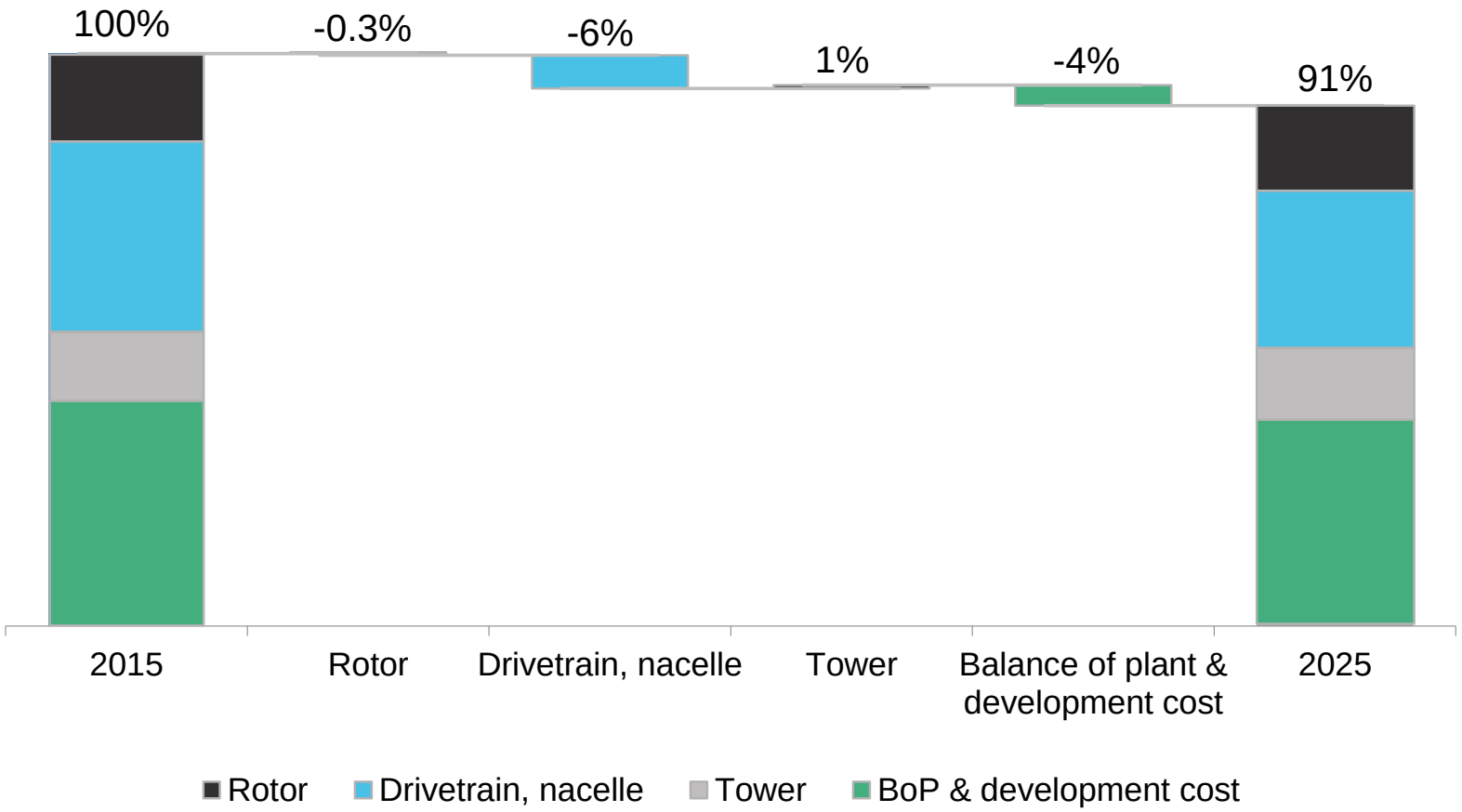
FORECAST OF INTEGRATED PRODUCTION COST FOR C-SI MODULE (US CENT/W)

Bloomberg NEW ENERGY FINANCE



WIND PROJECT CAPITAL EXPENDITURE COST (PER MW NAMEPLATE CAPACITY) REDUCTION DRIVERS (%)

Bloomberg NEW ENERGY FINANCE



Note: The reduction magnitude is our best indicative estimate of the potential impact. The magnitude could vary depending on the technological advancements and efficiency improvements.

Source: Bloomberg New Energy Finance

CAPACITY FACTOR IMPROVEMENTS

Bloomberg NEW ENERGY FINANCE

LONGER BLADES

LOW-WIND TURBINES AT HIGH-WIND SITES

SITE-OPTIMISED POWER CURVES

HIGHER TOWERS

Source: Siemens, Nordex, GE, Vestas

GLOBAL (EX. CHINA) ONSHORE WIND CAPACITY FACTOR IMPROVEMENTS, 1997-2015 (%)

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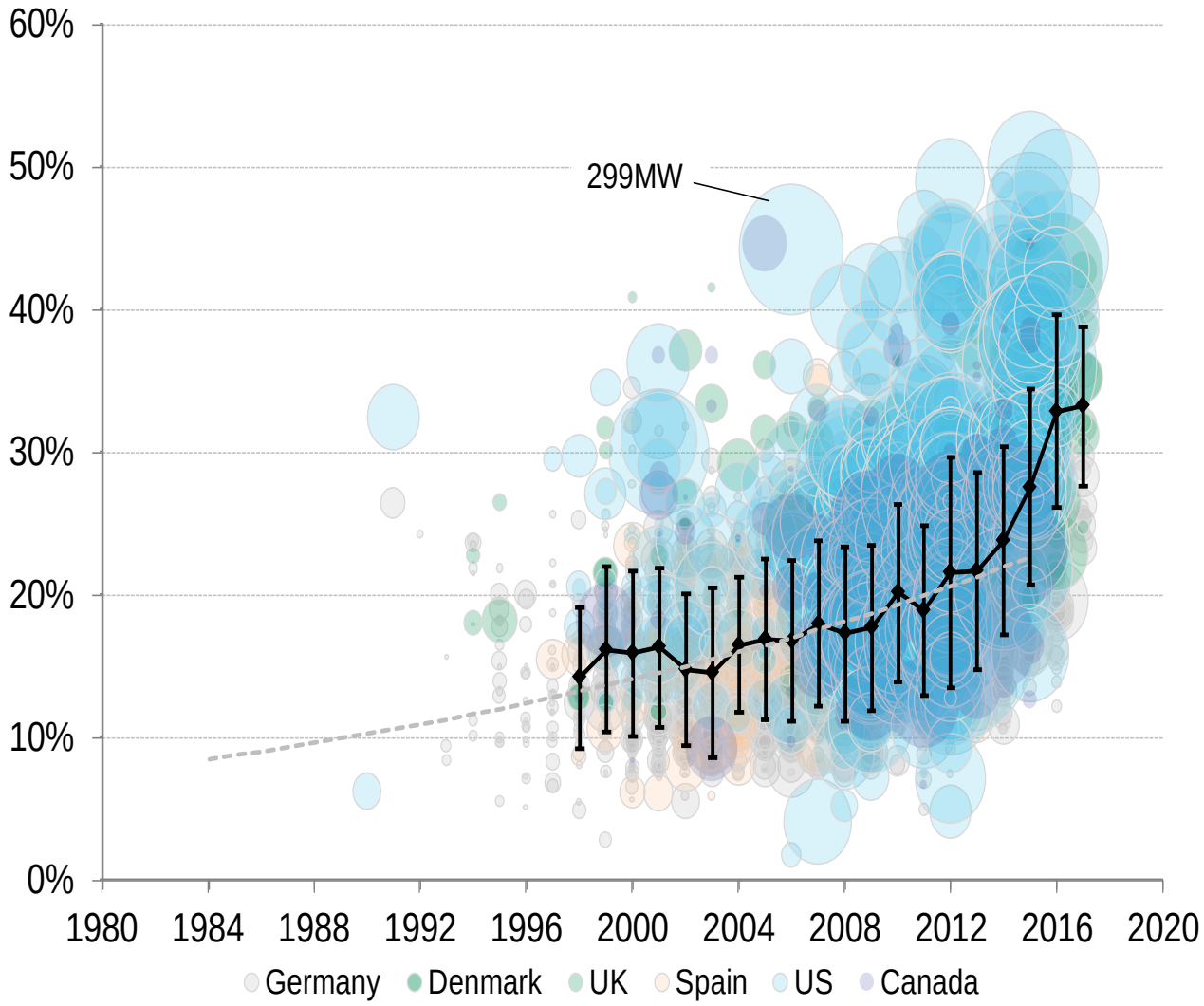
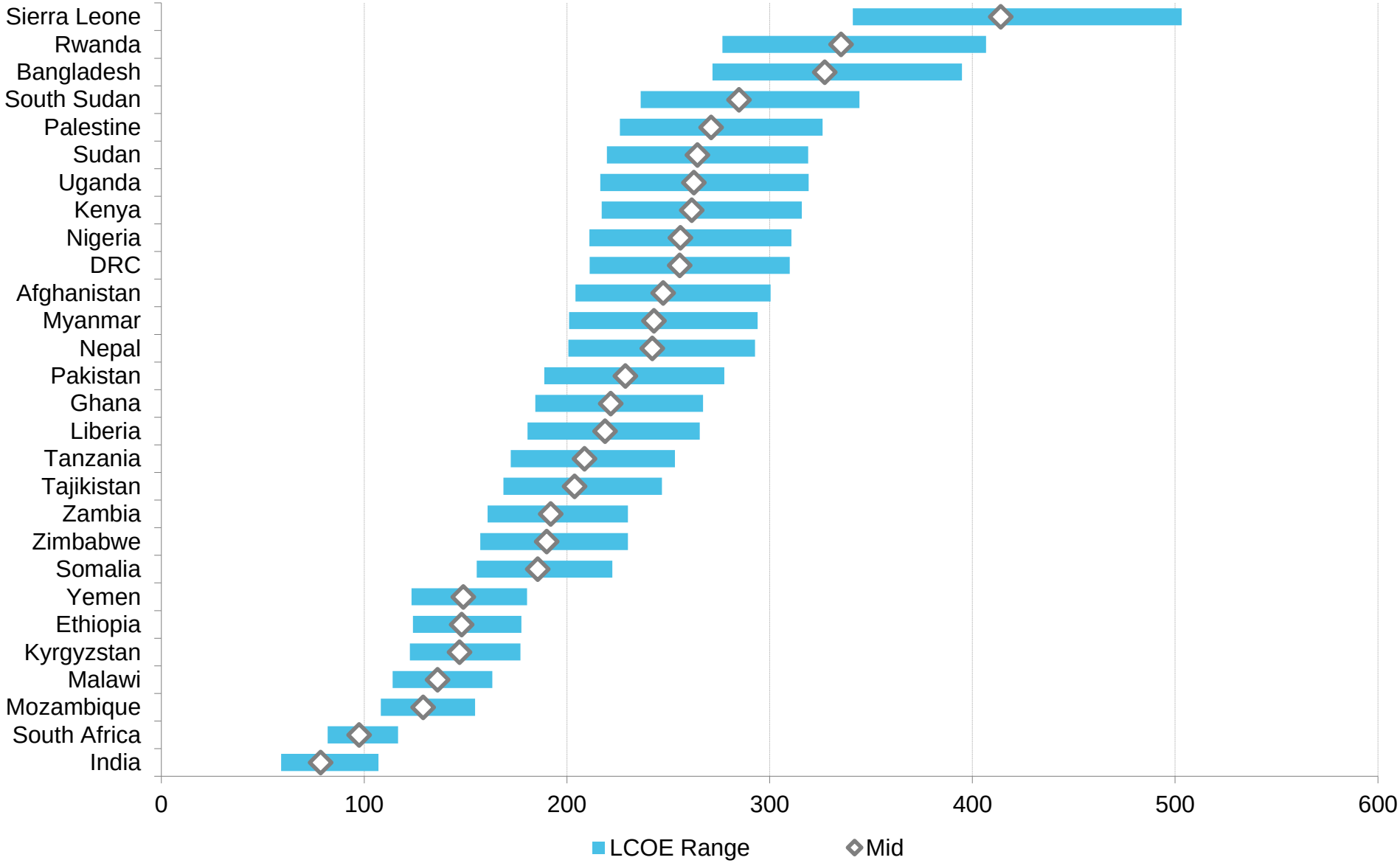


Note: Averages are capacity-weighted. We calculate the capacity factor with our proprietary Wind Farm Capacity Factor Tool using real project data and wind resource data provided by 3TIER by Vaisala. We assume P90 value in the capacity factor tool.

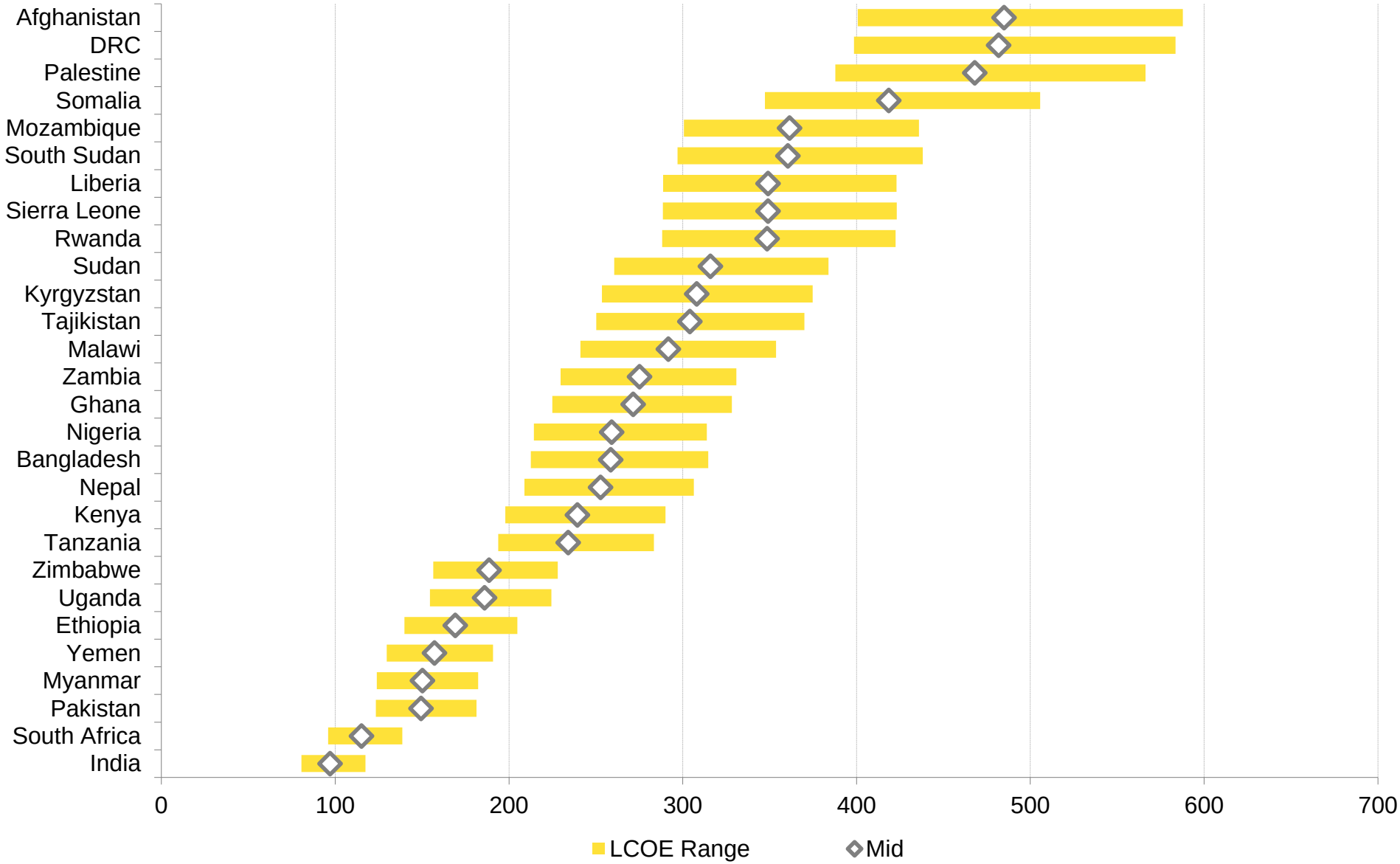
Source: Bloomberg New Energy Finance

ONSHORE WIND LCOE BY COUNTRY ($/MWH)

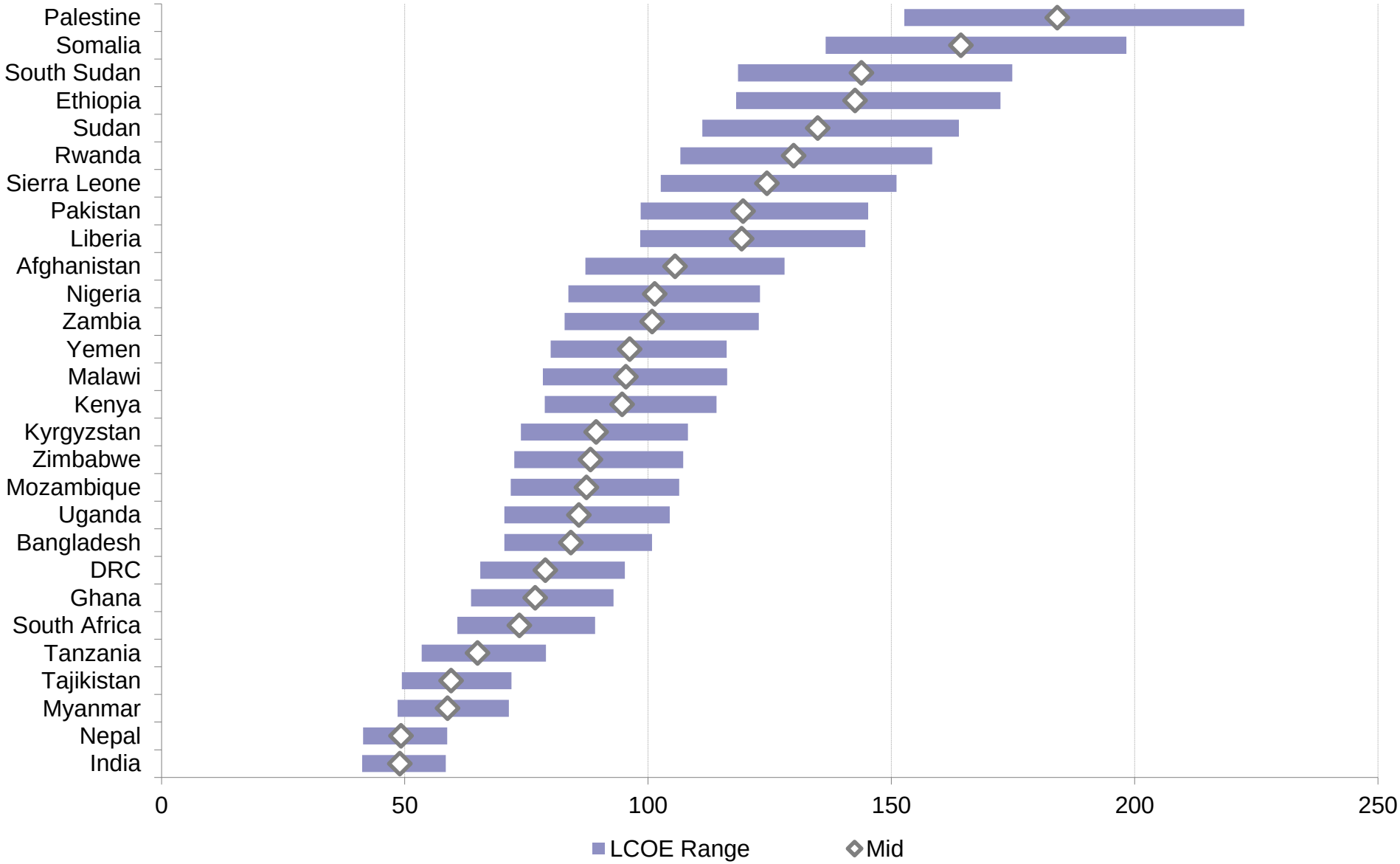
Bloomberg NEW ENERGY FINANCE



SOLAR PV LCOE BY COUNTRY ($/MWH)

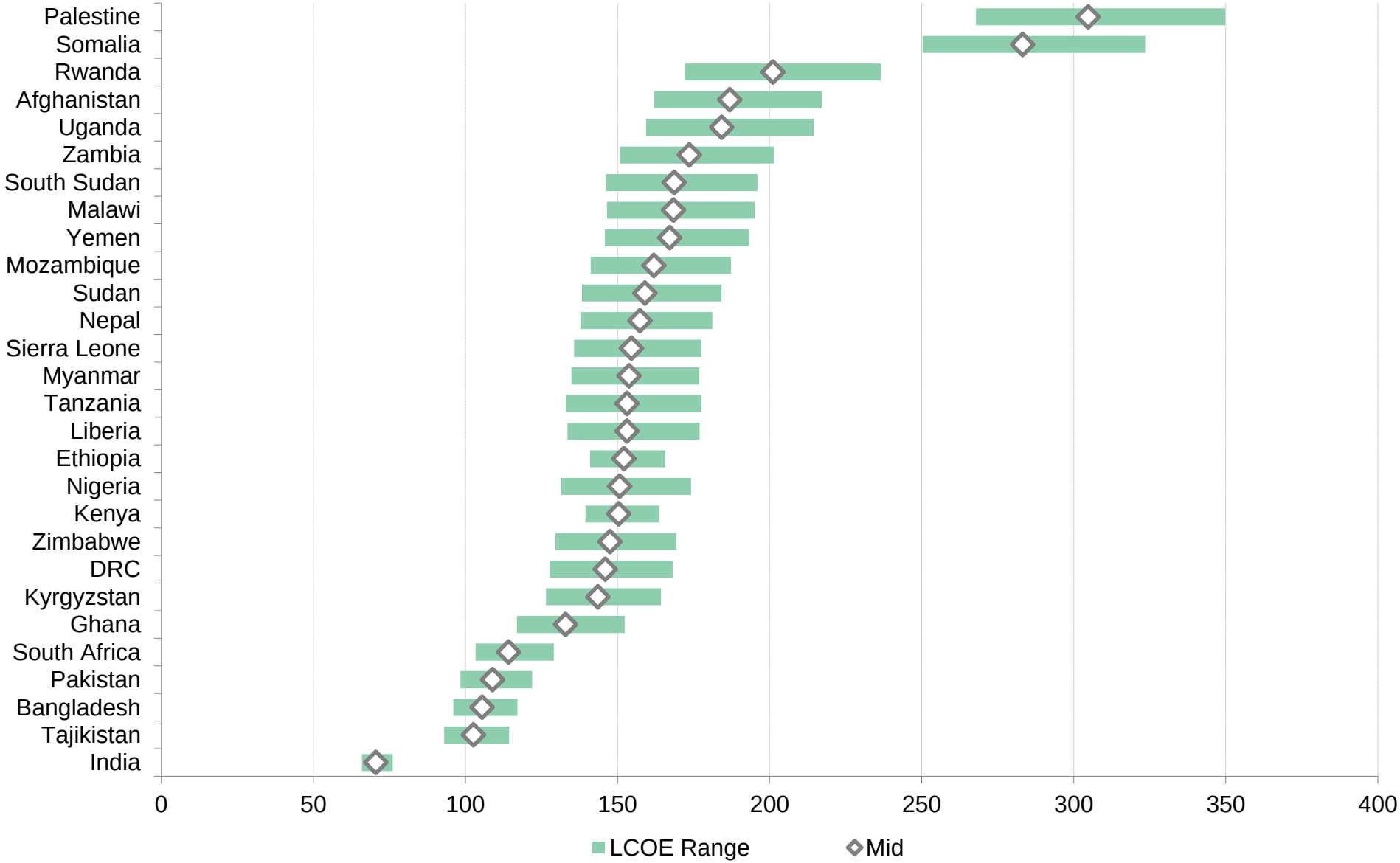


SMALL HYDRO LCOE BY COUNTRY ($/MWH)

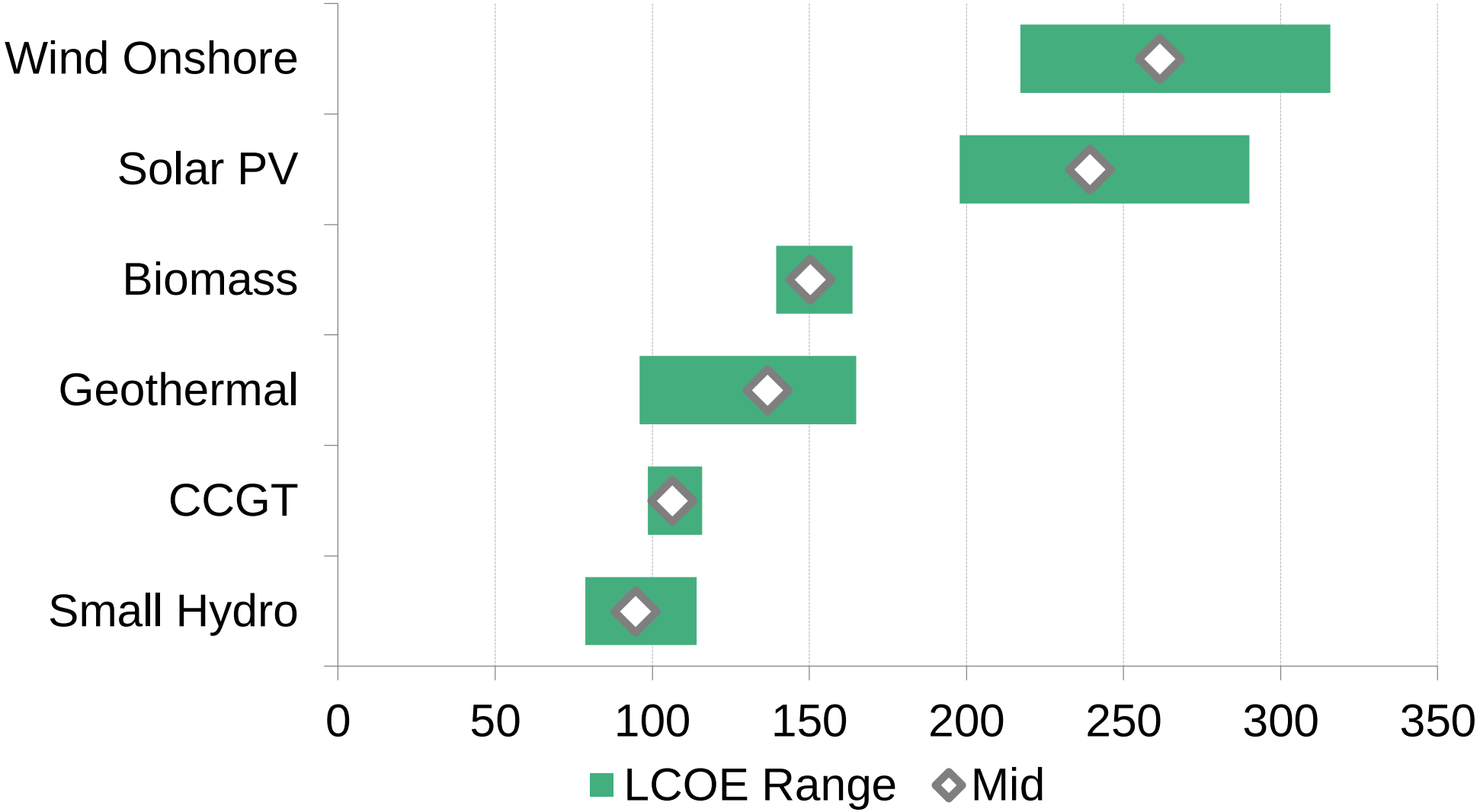


BIOMASS INCINERATION LCOE BY COUNTRY ($/MWH)

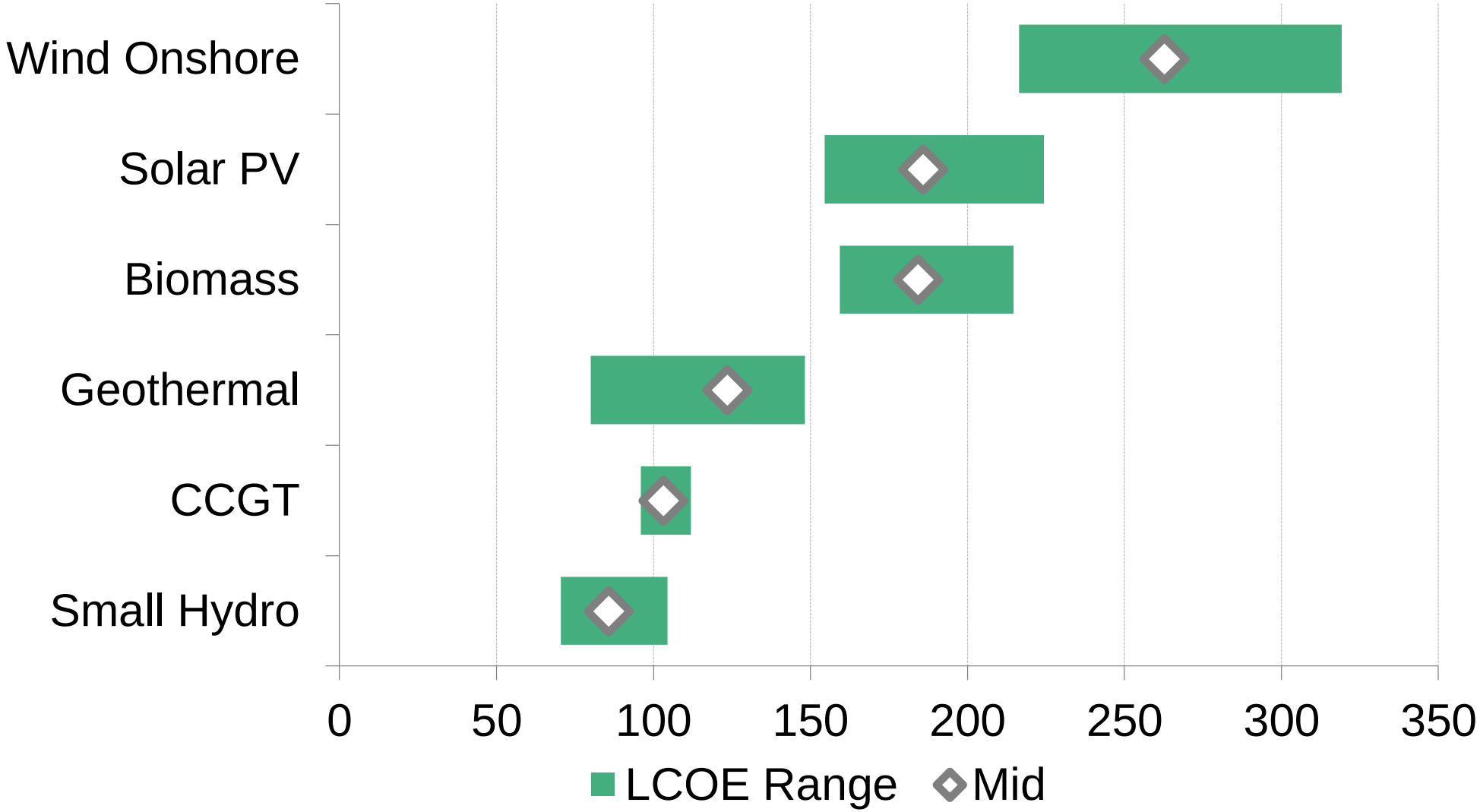
Bloomberg NEW ENERGY FINANCE



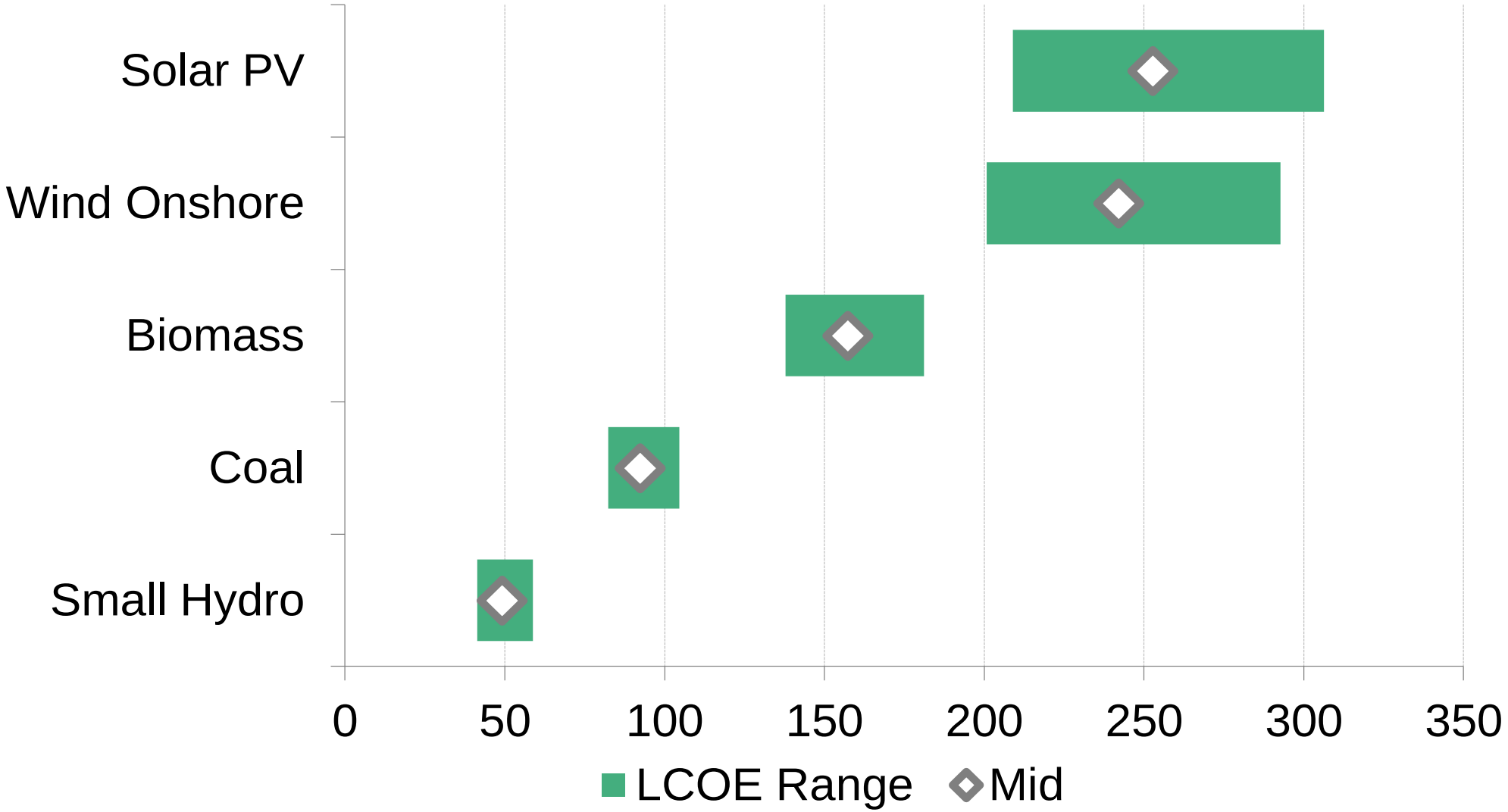
KENYA LCOE RANGES (US$/MWH), 2015



UGANDA LCOE RANGES (US$/MWH), 2015

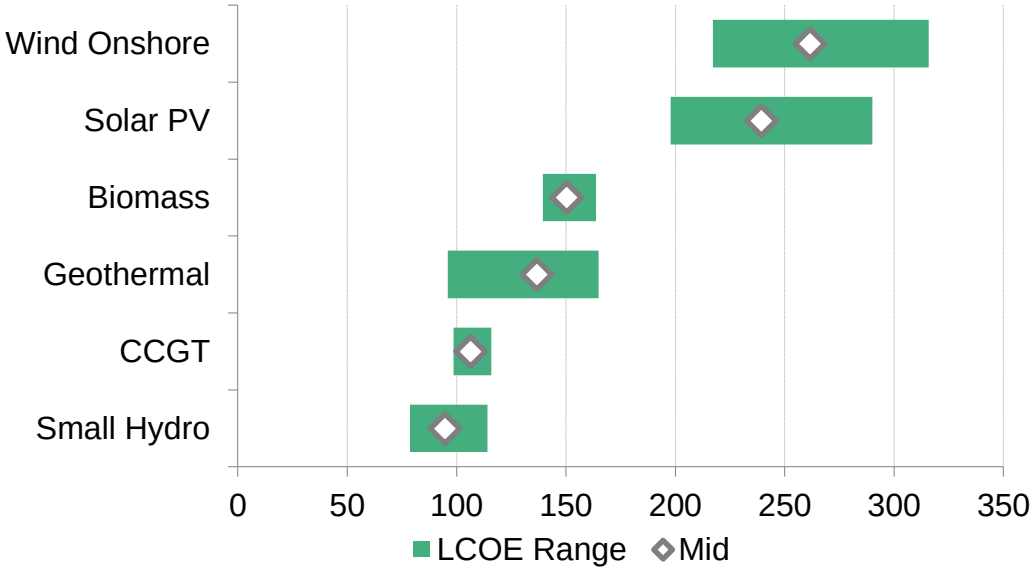


NEPAL LCOE RANGES (US$/MWH), 2015



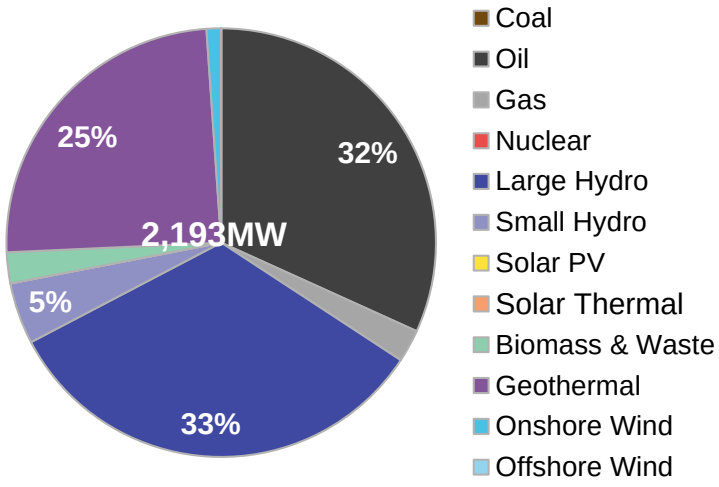
KENYA

Kenya LCOE ranges (US$/MWh), 2015



- Around 32% of Kenya's installed capacity comes from oil. These plants were commissioned in the 1980s and 1990s when diesel was relatively cheap. As oil prices rose, other technologies such as geothermal (25%) and hydro (38%) and more recently wind have been developed.
- Kenya plans to make clean energy a significant part of its ambitious 'Least Cost Power Development Plan' which targets 22.7GW of capacity by 2033
- Capex for wind is still high in Kenya at around $2.6m/MW. This figure is based on disclosed data from the Isiolo I wind farm. Recently a number of other projects were financed, including the 310MW Lake Turkana wind farm.
- The country has good potential for small hydro as well as significant geothermal resources (estimated at 10GW) which is to undergo a fast track development plan by the government owned Geothermal Development Company (GDC).
- Solar has struggled to gain a footing in Kenya despite the country's feed-in-tariff, as the rate offered has proven to be too low for project developers.
- Kenya has no proven domestic reserves of natural gas or coal however it does have some existing natural gas capacity which suggests supply is available.

Kenya capacity mix, 2014

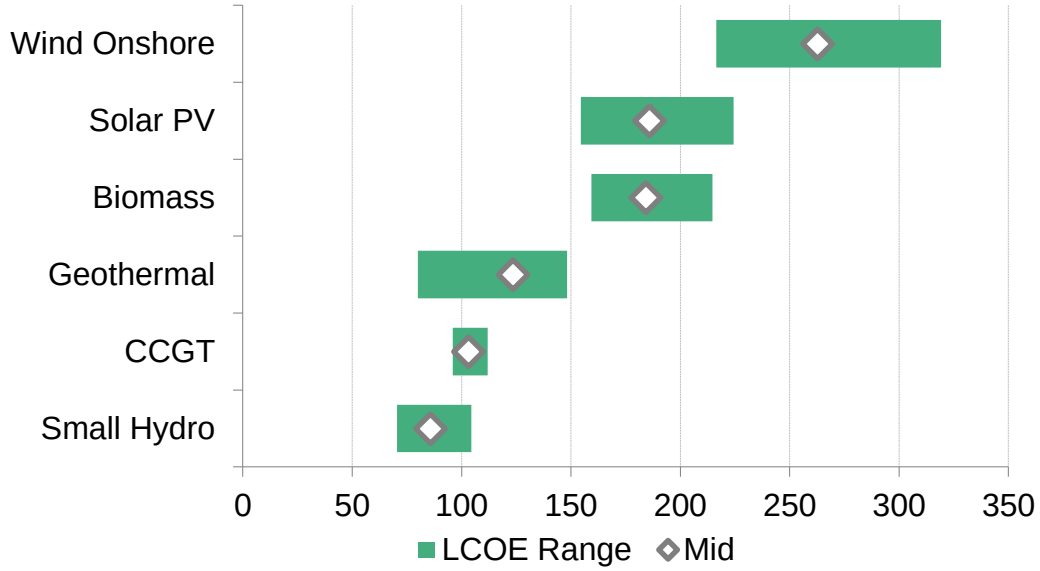


	Coal	CCGT	Wind Onshore	Solar PV	Small Hydro	Geothermal	Biomass
Capex ($m/MW)	-	1.41	2.60	2.12	2.66	4.04	2.34
Capacity factor	-	75%	21%	19%	60%	80%	80%
Fixed O&M ($/MW/yr)	-	29,797	38,000	35,000	70,000	60,616	58,000
Debt ratio	-	72%	70%	70%	70%	70%	70%
Cost of debt	-	11.6%	12.1%	12.6%	12.1%	13.6%	12.6%
Cost of equity	-	14.6%	15.1%	15.6%	15.1%	16.6%	15.6%
LCOE ($/MWh)	**-**	**106.4**	**261.6**	**239.4**	**94.7**	**136.8**	**150.4**

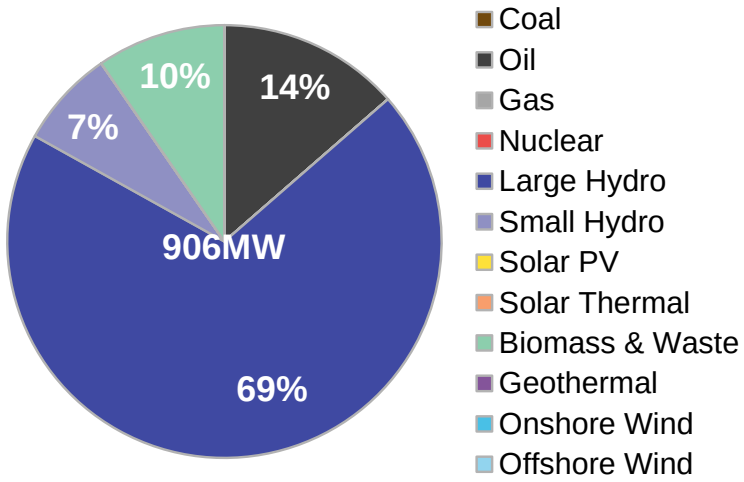
Source: Bloomberg New Energy Finance

UGANDA

Uganda LCOE ranges (US$/MWh), 2015



Uganda capacity mix, 2014



- Uganda is rich in hydro resources, which has thus shaped its energy mix. However the country has only 18% electrification.
- Small hydro – which currently accounts for 7%, or 66MW of installed capacity – is the cheapest of the technologies assessed. This is due to relatively low capex and O&M costs which reflect local experience. The country currently has around 60MW under construction and a further 100MW in the pipeline. Small hydro could be the only remaining hydro option when considering a 2008 report from Aldwych that suggests the completion of the Bujagali and Karuma large hydro projects have exhausted the larger scale options available outside the Murchison National Park.
- The same Aldwych report also mentions biomass as a feasible alternative to expensive emergency oil generation capacity, citing the benefits of local fuel supplies and an estimated $4.3m/MW capex costs (converted to $4.95m/MW in 2015 dollars). Despite this, at $184/MWh, the cost of new biomass appears relative high on a regional basis.
- Uganda has proven gas reserves, but no domestic production and no installed gas-fired power capacity. Applying a low capacity factor of 55% due to uncertainty about fuel availability, we estimate an LCOE for CCGT at $103/MWh.
- At $1.57/W, Uganda's solar PV capex is one of the lowest in the region. This reflects all-in bids by solar developers as low as $163.8/MWh. The country has around 72MW of solar PV in the pipeline.

	Coal	CCGT	Wind Onshore	Solar PV	Small Hydro	Geothermal	Biomass
Capex ($m/MW)	-	1.01	2.56	1.57	2.43	3.98	4.95
Capacity factor	-	55%	18%	18%	50%	80%	70%
Fixed O&M ($/MW/yr)	-	26,048	17,841	39,067	9,767	55,419	111,325
Debt ratio	-	70%	70%	70%	70%	70%	70%
Cost of debt	-	10.7%	11.2%	11.7%	11.2%	12.7%	11.7%
Cost of equity	-	13.7%	14.2%	14.7%	14.2%	15.0%	14.7%
LCOE ($/MWh)	**-**	**103.2**	**262.7**	**186.0**	**85.8**	**123.5**	**184.2**

Source: Bloomberg New Energy Finance

KEY TAKEAWAYS

Bloomberg NEW ENERGY FINANCE

- New utility-scale wind and solar PV are still more expensive than coal and gas-fired power
- Deployment experience is needed to build supply chains and to reduce cost
- Small-scale hydro can be more cost effective than utility-scale renewables
- Auction mechanism can generate competition amongst developers and drive down cost
- Carbon constraints or carbon pricing can increase lifetime cost of fossil-fuel power plants

2. OFF-GRID SOLAR

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SHARE OF POPULATION WITHOUT GRID ACCESS (% OF TOTAL)

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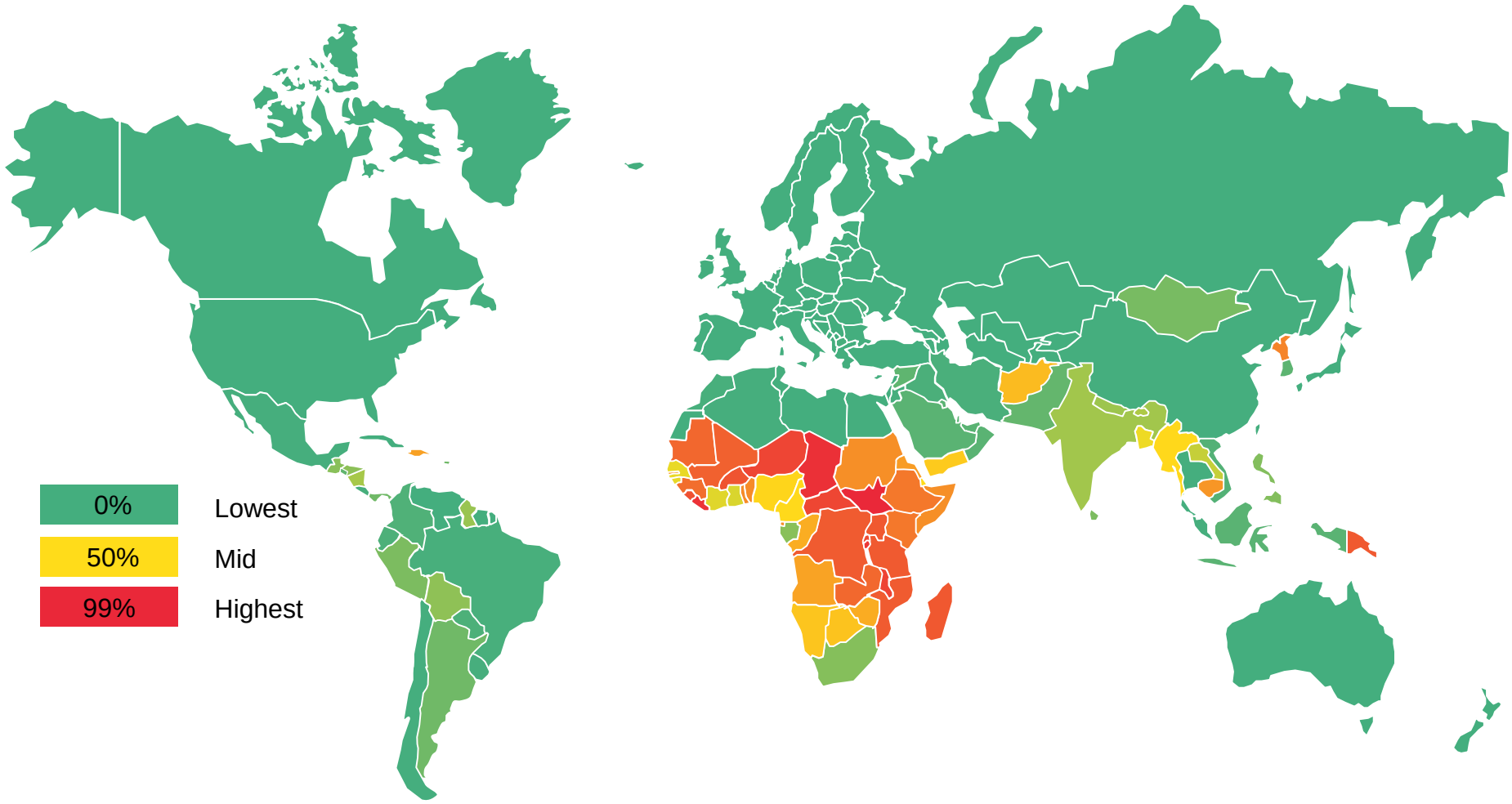
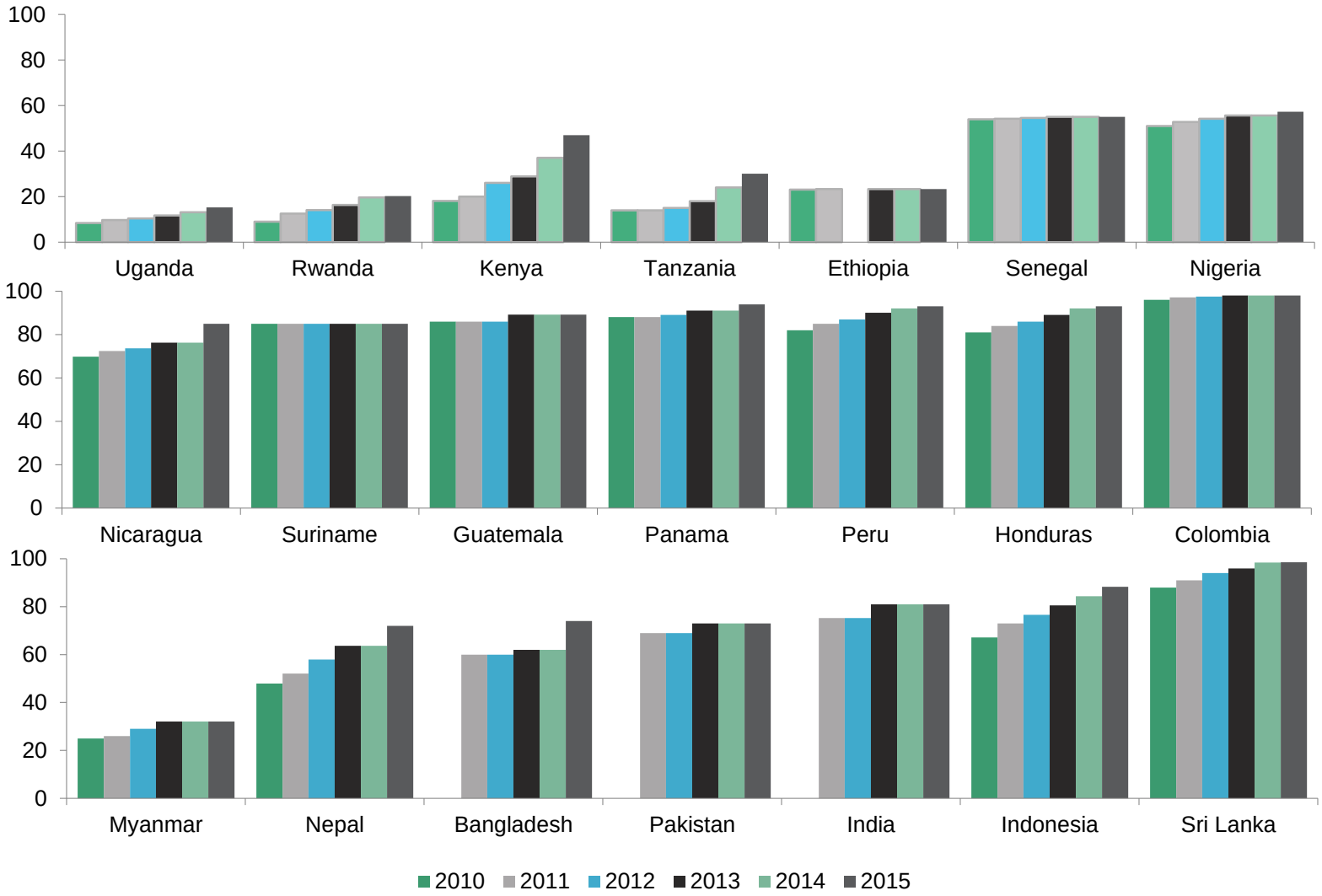


Note: Figures refer to 2012 data.

Source: Bloomberg New Energy Finance, World Bank, GOGLA, IFC Lighting Global

NATIONAL ELECTRIFICATION RATES (% OF TOTAL POPULATION)

Bloomberg NEW ENERGY FINANCE



Source: Bloomberg New Energy Finance, Climatescope

ENERGY ACCESS OPTIONS

Bloomberg NEW ENERGY FINANCE

Grid extensions

Pros:

- (Mostly) cheapest per kWh
- Allows industrial use

Cons:

- Slow regulatory and development cycles
- Fixed capital cost

Mini-grids

Pros:

- Allows productive use
- Standard appliances
- Modular development

Cons:

- No clear business model yet
- Requires collective action and density

Stand-alone systems

Pros:

- Buyer and seller are the only stakeholders
- ‘Self-powered appliances’
- It’s a product, not an electron

Cons:

- Costly per kWh
- Requires new appliance universe
- Limited productive use

Photo credits: Lighting Global, Wikipedia

ENERGY ACCESS OPTIONS

Bloomberg NEW ENERGY FINANCE

On demand power

On demand access

Grid extensions

Pros:

- (Mostly) cheapest per kWh
- Allows industrial use

Cons:

- Slow regulatory and development cycles
- Fixed capital cost

Mini-grids

Pros:

- Allows productive use
- Standard appliances
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Cons:

- No clear business model yet
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Stand-alone systems

Pros:

- Buyer and seller are the only stakeholders
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Cons:

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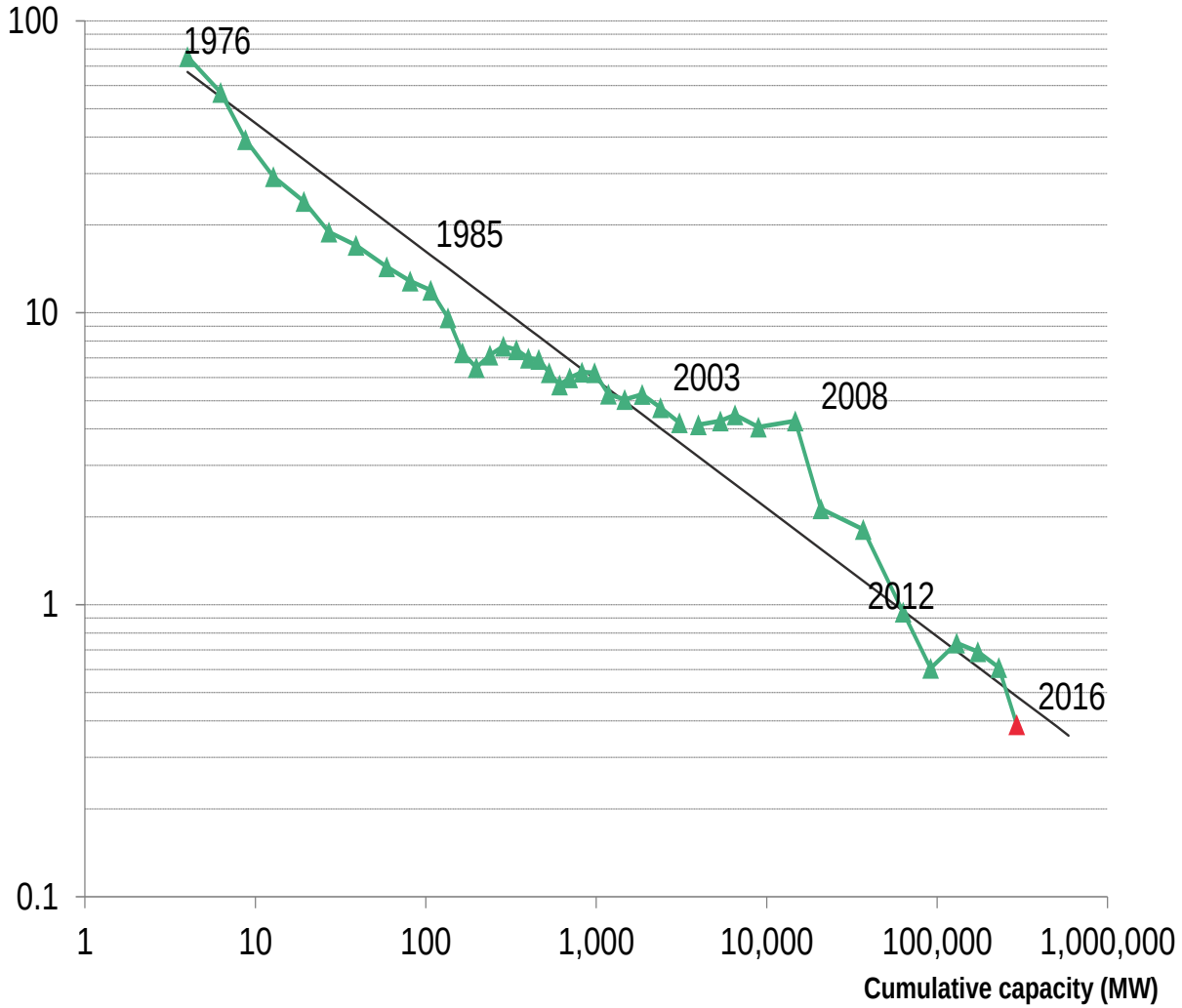
Photo credits: Lighting Global, Wikipedia

PV MODULE COST EXPERIENCE CURVE (USD/W)

Bloomberg NEW ENERGY FINANCE



Note: Prices are in real (2015) USD. 'Current price' is $0.61/W
Source: Bloomberg New Energy Finance, Maycock

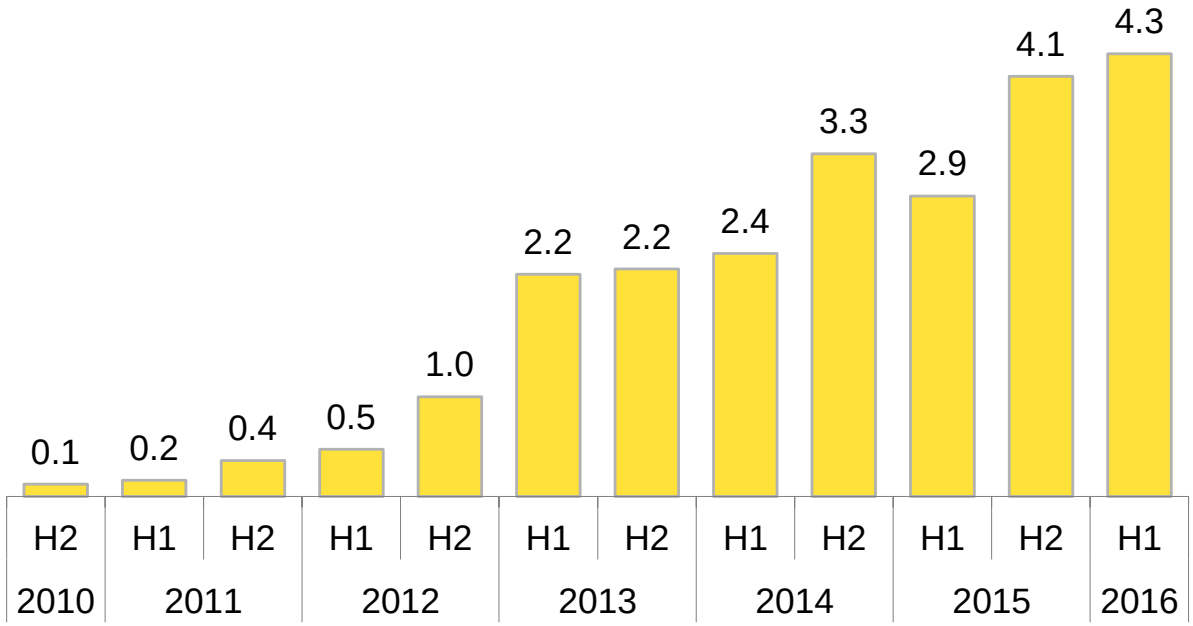
PORTABLE SOLAR KIT SALES TRENDS

Bloomberg NEW ENERGY FINANCE

- Sales are rising again after 2015 dip
- Average unit price is increasing
- Replacement sales?

UNIT SALES OF SOLAR KITS*

MILLIONS OF UNITS



Note: *GOGLA members and IFC associates only

Source: GOGLA, Lighting Global, Berenschot

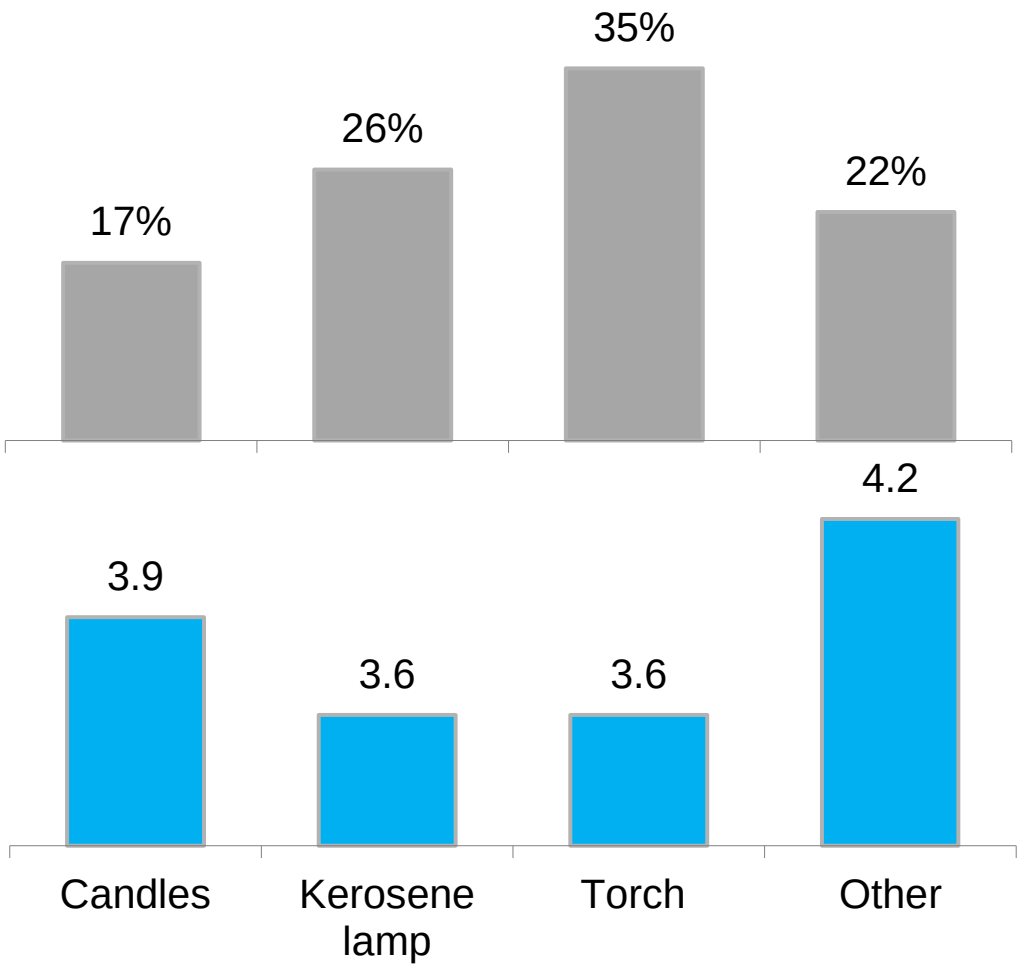
WHO BUYS SOLAR HOME SYSTEMS?

SURVEY DATA FROM RWANDA

Bloomberg NEW ENERGY FINANCE

Previously used technology…

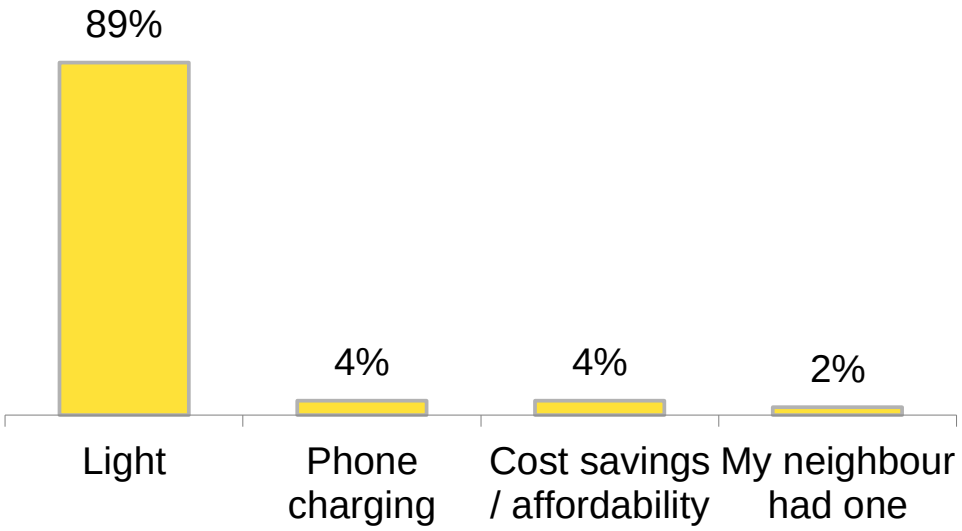
…and its cost
(USD/month for median user)



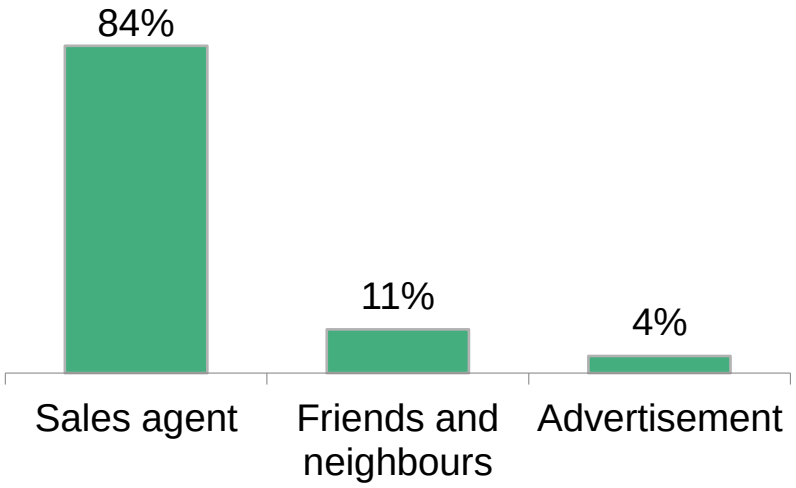
Source: Ignite Power survey. N=250

SOLAR HOME SYSTEM CONSUMER STATISTICS

WHAT WAS THE KEY CONSIDERATION WHEN YOU BOUGHT THE SYSTEM?



HOW DID YOU HEAR OF SOLAR?

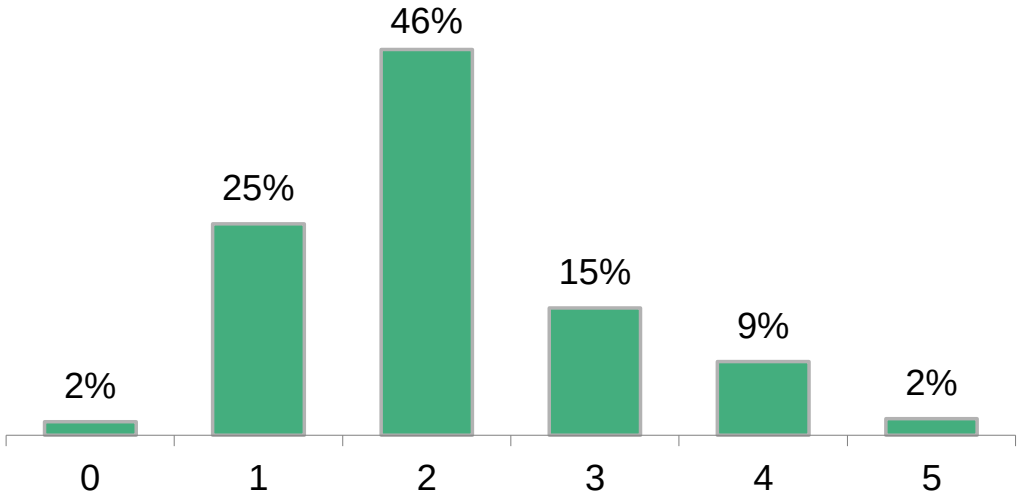


Source: Bloomberg New Energy Finance

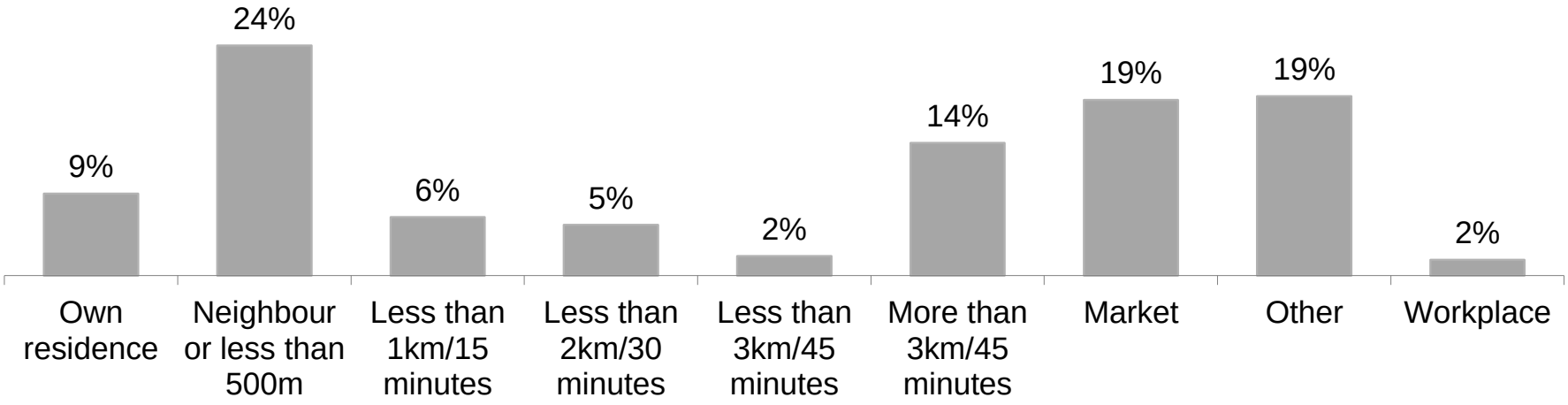
CONNECTIVITY: SOLAR PHONE CHARGING REPLACES DISTANT AND COSTLY CHARGING

Bloomberg NEW ENERGY FINANCE

HOW MANY MOBILE PHONES ARE THERE IN YOUR HOUSEHOLD?



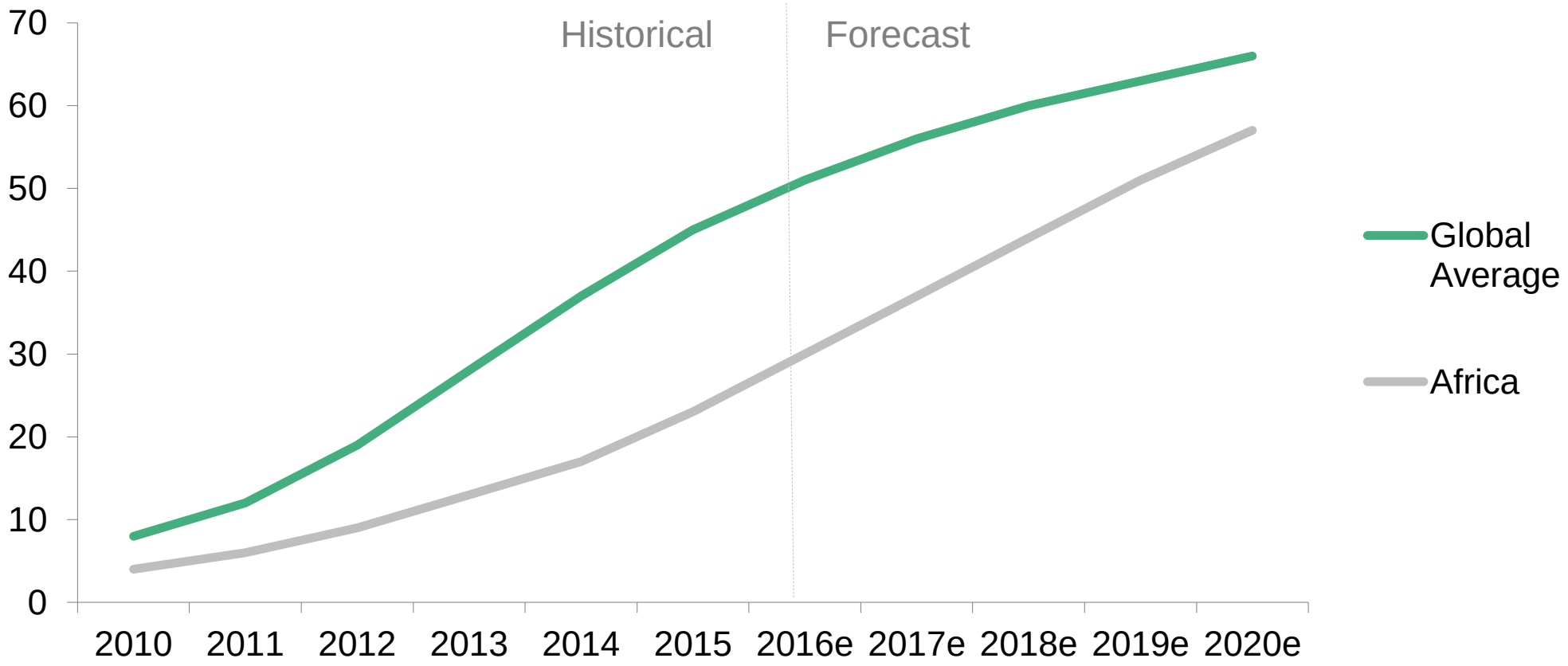
WHERE DID YOU CHARGE YOUR PHONE PREVIOUSLY?



Source: Ignite Power survey. N=250

SMARTPHONE ADOPTION (%)

Bloomberg NEW ENERGY FINANCE

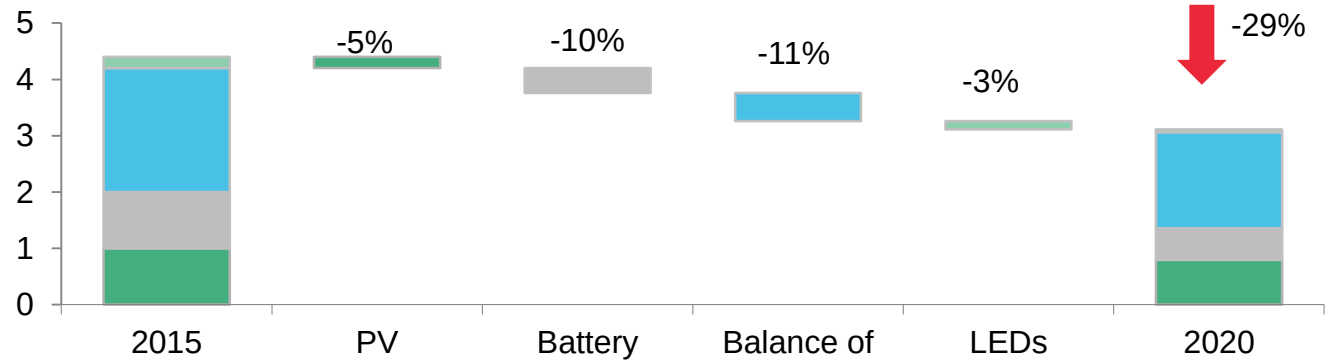


Source: GSMA

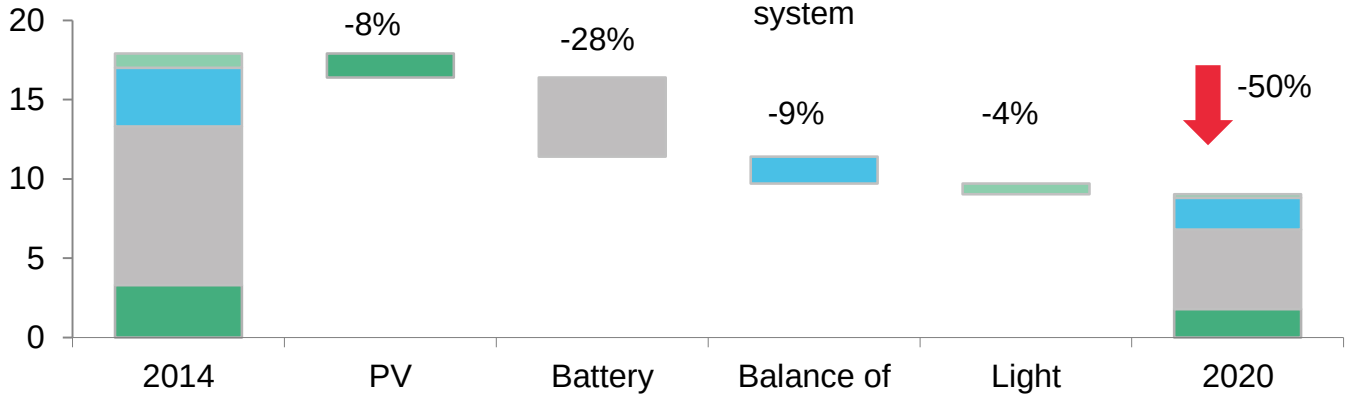
PRODUCTION COST DEVELOPMENTS, NOMINAL $ PER UNIT

Bloomberg NEW ENERGY FINANCE

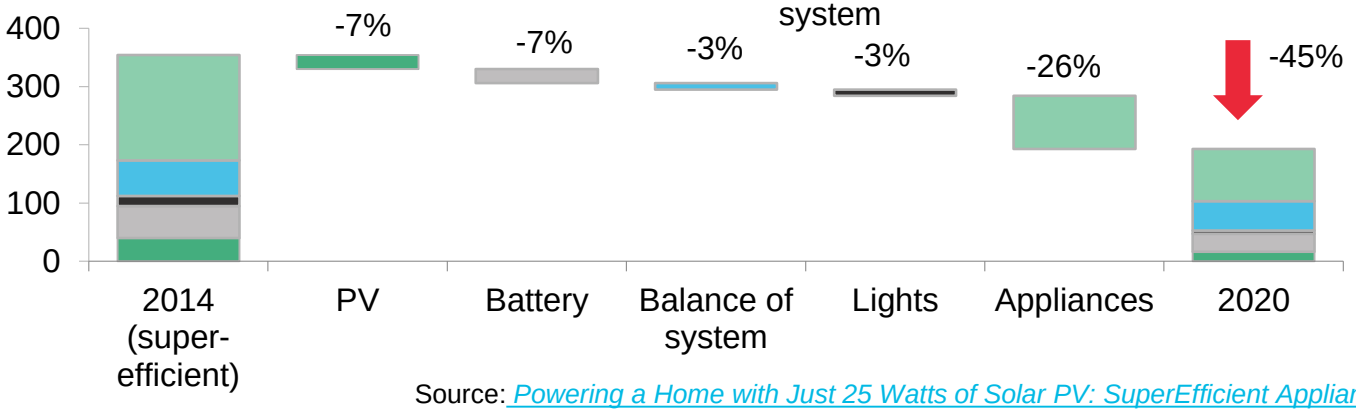
Entry-level portable light, eg d.light S2



Large portable light, eg d.light s300



Solar home system with TV, radio, lights



Source: *Powering a Home with Just 25 Watts of Solar PV: SuperEfficient Appliances Can Enable Expanded Off-Grid Energy Service Using Small Solar Power Systems, Dalberg, EERE Solid-State Lighting Programme, Bloomberg New Energy Finance ,* GOGLA, IFC Lighting Global

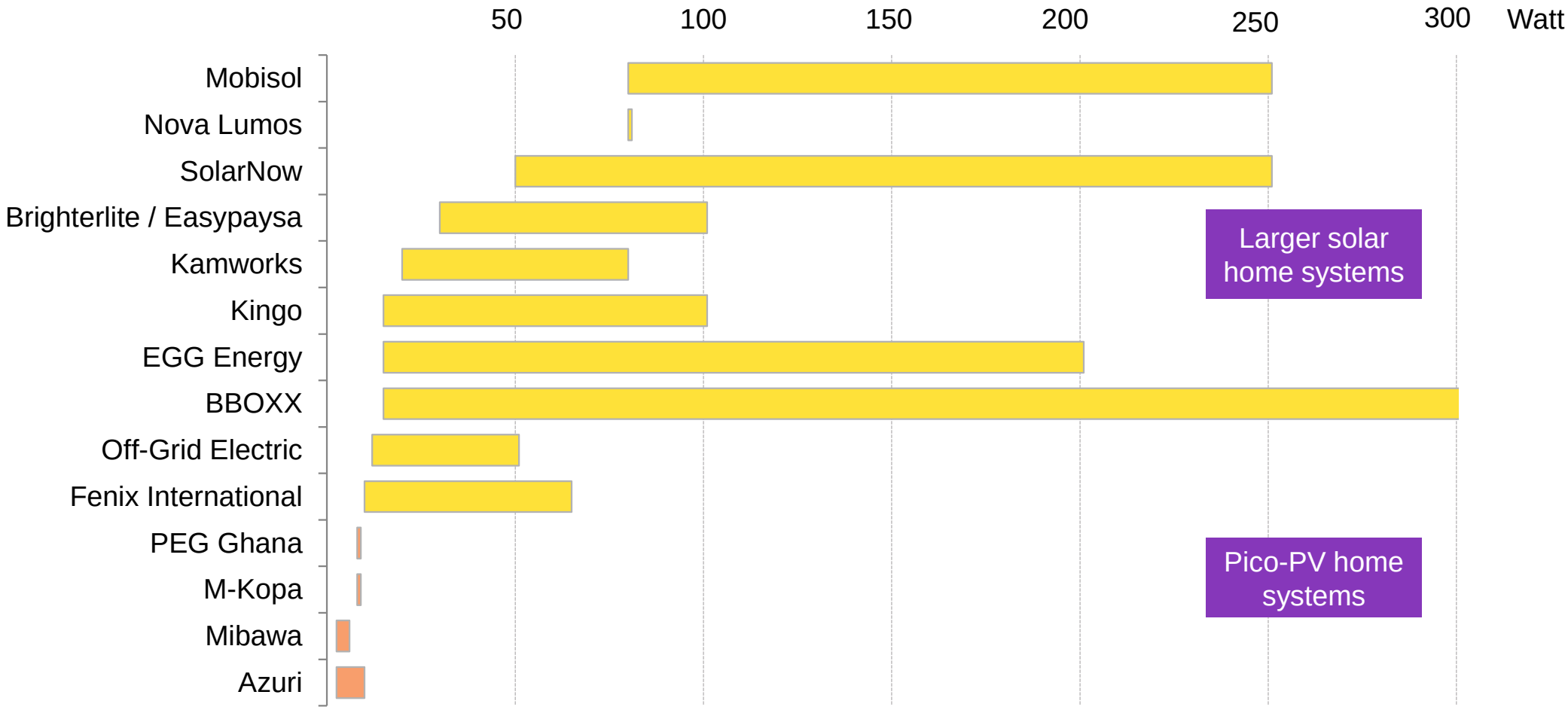
PAY-AS-YOU-GO

Bloomberg
NEW ENERGY FINANCE

SOLAR PANEL SIZE OF SELECTED PAY-AS-YOU-GO COMPANIES (W)

Bloomberg NEW ENERGY FINANCE

The majority of pay-as-you-go firms offer home systems designed to power more than just a few lights and a phone charger.



Note: Pico-PV is defined as <10W.

Source: GOGLA, IFC Lighting Global, Bloomberg New Energy Finance, company websites

THE SHIFT TO PAYG CHANGES THE DYNAMICS BETWEEN THE CUSTOMER AND THE PROVIDER

Bloomberg NEW ENERGY FINANCE

- Financing
- Technology risk
- Data
- Service guarantee
- Higher value services
- Upsell opportunity

BBOXX the solar revoluti

OFF-GRID:ELECTRIC

solar now

LUMOS FOR A BRIGHTER FUTURE

simpanetworks

mobisol Prepaid Energy

fenix intl

PEG AWIA KANIA POWER FOR THE PEOPLE

M-KOPA SOLAR

Stronger relationships between customer and provider

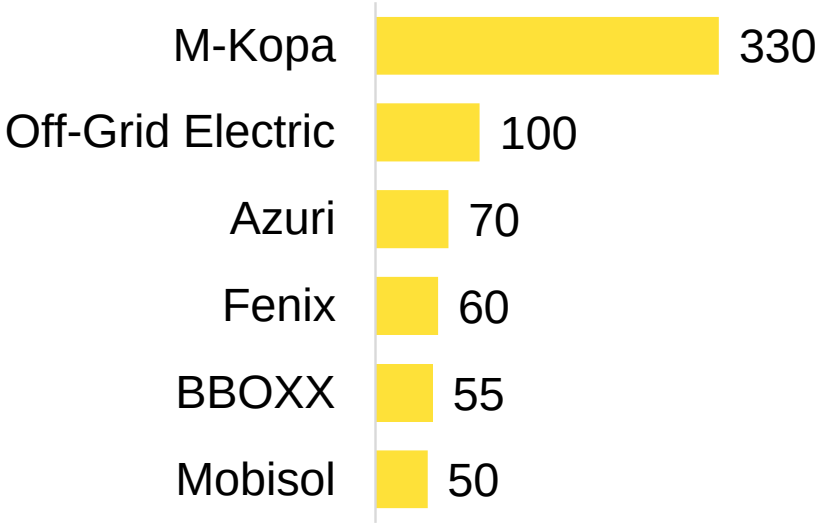
Note: The list of companies represents a sample and does not claim to be comprehensive.

Source: GOGLA, IFC Lighting Global, Bloomberg New Energy Finance

PAY-AS-YOU-GO SOLAR: CUMULATIVE SALES AND INVESTMENTS

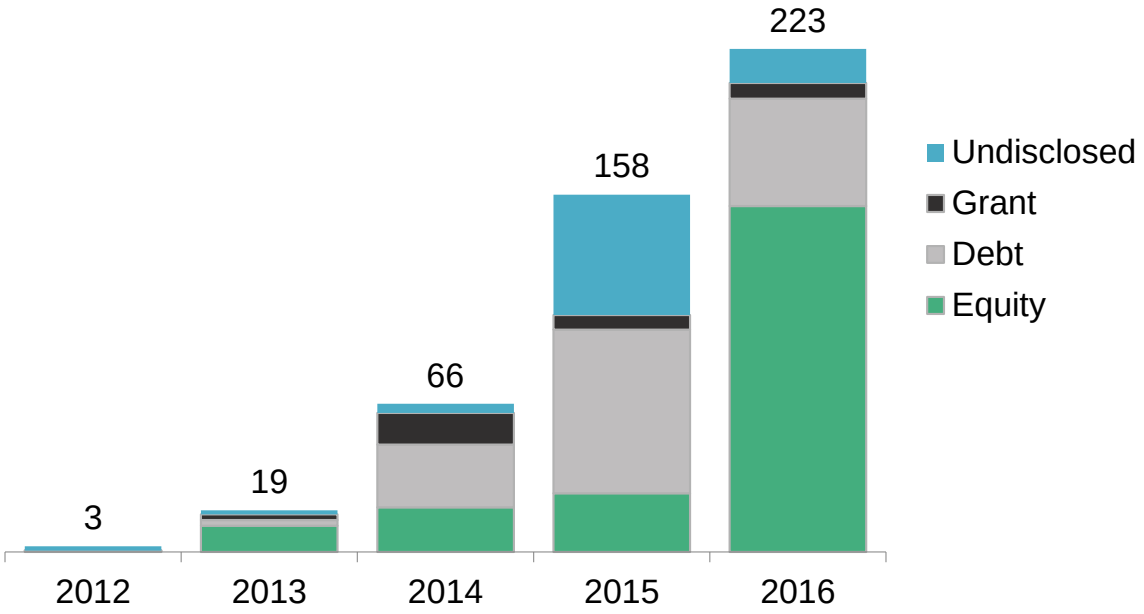
Bloomberg NEW ENERGY FINANCE

CUMULATIVE UNIT SALES OF SELECTED PAY-AS-YOU-GO SOLAR COMPANIES (THOUSAND UNITS)



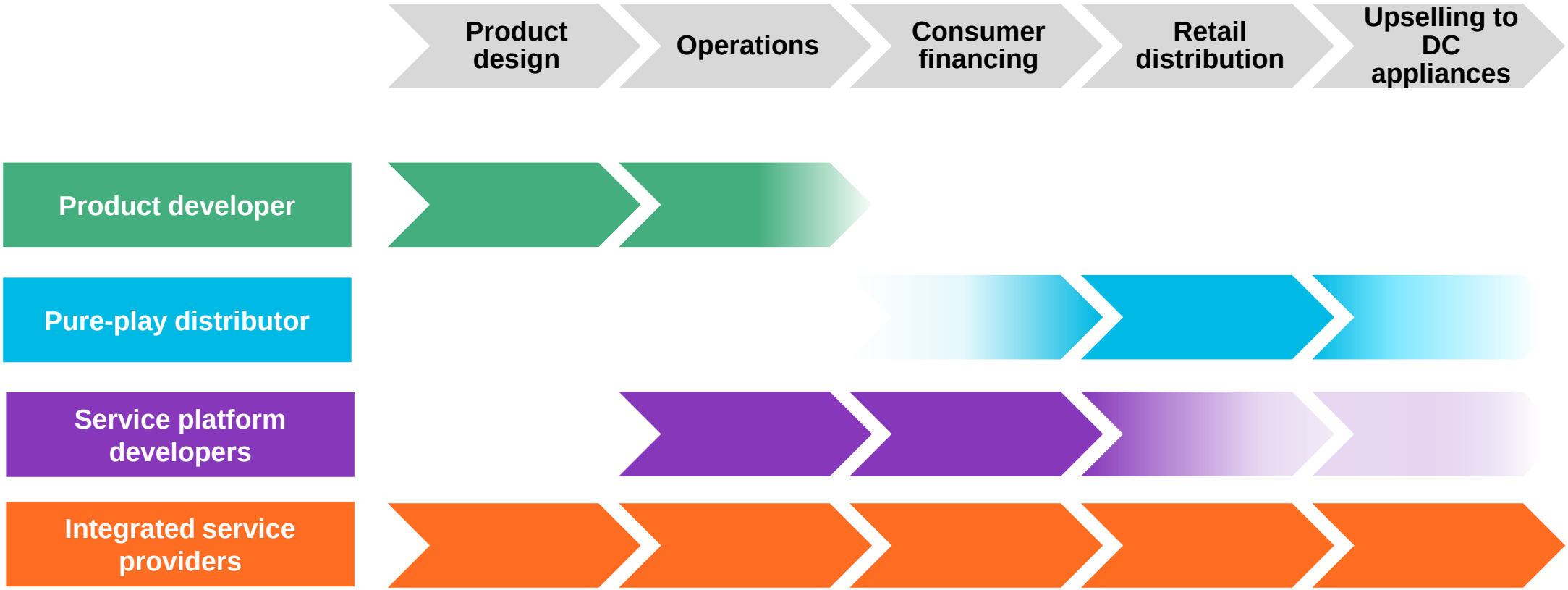
Source: Bloomberg New Energy Finance, news reports, company websites. All figures in the left chart are either latest or published between Jan – July 2016

INVESTMENTS IN PAY-AS-YOU-GO SOLAR COMPANIES ($M)



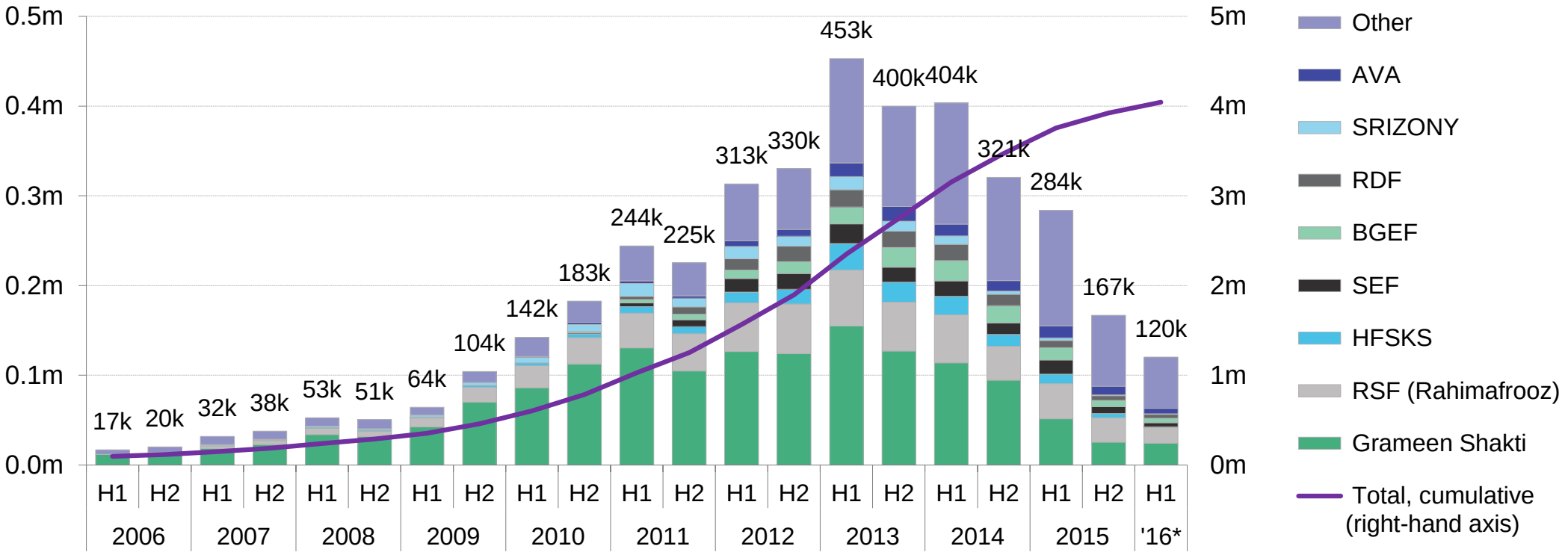
Source: Bloomberg New Energy Finance.

PAY-AS-YOU-GO BUSINESS STRATEGIES



Source: GOGLA, IFC Lighting Global, Bloomberg New Energy Finance

SALES OF SHS UNDER THE IDCOL PROGRAMME BY COMPANY, H1 2006–H1 2016* (UNITS)

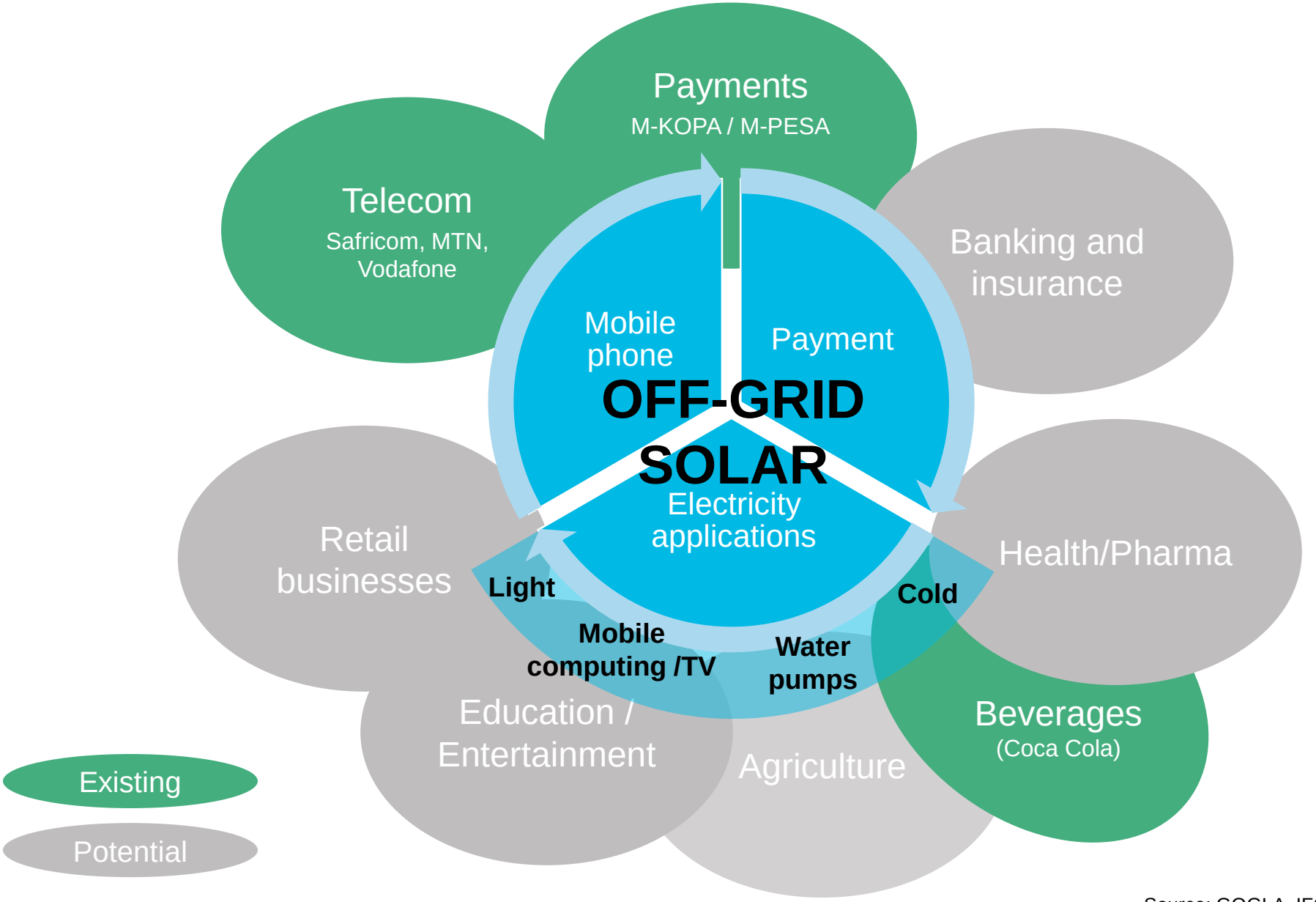


Note: *H1 2016 is estimated at 1.5x data reported up to May 2016.

Source: Bloomberg New Energy Finance, IDCOL.

EXISTING AND POTENTIAL CROSS-INDUSTRY PARTNERSHIPS

Bloomberg NEW ENERGY FINANCE



Source: GOGLA, IFC Lighting Global, Bloomberg New Energy Finance

CHALLENGES TO THE PAYG INDUSTRY

Bloomberg NEW ENERGY FINANCE

- Long lead time for building the company infrastructure
- Geographical differences in terms of business environment (eg., mobile-money infrastructure)
- Demand for debt financing will continue to outstrip supply for the foreseeable future

MINI-GRID

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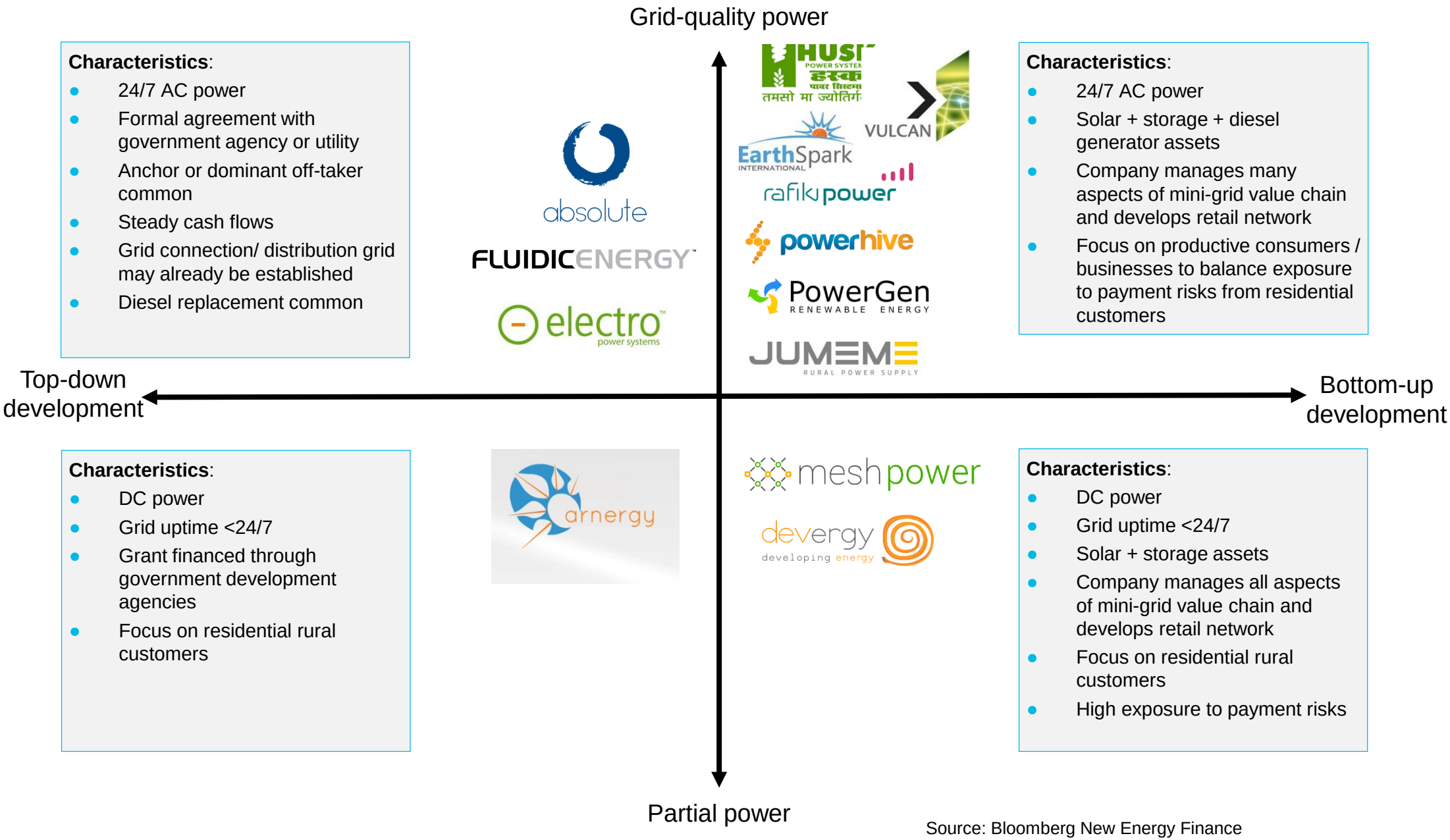
MINI-GRID DEVELOPMENT MODELS

Bloomberg NEW ENERGY FINANCE



Characteristics:
- 24/7 AC power
- Formal agreement with government agency or utility
- Anchor or dominant off-taker common
- Steady cash flows
- Grid connection/ distribution grid may already be established
- Diesel replacement common

Characteristics:
- 24/7 AC power
- Solar + storage + diesel generator assets
- Company manages many aspects of mini-grid value chain and develops retail network
- Focus on productive consumers / businesses to balance exposure to payment risks from residential customers

Characteristics:
- DC power
- Grid uptime <24/7
- Grant financed through government development agencies
- Focus on residential rural customers

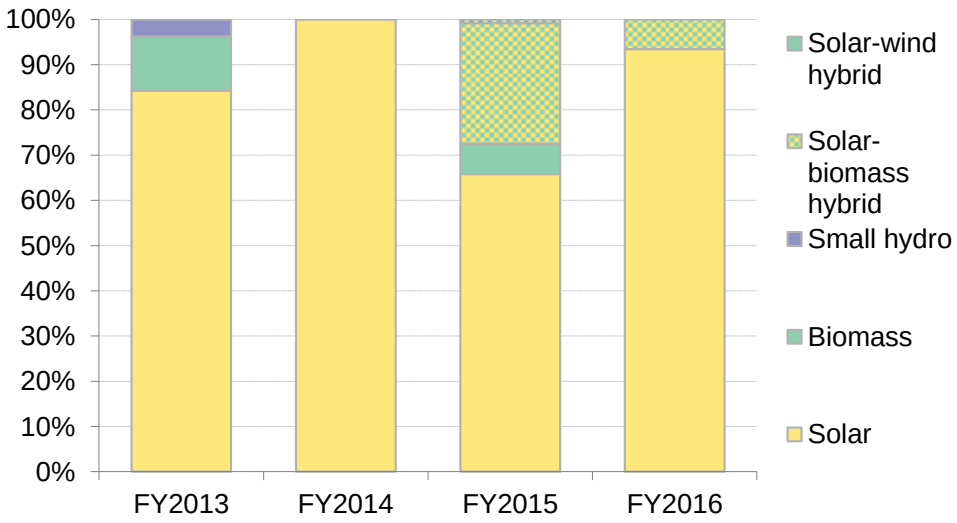
Characteristics:
- DC power
- Grid uptime <24/7
- Solar + storage assets
- Company manages all aspects of mini-grid value chain and develops retail network
- Focus on residential rural customers
- High exposure to payment risks

Source: Bloomberg New Energy Finance

MINI-GRIDS TRENDS

- Solar PV is rapidly becoming the main generation technology in mini-grids
- Remote monitoring mechanisms are crucial to keep costs in check
- Understanding what happens when the grid arrives remains the single largest challenge to financing

RENEWABLE TECHNOLOGIES USED IN MINI-GRIDS IN INDIA



Source: Bloomberg New Energy Finance

KEY TAKEAWAYS

- Consumers are willing to pay premium tariffs
- Simple technologies create a highly competitive market
- Distribution relationships open up-sell opportunities
- Future grid arrival remains the largest challenge to finance mini-grids

3. SUCCESSFUL POLICY CASES

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CASE 1: RENEWABLE ENERGY AUCTION

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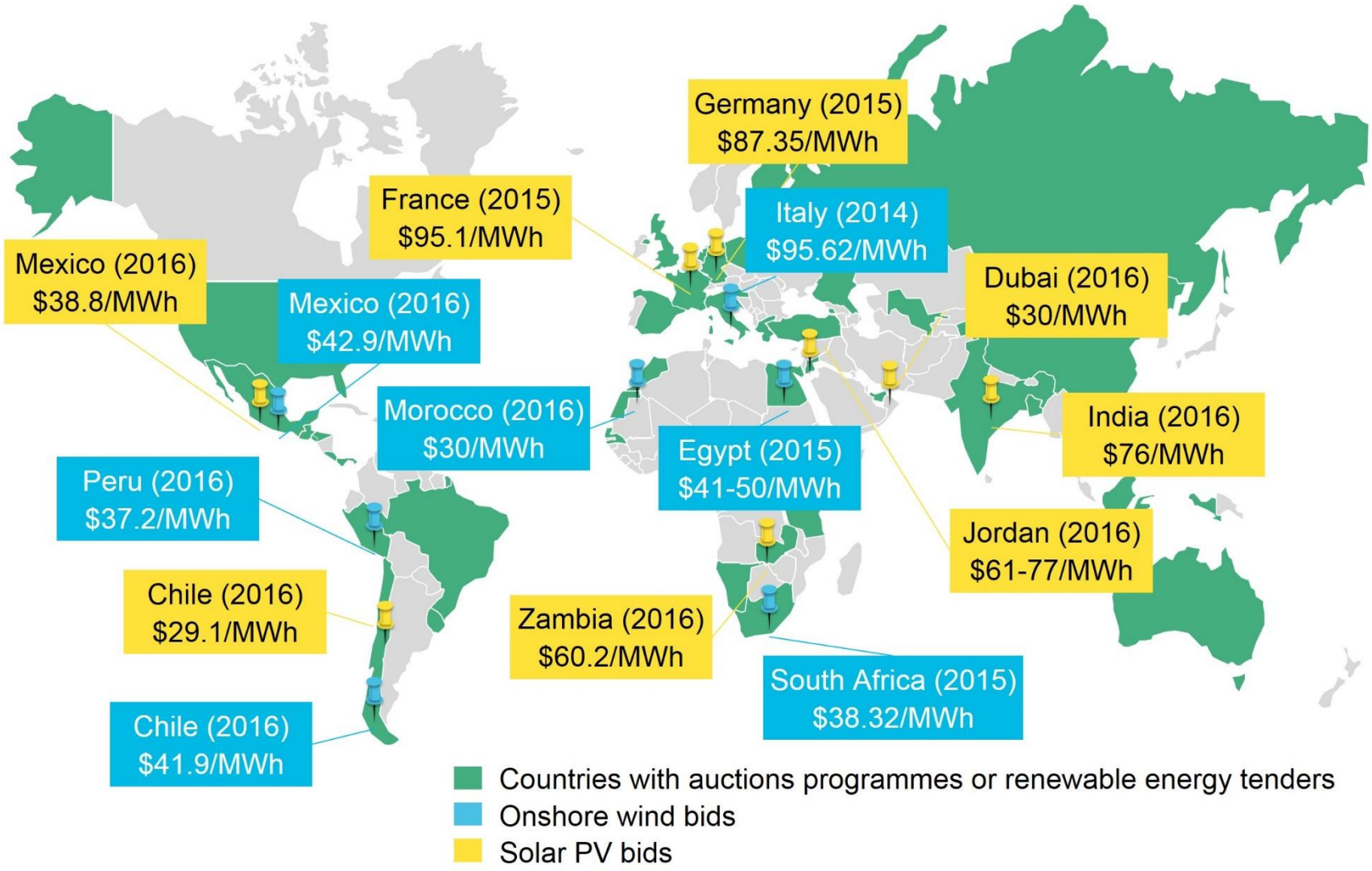
COUNTRIES WITH CLEAN ENERGY TENDER PROGRAMMES AND SELECT RECENT LOWEST CLEARING PRICES, H1 2016

Bloomberg NEW ENERGY FINANCE



Note: bids are reflective of lowest bid in each country. China's auction programme is currently on hold but may be re-introduced in the near future. Tenders have been used infrequently at a state level rather than nationwide in the US and Australia. Dollar values are nominal and converted using exchange rate on the day of the result announcement.

Source: Climatescope 2016

2016 UNSUBSIDISED CLEAN ENERGY 2016 WORLD RECORDS

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SOLAR PV

Location:	Peru
Bidder:	Enel Green Power
Signed:	February 2016
Construction:	2017
Price:	US$ 4.8 c/kWh

ONSHORE WIND

Location:	Morocco
Bidder:	Enel Green Power
Signed:	January 2016
Construction:	2018
Price:	US$ 3.0 c/kWh

Source: Bloomberg New Energy Finance; ImagesSiemens; Wikimedia Commons

2016 UNSUBSIDISED CLEAN ENERGY 2016 WORLD RECORDS

Bloomberg NEW ENERGY FINANCE

SOLAR PV

Location:	Coahuila, Mexico
Bidder:	Enel Green Power
Signed:	March 2016
Construction:	2018
Price:	US$ 3.6 c/kWh

ONSHORE WIND

Location:	Morocco
Bidder:	Enel Green Power
Signed:	January 2016
Construction:	2018
Price:	US$ 3.0 c/kWh

Source: Bloomberg New Energy Finance; ImagesSiemens; Wikimedia Commons

2016 UNSUBSIDISED CLEAN ENERGY 2016 WORLD RECORDS

Bloomberg NEW ENERGY FINANCE

SOLAR PV

Location:	Dubai
Bidder:	Masdar Consortium
Signed:	May 2016
Construction:	2019
Price:	US$ 2.99 c/kWh

ONSHORE WIND

Location:	Morocco
Bidder:	Enel Green Power
Signed:	January 2016
Construction:	2018
Price:	US$ 3.0 c/kWh

Source: Bloomberg New Energy Finance; ImagesSiemens; Wikimedia Commons

2016 UNSUBSIDISED CLEAN ENERGY 2016 WORLD RECORDS

Bloomberg NEW ENERGY FINANCE

SOLAR PV

Location: Chile
Bidder: Solarpack Corporation
Signed: August 2016
Construction: 2019
Price: US$ 2.91 c/kWh

ONSHORE WIND

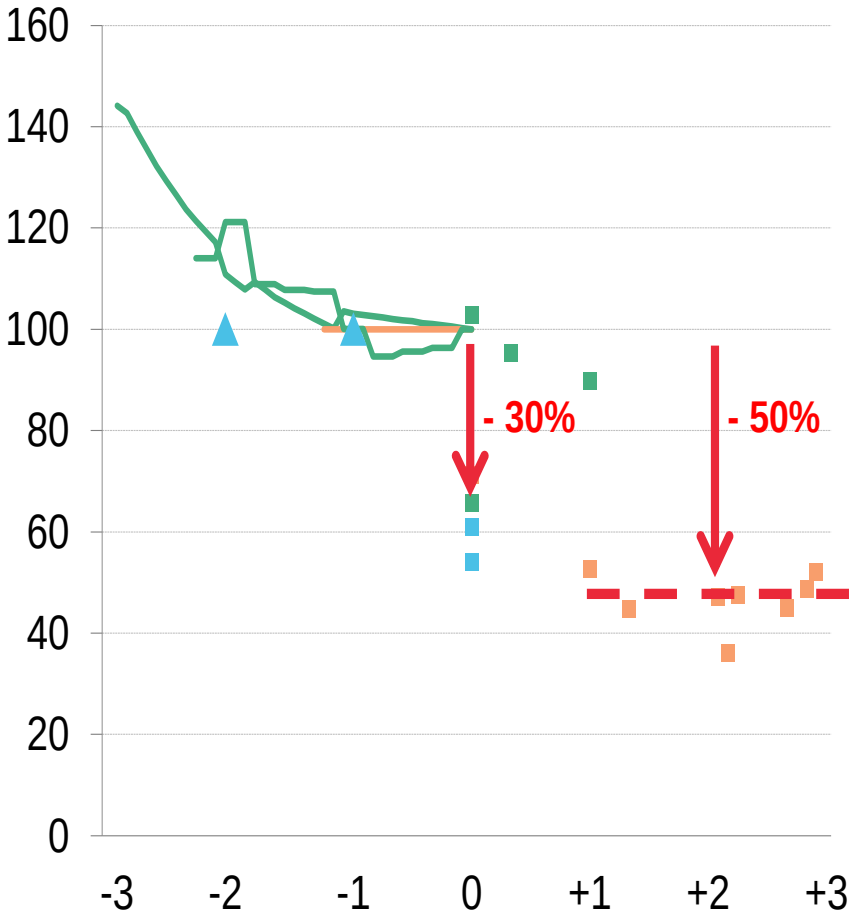
Location: Morocco
Bidder: Enel Green Power
Signed: January 2016
Construction: 2018
Price: US$ 3.0 c/kWh

Source: Bloomberg New Energy Finance; ImagesSiemens; Wikimedia Commons

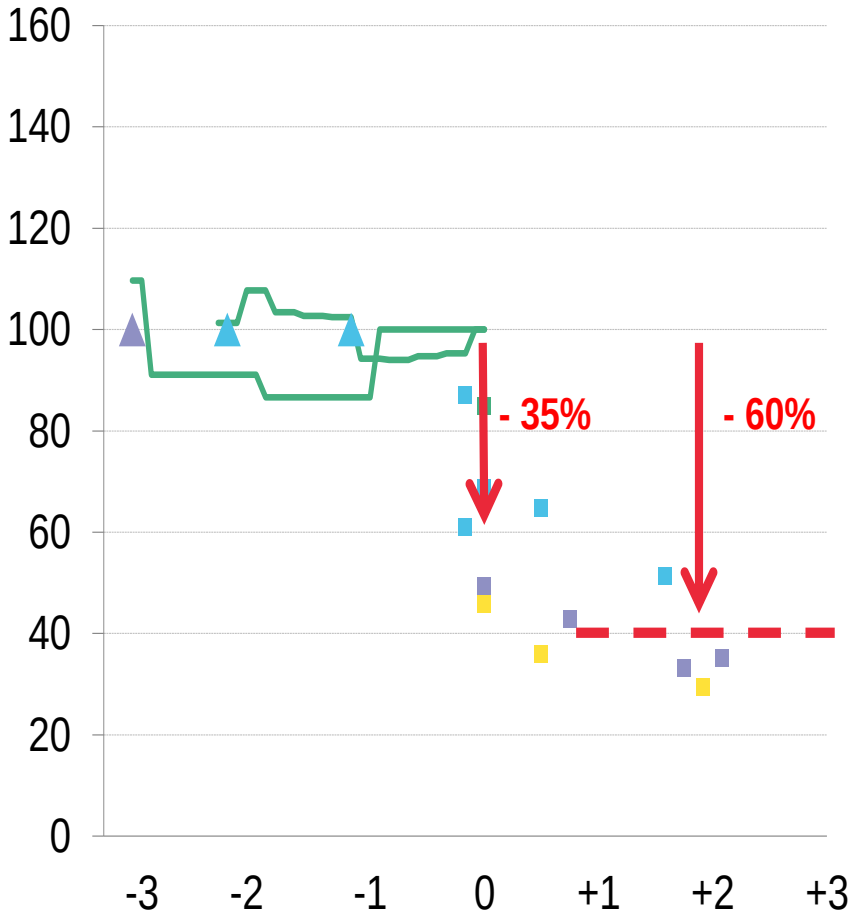
PRICE IMPACT OF SWITCH FROM FIT TO AUCTIONS, SELECTED COUNTRIES (NORMALISED)

Bloomberg NEW ENERGY FINANCE

SOLAR PV
(unit price normalised to 100 at date of first auction)



ONSHORE WIND
(unit price normalised to 100 at date of first auction)



KEY

: tariffs

: non-tariff price signals

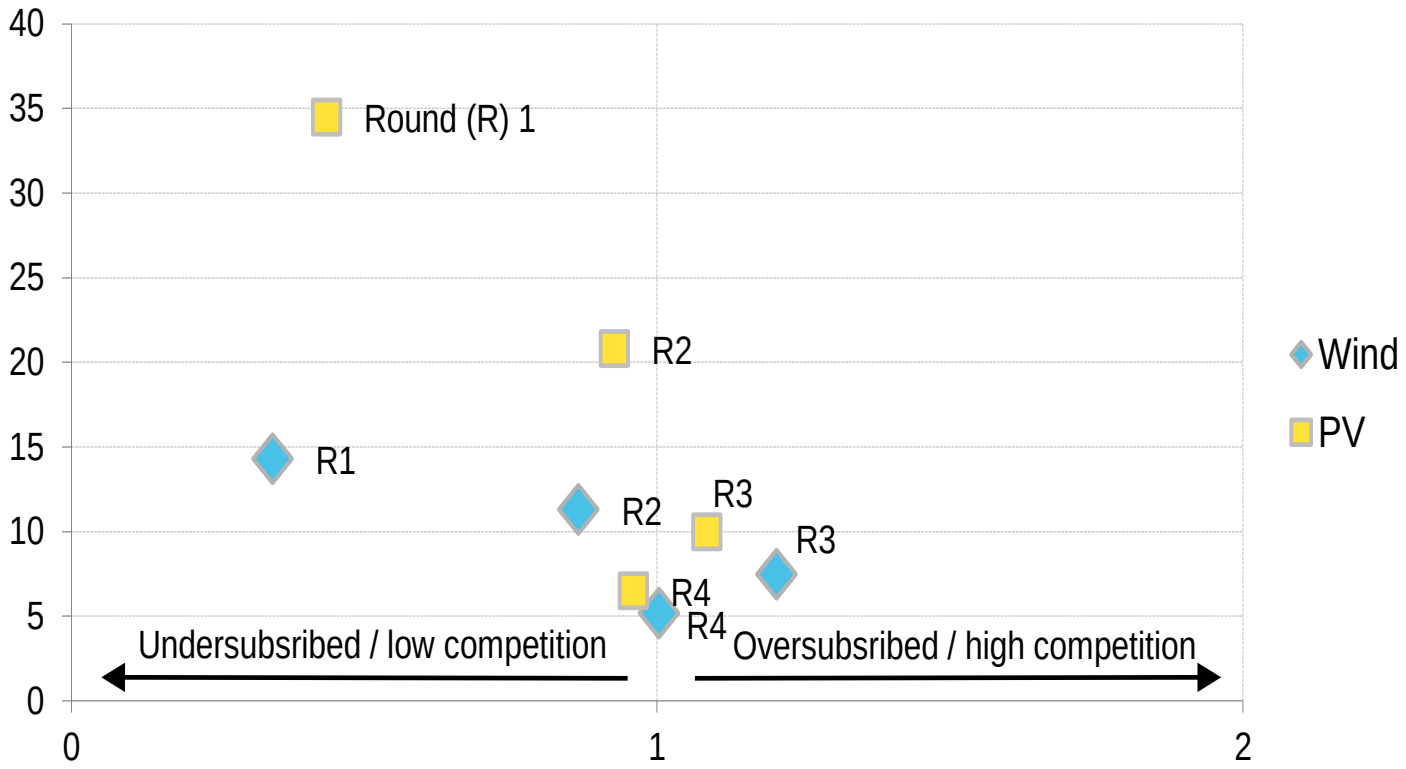
: auctions

- EMEA
- Other LatAm
- Brazil
- India
- South Africa

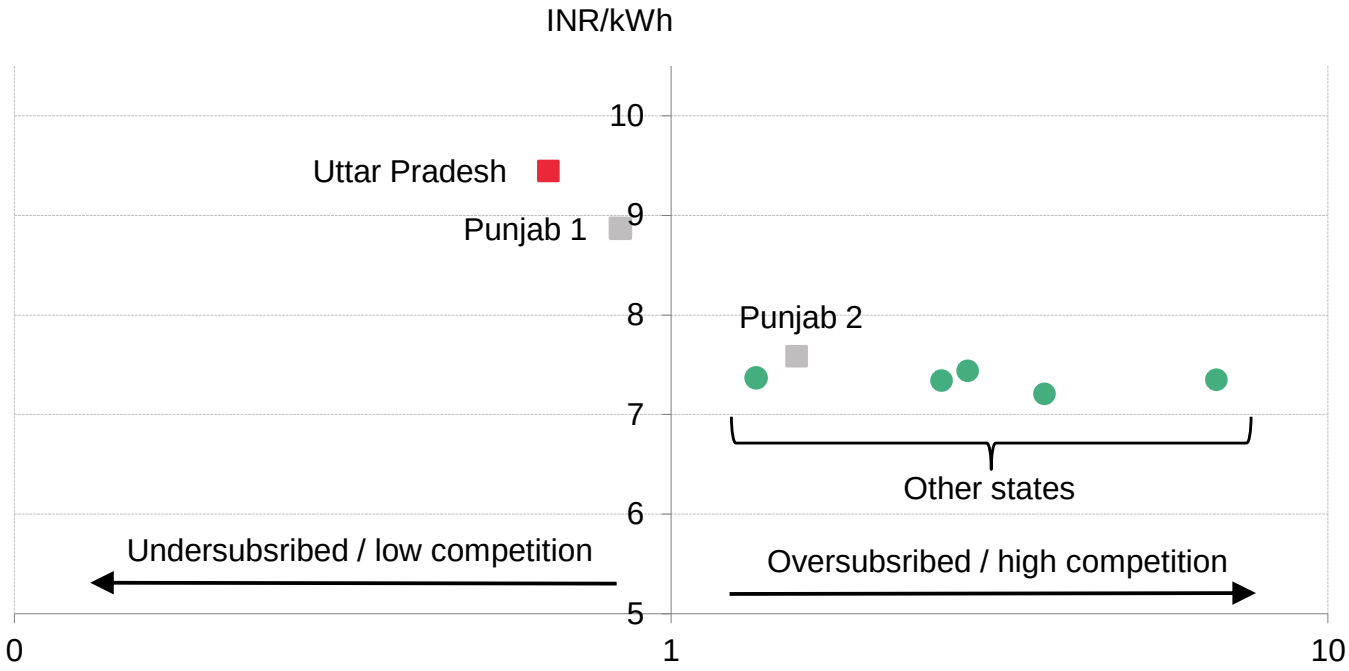
Source: Bloomberg New Energy Finance

PRICE AND COMPETITION LEVEL OF SOUTH AFRICA'S RENEWABLE ENERGY AUCTIONS ($/KWH)

Bloomberg NEW ENERGY FINANCE



WEIGHTED AVERAGE BID PRICE OF MAJOR PV AUCTIONS IN INDIA AND COMPETITION LEVEL (INR/KWH)



CASE 2: ELECTRIFICATION PROGRAMME IN PERU

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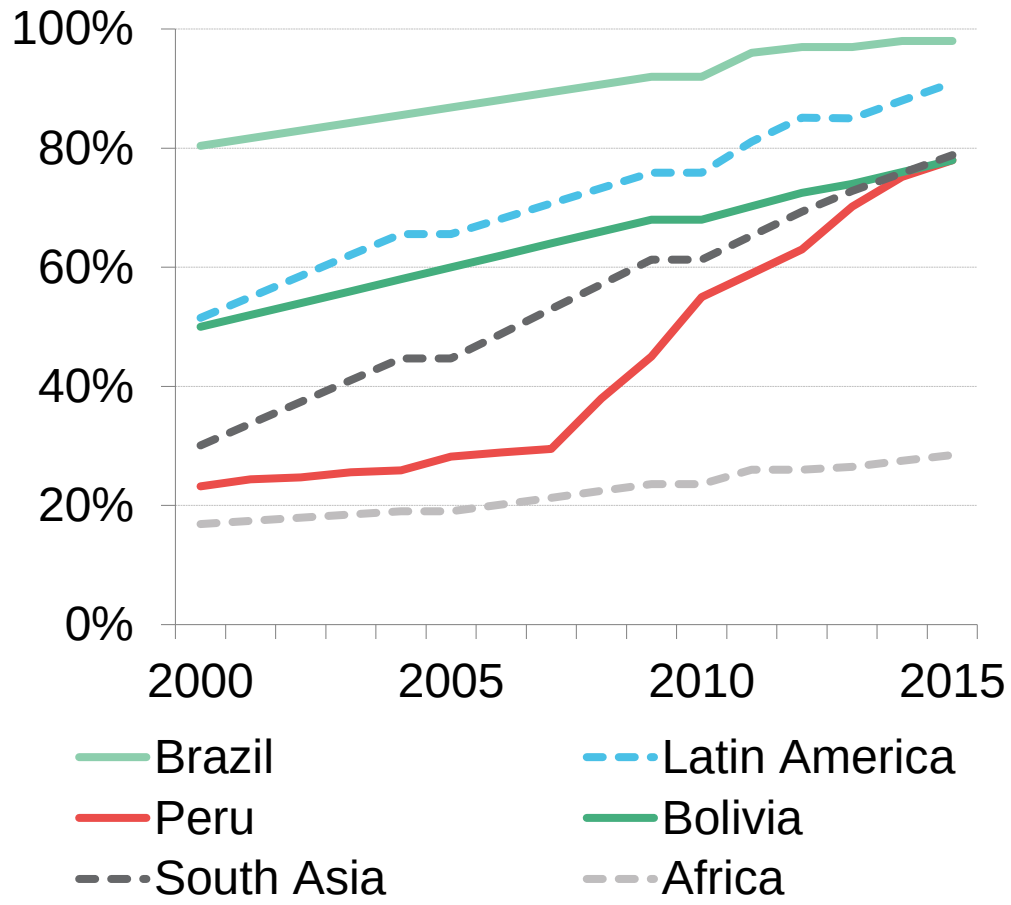
RURAL ELECTRIFICATION RATES, 2000 - 2015

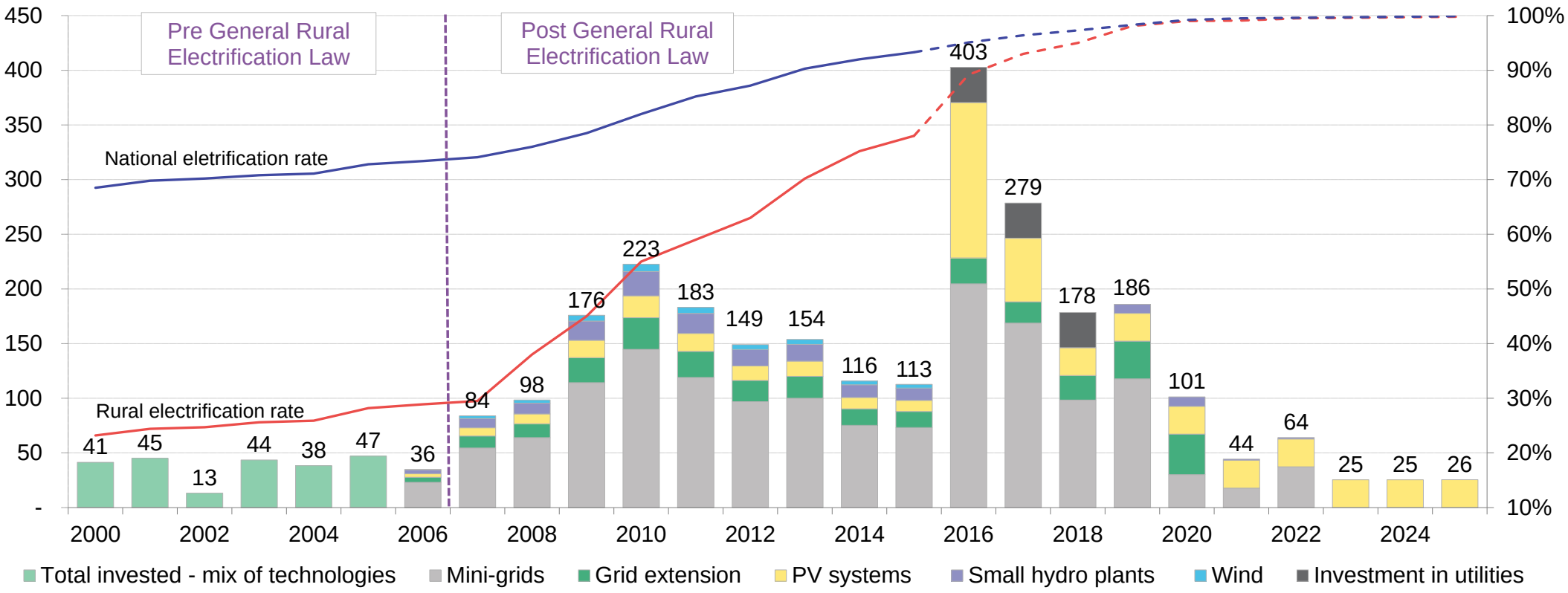


Note: South Asia includes Afghanistan, Bangladesh, India, Nepal, Pakistan and Sri Lanka.

Source: World Energy Outlook, World Bank, Bloomberg New Energy Finance.

PERU'S RURAL ELECTRIFICATION BUDGET AND ELECTRIFICATION RATES, 2000-2025

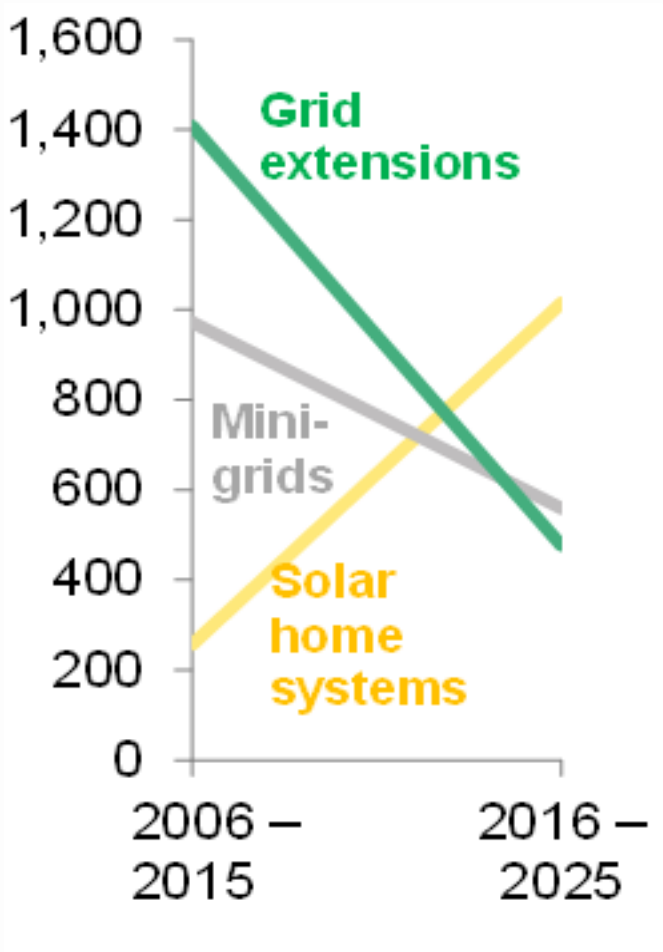
Bloomberg NEW ENERGY FINANCE



Note: 2006-2015 budget break down was estimated based on PNER 2004-2013 and PNER 2009-2018.

Source: OSINERGMIN, Bloomberg New Energy Finance.

HOUSEHOLDS ELECTRIFIED PER $1M INVESTED BY THE GOVERNMENT, 2006 - 2025



Source: OSINERGMIN, Bloomberg New Energy Finance

KEY TAKEAWAYS

- Auction can be an effective tool to reduce cost of renewables
- Lowering risk can lead more developers to participate auction
- Rural electrification can be accelerated at achievable cost through determined action.
- Technical regulations that do not fit consumer preference may need reconsideration.

SUMMARY

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SUMMARY

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Utility-scale renewables	A new utility-scale solar and wind projects are still more expensive than thermal power projects. A lack of local experience and supply chain is a major factor. Deployment experience with support of development banks is a key to reduce LCOE. A small-hydro could be a cost effective option.
Off-grid solar	Consumers are willing to pay premium tariffs for better energy services. Simple technologies can generate fierce competition amongst market players and lead them to deploy higher-valued products and services.
Policy	In auction programmes, lowering risks for developers is a key to generate competition in market and to reduce cost. Rural electrification can be accelerated at achievable cost through determined action.

BNEF COVERAGE OF FRONTIER POWER

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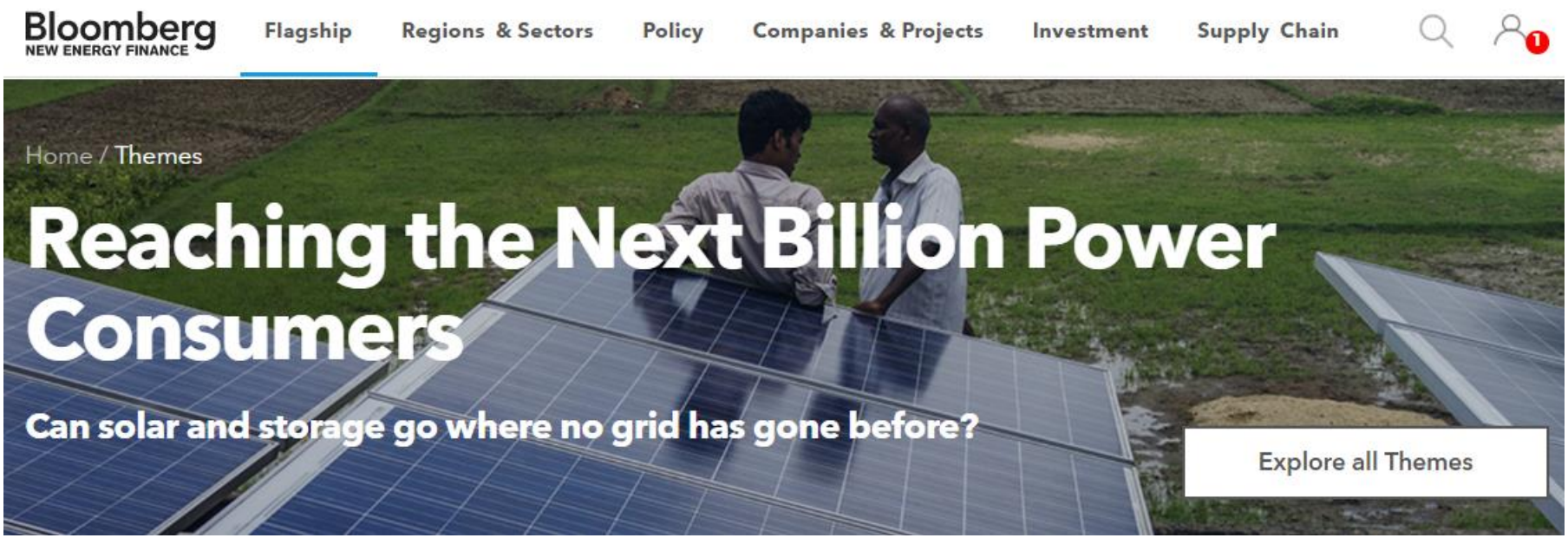
FURTHER READING

Bloomberg NEW ENERGY FINANCE



Sample reports

Experimenting in Tanzania

Case study: E.ON's Rafiki Power mini-grids

9 Dec 2016

Policy intervention

How Peru built LatAm's fastest electrification program

9 Nov 2016

Status update

Off-grid solar market trends report 2016

3 Mar 2016

Small-scale PV in emerging markets

Q1 2017 Off-grid and Mini-grid Market Outlook

5 Jan 2017

Market sizing

Small-scale solar in emerging markets

5 Jan 2017

24 off-grid countries reviewed

Climatescope 2016 - Full report

15 Dec 2016

Consumer survey

Who is buying Rwanda's biggest solar project?

23 Sep 2016

RESEARCH SCOPE FOR BNEF FRONTIER POWER

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Off-grid	Weak grid	Grid extensions
Solar lanterns		
Solar home systems		
DC micro grids		
24/7 AC mini-grids		
Irrigation and agriculture mechanisation		
Communication and critical infrastructure		
	(Back-up) diesel replacement	
	C&I energy in emerging markets	
	Uninterrupted power supply	
		Grid improvements

RESEARCH SCOPE FOR BNEF FRONTIER POWER

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How much kit is sold?

Who will own the customer relationship?

Who is investing in what?

What role can institutional investors play?

Can clean energy replace diesel generators?

How will countries electrify?

THE TEAM

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Analyst

Isabelle Edwards
Analyst

Raksha Gosai
Data researcher

REFERENCE

Climate Scope 2016
(http://global-climatescope.org/en/)

UK DFID LCOE Study
(https://www.gov.uk/dfid-research-outputs/levelised-cost-of-electricity)

Off-grid Solar Market Trend 2016
(https://about.bnef.com/blog/off-grid-solar-market-trends-report-2016/)

Off-Grid and Mini-Grid: Q1 2017 Market Outlook
(https://about.bnef.com/blog/off-grid-mini-grid-q1-2017-market-outlook/)

អរគុណច្រើន

Thank you

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