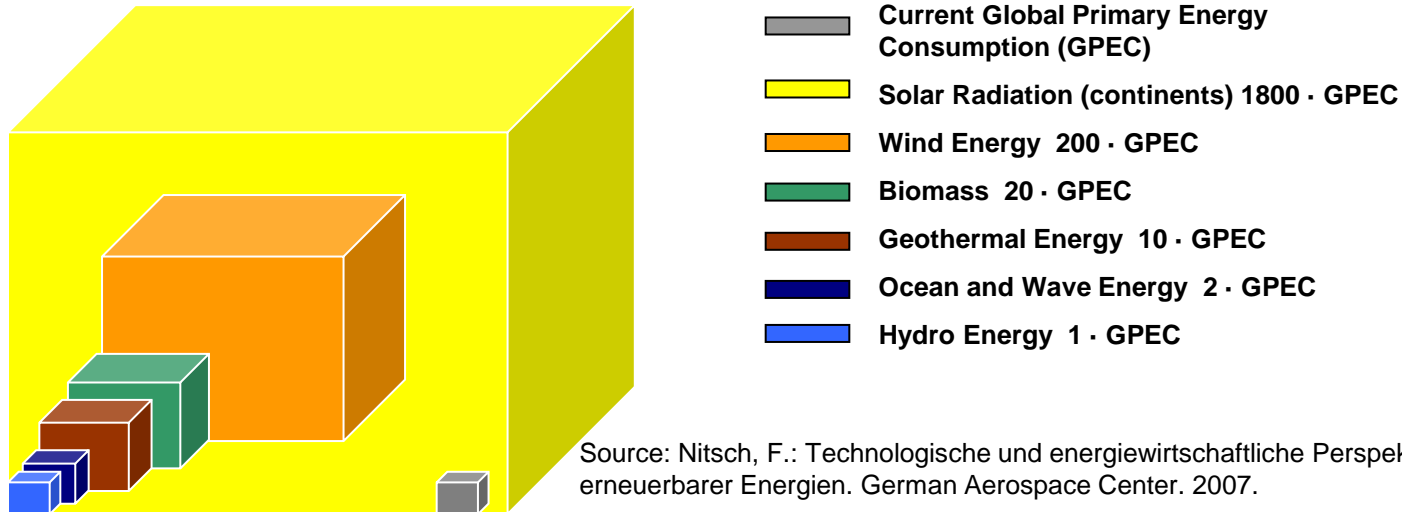

Global Renewable Energy Expansion

Hugo Lucas

International Conference: REVision 2014
Tokyo, 25th February 2014

The various types of Renewable Energy and their potential

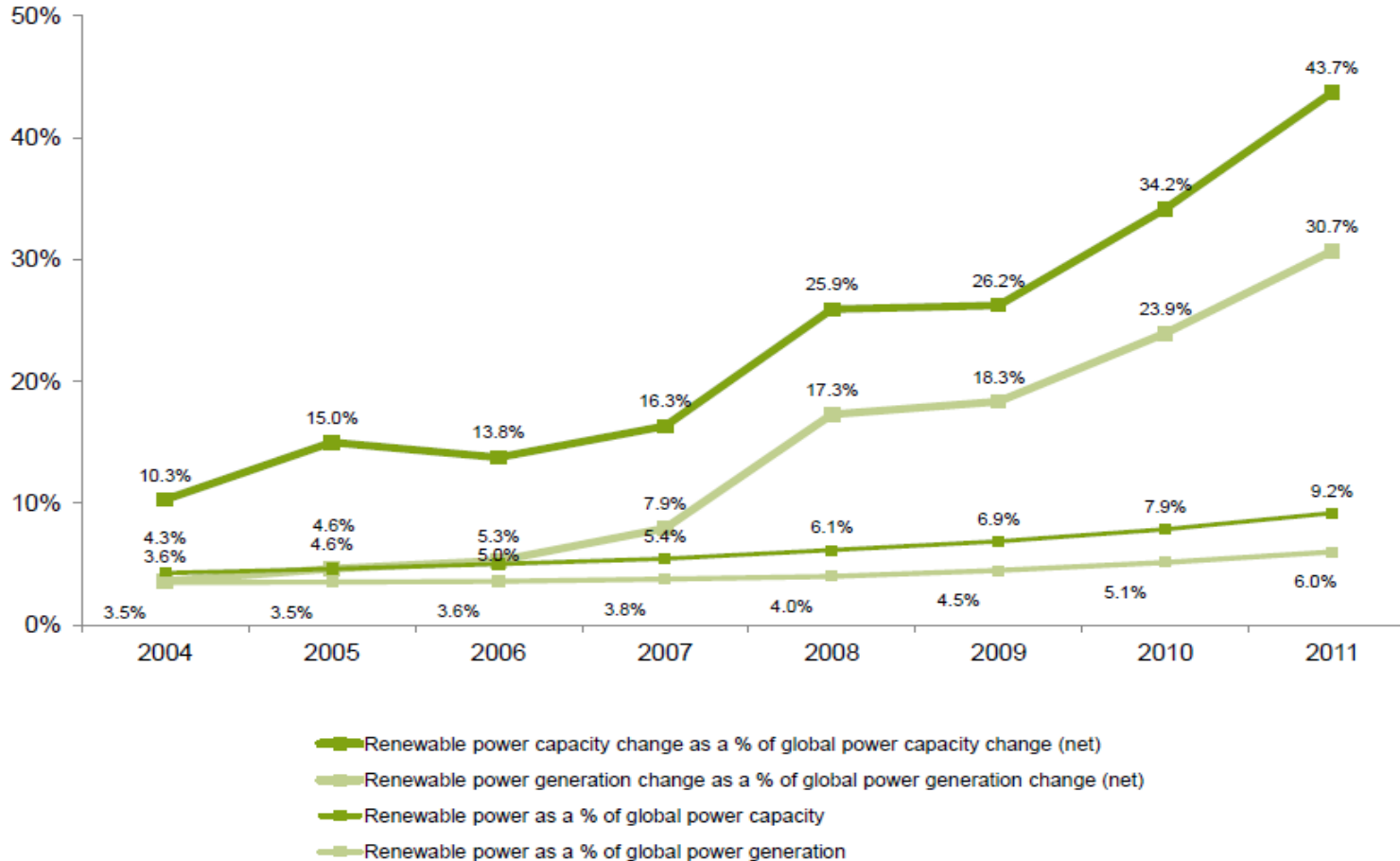


Source: Nitsch, F.: Technologische und energiewirtschaftliche Perspektiven erneuerbarer Energien. German Aerospace Center. 2007.



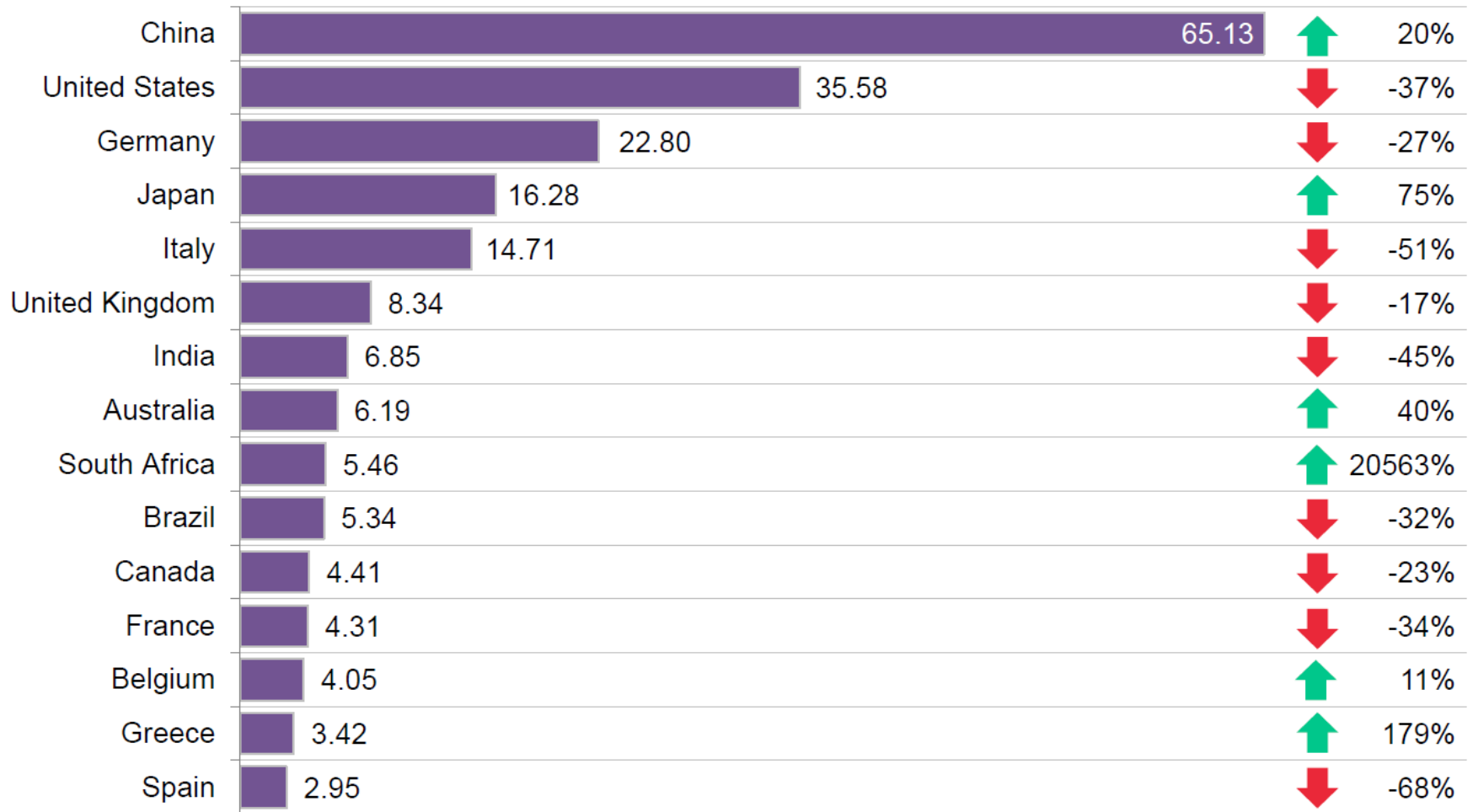
“The Stone Age didn’t end for lack of stone, and the oil age will end long before the world runs out of oil.”

RE New capacity installed is overtaking conventional technologies

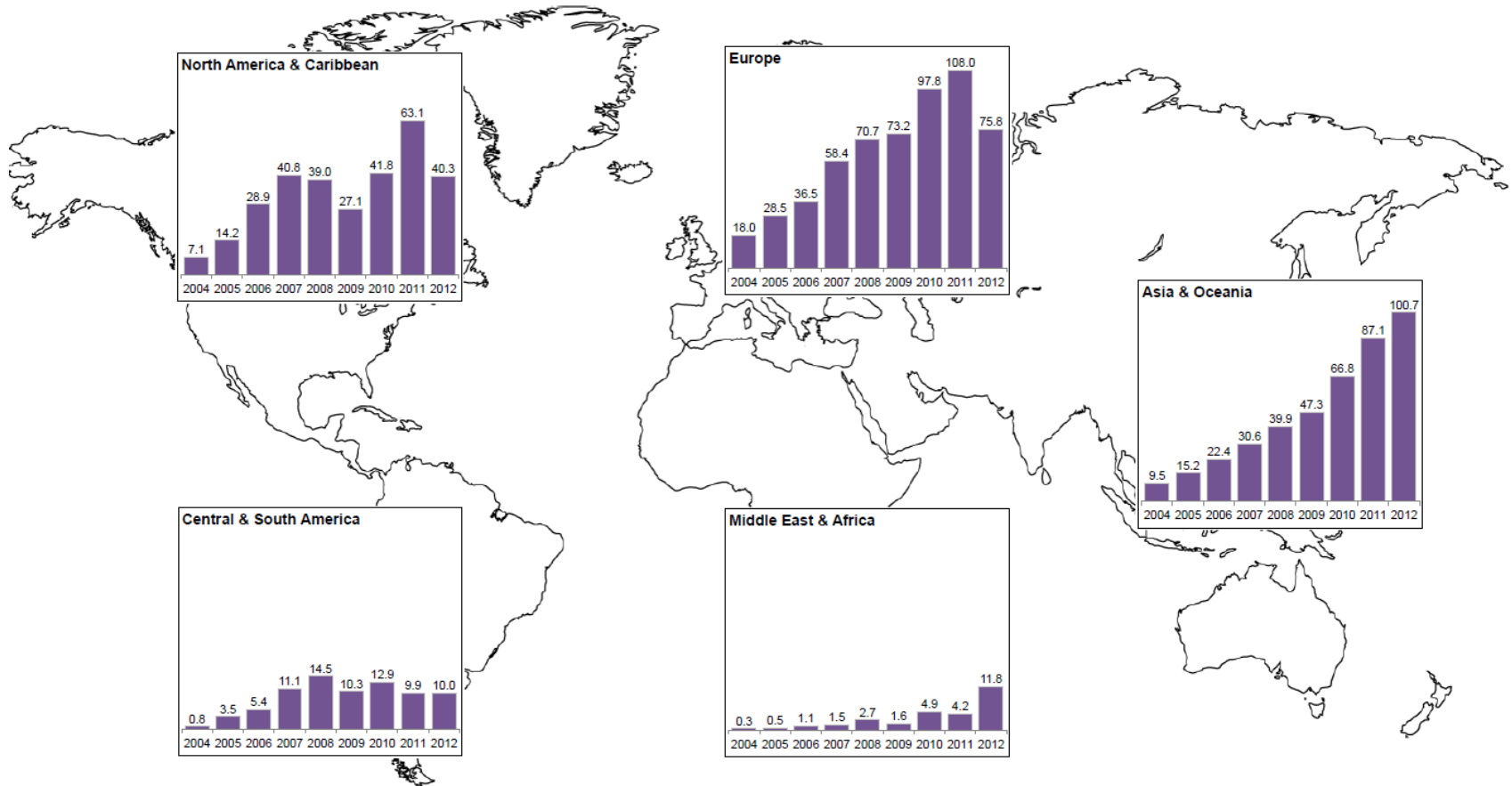


Sources: EIA, IEA, Bloomberg New Energy Finance

New Investment in Clean Energy by country in 2012 (\$Bn)

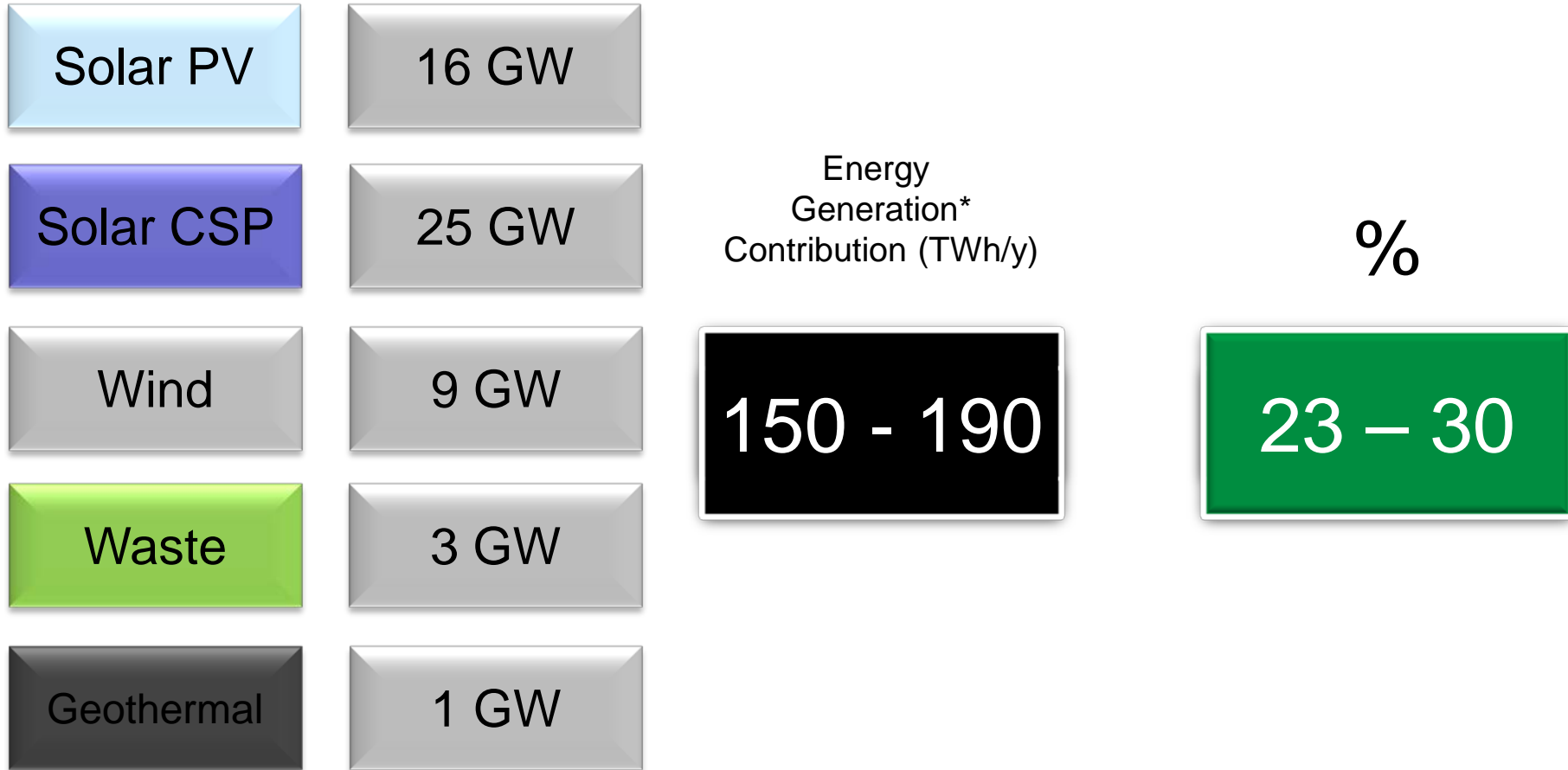


New Investment in Clean Energy by Region 2004-12 (\$Bn)



Source: BNEF, 2013

Saudi Arabian RE Programme 2032



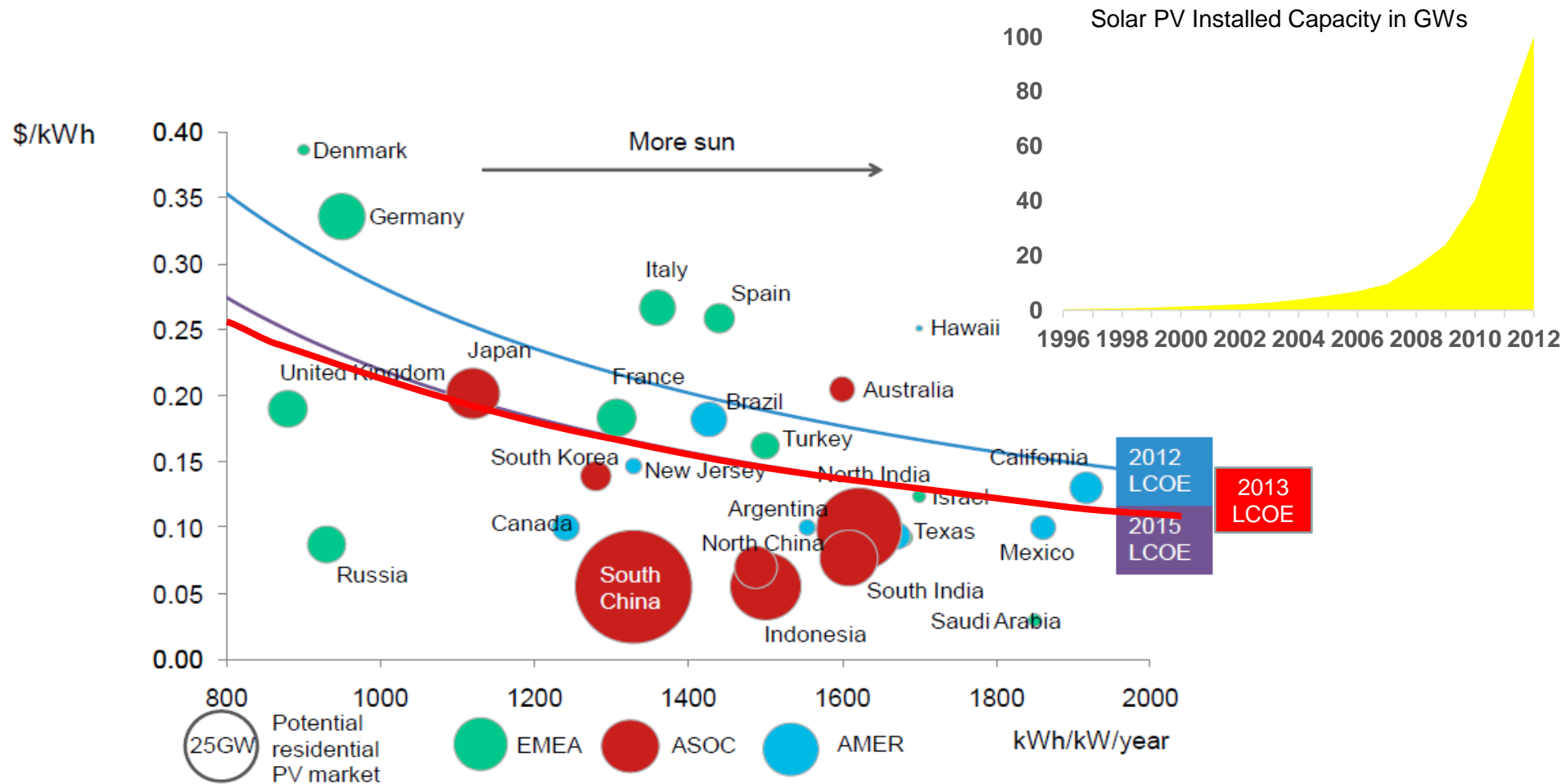
RE Policies driving growth

RE targets: At least 138 countries by 2012 (more than doubled from 2005)

RE support policies: 127 countries (two-thirds are developing and emerging economies):

- Some RE policy adaptation drivers:
 - Keeping up with rapidly decreasing cost of technology (e.g. Approaching grid-parity)
 - Impact of rising renewables on electricity markets and systems
- RE in cities; RE off-grid
- Shift away from fixed-price support schemes to more market-based mechanisms (e.g. auction schemes, feed-in premiums, etc.)
 - Number of countries that adopted RE auctions increased from 9 in 2009 to at least 45 by early 2013, out of which 30 were developing countries
- Approaching socket-parity

Trends: Approaching Parity

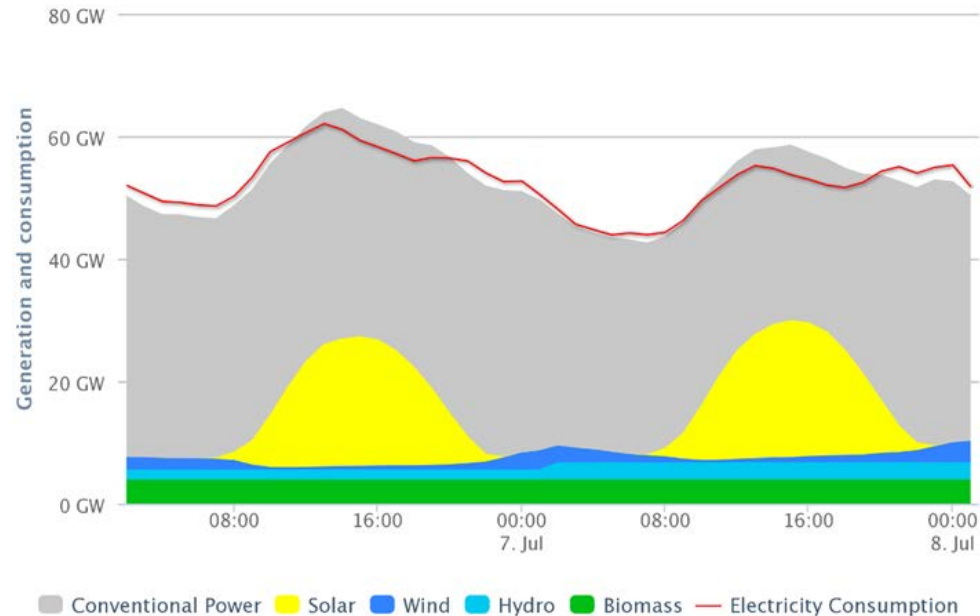


Source: Bloomberg New Energy Finance

Note: The blue line illustrates the LCOE levels (2012 data) for different insolation rates. Countries placed above the LCOE line have already reached the "socket parity".

Trends: Integrating RE

- 24th September 2012, Spain:
 - At peak production, wind energy provided around 64% (13GW) of the total electricity demand .
- 7th July 2013, Germany:
 - 42% of production at peak hour coming from RE mainly PV.
- 28th October 2013, Denmark:
 - At peak production, wind energy produced about 122% of the country's power needs.



Integrating Renewable Energy

- With increasing cost-competitive and share in electricity mix, RE market integration is emerging as a crucial challenge (and a significant cost)
- System should be operated to maximize (Systems more flexible, RE more predictable)
- Renewable Energy enters the market at zero marginal cost (and often dispatch priority) placing itself at the beginning of merit order
- Some specific challenges:
 - Decreasing profitability for conventional generators, in particular during max RE generation
 - Discouraging investment in flexible capacity, specifically natural gas-based. Flexibility is crucial for integrating increasing RE in the mix

Concerns lead to barriers



Thank you