



GLOBAL WIND ENERGY OUTLOOK | 2016



December 15, 2016

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BECKER BÜTTNER HELD



Associations



GWEC – Uniting the global wind industry and its representative associations

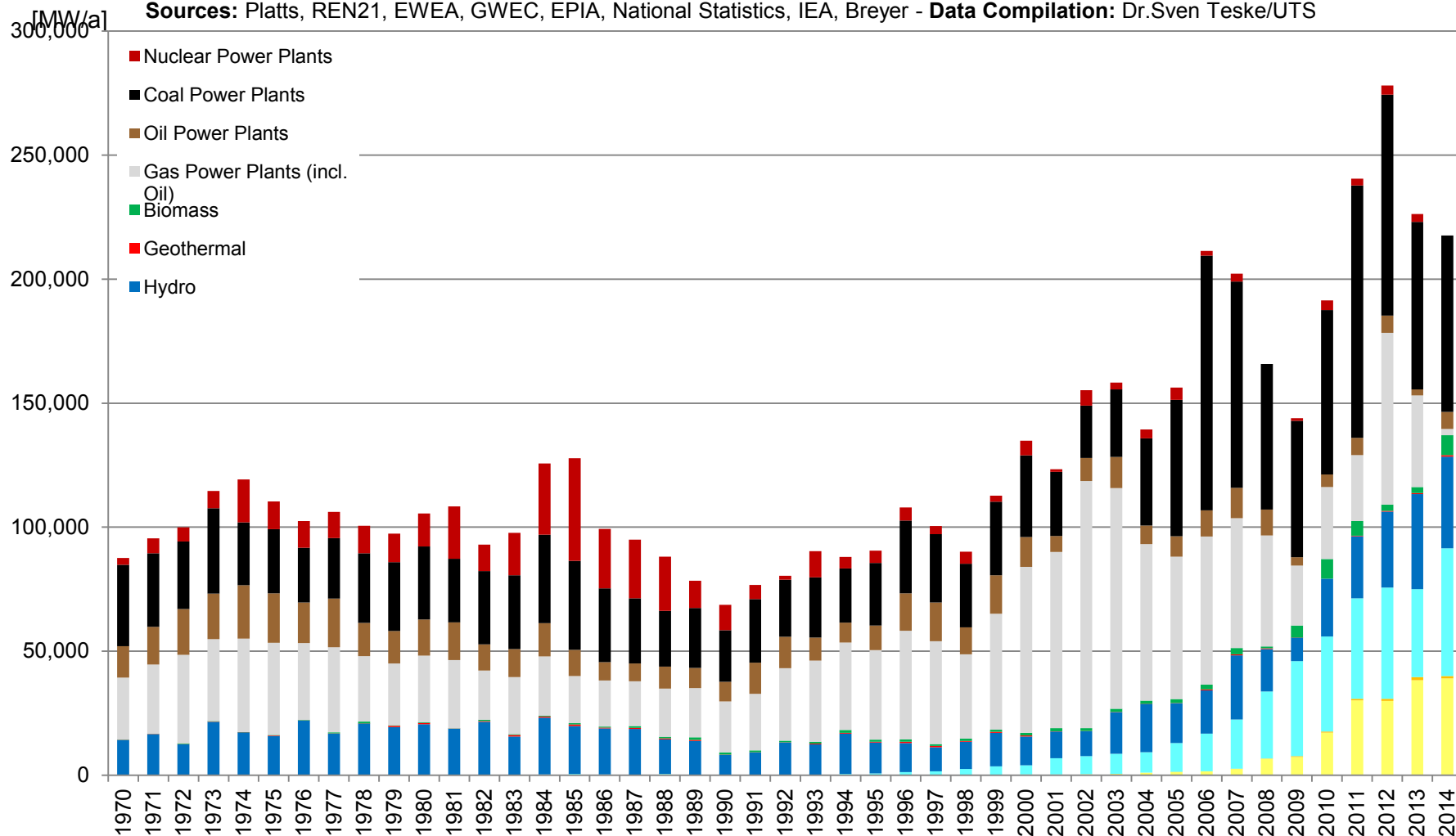
Outline:

1. Status of global power markets
2. Status of global wind power markets
3. Short term projections
4. Global Wind Energy Outlook Scenarios
5. New markets
6. Conclusions and Looking Ahead

The Current Renewable and Power Market

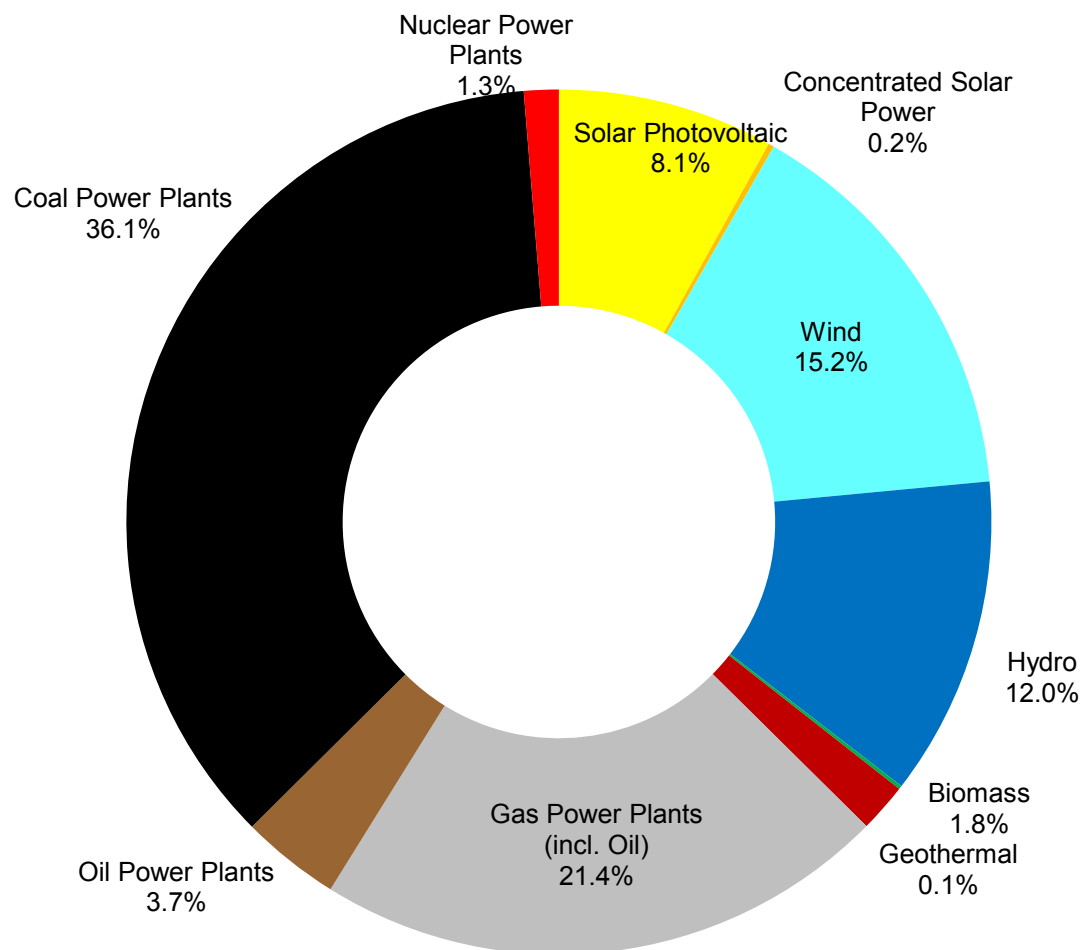
Global Power Plants - Annual Market 1970 - 2014

Sources: Platts, REN21, EWEA, GWEC, EPIA, National Statistics, IEA, Breyer - **Data Compilation:** Dr.Sven Teske/UTS

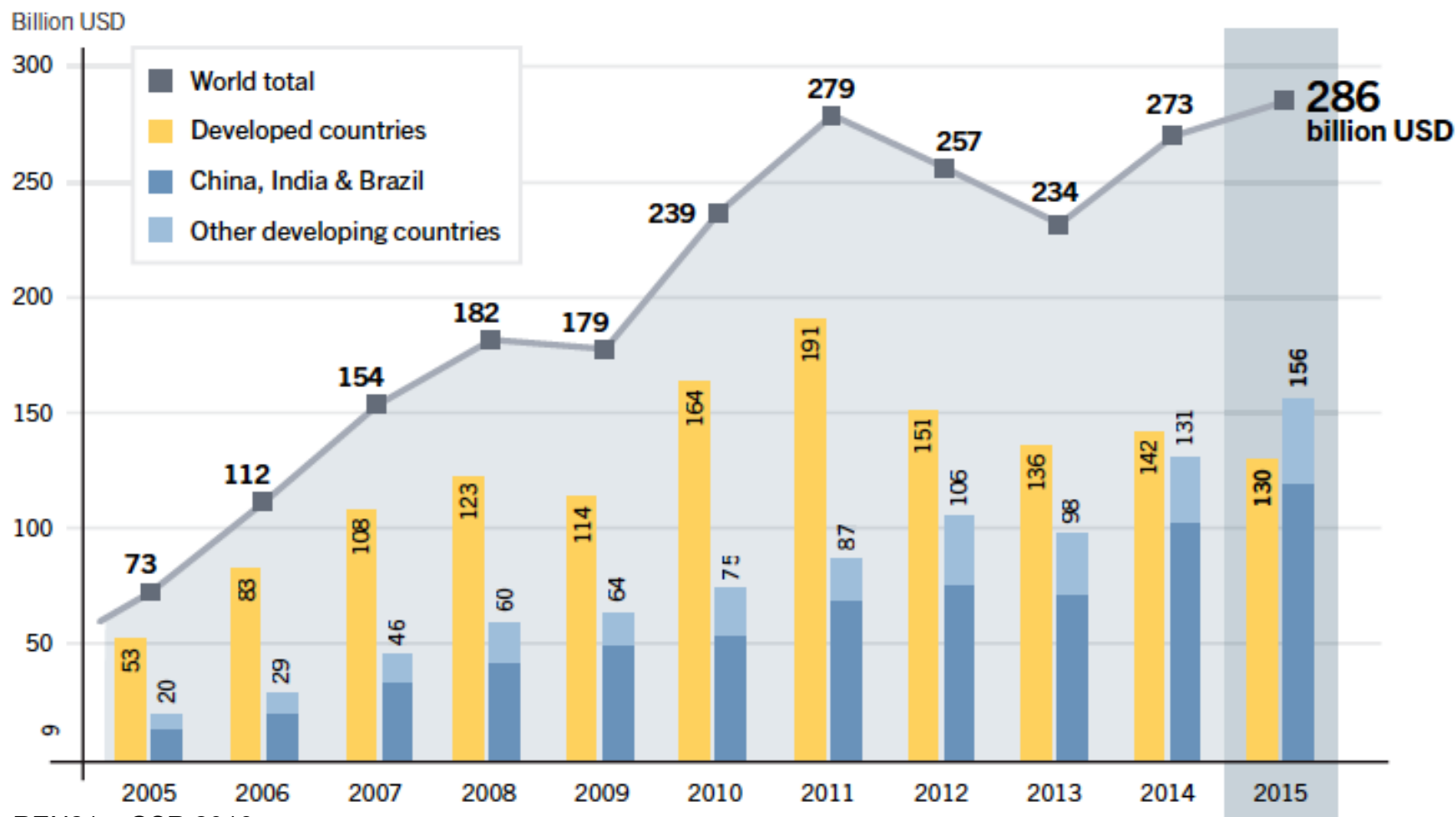


Global Power Plant Market Conditions:

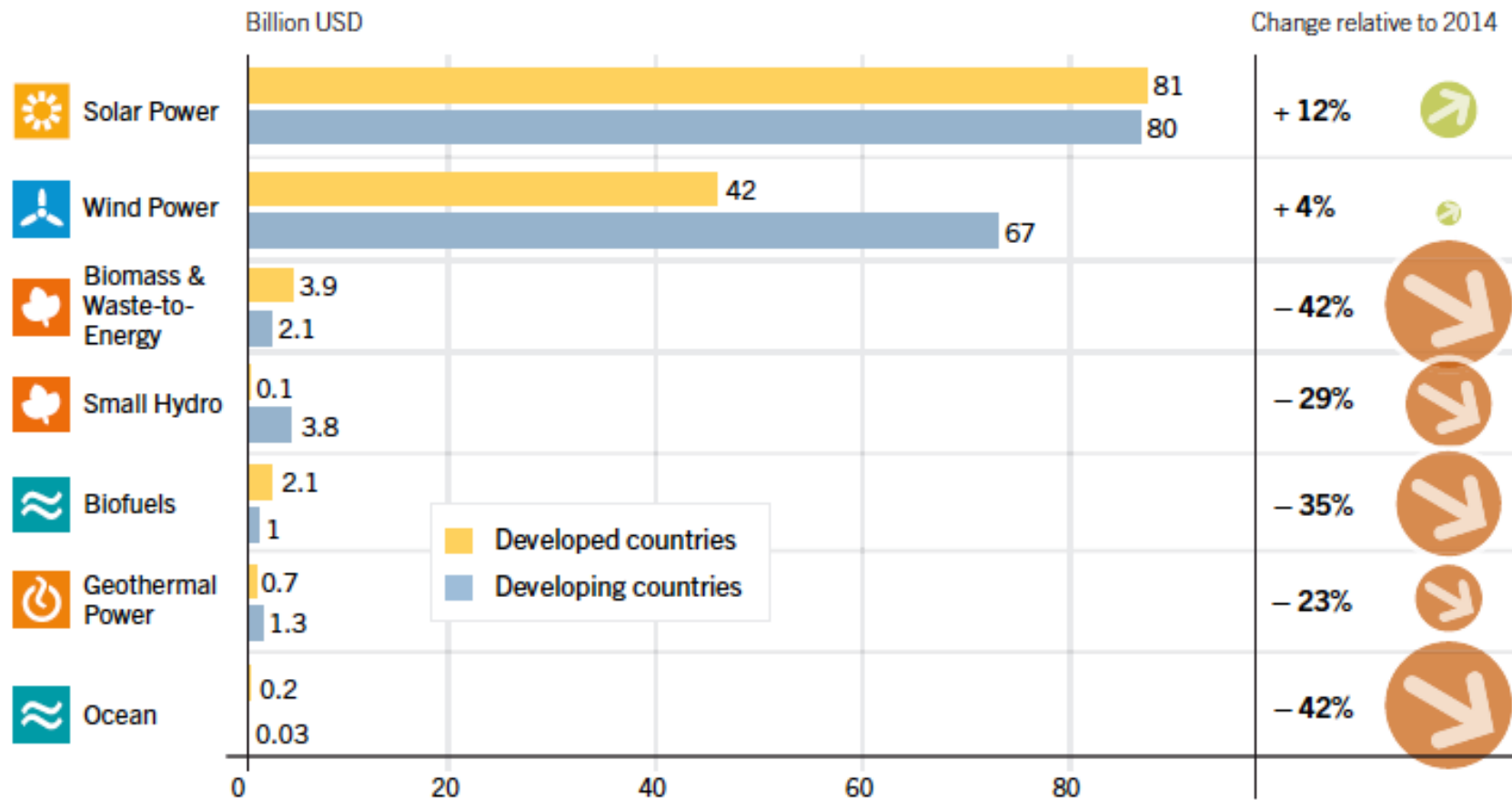
Global: Power Plant Market Shares: 2004 - 2014



Global New Investment in Renewable Power and Fuels, Developed, Emerging and Developing Countries, 2005-2015

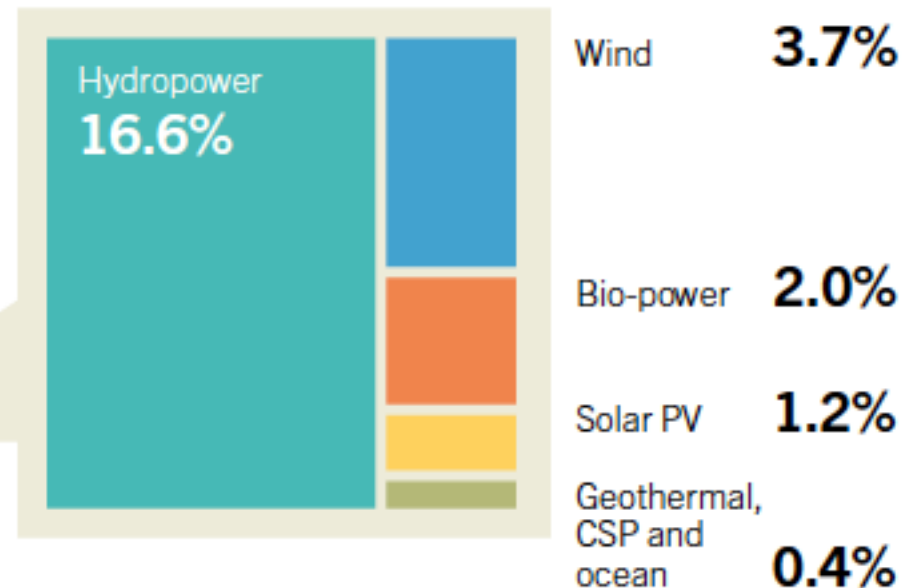
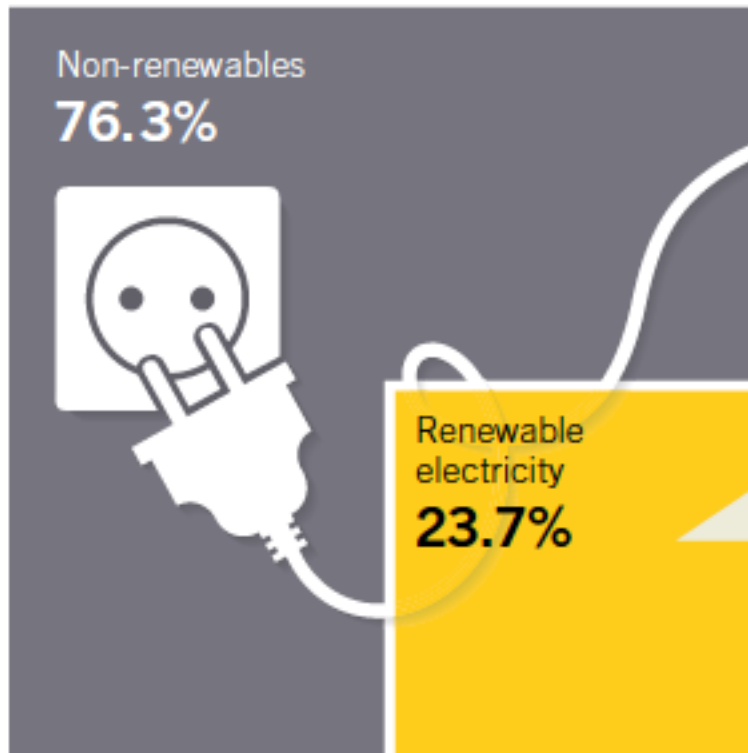


Global New Investment in Renewable Energy by Technology, Developed and Developing Countries, 2015



Source: BNEF

Estimated Renewable Energy Share of Global Electricity Production, End-2015

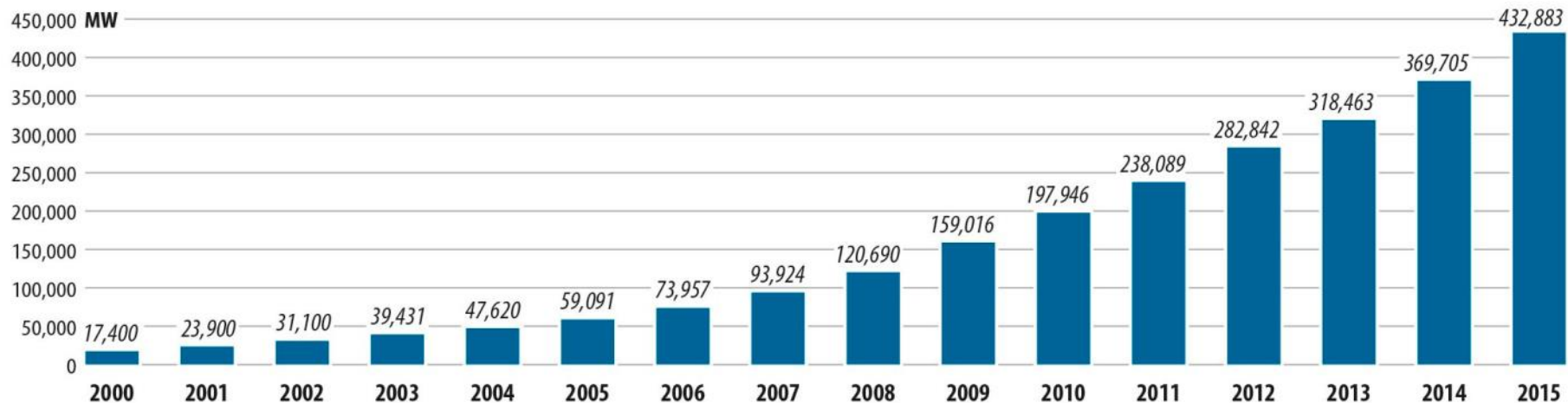


Based on renewable generating capacity at year-end 2015.
Percentages do not add up internally due to rounding.

Status Wind Power Market

2015 growth: 17%

GLOBAL CUMULATIVE INSTALLED WIND CAPACITY 2000-2015

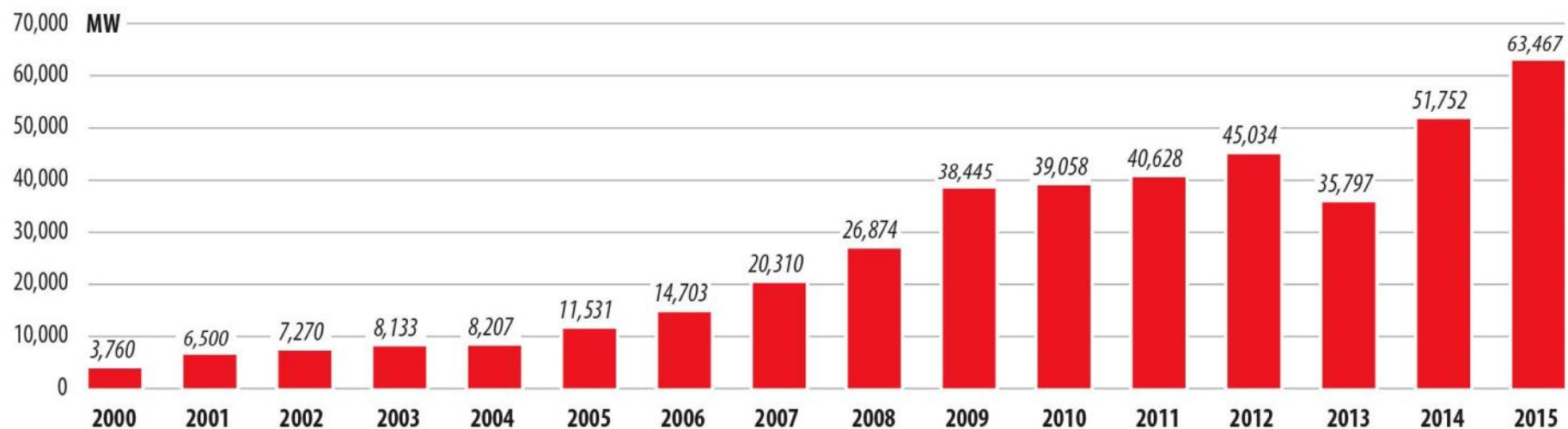


Source: GWEC

16 yr avg. growth: 24.2%

2015 growth: 22%

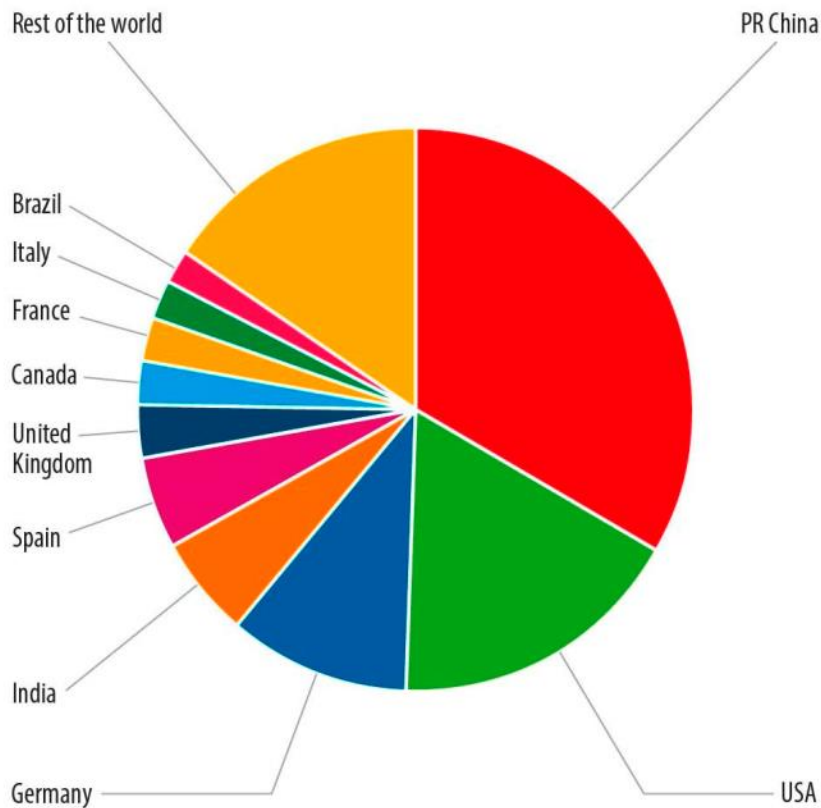
GLOBAL ANNUAL INSTALLED WIND CAPACITY 2000-2015



Source: GWEC

16 yr avg. growth: 24.9%

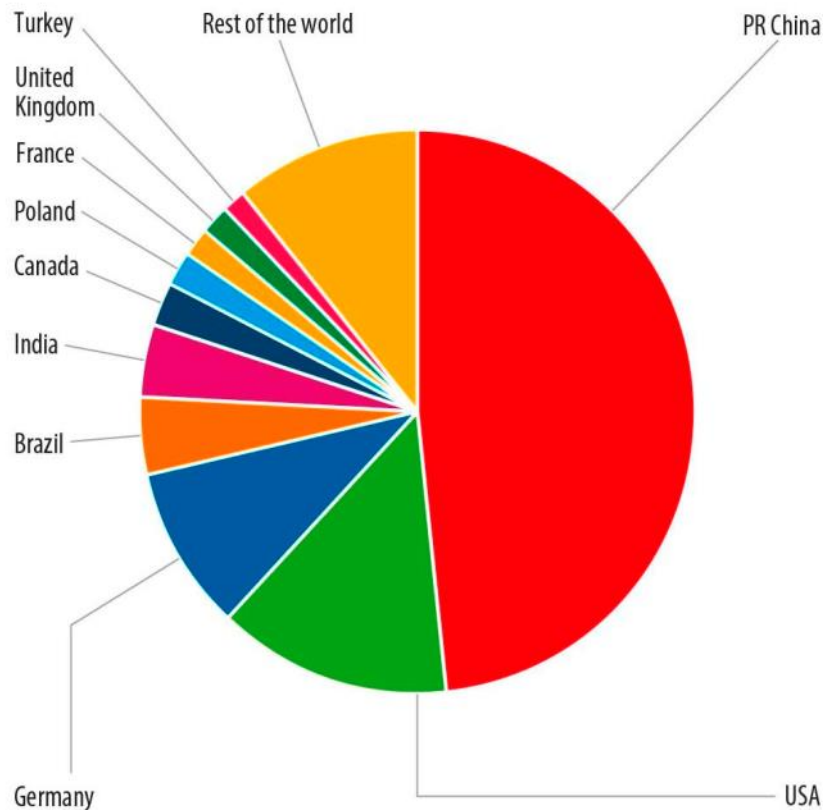
TOP 10 CUMULATIVE CAPACITY DEC 2015



Country	MW	% Share
PR China	145,362	33.6
USA	74,471	17.2
Germany	44,947	10.4
India	25,088	5.8
Spain	23,025	5.3
United Kingdom	13,603	3.1
Canada	11,205	2.6
France	10,358	2.4
Italy	8,958	2.1
Brazil	8,715	2.0
Rest of the world	67,151	15.5
Total TOP 10	365,731	84.5
World Total	432,883	100

Source: GWEC

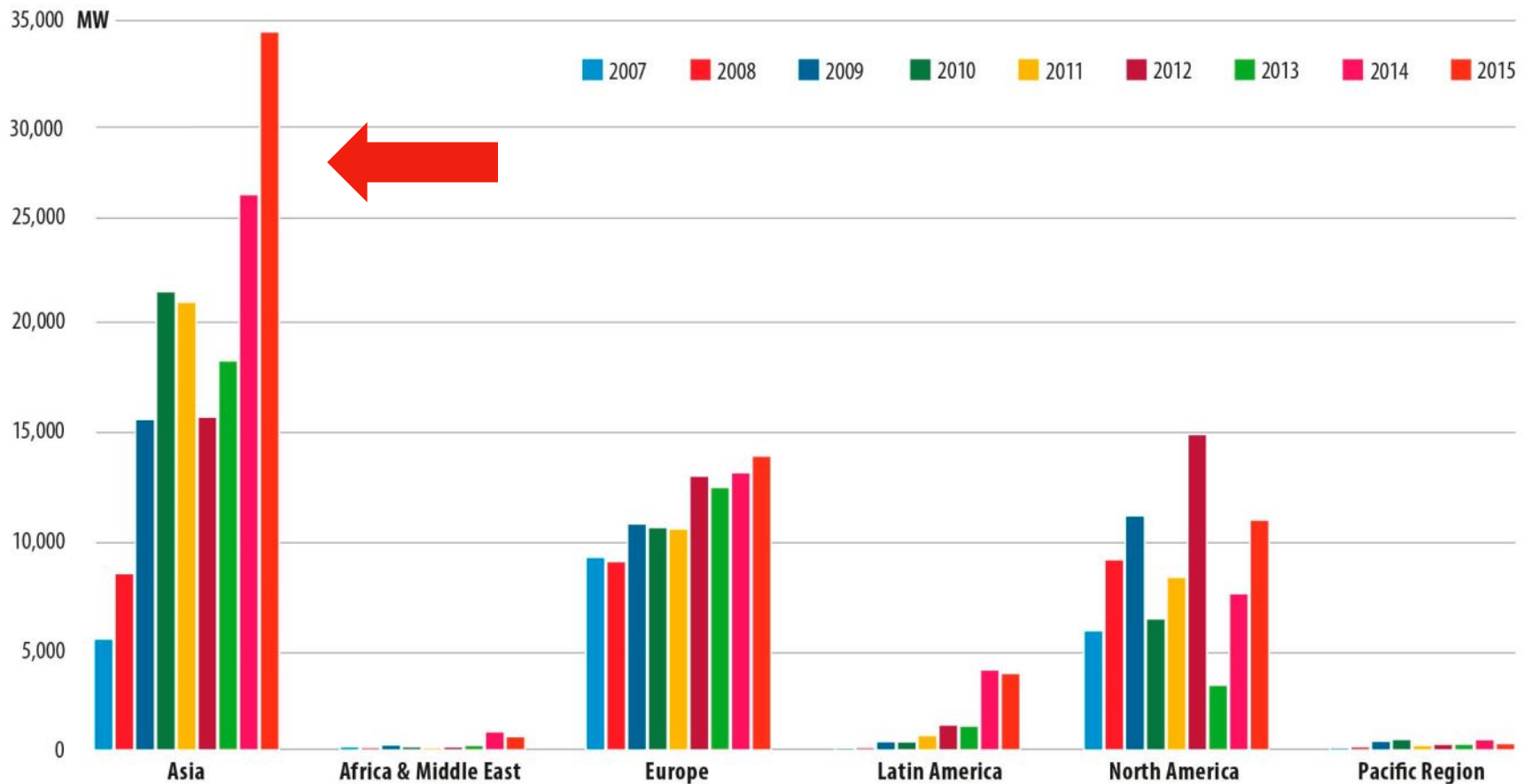
TOP 10 NEW INSTALLED CAPACITY JAN-DEC 2015



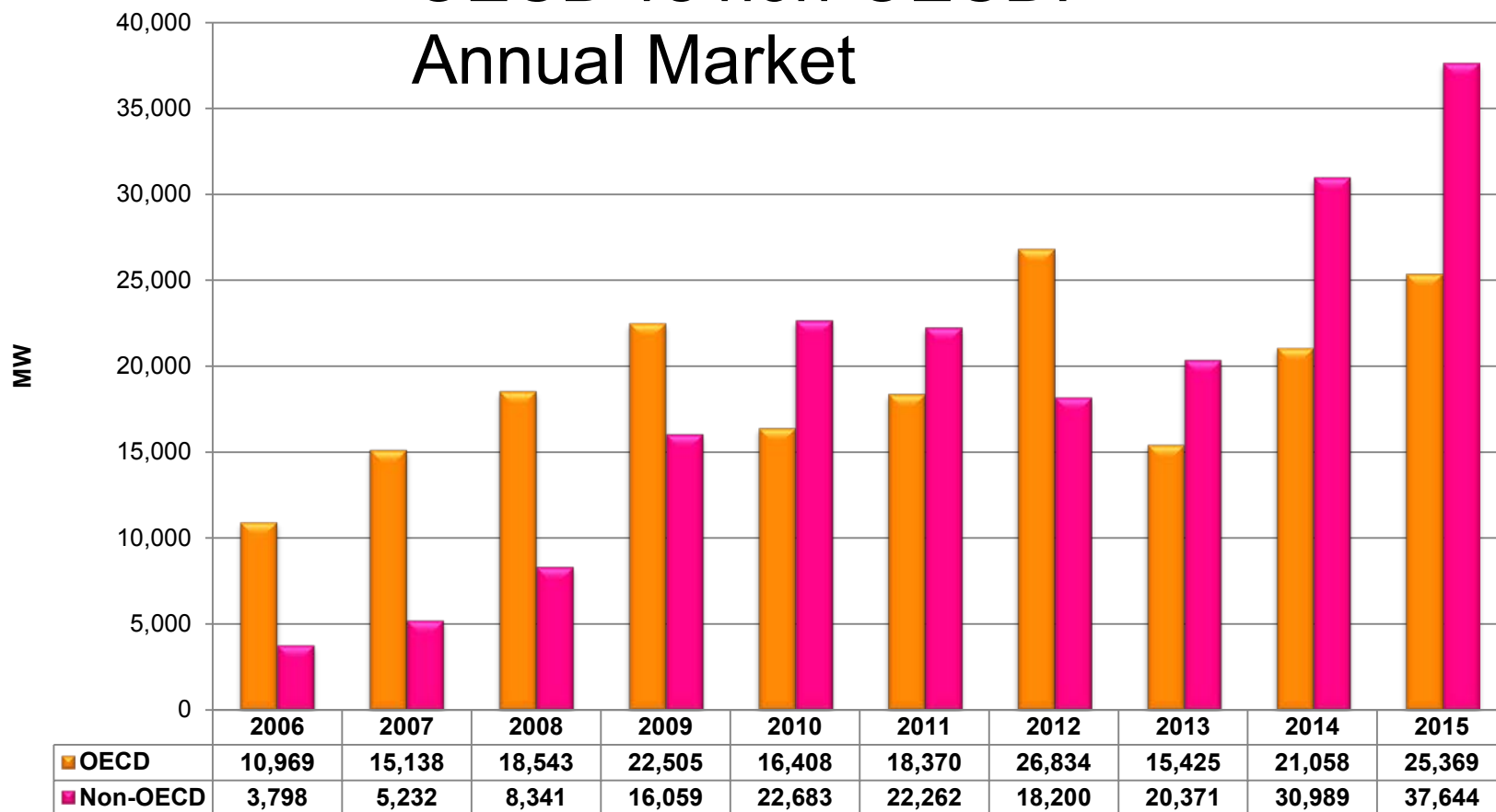
Country	MW	% Share
PR China	30,753	48.5
USA	8,598	13.5
Germany	6,013	9.5
Brazil	2,754	4.3
India	2,623	4.1
Canada	1,506	2.4
Poland	1,266	2.0
France	1,073	1.7
United Kingdom	975	1.5
Turkey	956	1.5
Rest of the world	6,950	11.0
Total TOP 10	56,517	89
World Total	63,467	100

Source: GWEC

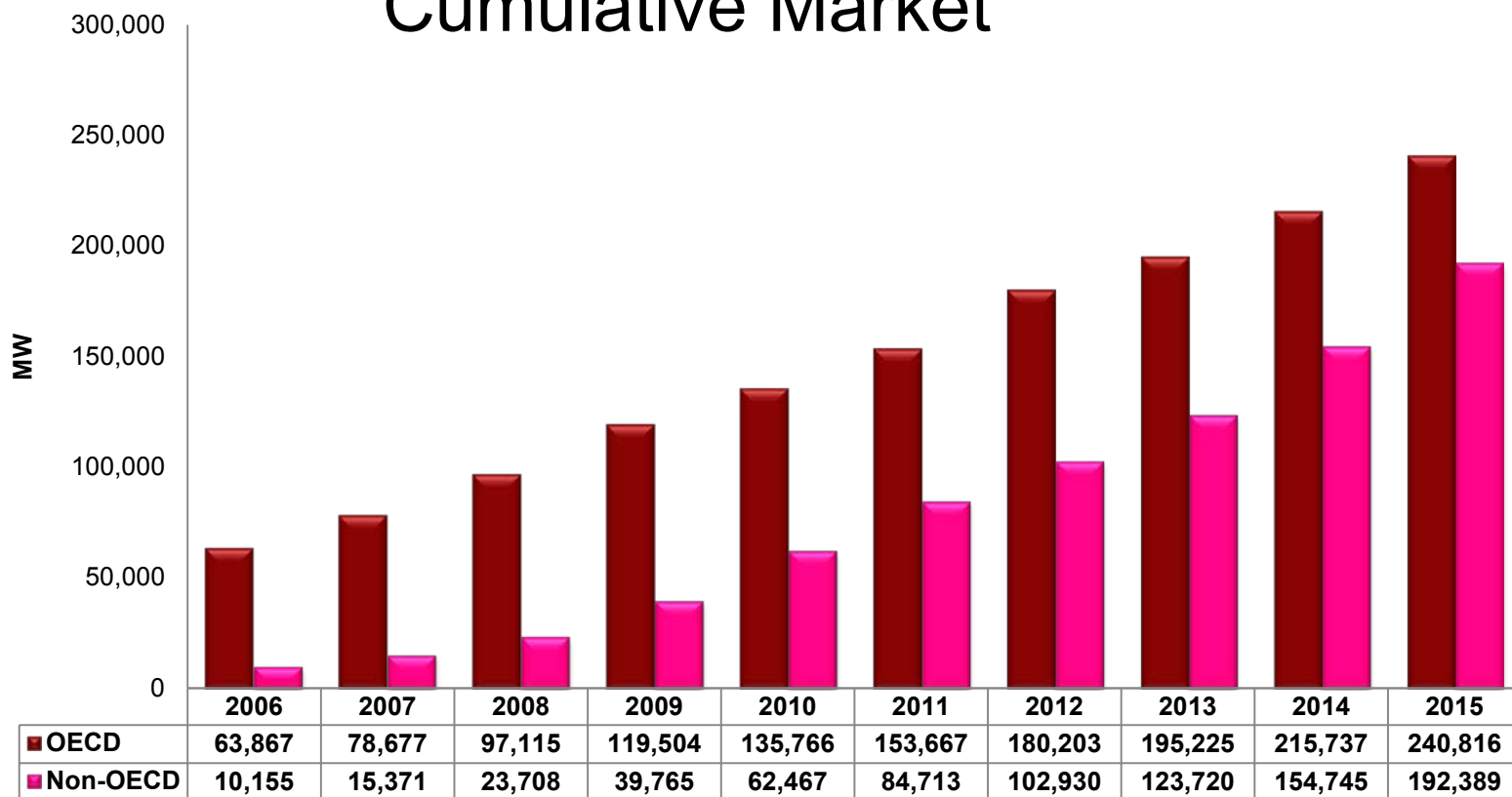
ANNUAL INSTALLED CAPACITY BY REGION 2007-2015



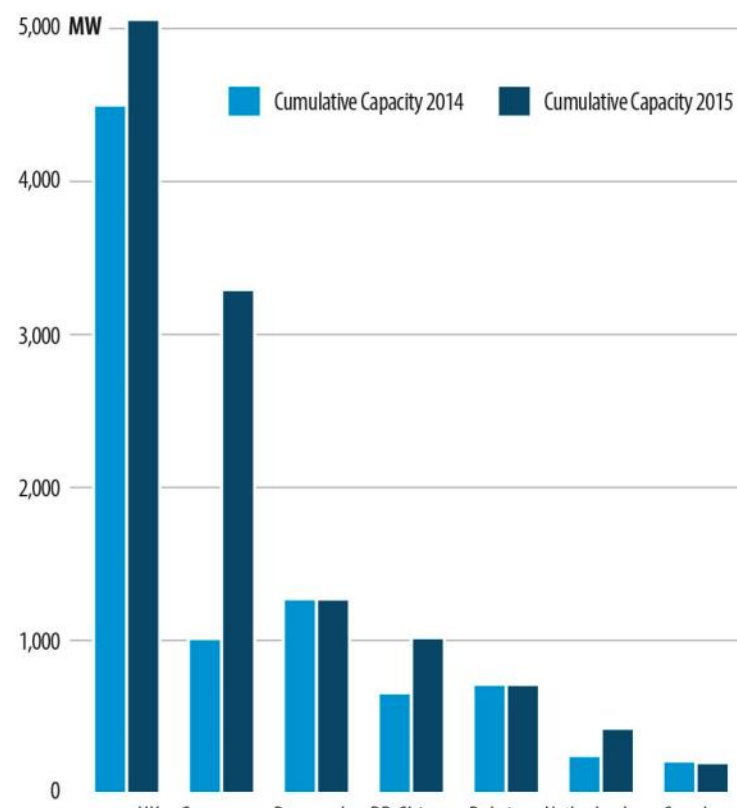
OECD vs non-OECD: Annual Market



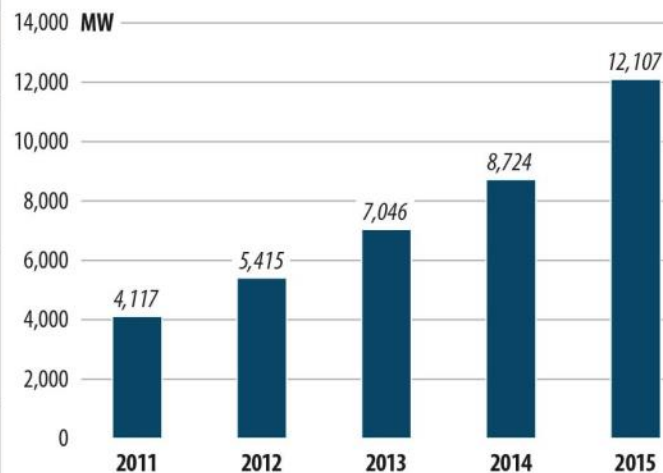
OECD vs non-OECD: Cumulative Market



GLOBAL CUMULATIVE OFFSHORE WIND CAPACITY IN 2015



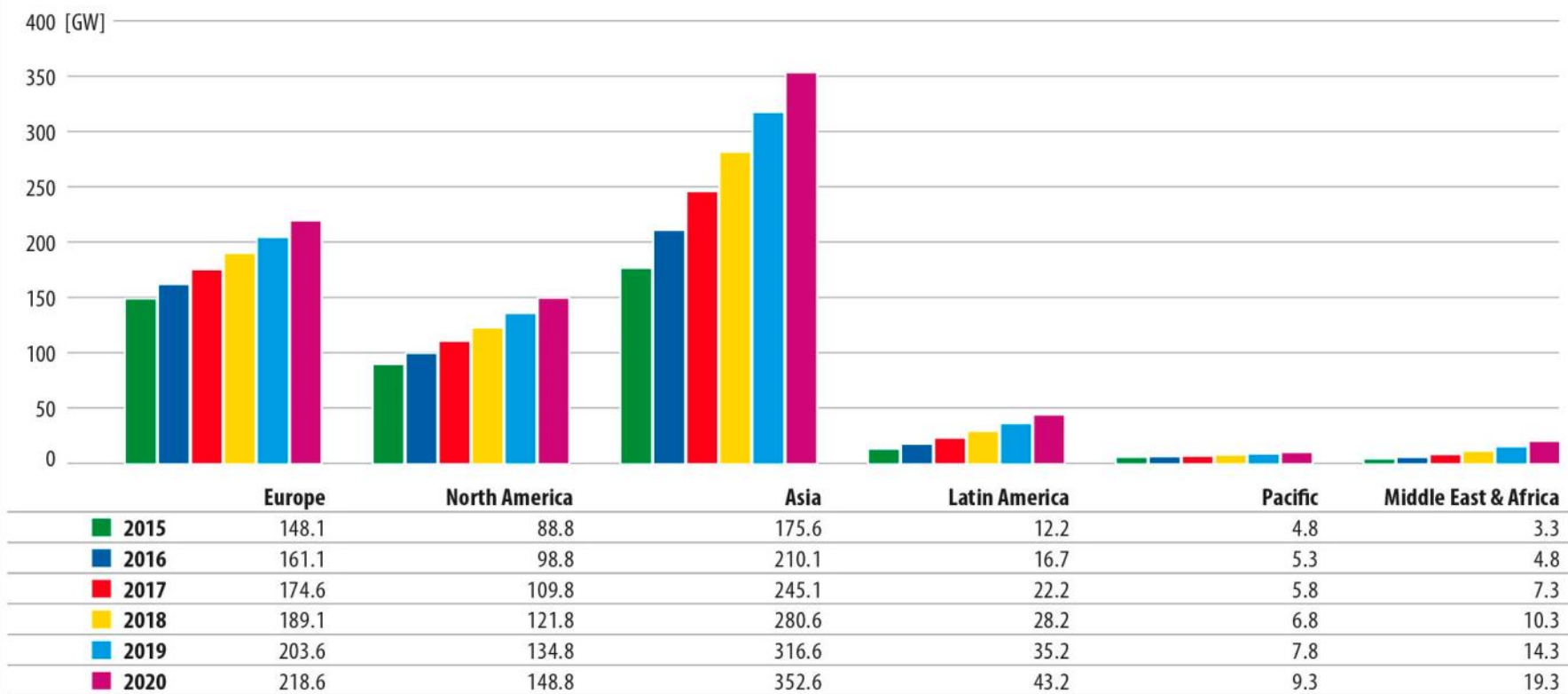
ANNUAL CUMULATIVE CAPACITY (2011-2015)



	UK	Germany	Denmark	PR China	Belgium	Netherlands	Sweden	Japan	Finland	Ireland	S Korea	Spain	Norway	Portugal	US	Total
Total 2014	4,500.4	1,012	1,271	654	712	247	212	50	26	25	5	5	2	2	0.02	8,724
New 2015	572.1	2,282.4	0	360.5	0	180	0	3	0	0	0	0	0	0	0	3,398
Total 2015	5,066.5	3,294.6	1,271.3	1,014.7	712.2	426.8	201.7	53	26.3	25.2	5	5	2.3	2	0.02	12,107

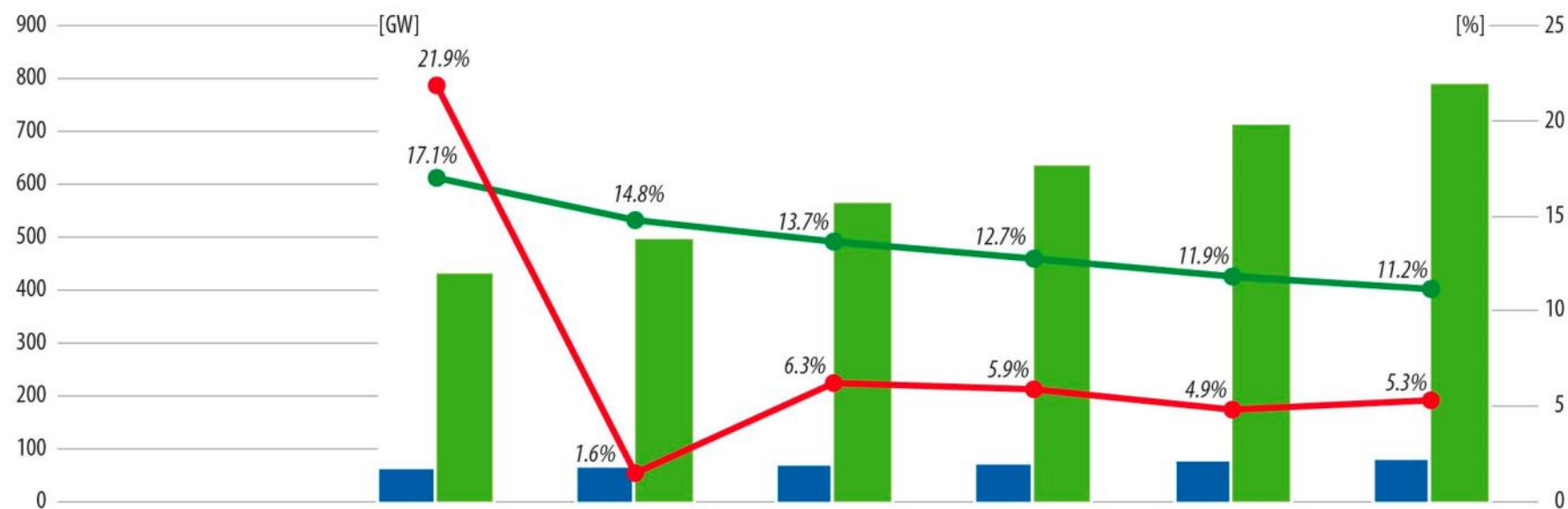
Source: GWEC, 2016

CUMULATIVE MARKET FORECAST BY REGION 2016-2020



Source: GWEC

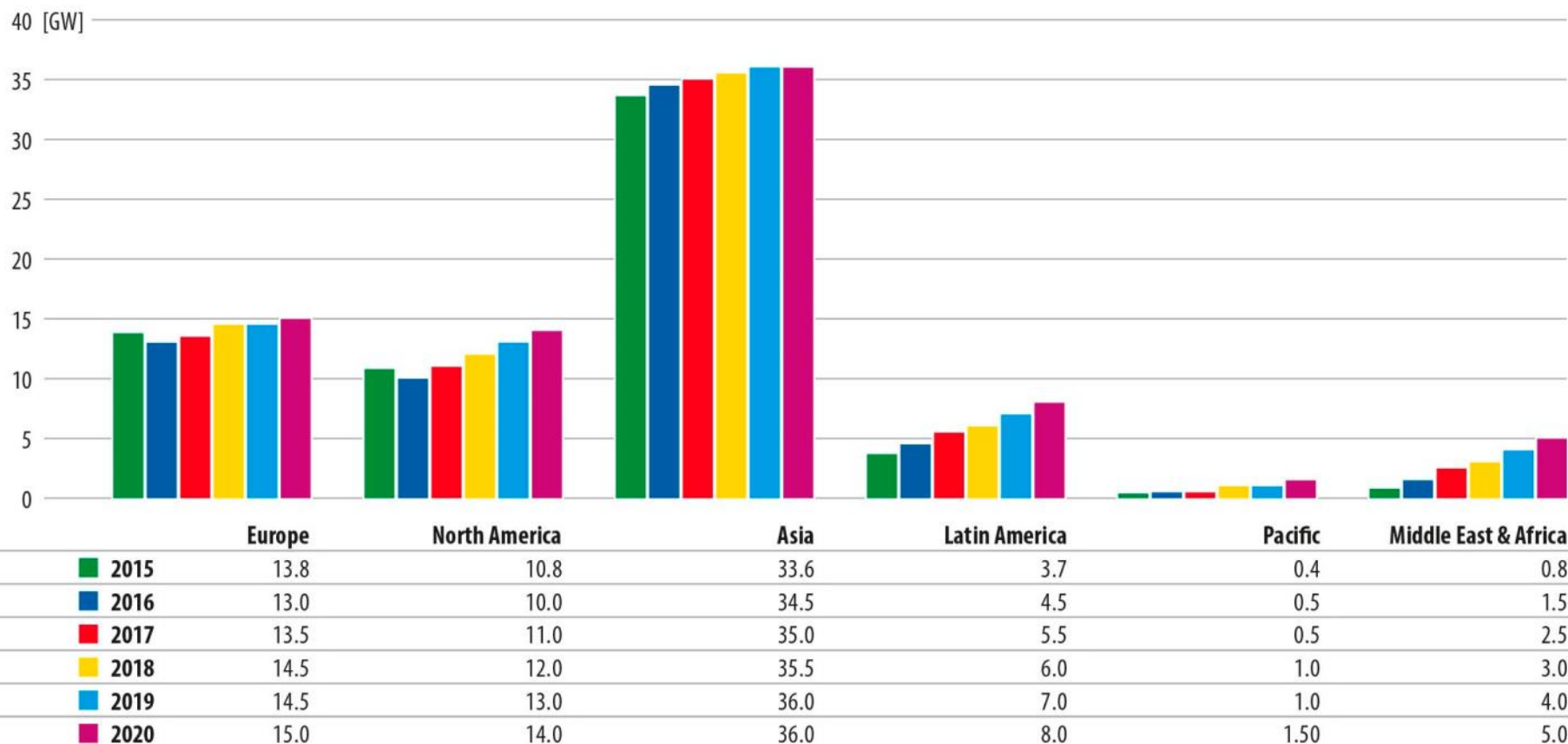
MARKET FORECAST FOR 2016-2020



Cumulative [GW]	2015	2016	2017	2018	2019	2020
Cumulative capacity growth rate [%]	2015	2016	2017	2018	2019	2020
Annual installed capacity [GW]	2015	2016	2017	2018	2019	2020
Annual installed capacity growth rate [%]	2015	2016	2017	2018	2019	2020

Source: GWEC

ANNUAL MARKET FORECAST BY REGION 2016-2020



Source: GWEC

Key Findings

- Unexpected growth (22%) in 2015, mostly China, US and Germany. 2016 should be less spectacular.
- Wind supplied about half of all global power generation growth in 2015, more than any other technology
- 28 markets with more than 1,000 MW; 9 with more than 10,000 MW; Proliferation of new markets in Africa, Asia, and Latin America.
- Technology evolution continues, but incrementally, not spectacularly, except perhaps in offshore.
- Costs continue to come down and wind is the cheapest way to add capacity in a growing number of markets in Africa, Asia and Latin America, as well as the in US and Canada. Offshore costs still coming down the learning curve, but dramatic progress of late

Development of Long Term Wind Market Projections

The Scenarios – Main Assumptions

IEA New Policies scenario:

- based on International Energy Agency (IEA) 2015 World Energy Outlook
- IEA assessment has then been extended up to 2050 from UTS-ISF

IEA 450 scenario:

- based on International Energy Agency (IEA) 2015 World Energy Outlook: sets out an energy pathway consistent with the goal of having about a 50% chance of limiting the global increase in average temperature to 2 °C / 450 parts per million of carbon-dioxide equivalent (ppm CO₂-eq)
- IEA assessment has then been extended up to 2050 from UTS-ISF

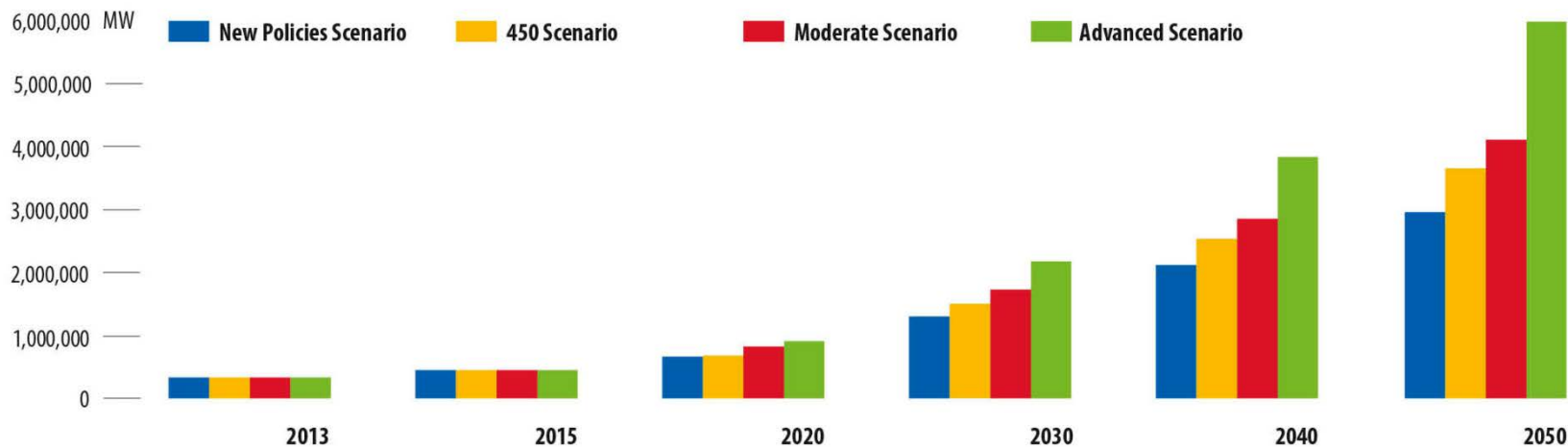
GWEC Moderate scenario:

- takes into account all policy measures to support renewable energy either under way or planned around the world
- assumes that renewables or wind targets set by many countries are successfully implemented

GWEC Advanced scenario:

- assumption is that all policy options in favour of renewable energy are selected and the political will is there to carry them out

GLOBAL CUMULATIVE WIND POWER CAPACITY



New Policies Scenario

MW	318,354	432,656	639,478	1,259,974	2,052,583	2,869,611
TWh/a	714	868	1,569	3,311	5,394	7,541

450 Scenario

MW	318,354	432,656	658,009	1,454,395	2,458,757	3,545,595
TWh/a	714	868	1,614	3,822	6,462	9,318

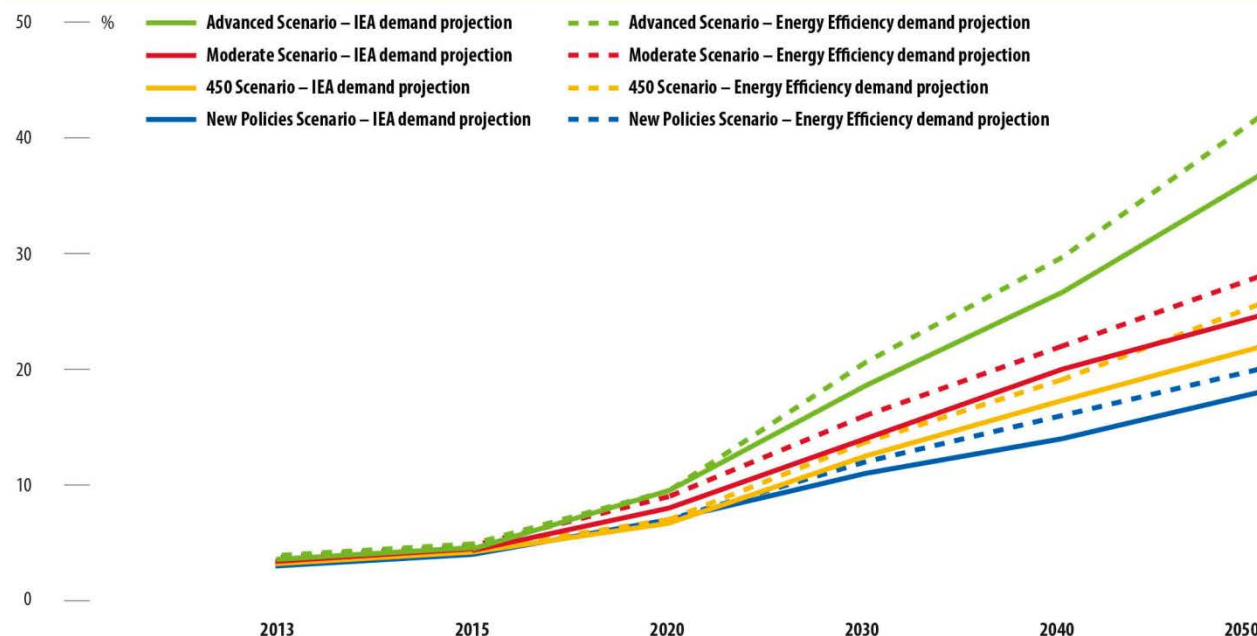
Moderate Scenario

MW	318,354	432,656	797,028	1,675,624	2,767,351	3,983,995
TWh/a	714	868	1,955	4,404	7,273	10,470

Advanced Scenario

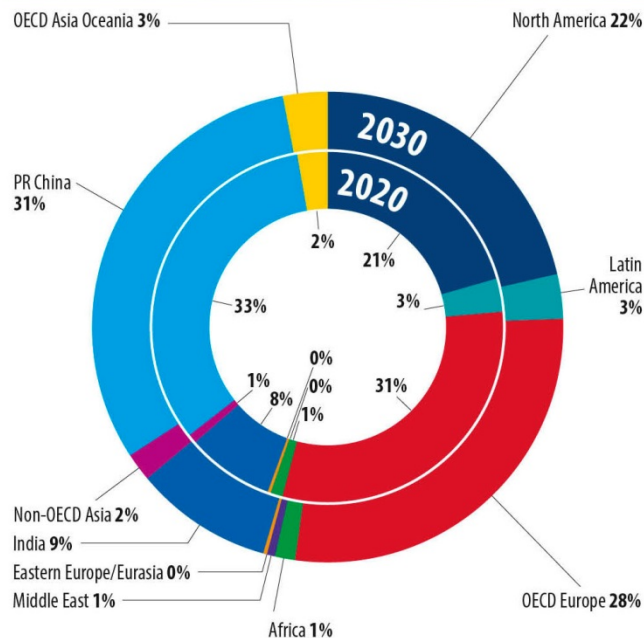
MW	318,354	432,656	879,446	2,110,161	3,720,919	5,805,882
TWh/a	714	868	2,157	5,546	9,779	15,258

WIND POWER SHARE OF GLOBAL ELECTRICITY DEMAND



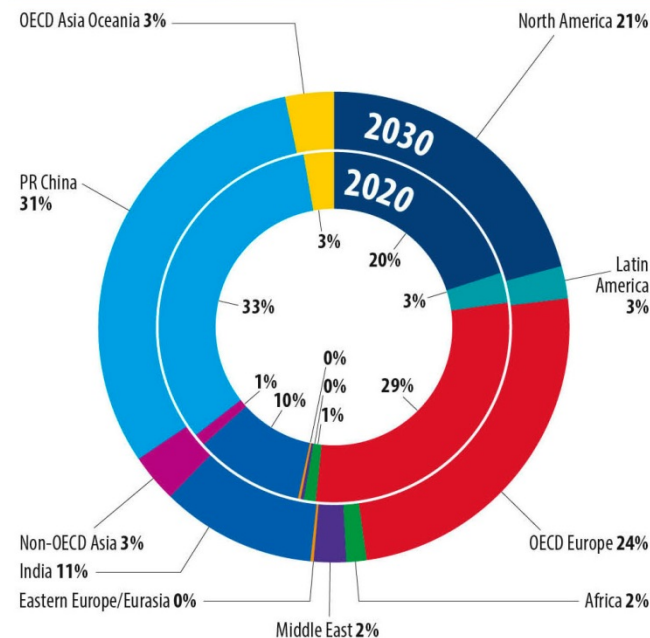
	2013	2015	2020	2030	2040	2050
New Policies Scenario						
IEA demand projection	3%	4%	7%	11%	14%	18%
Energy Efficiency demand projection	3%	4%	7%	12%	16%	20%
450 Scenario						
IEA demand projection	3%	4%	7%	13%	17%	22%
Energy Efficiency demand projection	3%	4%	7%	14%	19%	25%
Moderate Scenario						
IEA demand projection	3%	4%	8%	14%	20%	25%
Energy Efficiency demand projection	3%	4%	9%	16%	22%	28%
Advanced Scenario						
IEA demand projection	3%	4%	9%	18%	26%	36%
Energy Efficiency demand projection	3%	4%	9%	20%	29%	41%

REGIONAL BREAKDOWN: NEW POLICIES SCENARIO



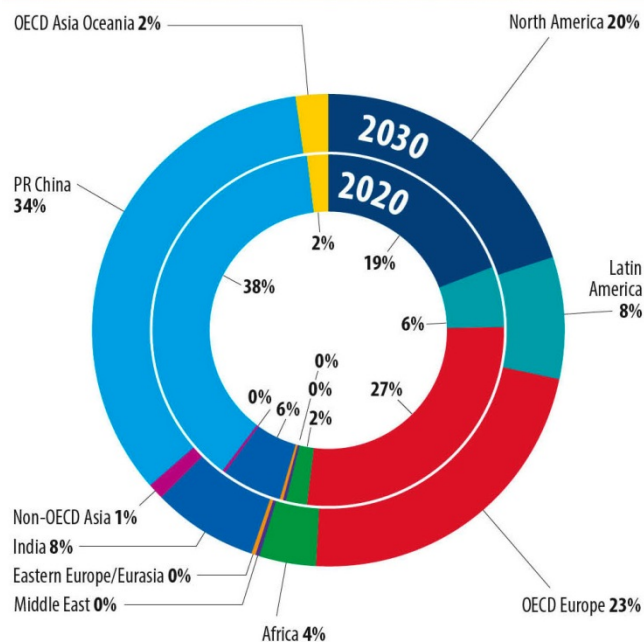
	2020	2030
North America	126,961	252,784
Latin America	18,749	36,196
OECD Europe	186,878	323,091
Africa	6,575	15,908
Middle East	1,072	8,009
Eastern Europe/Eurasia	668	1,117
India	50,063	111,938
Non-OECD Asia	5,213	21,796
PR China	201,178	364,801
OECD Asia Oceania	15,322	34,598
Global Total / MW	639,478	1,259,974

REGIONAL BREAKDOWN: 450 SCENARIO



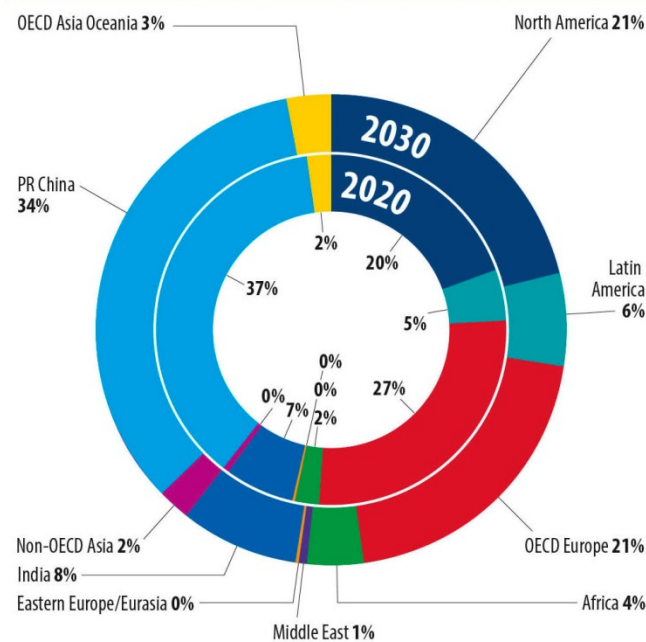
	2020	2030
North America	131,659	303,322
Latin America	18,913	35,830
OECD Europe	190,855	355,769
Africa	7,207	23,005
Middle East	1,501	30,124
Eastern Europe/Eurasia	722	1,982
India	67,098	155,736
Non-OECD Asia	6,411	49,250
PR China	216,806	452,081
OECD Asia Oceania	16,836	47,295
Global Total / MW	658,009	1,454,395

REGIONAL BREAKDOWN: MODERATE SCENARIO



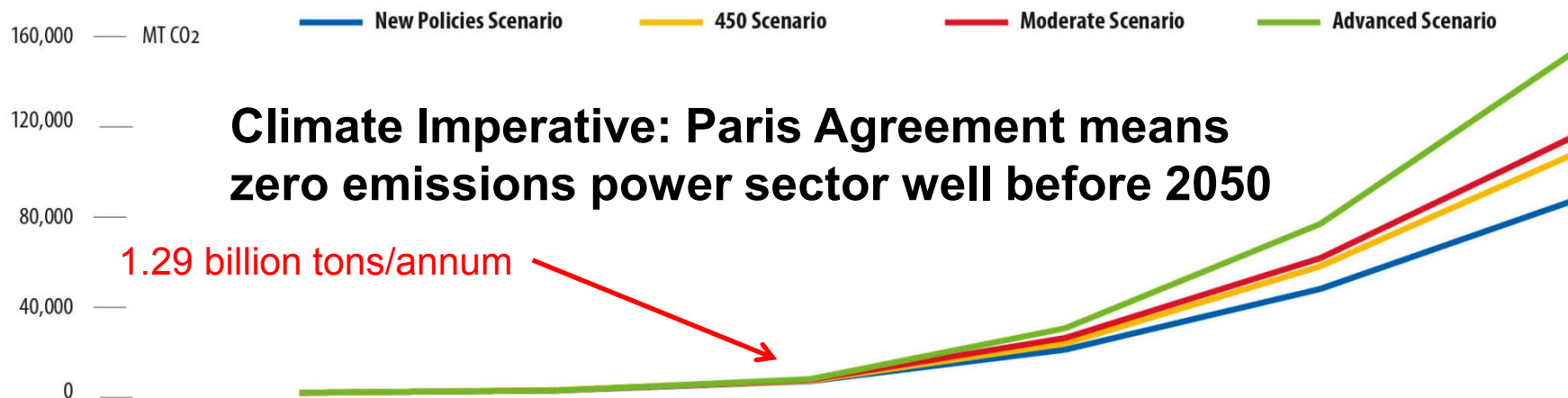
	2020	2030
North America	149,120	318,390
Latin America	42,997	129,491
OECD Europe	207,955	358,554
Africa	16,805	60,852
Middle East	777	4,995
Eastern Europe/Eurasia	644	1,895
India	44,734	116,257
Non-OECD Asia	2,344	14,842
PR China	291,439	541,577
OECD Asia Oceania	13,364	32,887
Global Total / MW	797,028	1,675,624

REGIONAL BREAKDOWN: ADVANCED SCENARIO



	2020	2030
North America	165,181	413,970
Latin America	38,203	124,494
OECD Europe	227,217	398,691
Africa	18,337	72,229
Middle East	1,017	10,234
Eastern Europe/Eurasia	650	2,835
India	56,297	163,473
Non-OECD Asia	4,296	41,659
PR China	313,061	666,500
OECD Asia Oceania	17,242	57,084
Global Total / MW	879,446	2,110,161

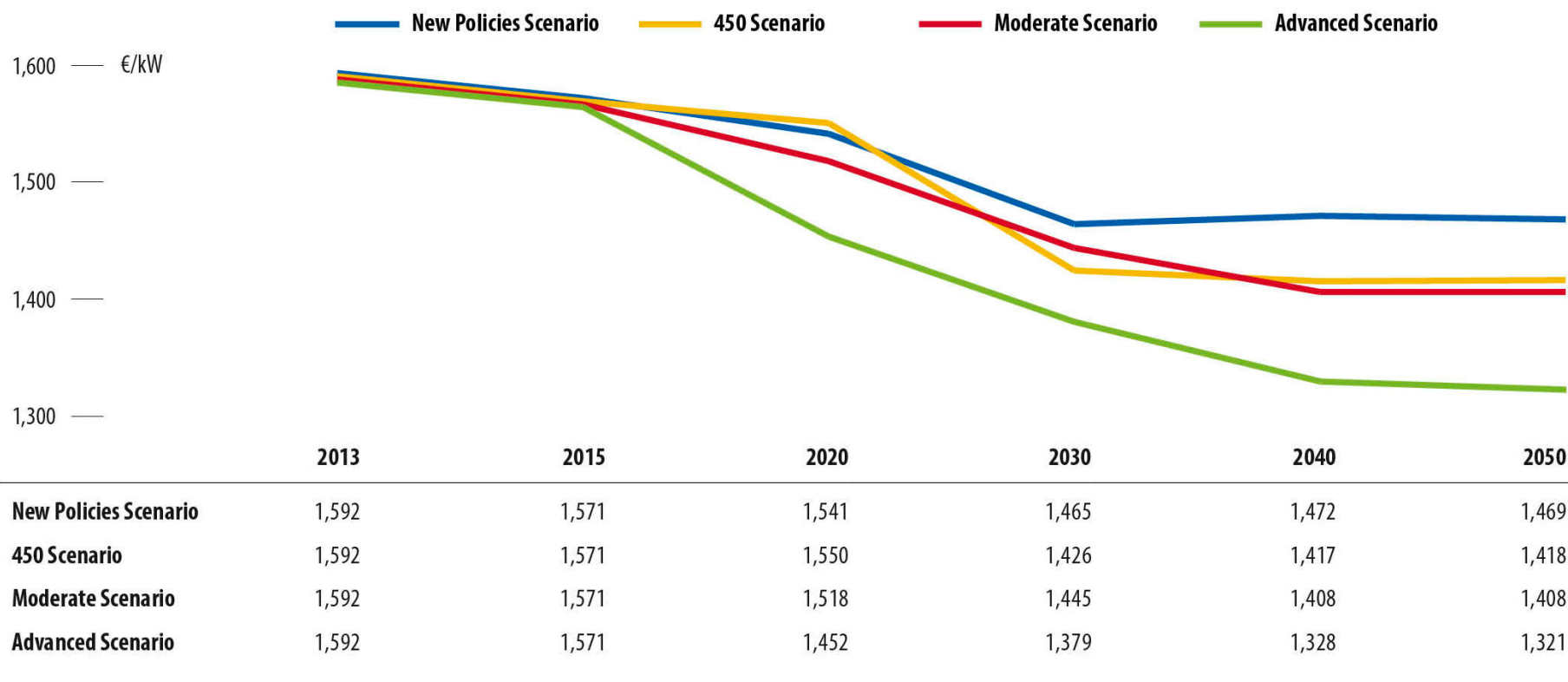
CUMULATIVE CO₂ EMISSIONS REDUCTIONS



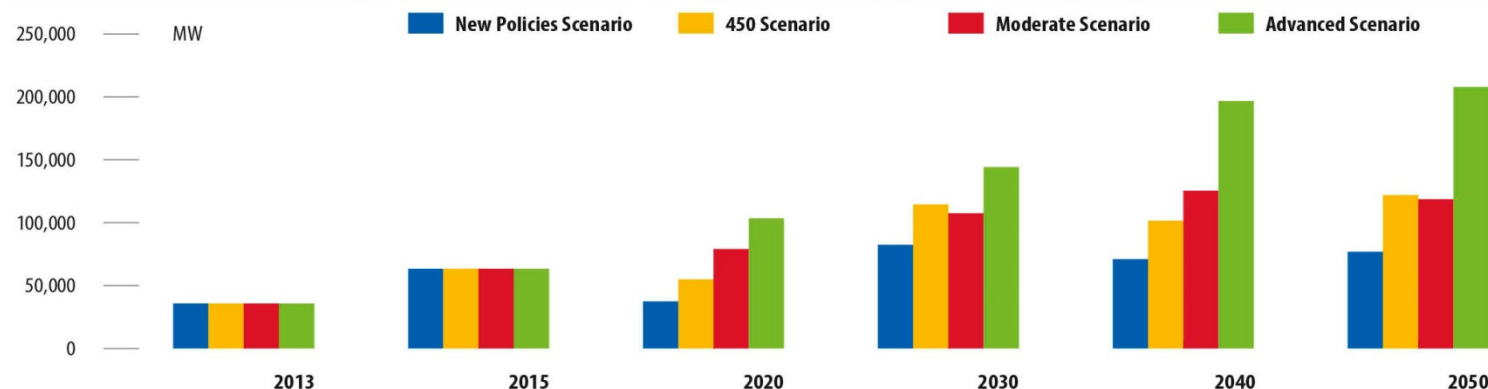
ANNUAL AND CUMULATIVE CO₂ EMISSIONS REDUCTIONS (MT CO₂)

	2013	2015	2020	2030	2040	2050
New Policies Scenario						
Annual CO ₂ savings	428	521	941	1,987	3,237	4,525
Cumulative CO ₂ savings	2,112	3,105	7,247	21,223	48,137	87,610
450 Scenario						
Annual CO ₂ savings	428	521	968	2,293	3,877	5,591
Cumulative CO ₂ savings	2,112	3,105	7,279	22,730	54,687	102,639
Moderate Scenario						
Annual CO ₂ savings	428	521	1,173	2,642	4,364	6,282
Cumulative CO ₂ savings	2,112	3,105	7,850	26,393	61,770	116,043
Advanced Scenario						
Annual CO ₂ savings	428	521	1,294	3,327	5,867	9,155
Cumulative CO ₂ savings	2,112	3,105	8,153	30,702	76,953	153,634

SPECIFIC COSTS (€/kW)



TOTAL INSTALLED COST, INVESTMENT AND EMPLOYMENT



New Policies Scenario

Annual Installation MW	35,787	63,350	37,370	82,428	70,955	76,955
Cost € / kW	1,592	1,571	1,541	1,465	1,472	1,469
Investment € billion / year	57	100	58	121	104	113
Employment Job / year	606,076	1,029,681	696,841	936,232	1,080,374	1,316,408

450 Scenario

Annual Installation MW	35,787	63,350	54,962	114,494	101,525	121,998
Cost € / kW	1,592	1,571	1,550	1,426	1,417	1,418
Investment € billion / year	57	100	85	163	144	173
Employment Job / year	606,076	1,029,681	931,654	1,385,182	1,370,137	1,682,231

Moderate Scenario

Annual Installation MW	35,787	63,350	79,005	107,488	125,397	118,604
Cost € / kW	1,592	1,571	1,518	1,445	1,408	1,408
Investment € billion / year	57	100	120	155	177	167
Employment Job / year	606,076	1,029,681	1,290,079	1,374,111	1,469,931	1,866,633

Advanced Scenario

Annual Installation MW	35,787	63,350	103,423	144,165	196,748	207,879
Cost € / kW	1,592	1,571	1,452	1,379	1,328	1,321
Investment € billion / year	57	100	150	199	261	275
Employment Job / year	606,076	1,029,681	1,634,721	2,426,331	3,588,875	4,202,612

New Markets



How to stay on the *Advanced Scenario* track

- The industry has been back on the *Advanced Scenario* track for the past two years. How to stay there?
- Governments are still subsidizing fossil fuel production and consumption to the tune of somewhere between \$US 500 billion and \$US 6 trillion per annum. This has to stop, and soon.
- New market designs are necessary to drive both electricity system transformation and the proper valuation of carbon-free and flexible generation. The old utility model is dead or dying just about everywhere;
- International institutions have to stop talking out of both sides of their mouths and top financing fossil fuel projects with international development finance.
- Renewables have won or are winning the price war; now we have to win the struggle over the system design;
- Any decision to build a fossil fueled power plant today means either: a) investing in a stranded asset; or b b) governments weren't serious in Paris

Conclusions

- Asian market driving global growth – Asia is power hungry
- European market uncertain, especially after 2020
- North America uncharacteristically stable through 2020
- Largest growth markets by percentage are in Africa and Latin America
- Downward price pressure continues
- Accelerating consolidation of players in the OECD and to some extent in China, but new players continue to emerge in Africa, Asia and Latin America

Looking Ahead – Climate Policy

- ~4% of global electricity supply now, should be 6-8% by 2020, 18-20% by 2030, around 1/3 by 2050 if we are to get to grips with the climate problem;
- With the entry into force of the Paris Agreement, governments now need to demonstrate that they're serious about implementing the targets;
- Early implementation key to have any chance to meet 2 degrees C target;
- Either the 2 degrees target and especially the 1.5 degrees target means complete decarbonisation of the power sector well before 2050.
- Any decision to build a fossil fueled power plant today means: a) investing in a stranded asset; b) governments weren't serious in Paris

Looking Ahead (2)

The Paris Agreement needs to be embedded in concrete action plans in order for wind power to achieve its maximum potential, but for the short term we will continue to face...

Uncertainty:

- in international political landscape, and in various countries
- in the future of the carbon markets
- in 'new' climate-related funds

Focus on national/regional legislation and markets

Market drivers all still in place, and increasingly prominent: energy security; cost stability; macroeconomic security; local economic development and job creation; local environment and climate



Thank you!

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