HWEA- HELLENIC WIND ENERGY ASSOCIATION

Wind in the Black Sea

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"The Greek experience on wind energy development."

Trabzon 12th May 2015

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Hellenic Wind Energy Association – H.W.E.A.
ΕΛΕΤΑΕΝ

HWEA- HELLENIC WIND ENERGY ASSOCIATION

The Hellenic Wind Energy Association (H.W.E.A.) was founded in 1990 by 50 Wind Energy believers (Prof Arthouros Zervos, later Chairman of EWEA and GWEC and currently of REN21, Dr. Ioannis Tsipouridis, Prof Dimitris Lalas and Dr Takis Chaviaropoulos are founding members).

In Greece it is known by its acronym ELETAEN

Today its membership is over 400 members of which 200 can be considered actively involved.

They comprise of wind energy professionals – engineers, scientists, lawyers, financiers and wind Energy companies – producers, developers, resource assessment, contractors.

HWEA- HELLENIC WIND ENERGY ASSOCIATION

HWEA does advocacy work with the Greek authorities, takes active part in the social dialogue, organises events and communicates the benefits of wind power via multiple channels.

H.W.E.A. is a non profit organisation.
It has no permanent staff and
all its officers offer their services on a voluntary basis.
Its income is derived from annual subscription fees and sponsorships from its member companies.

HWEA- HELLENIC WIND ENERGY ASSOCIATION

International highlights of its activities are

- ❖The Organisation of the 1994 EWEC Conference & Exhibition in Thessaloniki
- ❖The organisation of 2006 EWEC Conference & Exhibition in Athens

Other, more national, activities involve

- ➢The publication of the bimonthly magazine ANEMOLGIA which has reached 5.000 copies per issue
- ➢The operation of a website www.eletaen.gr and a social media facebook page https://www.facebook.com/groups/eletaen/
- ➢Publication of other informative and promotional material
- ➢Press releases and writing of articles for newspapers, magazines and energy portals
- ➢Lobbying the Government and authorities
- ➢Taking active part in the social dialogue for the sustainable future, for climate changes, for environmental deterioration, in collaboration with environmental groups and especially Greenpeace.
- ➢Organising public events such as the Global Wind Day week, workshops on key energy issues and an annual sector reception for the new year.

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Kythnos 100kW Wind park.
Official inauguration date 15th April 1982

Kythnos Wind Park

Wind turbine type: AEROMAN 11/20 (1st generation) 20kW power output, 5 units totaling 100kW power output

Two bladed turbines equipped with a hydroelectric blade tip control and an 11,6 m swept area.

Lattice tower 10m high, constructed of galvanized pipes.

Official inauguration date 15th April 1982

In 1990, these first 5 wind turbines were replaced by 5 third generation wind turbines 33kW each, totaling 165kW, on conical cylindrical towers of 15m height.

Kythnos 100kWp PV station.
Start of operation 1st of July 1983

HWEA- HELLENIC WIND ENERGY ASSOCIATION

PPC DIRECTION OF ALTERNATIVE ENERGY SOURCES from 1982 - 2000

WIND PROJECTS					SOLAR PROJECTS	
SITE	WIND TYPE	kW	W/T No	MW	SITE	kWp
ANDROS	Vestas	225	7	1,575	KYTHNOS	100
SAMOS	Vestas	225	9	2,025	GAVDOS	20
CHIOS	Vestas	225	11	2,475	ANTIKYTHIRA	25
PSARA	Vestas	225	9	2,025	ARKOI	40
CRETE TOPLOU I	HMZ/WINDMASTER	300	17	5,1	SIFNOS	60
EUBOIA MARMARI	HMZ/WINDMASTER	300	17	5,1	CHIOS PANAGITSA	2,8
SAMOTHRACE	Eolous/Wind Matic	55	4	0,22	CHIOS OINOUSES	0,7
IKARIA	Eolous/Wind Matic	55	7	O,385	SAMOS SAMIOPOULA	2,1
KARPATHOS	Eolous/Wind Matic	55	5	0,275	SAMOS AGIOS MHNAS	0,7
LHMNOS BIGLA	Eolous/Wind Matic	100	7	0,7	KYKLADES ANTIKERI	1,4
LHMNOS BOUNAROS	Eolous/Wind Matic	55	8	0,44	KYKLADES KATO KOYFONHSI	6,3
SAMOS MARATHOKAMPOS	Eolous/Wind Matic	100	9	0,9	KYKLADES DONOYSA	3,5
CHIOS POTAMIA	Eolous/Wind Matic	100	10	1	DODEKANHSA KYNAROS	0,7
KYTHNOS	MAN	33	5	0,165	DODEKANHSA LEVITHA	2,1
SKYROS	NTUA	140	1	0,14	DODEKANHSA MARATHOS	3,5
CRETE TOPLOU II	TACHE I, TW 500	500	1	0,5	DODEKANHSA SARIA	1,4
CRETE TOPLOU III	TACHE II, TW 500	500	1	0,5	DODEKANHSA SYRNA	1,4
CRETE TOPLOU IV	NORDANK NTK 500/37	500	1	0,5	DODEKANHSA RO	2,1
KYTHNOS	Vestas	500	1	0,5	DODEKANHSA STROGGYLH	0,7
LESVOS	Vestas	225	9	2,025	DODEKANHSA NIMOS	1,4
CRETE XIROLIMNI I	NEG Micon	600	8	4,8	DODEKANHSA ALIMIA	0,7
CRETE XIROLIMNI II	NEG Micon	600	9	5,4	DODEKANHSA SISKLI	0,7
TOTAL NUMBER OF W/T'S			156		MAGNHSIA PERISTERA	6,3
					MAGNHSIA KYRA PANAGIA	2,1
					MAGNHSIA GIOYRA	1,4
17 WIND PARKS 5 ISOLATED W/T'S					CHANIA GAVDOS	10,5
					ANTIKYTHIRA	9,1
					LHMNOS	0,7
					AGIOS EFTRATIOS	0,7
TOTAL POWER OUTPUT				36,365	TOTAL POWER OUTPUT	308

LEGEND	
KYTHNOS	1982 - 1994
CRETE XIROLIMNI I	1994 - 2000

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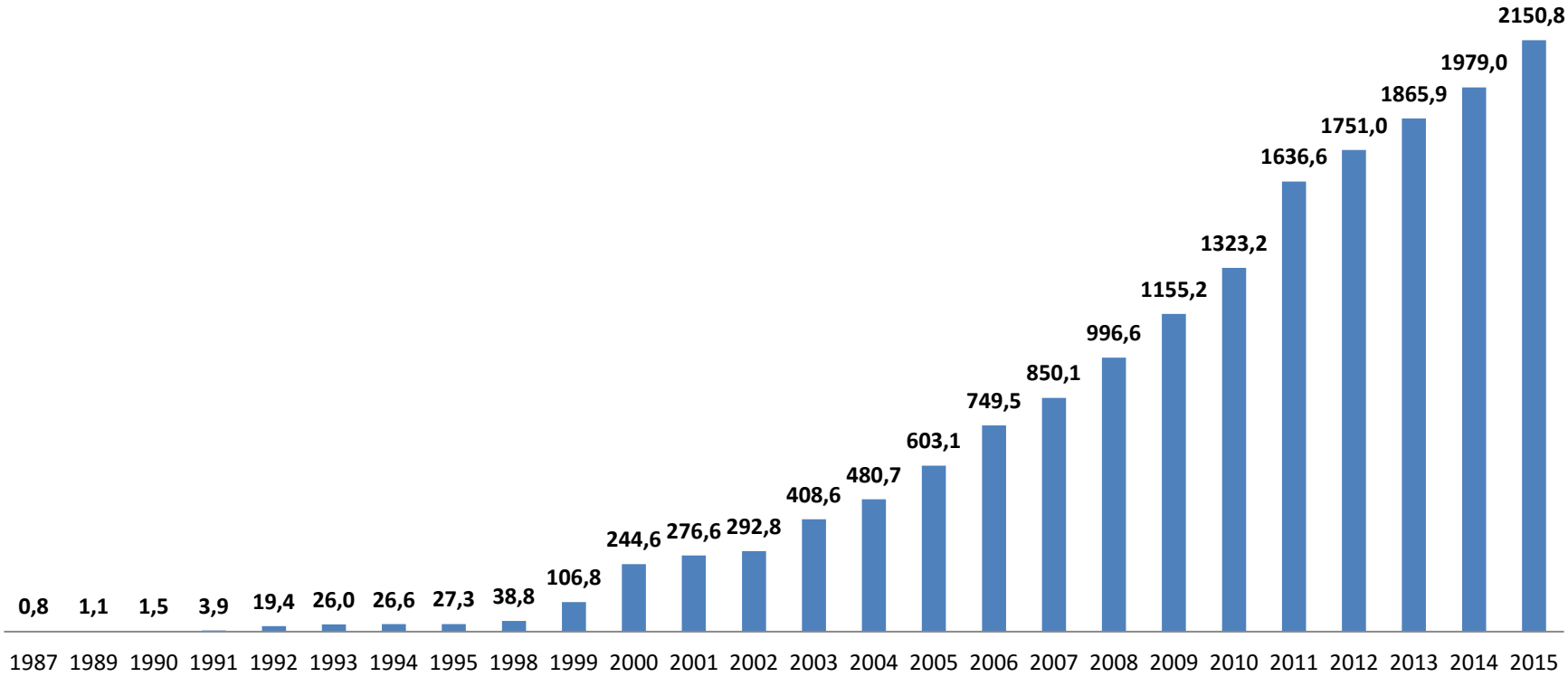
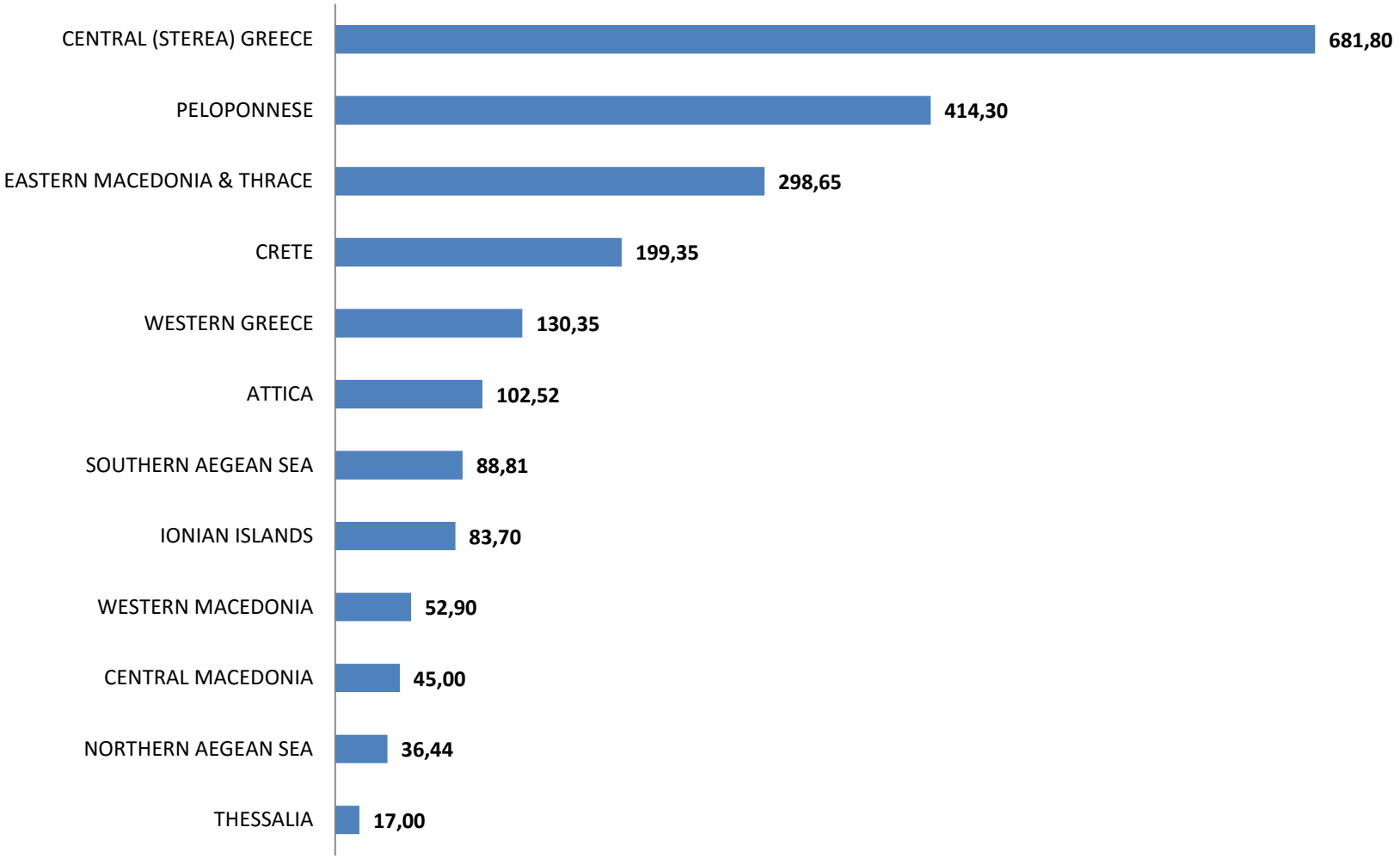
Total installed MW per year

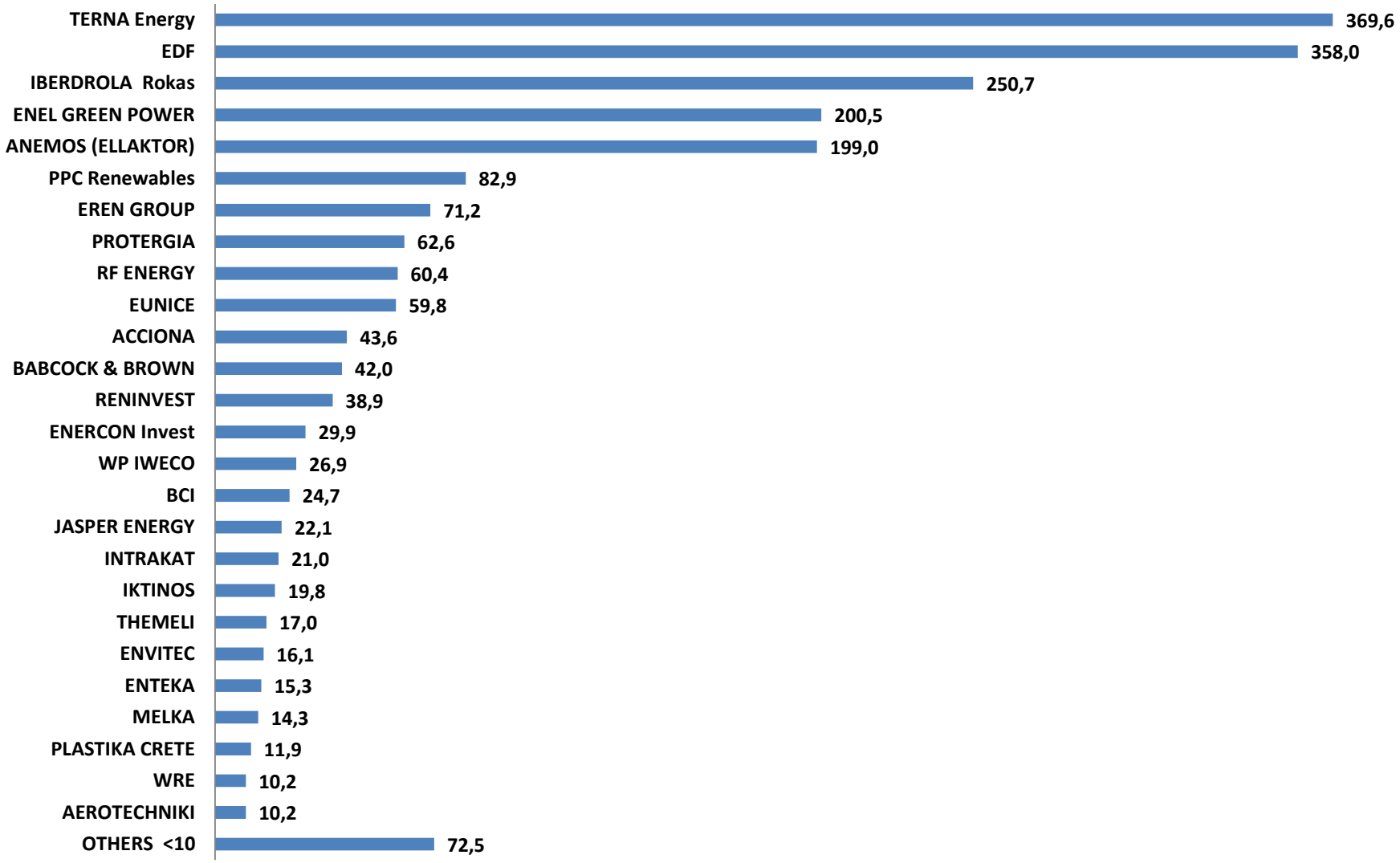


The HWEA Wind Energy Statistics take into account the wind capacity which is in commercial or test operation in Greece and it is based on sources from the market actors.

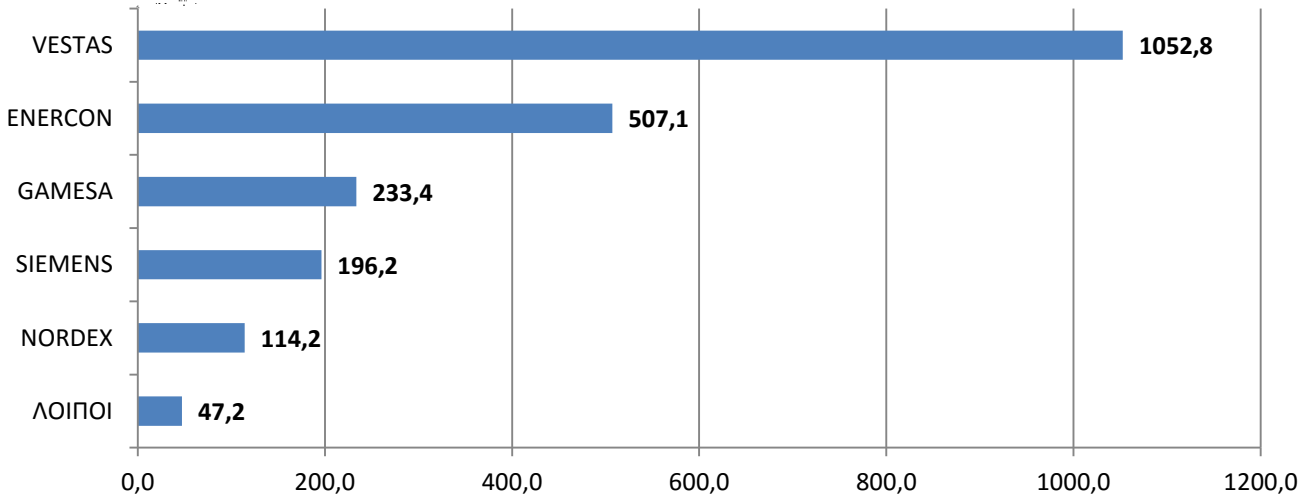
Installed MW per region



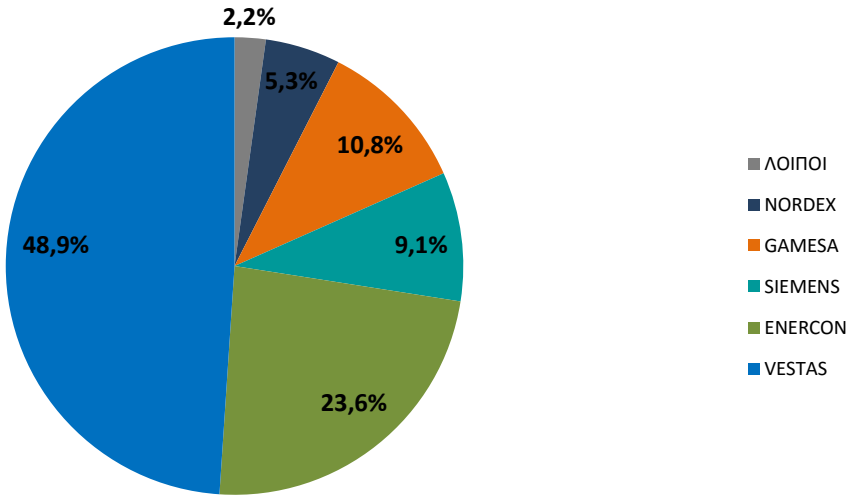
Installed MW per wind energy producer



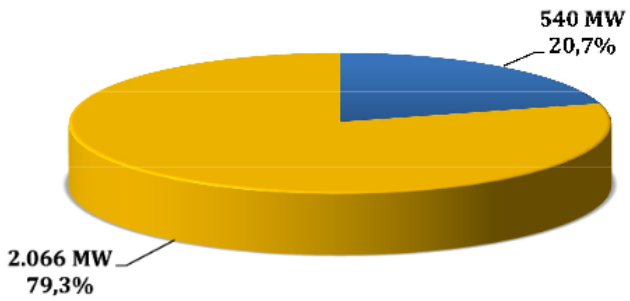
Installed MW per manufacturer



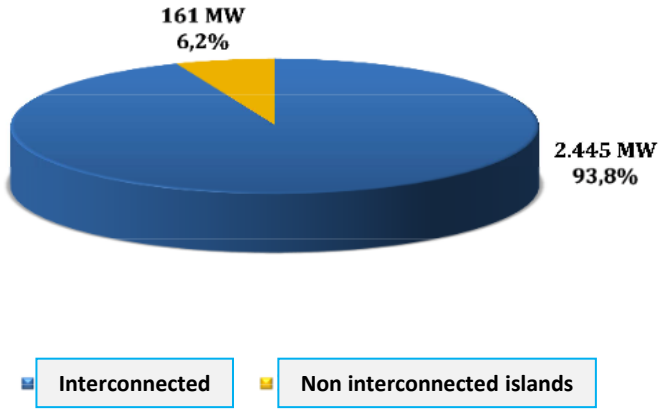
Market share per manufacturer

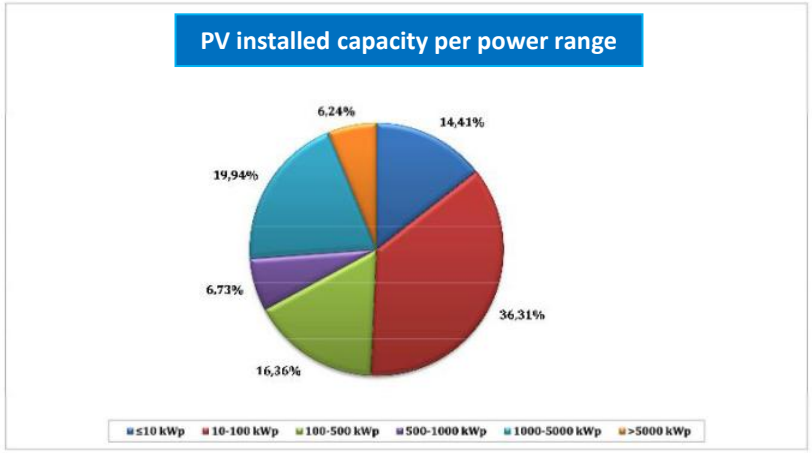


PV installed capacity per grid system

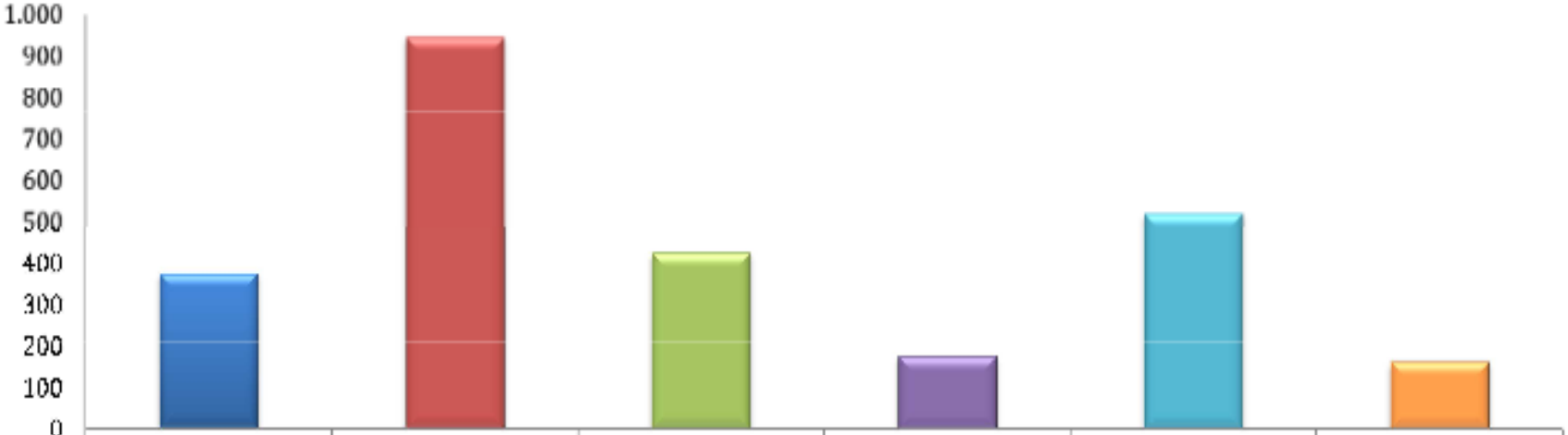


PV installed capacity 2015





PV installed capacity per power range



	≤10 kWp	10-100 kWp	100-500 kWp	500-1000 kWp	1000-5000 kWp	>5000 kWp
MWp	375,48	946,08	426,25	175,47	519,60	162,70

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Greece 2020 renewable energy targets under EU directive 28/2009

Overall target : 18% of share of energy generated from renewable sources in gross final energy consumption:

- ✓**Heating and cooling**: 20% of heat consumption met by renewable sources;
- ✓**Electricity**: 40% of electricity demand met by electricity generated from renewable energy sources;
- ✓**Transport**: 10% of energy demand met by renewable energy sources.

Share of renewable consumption to gross final energy consumption. Comprises of direct use of renewables (e.g. biofuels) plus energy produced from renewables (e.g. wind, hydro).
Final energy consumption is the energy that households, industry, services, agriculture and the transport sector use.

EU Member State	2006	2007	2008	2020 Target	% To cover:
Greece	7.2 %	8.1 %	7.9 %	18 %	**10.1 %**
Germany	6.9 %	9 %	8.9 %	18 %	**9.1 %**
Denmark	16.8 %	18.1 %	18.7 %	30 %	**11.3 %**
Portugal	20.5 %	22.2 %	23 %	31 %	**8 %**

The road map to reach 18% of final consumption from RES by 2020 The Targets (2010 – 2014 - 2020)		
Technology	Target Capacity Shares (MW)	
	2014	2020
Small Hydro (<=15MW)	300	350
PV	1500	2200
CSP	120	250
Wind (onshore & Offshore)	4000	7500
Geothermal energy	0	120
Biomass	200	350

Investments needed (2010-2020)

Mil. euro (2005)	Total 2010-2020
Lignite	2.100
Natural gas	3.311
Oil	249
Large hydro	650
Small hydro	137
Pump storage	1.672
PV	5.508
Solar thermal	1.120
Wind	6.710
Geothermal	264
Biomass/biogas	530
Total	22.252
from which RES	16.455

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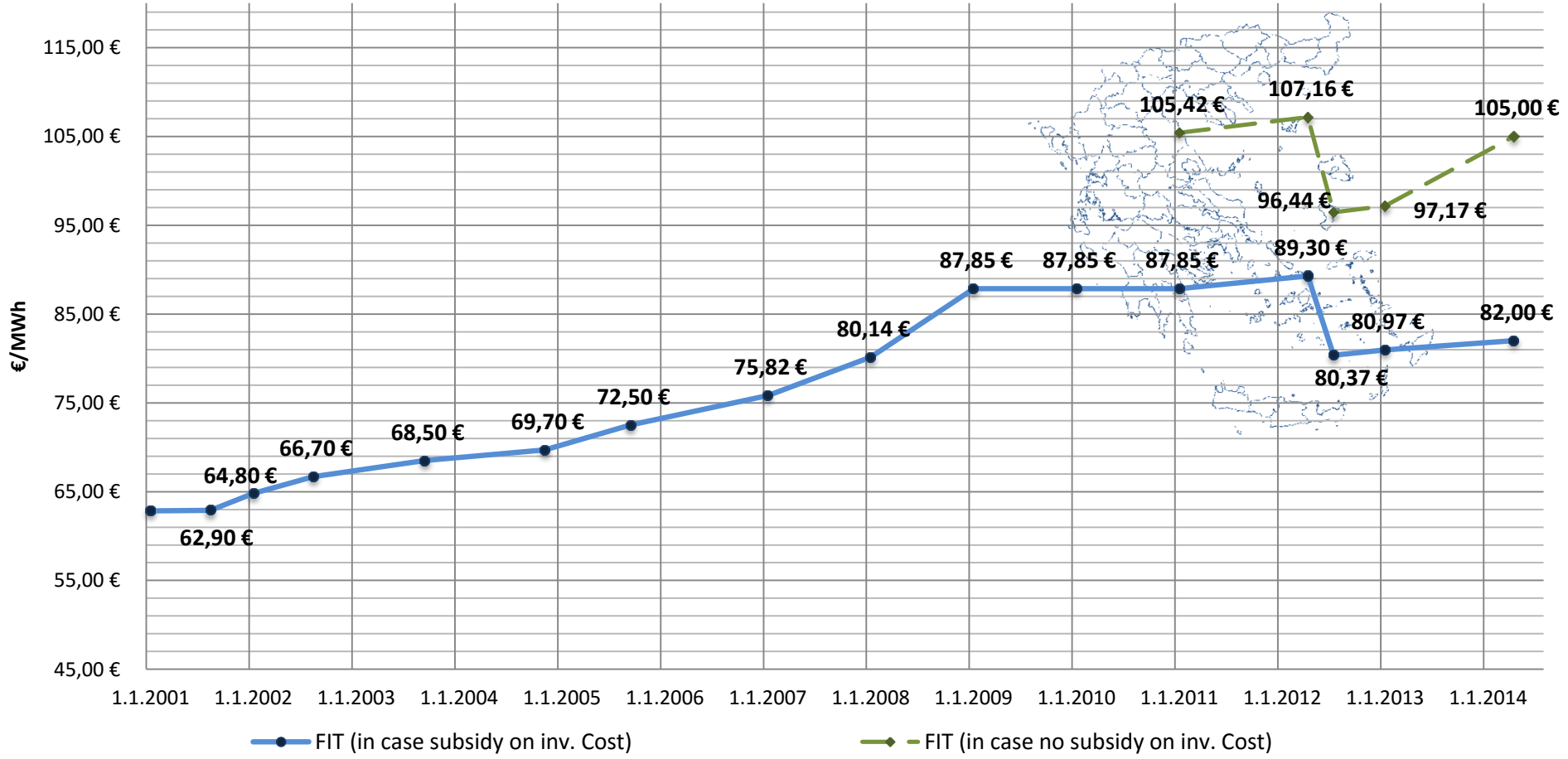
What are the ingredients for growth in any Wind energy market?

Factors influencing wind energy development:

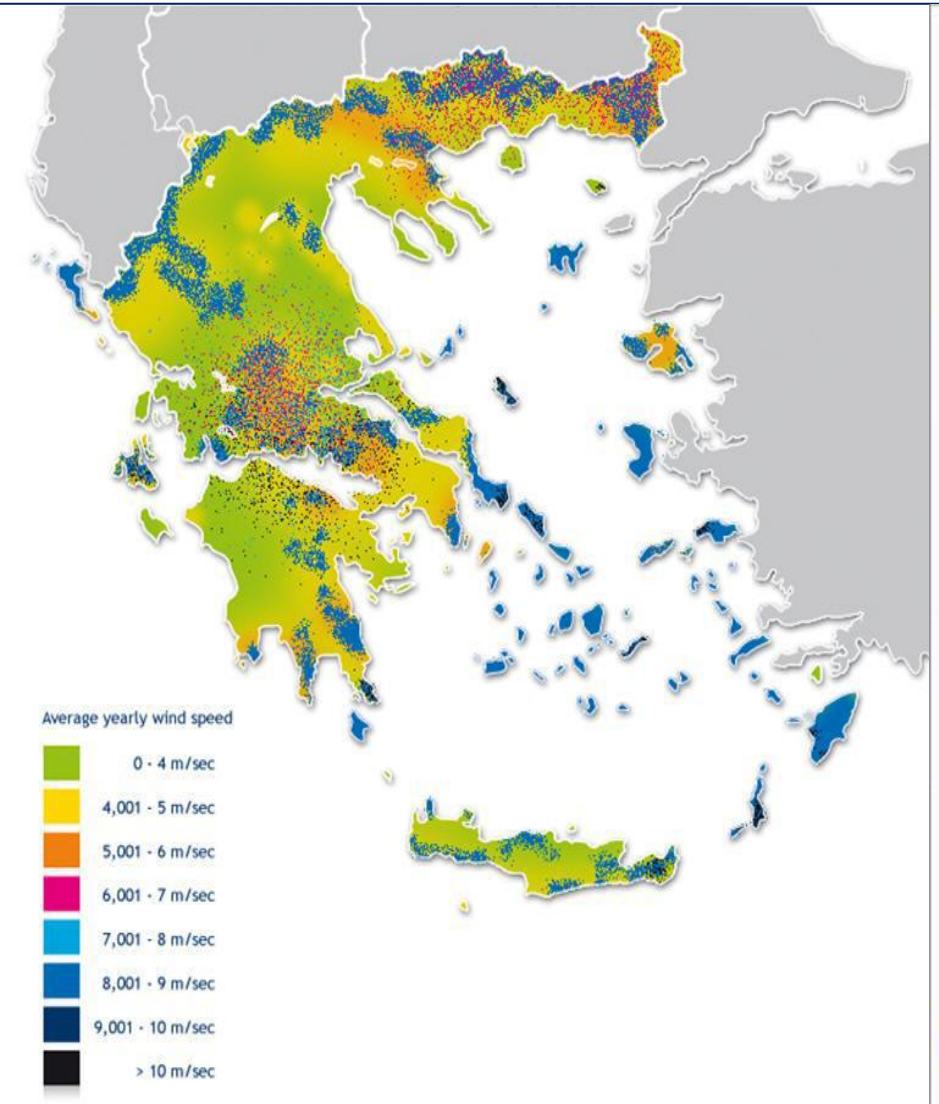
- Wind potential/Wind Technology
- Knowhow
- Personnel
- Legislation - Licensing procedure
- Incentives (financial or corporate) / Feed in Tariff (Feed in Premium)
- Financing access
- industrial activity

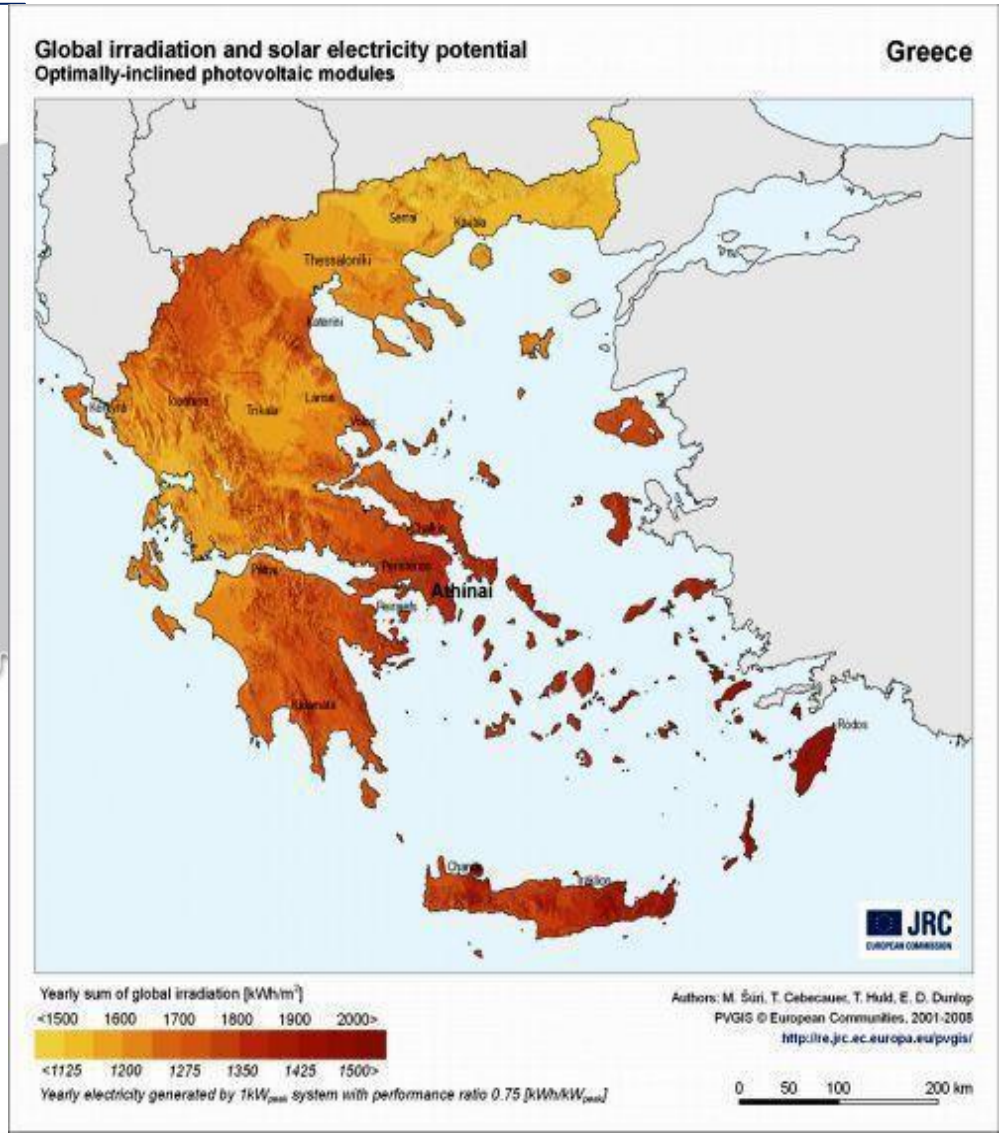
Investment drivers for wind energy (I)
Wind feed-in tariffs / Feed in Premiums.

Evolution of Wind Feed In Tariff in Greece, 2001 - 2014 (€/MWh)



Investment drivers (II)
Capacity factor





Investment drivers (III) – Investment cost

The most significant investment driver on the expenditure side is the initial investment cost. The cost has followed the rapid fall in WTG's prices .

- ✓**EUR 1,200/kW in the interconnected system**
- ✓**EUR 1,400/kW in autonomous islands.**

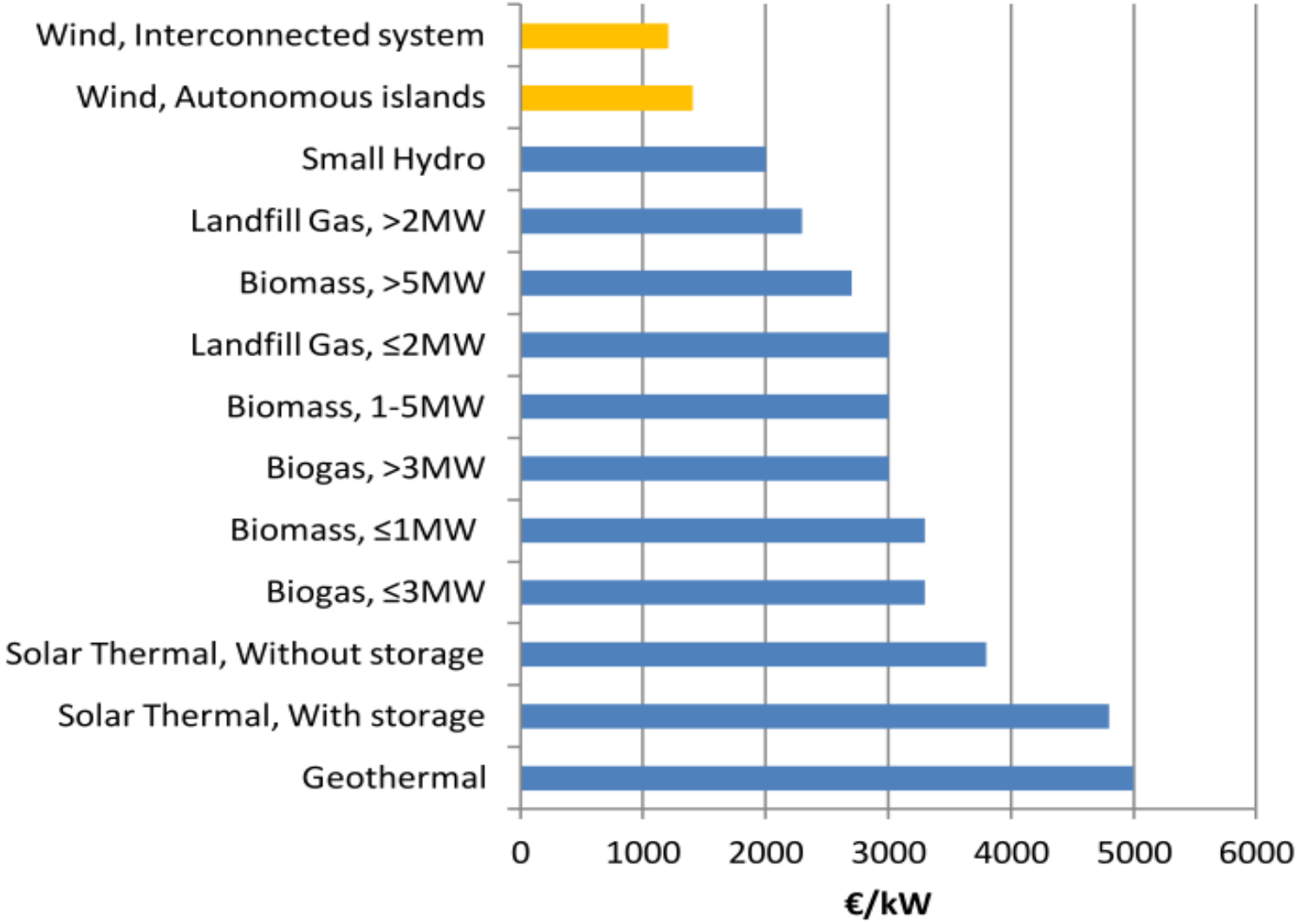
In comparison

- ✓hydroelectric systems, at EUR 2,000/kW,
- ✓solar thermal EUR 3,800-4,800/kW
- ✓geothermal installation EUR 5,000/kW

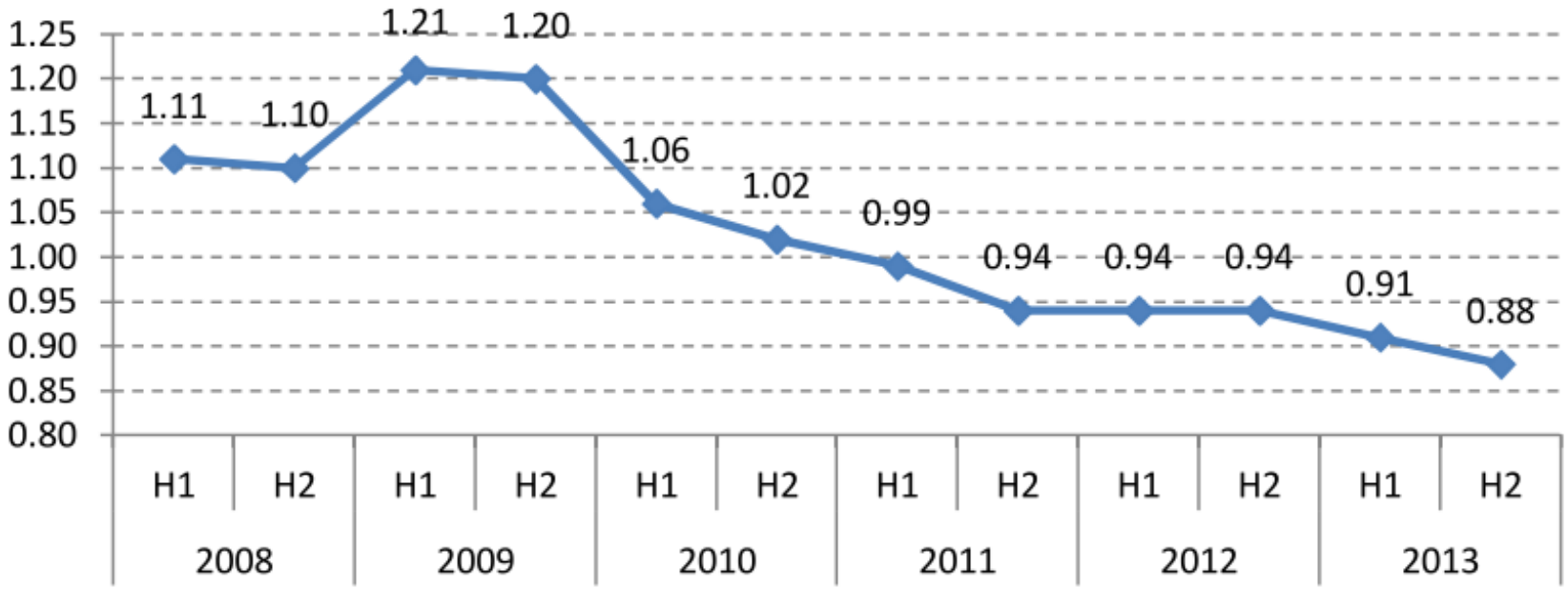
More than **three quarters of the wind installation cost correspond to the price of the wind turbine** itself

- ✓**grid connection (8.9%),**
- ✓**foundation (6.5%)**
- ✓**land rent (3.9%),**

Installation cost of wind and other renewable energy sources



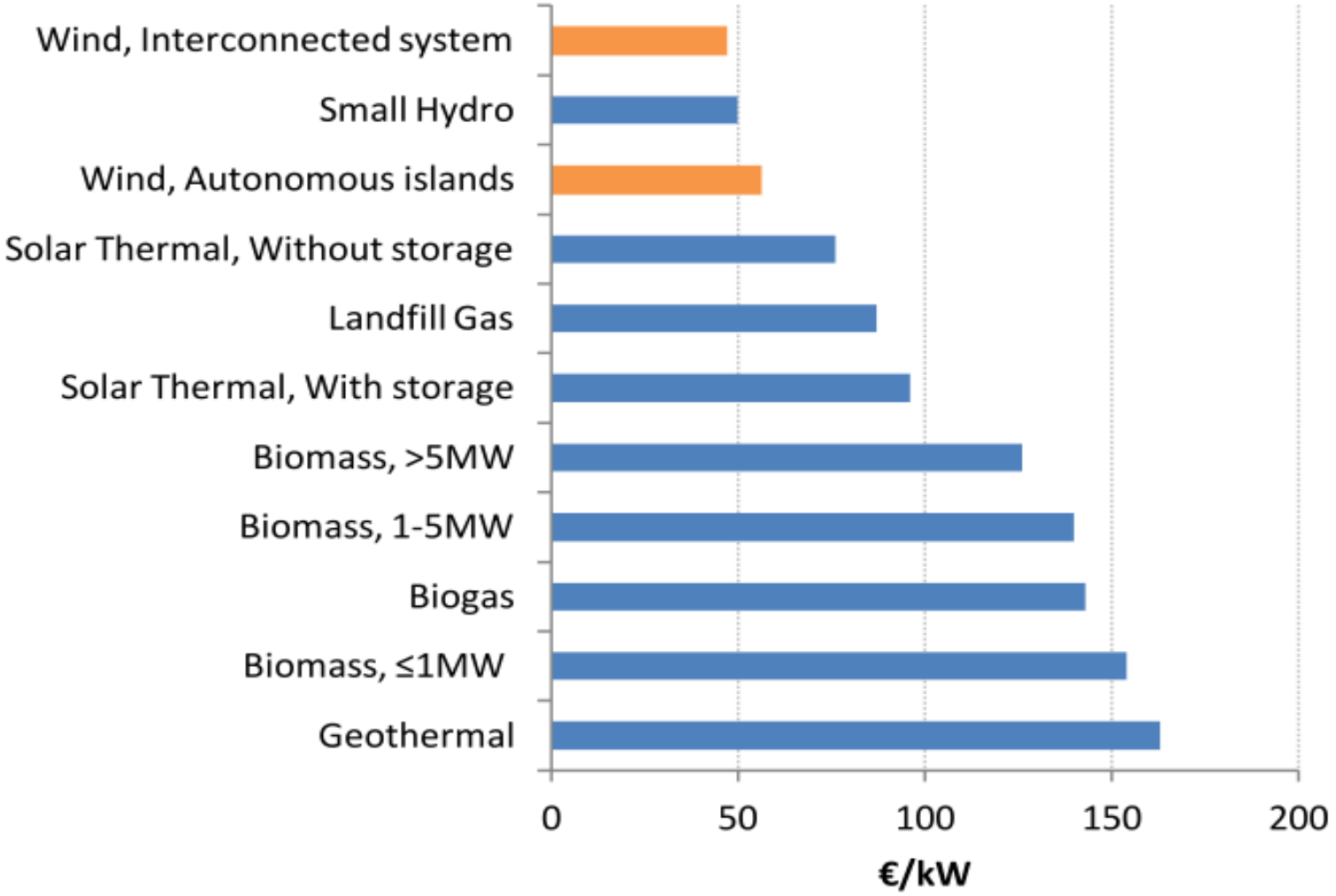
Wind turbine price (million € per MW), mean price by date of delivery



Source: Bloomberg.

Note: Due to the reasonable time gap between contracting and delivery, the above curve indicates contract prices with almost one year lag.

Annual operation and maintenance cost in Greece per technology



Note: The estimates on Biomass, Biogas and Landfill gas do not include fuel costs.

Investment drivers (IV)

Infrastructure

✓The electricity grid is a serious constraint on wind energy development everywhere. Areas with high wind potential, such as Peloponnese and Evia, are characterised as congested and the installed renewable energy facilities, together with the binding grid connection offers, cover the current grid availability.

✓The Aegean islands, with the strongest wind potential, are not connected to the mainland electricity grid. The autonomous oil stations of the islands, with strong seasonality of demand and peak during the tourist season, have limited capacity to absorb stochastic electricity generation and use expensive oil.

✓The full harnessing of the wind energy potential requires the island interconnection, including Crete with the mainland system and the completion of mainland grid extension works.

✓The system operator has a long term plan for the development of the electricity network, which takes into account the need to strengthen the network to facilitate additions of wind capacity.

Special Case: The economic crisis and its effect on RES development

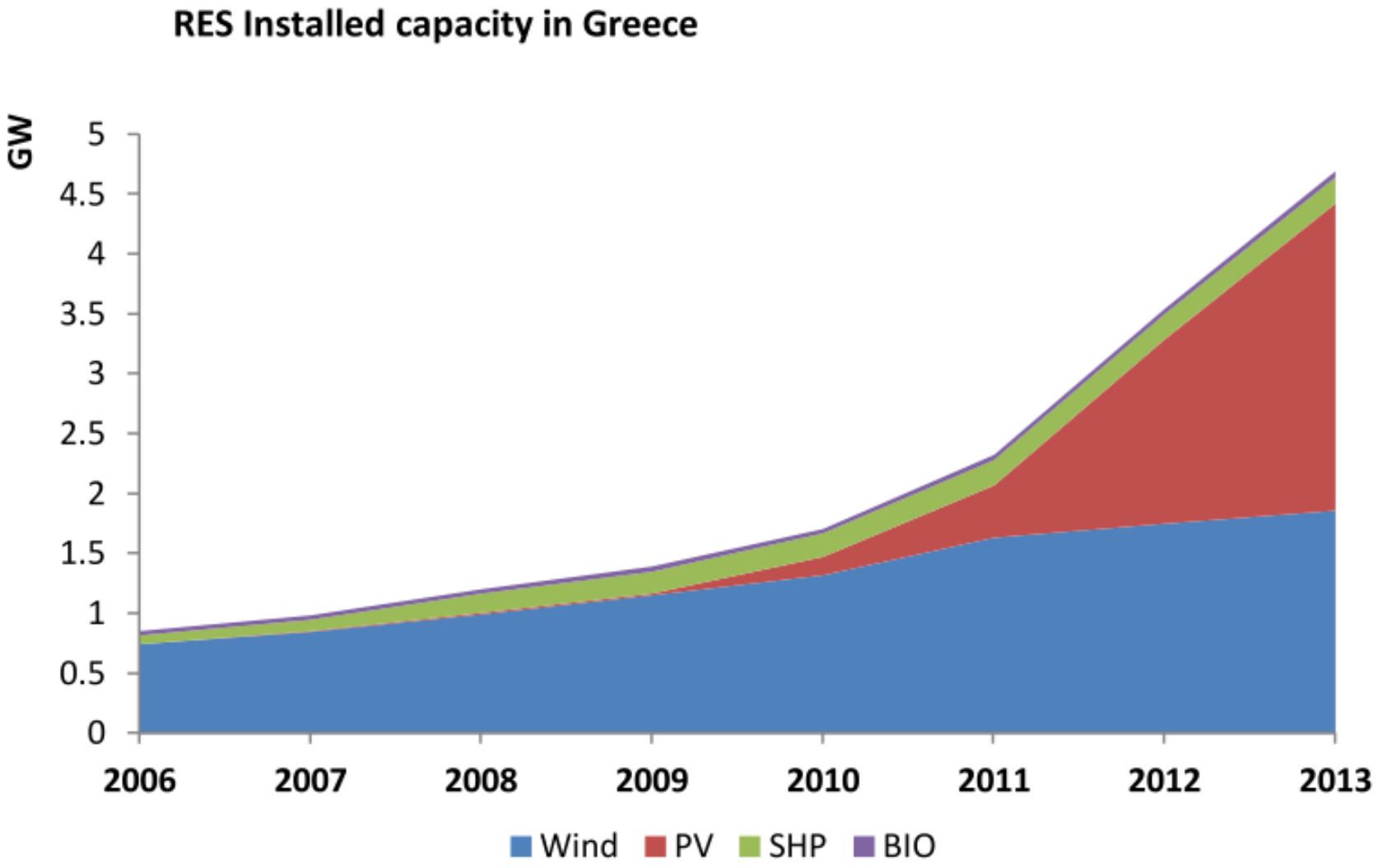
✓Despite the severity of the financial crisis, which had a profound impact on investment in the country, **the penetration of renewable energy sources accelerated during the years of economic contraction.**

✓RES attracted over **EUR 7.6 billion of investment in Greece cumulatively over the period 2006-2013**. Despite the crisis, investment in RES accelerated between 2008 and 2012

✓During **2010-2013, approximately EUR 6.3 billion** were invested in renewable energy technologies in Greece, almost **five times as high** compared with the investments made during **2006-2009.**

✓**Wind energy, in particular, experienced an investment boom in 2011,** at a time when the sovereign bond spreads were considerably higher than today. Investment in wind fell in the second half of 2012 and has returned to half-on-half growth since then.

RES grew at an average rate of 28% p.a. between 2006 and 2013.



The economic crisis and its effect on RES development

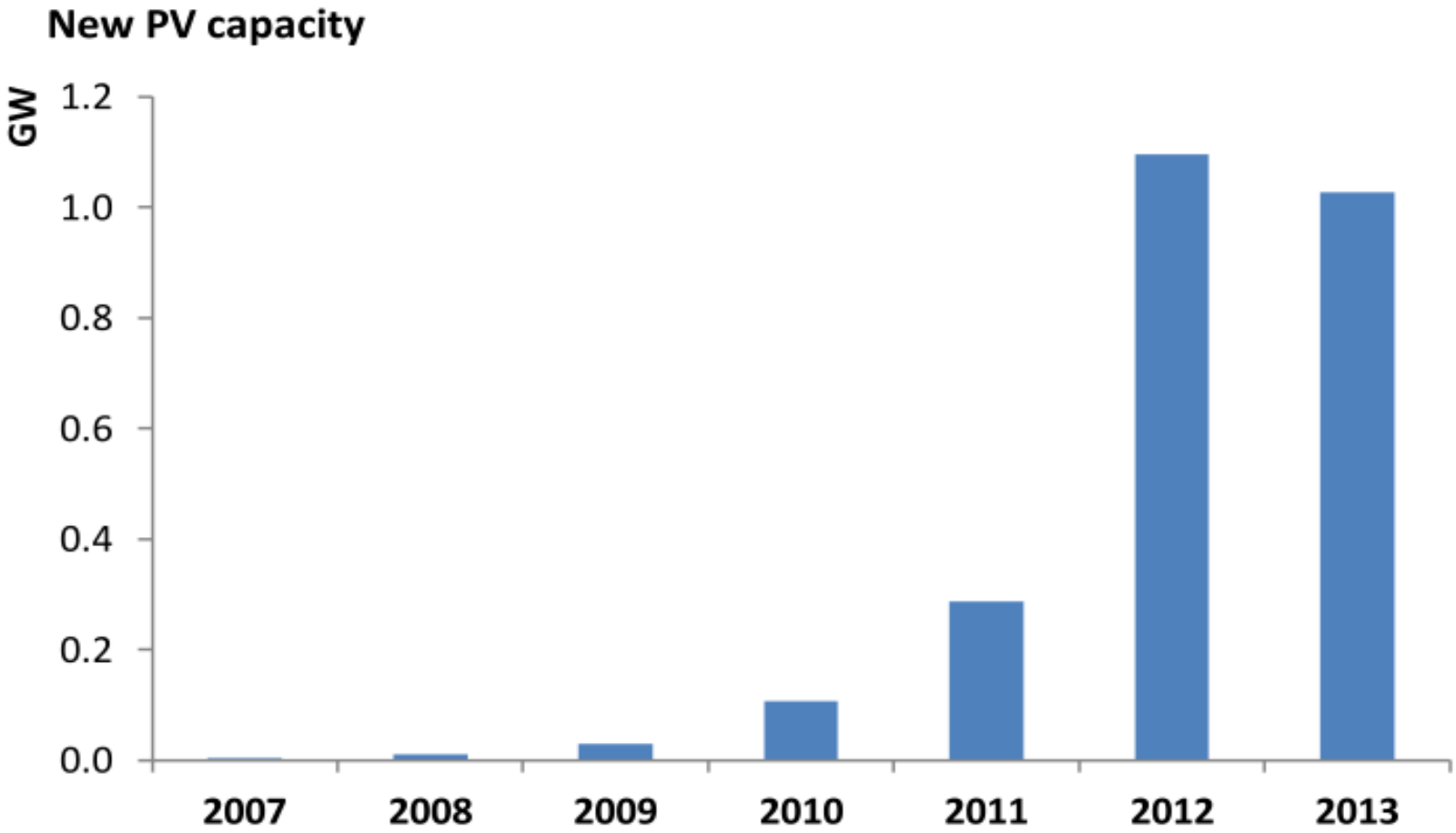
✓The main reason of lower investment in wind in 2012 and 2013, compared to 2011, is **the boom experienced in photovoltaic technology** during these 2 years.

✓In practice, there is a significant **overlap between wind and PV investors,** as part of a strategy of building a portfolio of renewable energy installations.

✓PV & Wind absorbed the largest share (93% of total over the period 2006-2013 with **EUR 5.4 billion for PV** and **EUR 1.7 billion for Wind**).

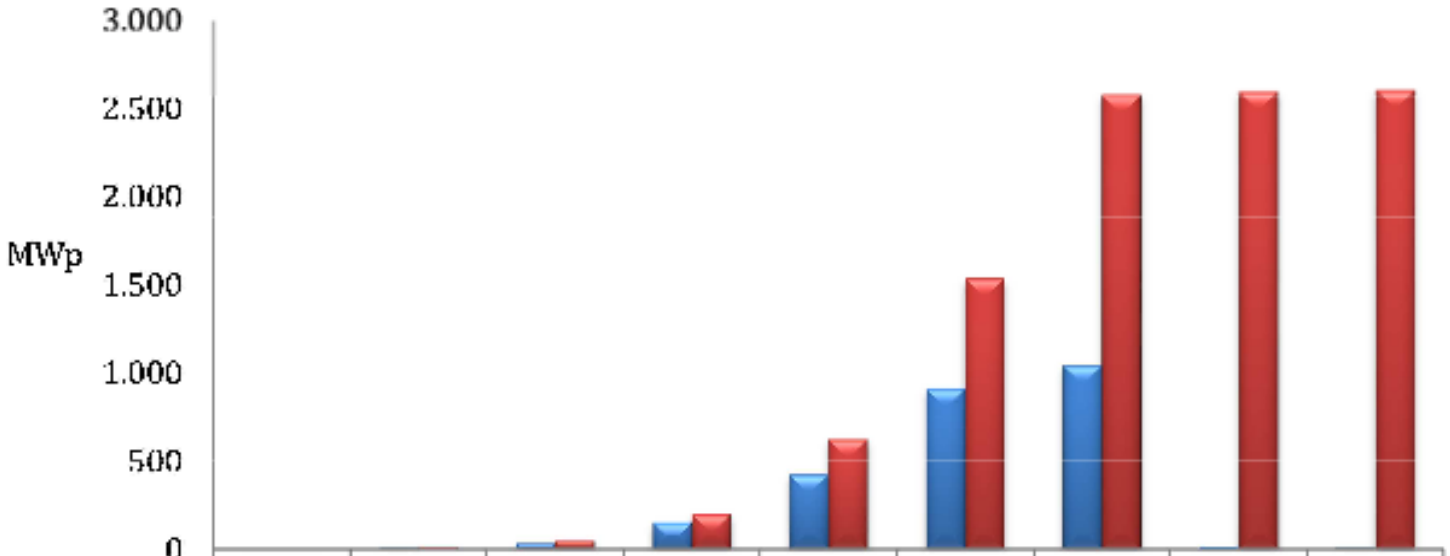
The boom experienced in photovoltaic technology

✓The **higher return observed for PV** in the past two years, driven by **the sharp fall in PV panel prices**, as well as the **prospect of lower PV feed-in tariffs** in the future, were the main reasons for the switch from wind to PV.



Interconnected systems	MWp
New capacity 2015	10,3
Total capacity 2015	2.605,6

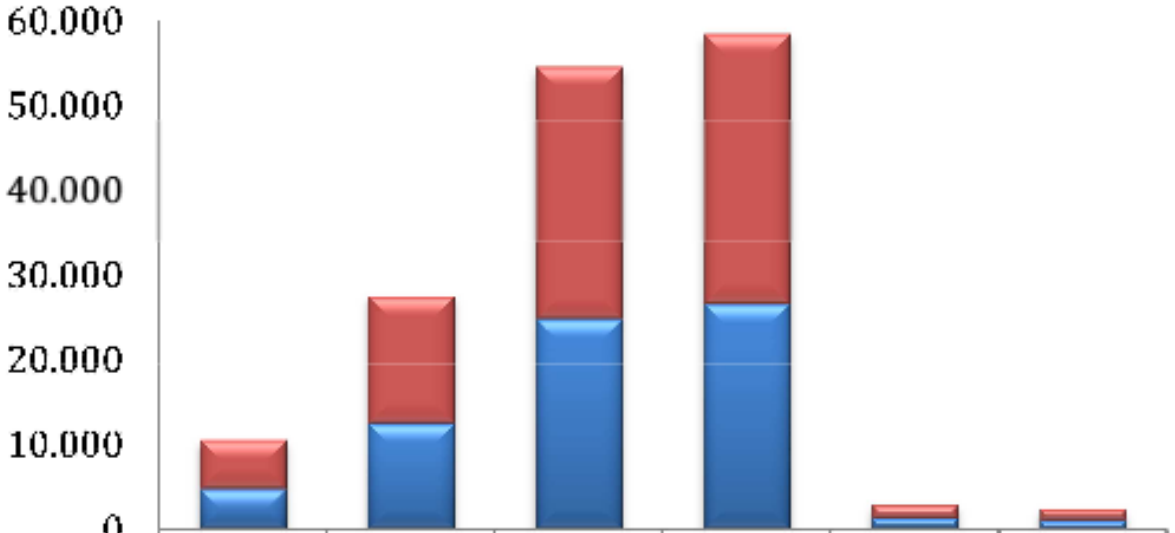
Greek PV market



	2007	2008	2009	2010	2011	2012	2013	2014	2015
Annual capacity	2	10	35	152	425	912	1.043	17	10
Total capacity	2	12	47	199	624	1.536	2.579	2.596	2.606

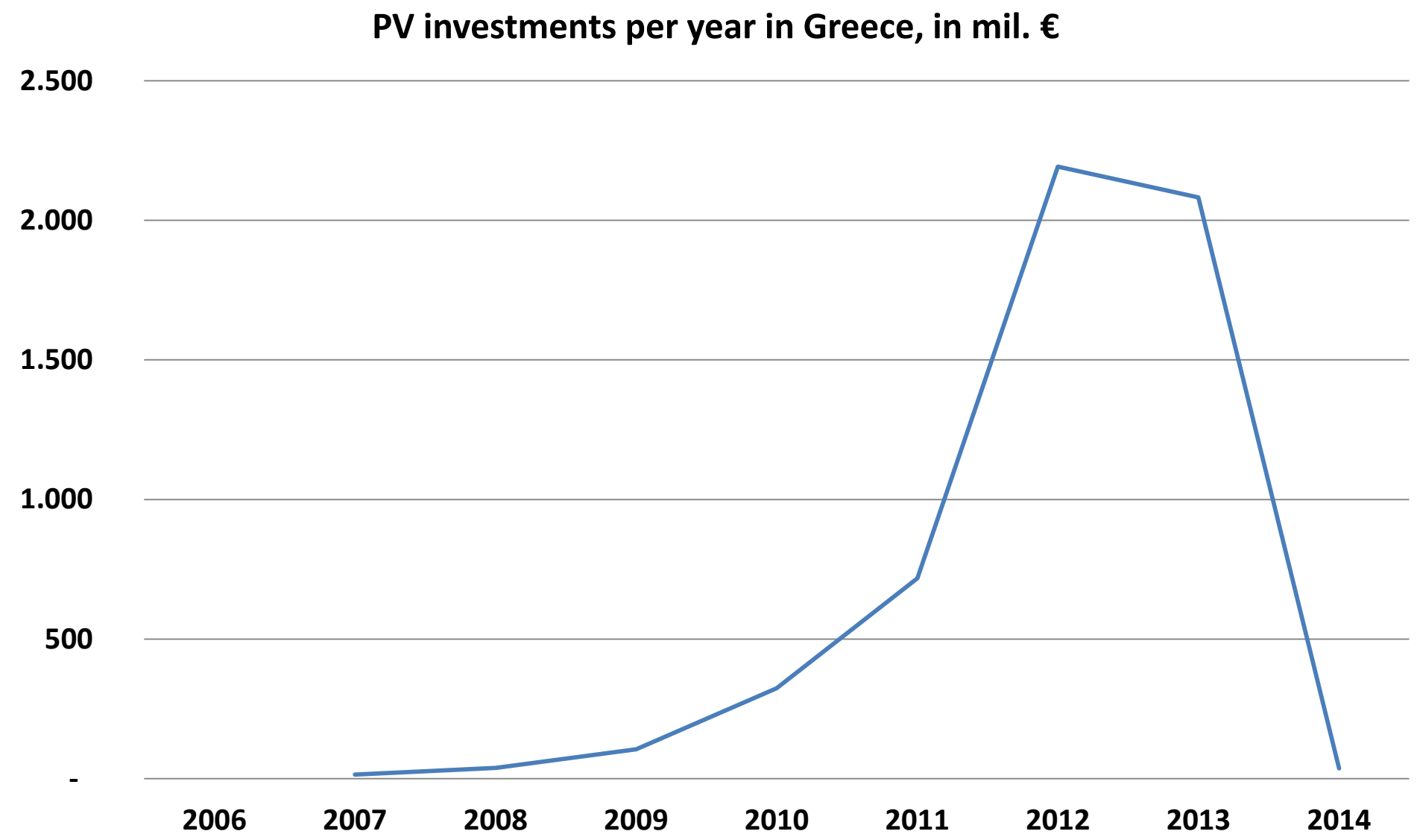
A success story that went wrong

PV and job creation

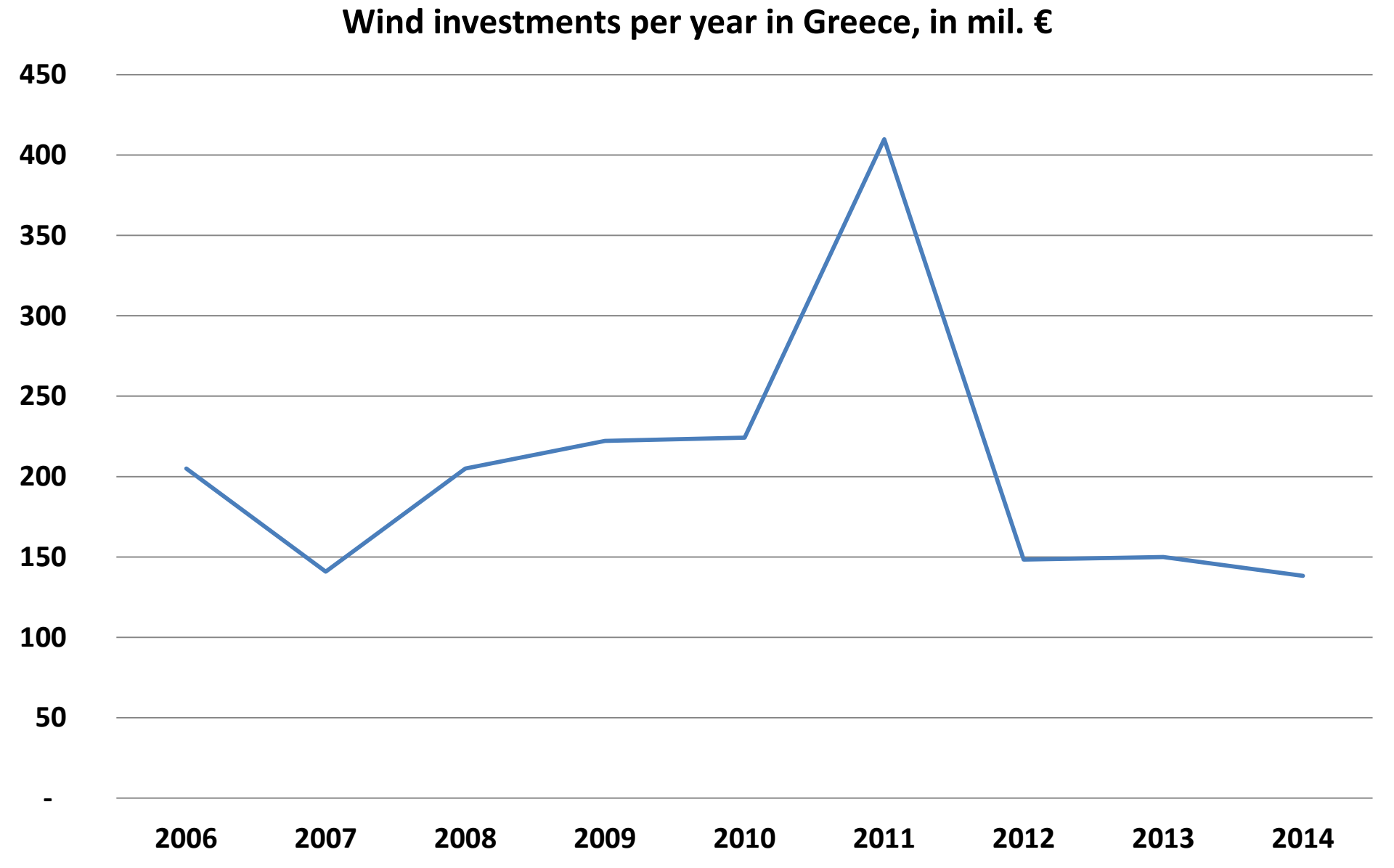


	2010	2011	2012	2013	2014	2015
Direct employment	5.760	15.020	29.810	31.920	1.570	1.300
Indirect employment	4.800	12.520	24.840	26.600	1.310	1.080

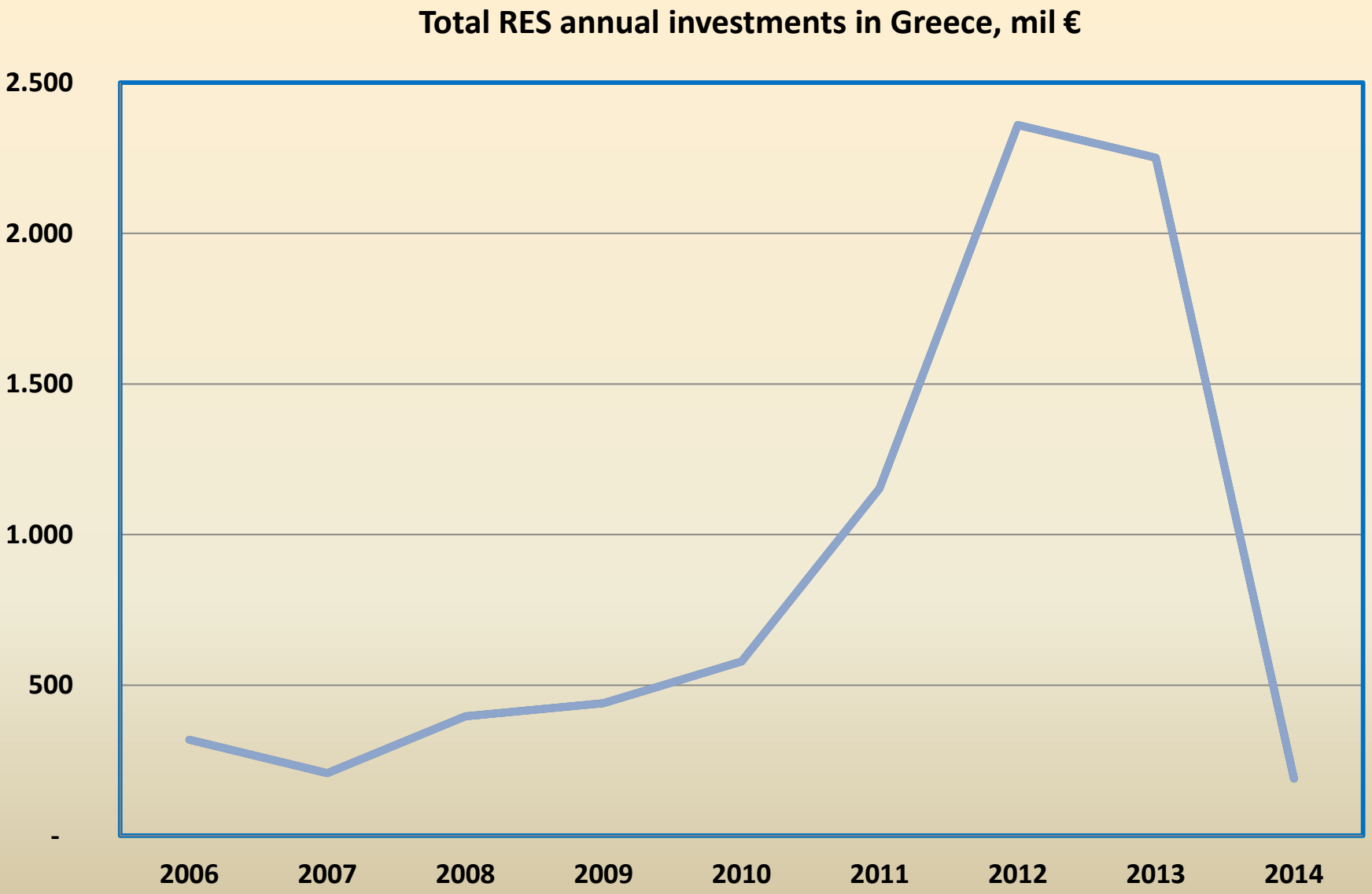
The investment vacuum



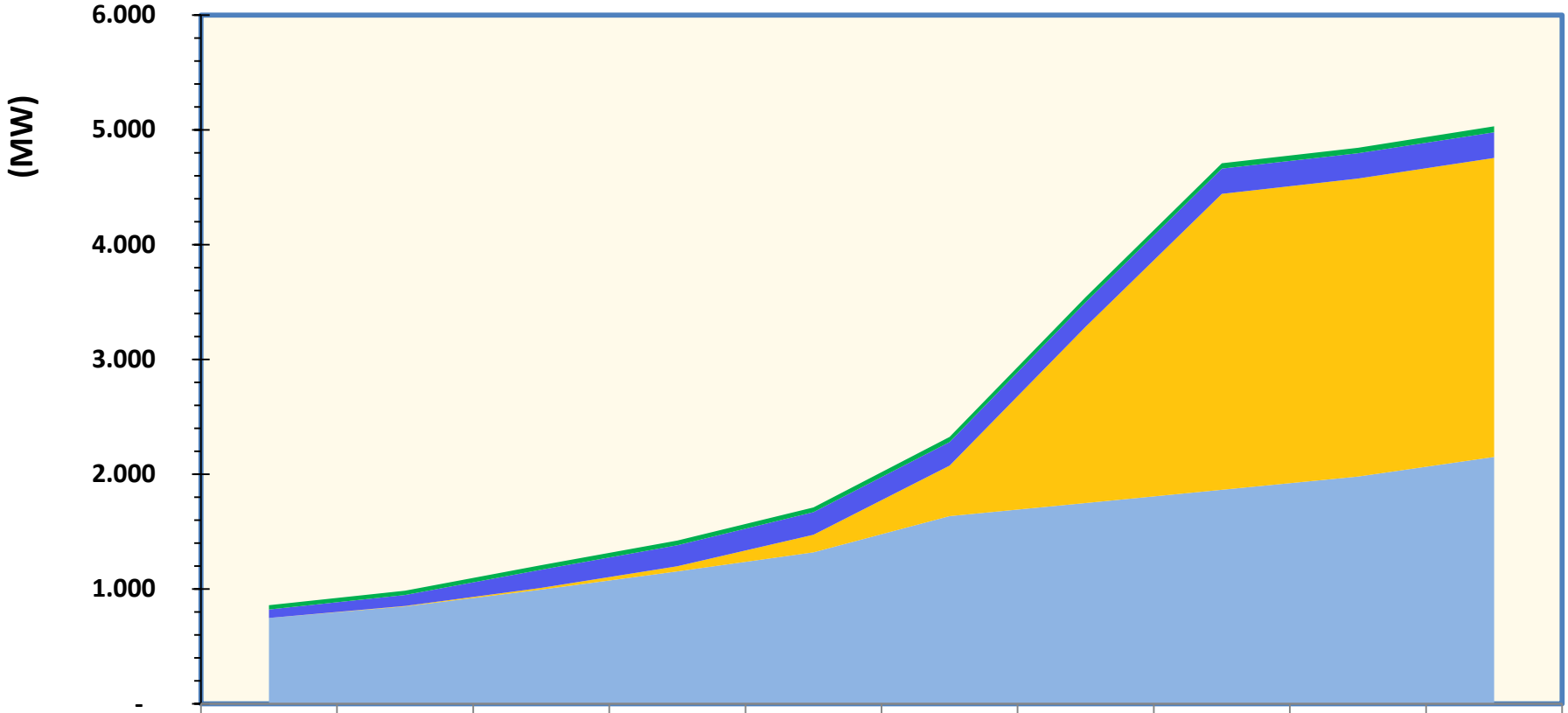
The investment vacuum



The investment vacuum

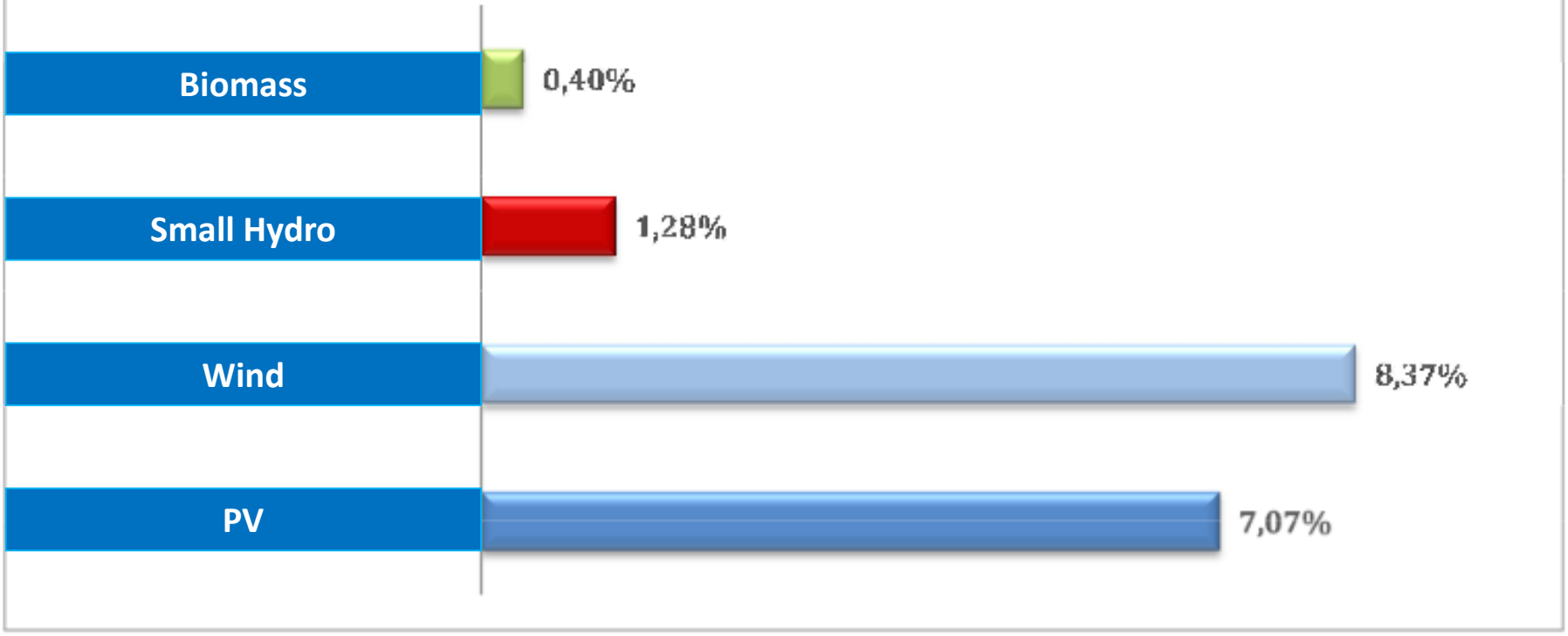


Cumulative RES Installed capacity in Greece



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ΒΙΟ	37	37	39	41	41	45	45	46	47	52
ΜΥΗΣ	74	96	158	183	197	205	213	220	220	224
Φ/Β		4	15	45	153	440	1.536	2.577	2.596	2.604
Αιολικά	748	849	995	1.154	1.320	1.635	1.749	1.865	1.980	2.151

RES Technology share in electricity consumption in 2015



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Conclusions

- RES exploitation addresses positively all major energy policy targets/drivers (Global-European and National):
  - ✓ **Technically feasible**
  - ✓ **Environmentally friendly**
  - ✓ **Local source enhances security of supply,**
  - ✓ **Economic competitiveness and job creation**
  - ✓ **Combats effectively climate change**
- Greece is rich in RES, in particular Wind and Solar (but also hydro, geothermal and biomass). Greece has not exploited yet all the opportunities associated to RES deployment, especially those related to technology development, innovation and smart specialization
- **The country is endowed with an abundance of all renewable energy sources, while it has adequate experienced personnel and the required knowhow to provide the platform for the much awaited take off of renewable energy development.**

Evaluating the investment drivers the market voted:

12.900 MW of mature RES projects

Licensing Progress of RES up to 31.06.2014

Technology	Applications	Production license	Installation License	Binding connection terms	With connection contract	with PPA	Operating
Wind	24.102	23.150	1.524	5.659	514	1007	1.866
Biomass	50	474	34	89	33	34,5	47
Geothermal	20	8	0	0	0	0	0
Small Hydro	115	964	41	76	15	23,5	220
PV*(inl. Rooftops & PL exceptions)*	100	4.422	488	1.554	567	1.008	2.588
CSP	316	471	38	212	0	0	0
Hybrid	920	295	0	2,5	0	0	0
TOTAL	25.622	29.784	2.124	7.592	1.128,6	2.073,8	4.721,2

1.524+5.659+514+1.007 = 8.704 MW of mature wind projects

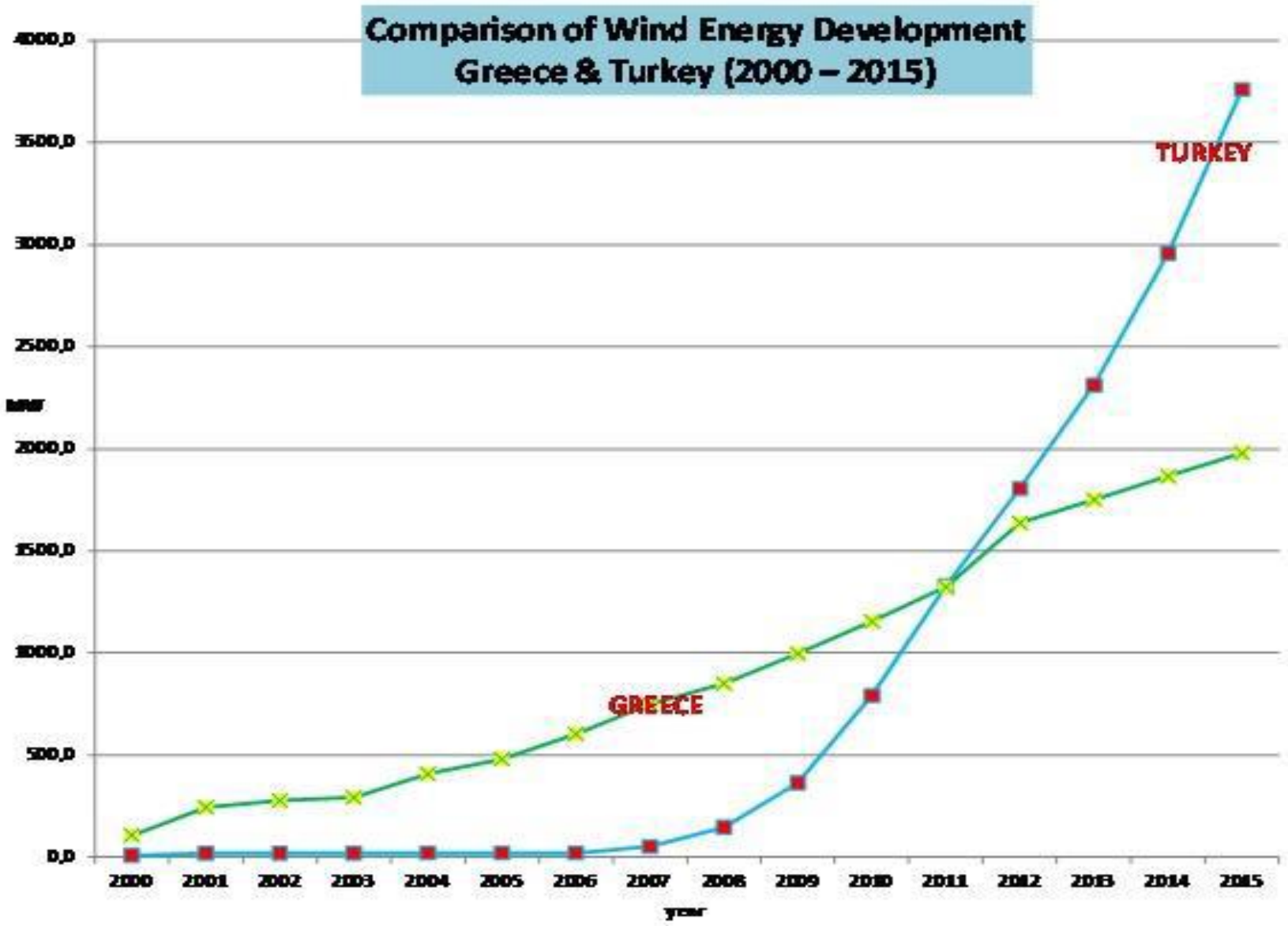
488 +1.554+567+ 1.008 = 3.617 MW of mature p/v projects

What are the ingredients for growth in any Wind energy market?

Factors influencing wind energy development:

- Wind potential/Wind Technology
- Knowhow
- Personnel
- Legislation - Licensing procedure
- Incentives (financial or corporate) / Feed in Tariff (Feed in Premium)
- Financing access
- industrial activity

Political will, political leadership and vision.


Comparison of Wind Energy Development
Greece & Turkey (2000 – 2015)
4000,0
3500,0
3000,0
2500,0
MW
2000,0
1500,0
1000,0
500,0
0,0
TURKEY
GREECE
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
year

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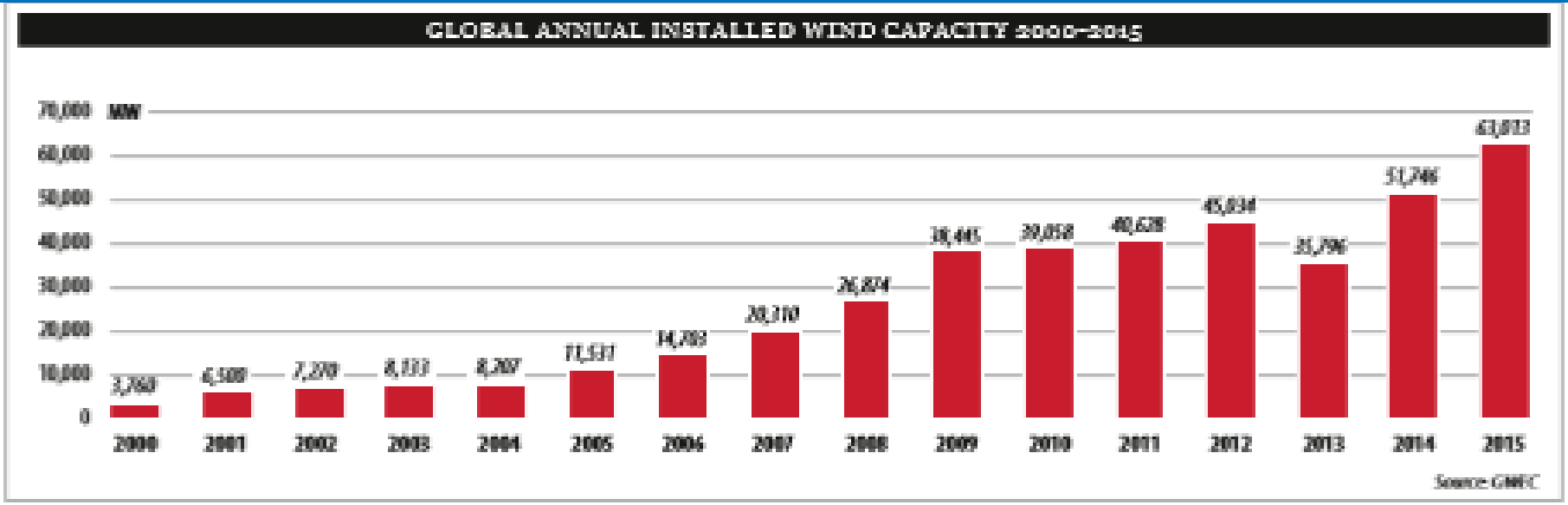
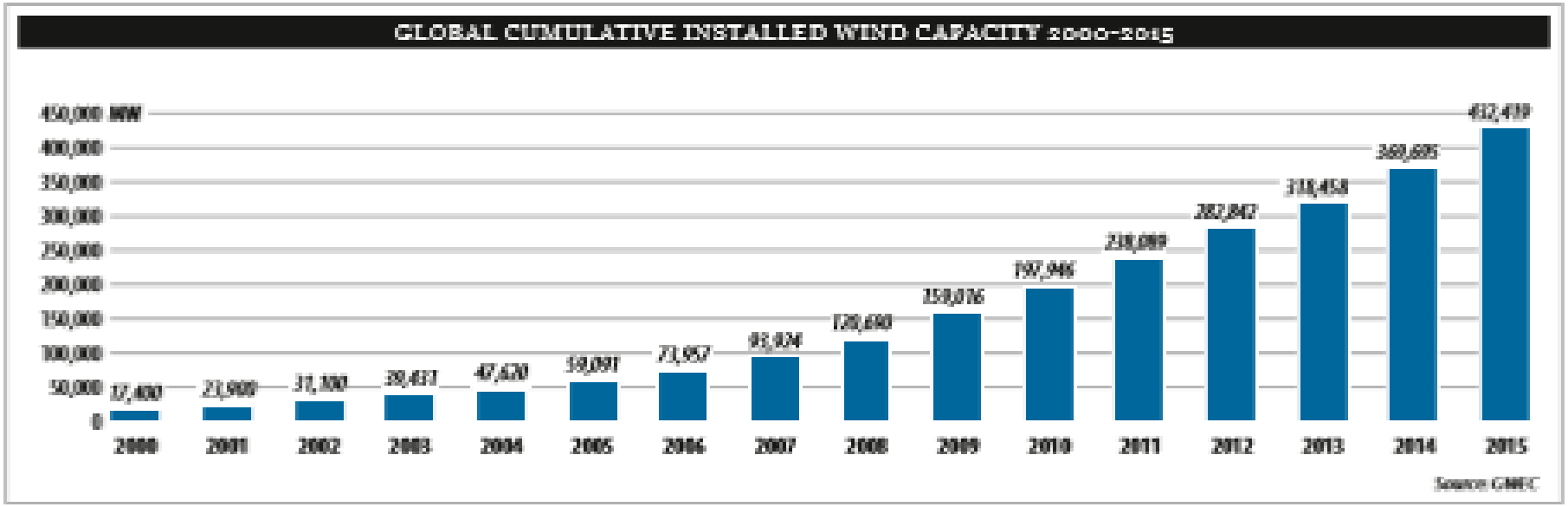
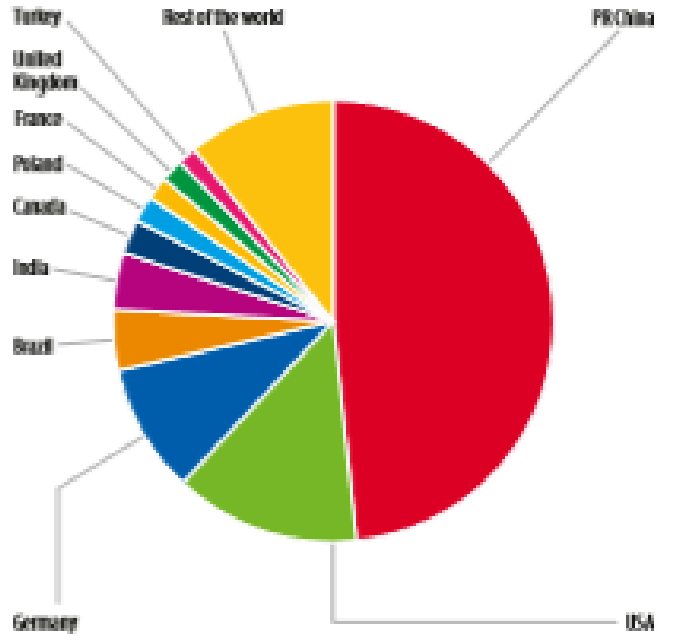
Global Wind Energy development





The global markets

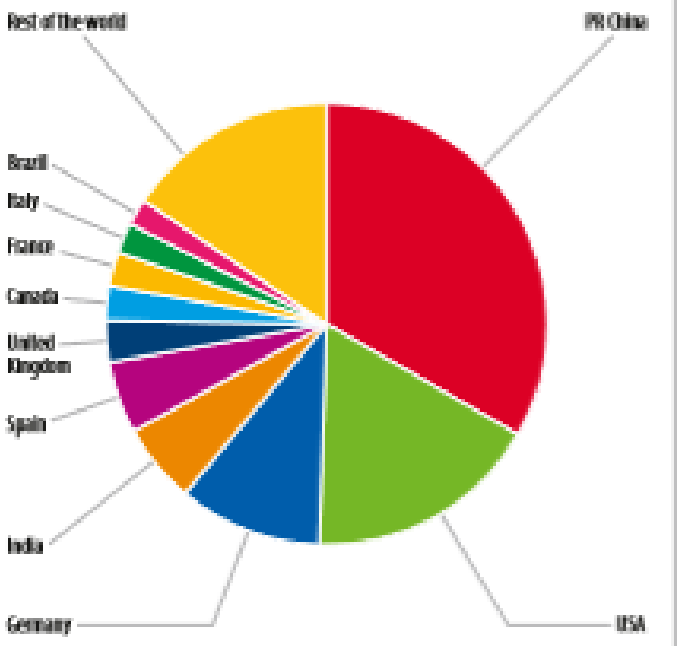
TOP 10 NEW INSTALLED CAPACITY JAN-DEC 2015



Country	MW	% Share
PR China**	30,500	48.4
USA	8,598	13.6
Germany	6,013	9.5
Brazil	2,754	4.4
India	2,623	4.2
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	6,749	10.7
Total TOP 10	56,264	89
World Total	63,013	100

Source: GWEC

TOP 10 CUMULATIVE CAPACITY DEC 2015



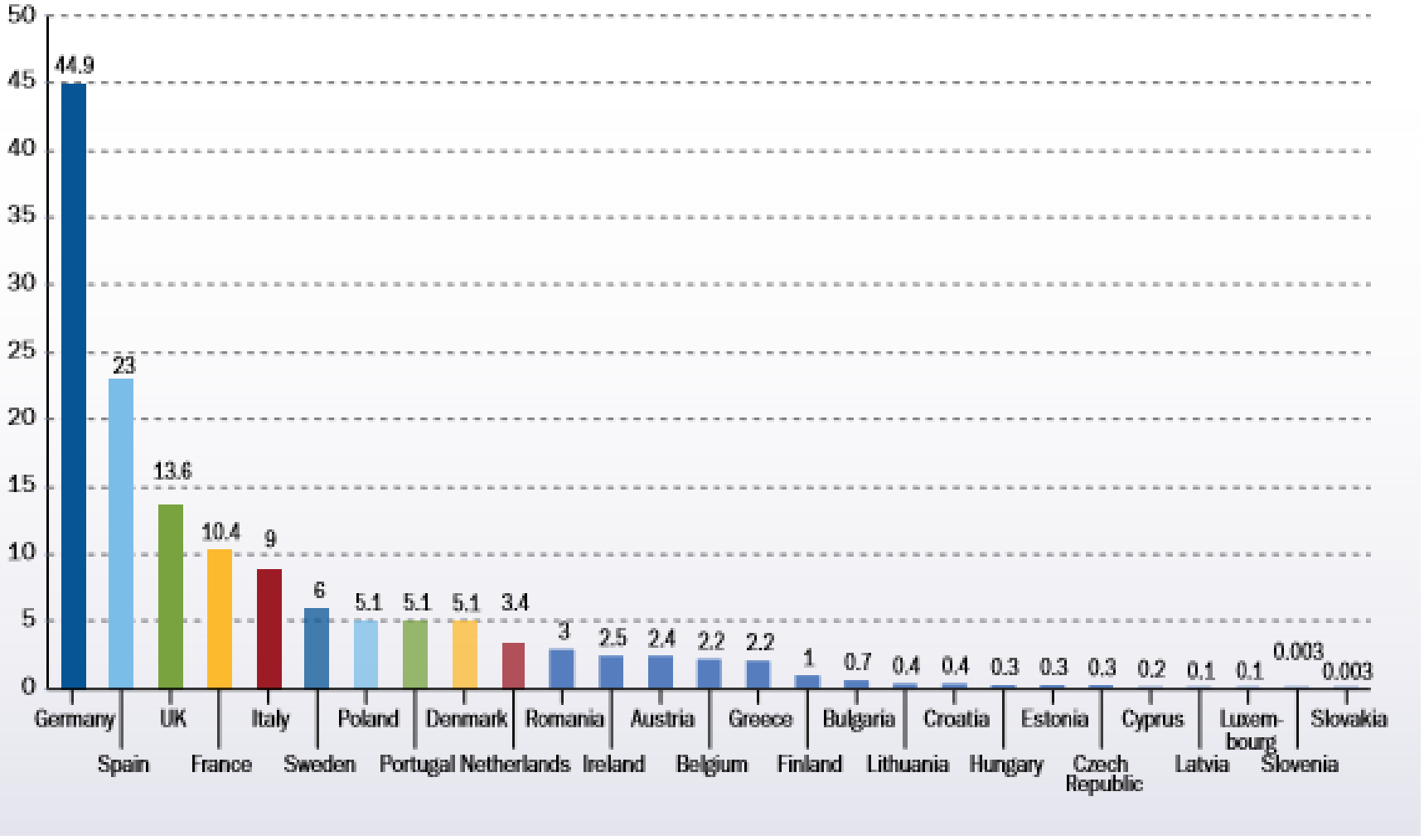
Country	MW	% Share
PR China**	145,104	33.6
USA	74,471	17.2
Germany	44,947	10.4
India	25,088	5.8
Spain	23,025	5.3
United Kingdom	13,601	3.1
Canada	11,200	2.6
France	10,358	2.4
Italy	8,958	2.1
Brazil	8,715	2.0
Rest of the world	66,951	15.5
Total TOP 10	365,468	84.5
World Total	432,419	100

Source: GWEC

** Provisional figure

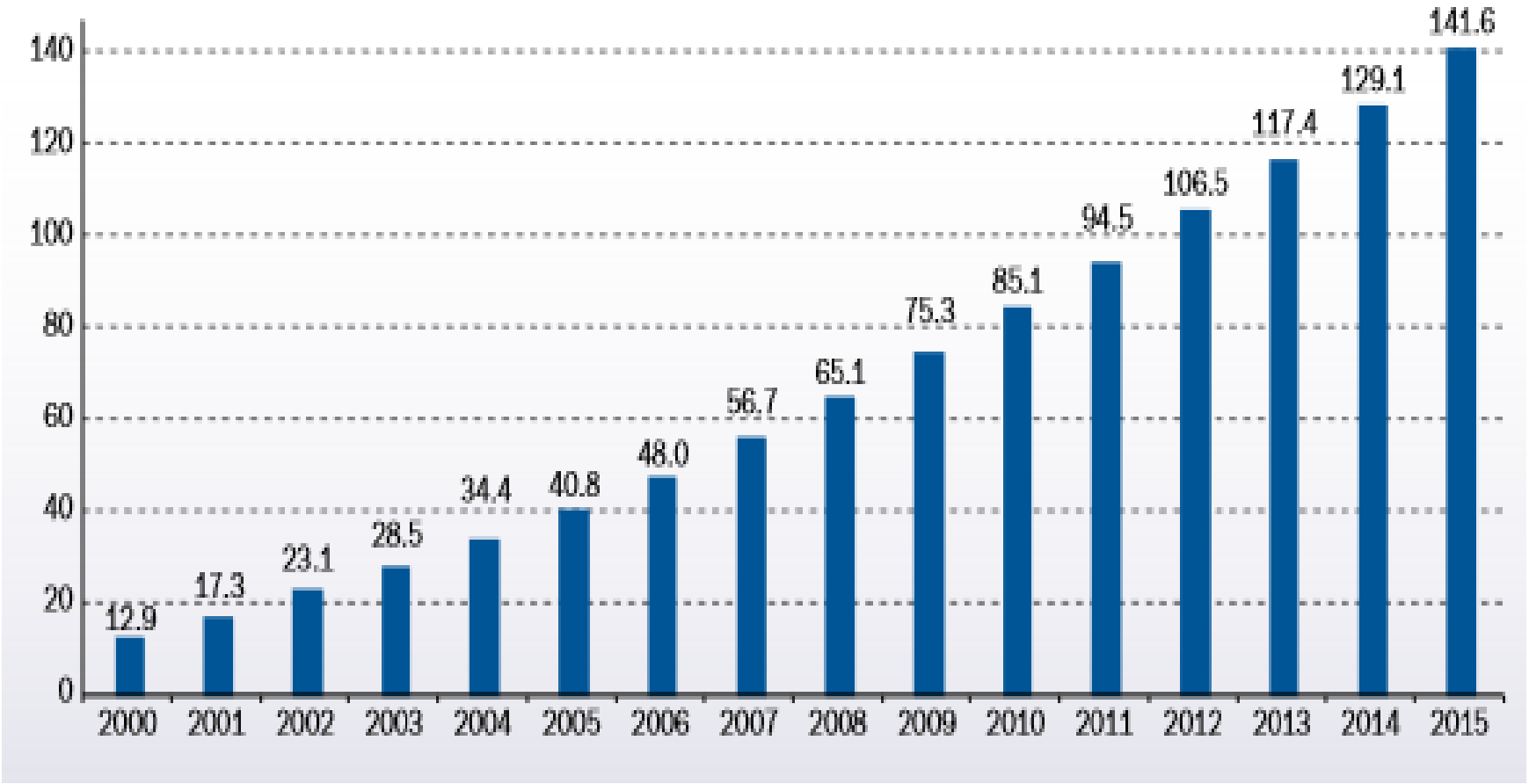
The EU member states share of wind development

FIGURE 13: EU MEMBER STATE MARKET SHARES FOR TOTAL INSTALLED CAPACITY (GW). TOTAL 141.6 GW



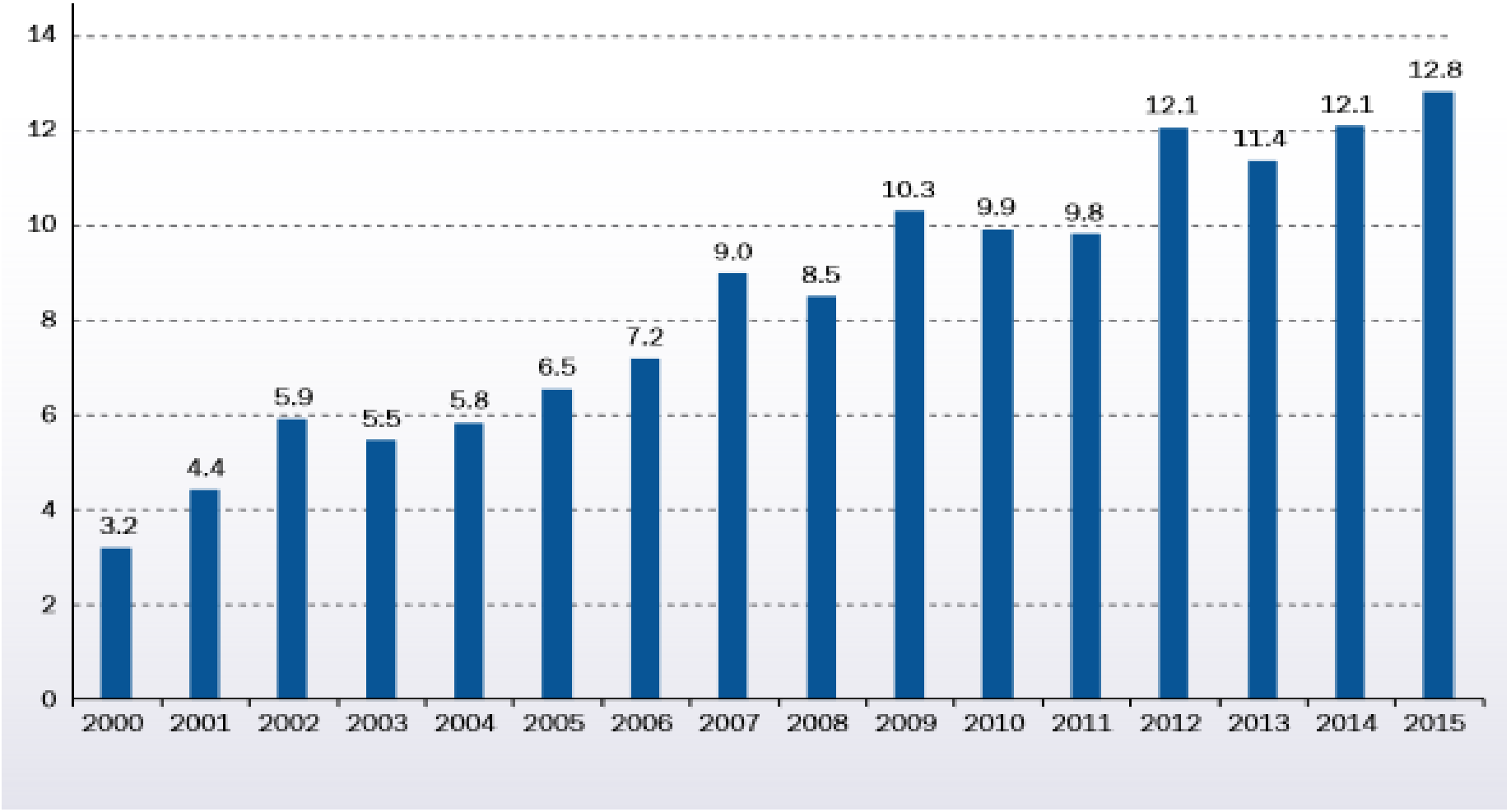
The European Union market

FIGURE 12: CUMULATIVE WIND POWER INSTALLATIONS IN THE EU (GW)



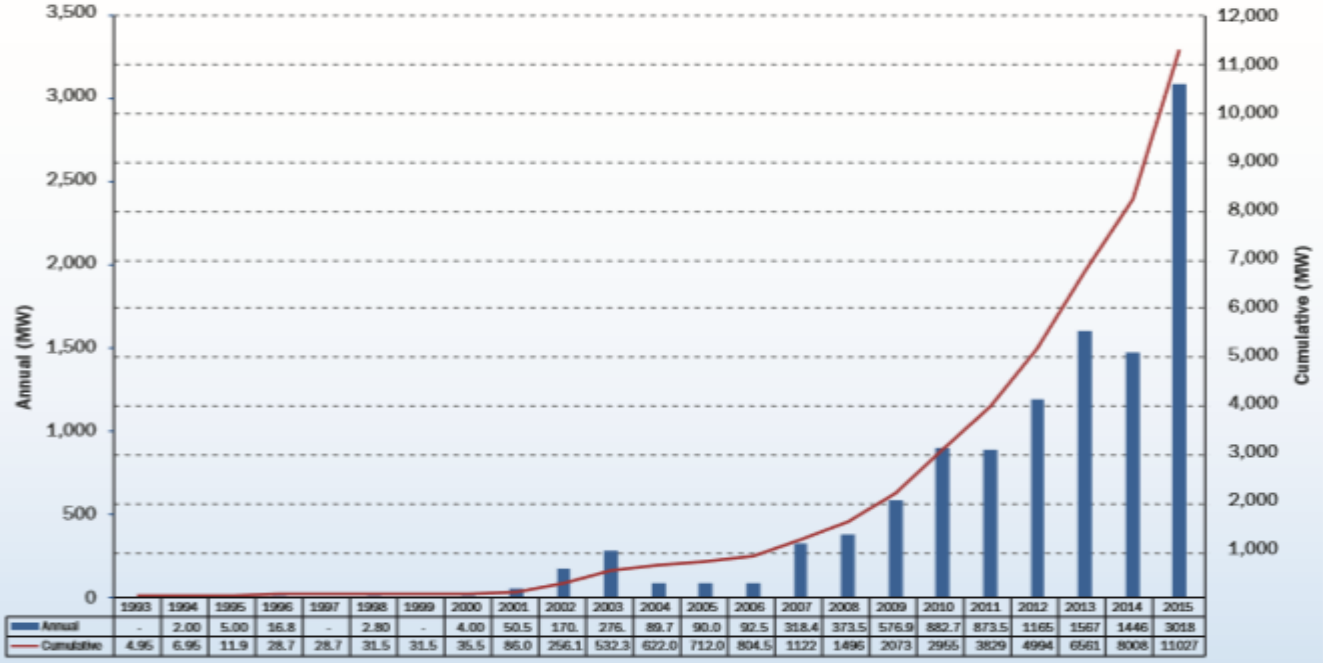
The annual growth in EU

FIGURE 9: ANNUAL WIND POWER INSTALLATIONS IN EU (GW)



The offshore market

FIG 11: CUMULATIVE AND ANNUAL OFFSHORE WIND INSTALLATIONS (MW)



	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Annual	-	2.00	5.00	16.8	-	2.80	-	4.00	50.5	170.	276.	89.7	90.0	92.5	318.4	373.5	576.9	882.7	873.5	1165	1567	1446	3018
Cumulative	4.95	6.95	11.9	28.7	28.7	31.5	31.5	35.5	86.0	256.1	532.3	622.0	712.0	804.5	1122	1496	2073	2955	3829	4994	6561	8008	11027

TABLE 3: NUMBER OF WIND FARMS WITH GRID-CONNECTED TURBINES, NO. OF TURBINES CONNECTED AND NO. OF MW FULLY CONNECTED TO THE GRID AT THE END OF 2015 PER COUNTRY.

Country	BE	DE	DK	ES	FI	IE	NL	NO	PT	SE	UK	Total
No. of farms	5	18	13	1	2	1	6	1	1	5	27	**80**
No. of turbines	182	792	513	1	9	7	184	1	1	86	1,454	**3,230**
Capacity installed (MW)	712	3,295	1,271	5	26	25	427	2	2	202	5,061	**11,027**

Epilogue

Why do we develop wind energy

(and the other Renewables)?

Because :

- ✓ **It's abundant**
- ✓ **It's technically feasible**
- ✓ **It's economically viable**

If coal, gas and oil were free would we continue to use them and abandon Wind energy and the other Reneawables?

Epilogue

CLIMATE CHANGE

- ✓The Scientific Evidence
  - ✓ Global average temperature rise
  - ✓ Sea level rise
  - ✓ Shrinking ice sheets, Declining Arctic sea ice, Glacial retreat
  - ✓Scientific consensus
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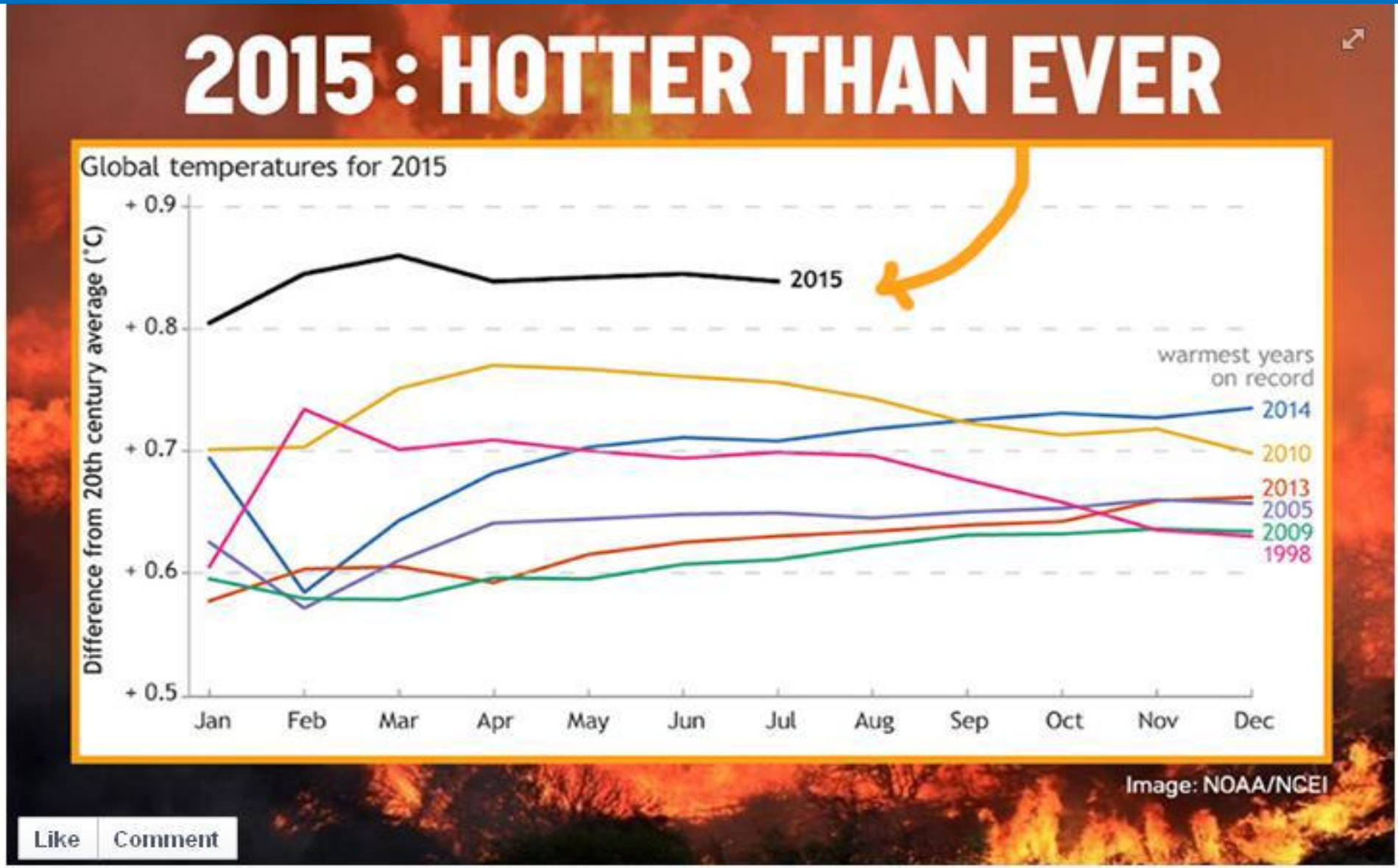
2015: The warmest year on record



350.org

New research released this week shows how 2015 stacks up against all the other hot years of recent past. We're already breaking records in scary new ways.

February breaks global temperature records by 'shocking' amount

Warnings of climate emergency after surface temperatures 1.35C warmer than average temperature for the month

Drought-hit land in Thailand. Stefan Rahmstorf, from Germany's Potsdam Institute of Climate Impact Research, says the global temperatures for February are 'unprecedented'. Photograph: Rungroj Yongrit/EPA

February smashed a century of global temperature records by a "stunning" margin, according to data released by Nasa.

The unprecedented leap led scientists, usually wary of highlighting a single month's temperature, to label the new record a "shocker" and warn of a "climate emergency".

The Nasa data shows the average global surface temperature in February was 1.35C warmer than the average temperature for the month between 1951-1980, a far bigger margin than ever seen before. The previous record, set just one month earlier in January, was 1.15C above the long-term average for that month.

February 2016:
The 10th consecutive month of record-breaking global temperature and with a particularly bigger margin.

2016 will probably be the warmest year.

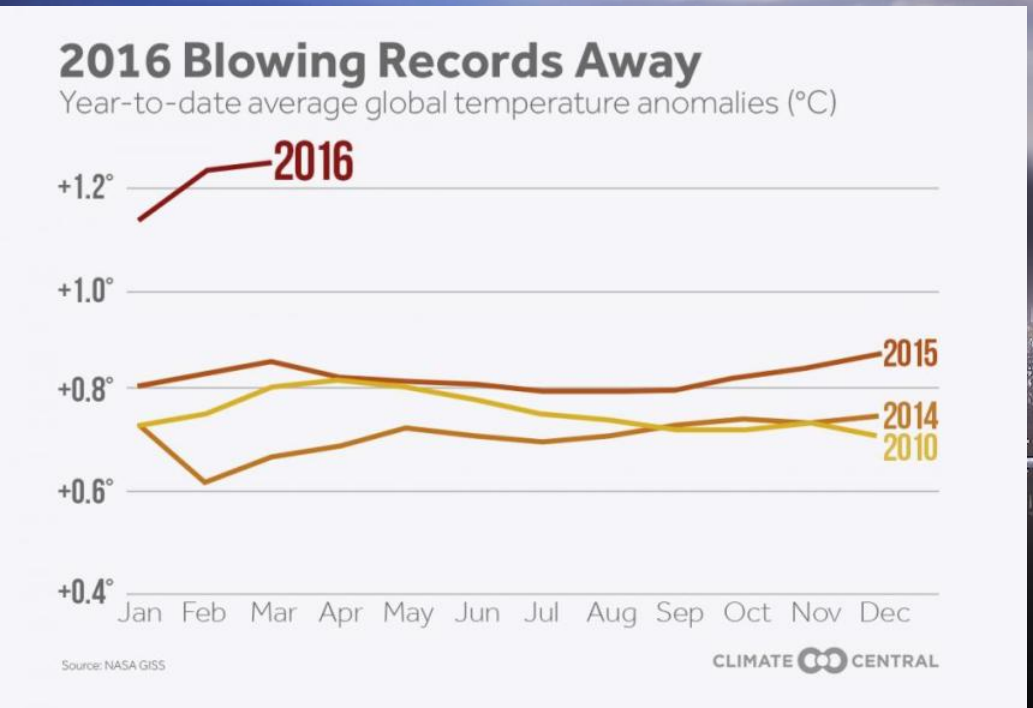
Earth's Temperature Just Shattered the Thermometer

Bloomberg

Only three months in, and 2016 will almost certainly be the hottest year on record.

April 19, 2016

by Tom Randall
tsrandall



No one under the age of 30 has lived one month in which the average temperature was below average.

CLIMATE

FEBRUARY 26, 2015

Earth Has Now Had 30 Straight Years of Record Monthly Temperatures

By Richard B. Rood

If you're younger than 30, you've never experienced a month in which the average surface temperature of the Earth was below average.

NEW REPUBLIC

The sixteen warmest years

Rank 1 = Warmest Period of Record: 1880–2015	Year	Anomaly °C	Anomaly °F
1	2015	0.90	1.62
2	2014	0.74	1.33
3	2010	0.70	1.26
4	2013	0.66	1.19
5	2005	0.65	1.17
6 (tie)	1998	0.63	1.13
6 (tie)	2009	0.63	1.13
8	2012	0.62	1.12
9 (tie)	2003	0.61	1.10
9 (tie)	2006	0.61	1.10
9 (tie)	2007	0.61	1.10
12	2002	0.60	1.08
13 (tie)	2004	0.57	1.03
13 (tie)	2011	0.57	1.03
15 (tie)	2001	0.54	0.97
15 (tie)	2008	0.54	0.97

The table lists the global combined land and ocean annually-averaged temperature rank and anomaly for each of the 16 (two tied at #15) warmest years on record.

Much of the record warmth for the globe can be attributed to record warmth in the global oceans.
The annually-averaged temperature for ocean surfaces around the world was 0.74°C (1.33°F) higher than the 20th century average, easily breaking the previous record of 2014 by 0.11°C .
Ocean temperatures for the year started with the first three months each third warmest for their respective months, followed by record high monthly temperatures for the remainder of the year as one of the stongest El Niños in the historical record evolved.

How much warmer was Trabzon in 2015?

Home

The New York Times | U.S.

Share

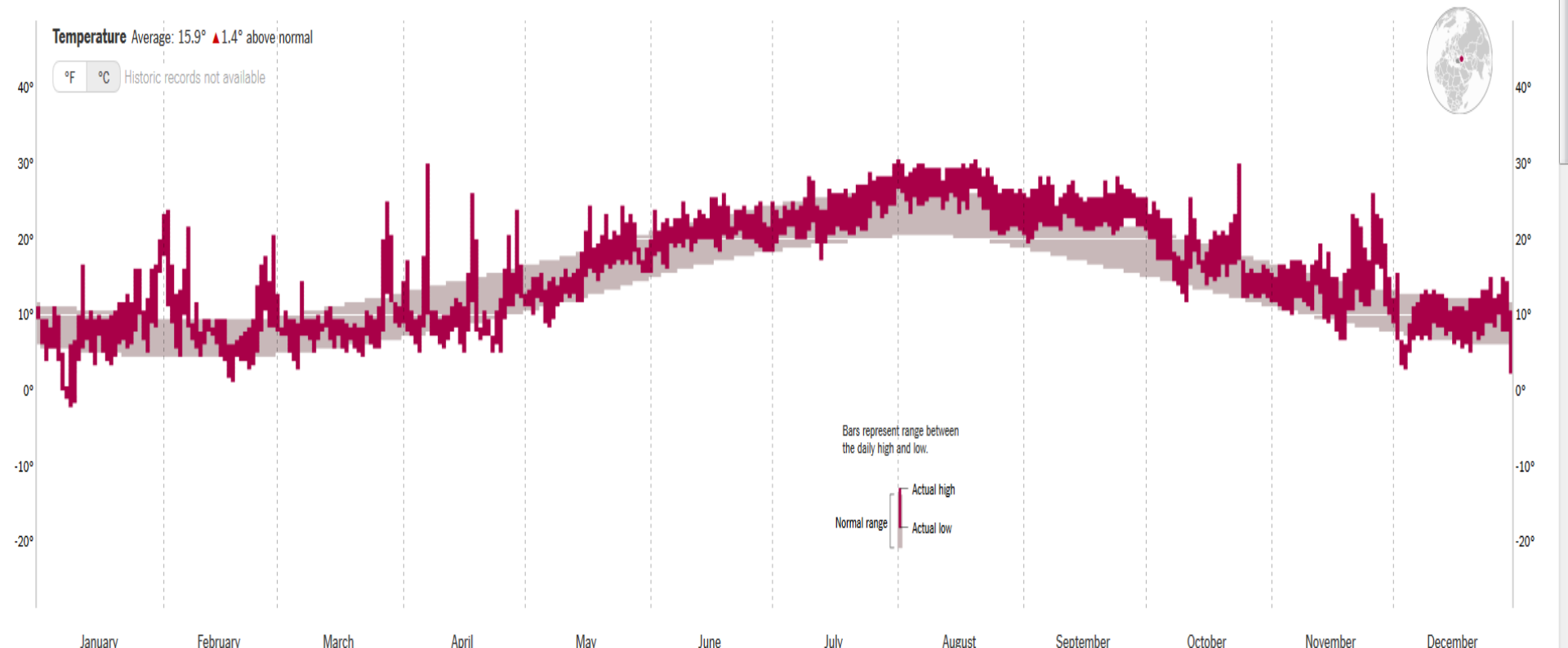
How Much Warmer Was Your City in 2015?

By K.K. REBECCA LAI FEB. 19, 2016

Scientists declared that 2015 was Earth's hottest year on record. In a database of 3,116 cities provided by AccuWeather, about 90 percent of them were warmer than normal. Enter your city in the field below to see how much warmer it was last year.

RELATED ARTICLE

Trabzon, Turkey



CLIMATE CHANGE

- ✓ The Scientific Evidence
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  - ✓ Sea level rise
  - ✓ Shrinking ice sheets, Declining Arctic sea ice, Glacial retreat
  - ✓ Scientific consensus
- ✓ The inevitable consequences
- ✓ The way out
- ✓ Epilogue

Published: February 22nd, 2016

Study Reveals Stunning Acceleration of Sea Level Rise

By John Upton
Follow @johnupton

CLIMATE CENTRAL

The oceans have heaved up and down as world temperatures have waxed and waned, but as new research tracking the past 2,800 years shows, never during that time did the seas rise as sharply or as suddenly as has been the case during the last century.

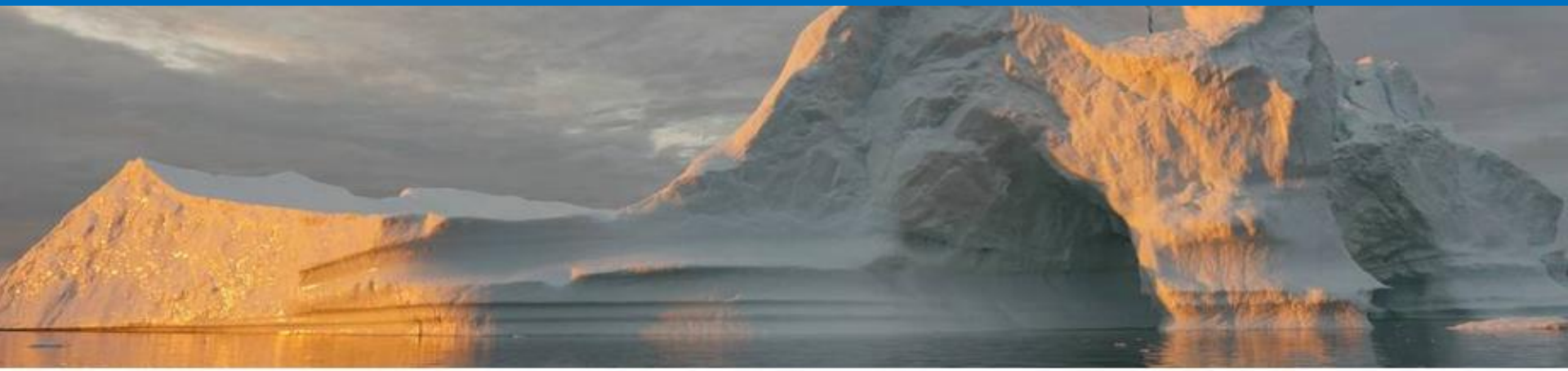
The new study, the culmination of a decade of work by three teams of farflung scientists, has charted what they called an "acceleration" in sea level rise that's triggering and worsening flooding in coastlines around the world.

The findings also warn of much worse to come.

The scientists reported in a paper published Monday in Proceedings of the National Academy of Sciences that they have greater than 95 percent certainty that at least half of more than 5 inches of sea level rise they detected during the

New research tracking the past 2.800 years, shows the sudden and sharp sea rice during the last century.

Since 1992 seas around the world have risen an average of 3 inches (7,6 cm) and it's pretty certain we are locked into at least 3 ft (91,5 cm) sea level rise!!



Aug. 26, 2015
15-174

NASA Science Zeros in on Ocean Rise: How Much? How Soon?

Seas around the world have risen an average of nearly 3 inches since 1992, with some locations rising more than 9 inches due to natural variation, according to the latest satellite measurements from NASA and its partners. An intensive research effort now underway, aided by NASA observations and analysis, points to an unavoidable rise of several feet in the future.

Members of NASA's new interdisciplinary Sea Level Change Team will discuss recent findings and new agency research efforts during a media teleconference today at 12:30 p.m. EDT. NASA will stream the teleconference live online.

The question scientists are grappling with is how quickly will seas rise?

"Given what we know now about how the ocean expands as it warms and how ice sheets and glaciers are adding water to the seas, it's pretty certain we are locked into at least 3 feet of sea level rise, and probably more," said Steve Nerem of the University of Colorado, Boulder, and lead of the Sea Level Change Team. "But we don't know whether it will happen within a century or somewhat longer."

For some, however, it is already late.
The small islands (atolls) already face flooding from rising sea levels.
The Cabinet of Tuvalu, in an effort to raise awareness of developed countries and public opinion, held an underwater cabinet meeting. (20/09/2011)

Energy and Environment

It's not just Antarctica — why Greenland could also melt faster than expected

By Chelsea Harvey April 5

The Washington Post

A large iceberg floats in the ocean near the town of Uummannaq in western Greenland March 17, 2010. Dutch artist Ap Verheggen plans to erect two giant sculptures on a piece of Greenland's sea ice and monitor them drifting away after the glacier breaks off. REUTERS/Svebor Kranjc (GREENLAND - Tags: ENVIRONMENT ENTERTAINMENT) - RTR2BR4B

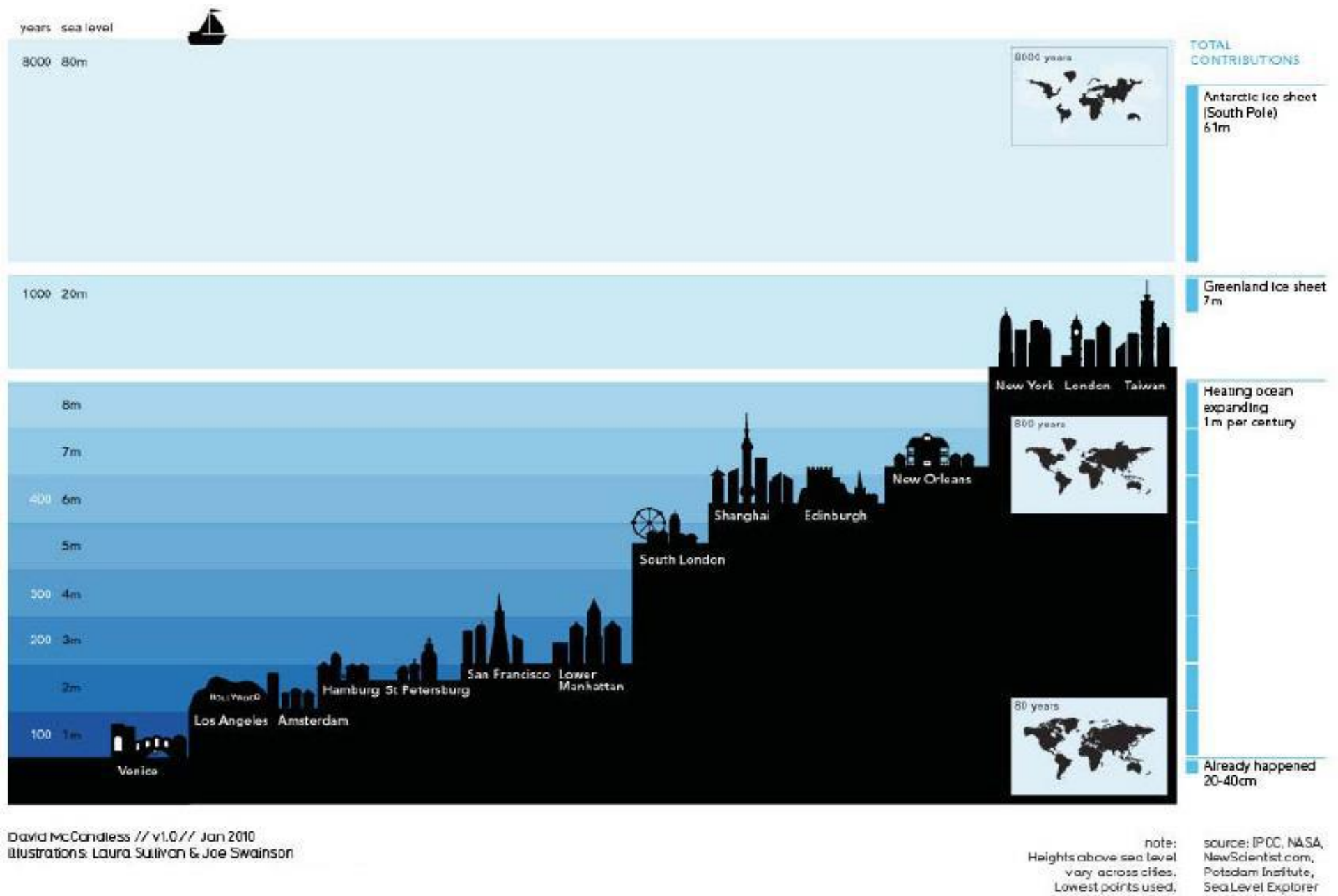
The Greenland ice sheet is melting Faster.

Frightening scenario:
If the Greenland "stable" ice sheet starts to melt we are looking at a sea level rise of 7 meters

THE INDEPENDENT THURSDAY 20 MARCH 2014

Fears of faster rising global sea levels as 'stable' Greenland ice sheet starts to melt

An even more frightening scenario involves the melting of the Antarctica glacier.



David McCandless // v1.0 // Jan 2010
Illustrations: Laura Sullivan & Joe Swainson

note: Heights above sea level vary across cities. Lowest points used.

source: IPCC, NASA, NewScientist.com, Potsdam Institute, Sea Level Explorer

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Antarctic ice is melting so fast that the whole continent may be at risk by 2100

Antarctic ice is melting so fast the whole continent may be at risk by 2100

theguardian

New research predicts a doubling of surface melting of the ice shelves by 2050, risking their collapse by the end of the century, say scientists

Collapse of Antarctic ice shelves could lead to dramatic sea level rise. Photograph: blickwinkel/Alamy

Antarctic ice is melting so fast that the stability of the whole continent could be at risk by 2100, scientists have warned.

Widespread collapse of Antarctic ice shelves - floating extensions of land ice projecting into the sea - could pave the way for dramatic rises in sea level.

The new research predicts a doubling of surface melting of the ice shelves by 2050. By the end of the century, the melting rate could surpass the point associated with ice shelf collapse, it is claimed.

If that happened a natural barrier to the flow of ice from glaciers and land-covering ice sheets into the oceans would be removed.

The melting of glaciers is clear in before and after pictures

The melting of glaciers is clear in before and after pictures

The melting of glaciers is clear in before and after pictures

Shepard Glacier

Grinell Glacier

Boulder Glacier

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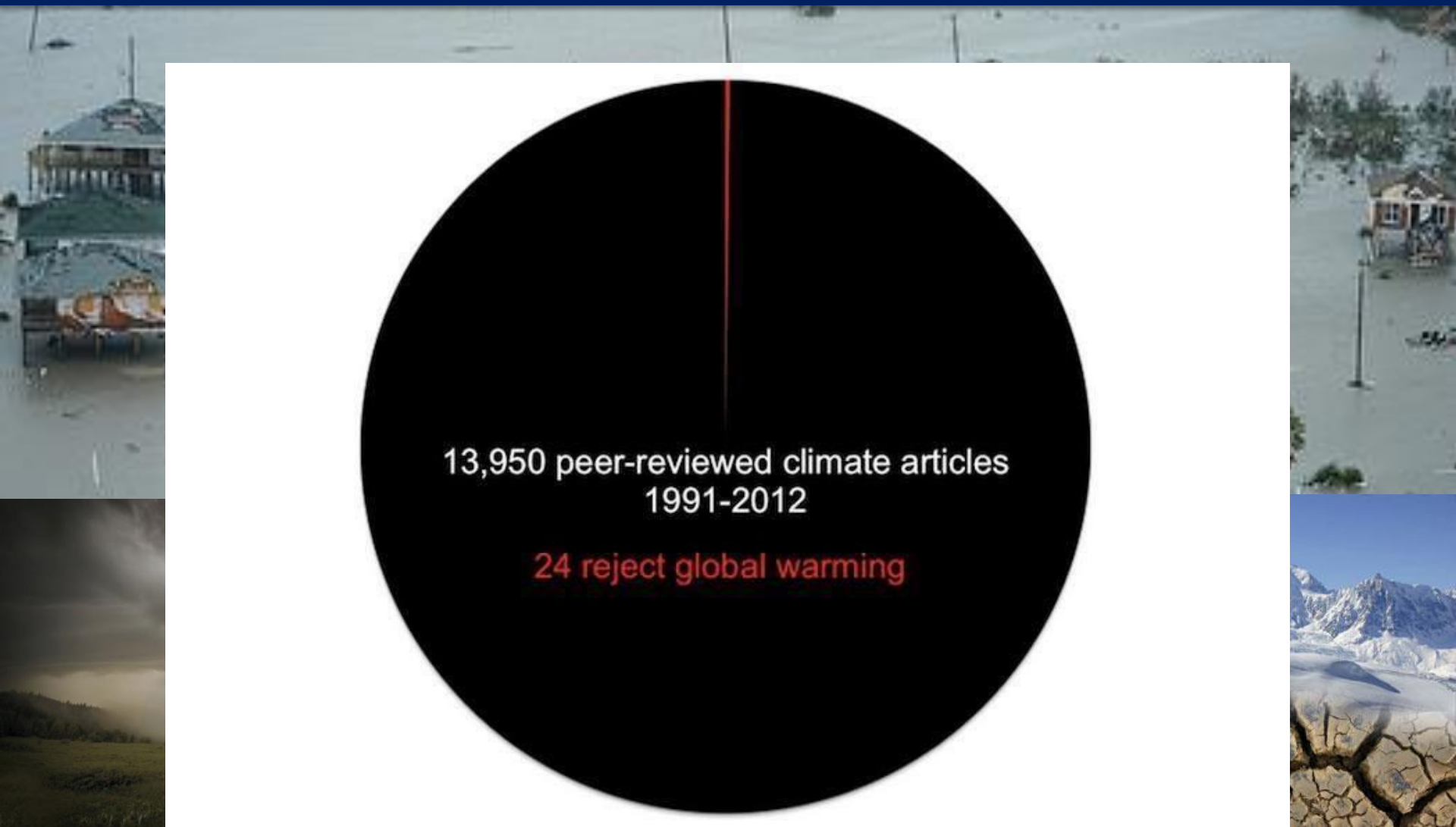
Climate change: How do we know?

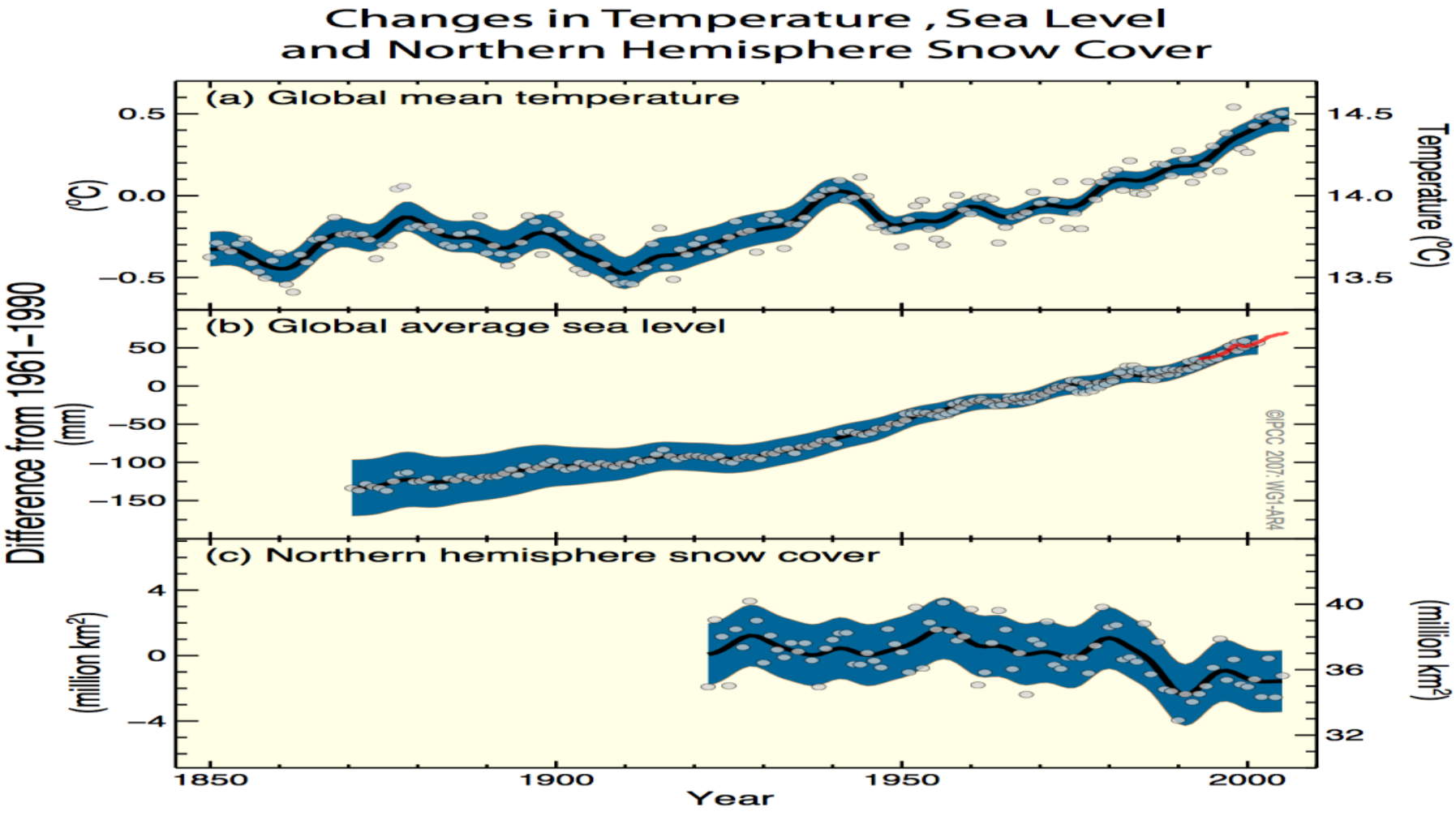
The overwhelming majority of the scientists (> 97%) agree that:

- **climate change is happening now and**
- **the heart of the cause is human activities**



The main scientific findings that led scientists to this conclusion are:

- **The increase in the average global temperature**
- **Sea level rise**
- **The reduction of ice cover in the Northern Hemisphere**



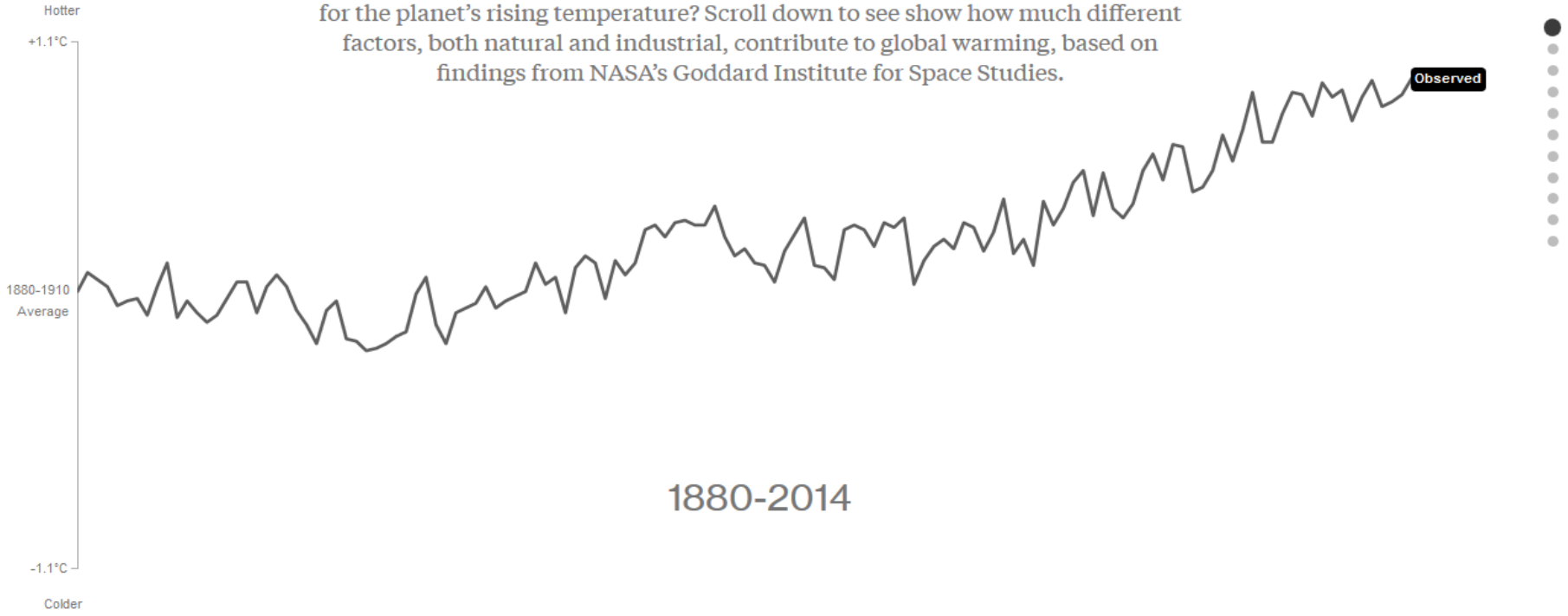
http://www.metoffice.gov.uk/climate-change/resources/hadleycentre

What's really warming the world?

What's Really Warming the World?

By Eric Roston and Blacki Migliozzi | June 24, 2015

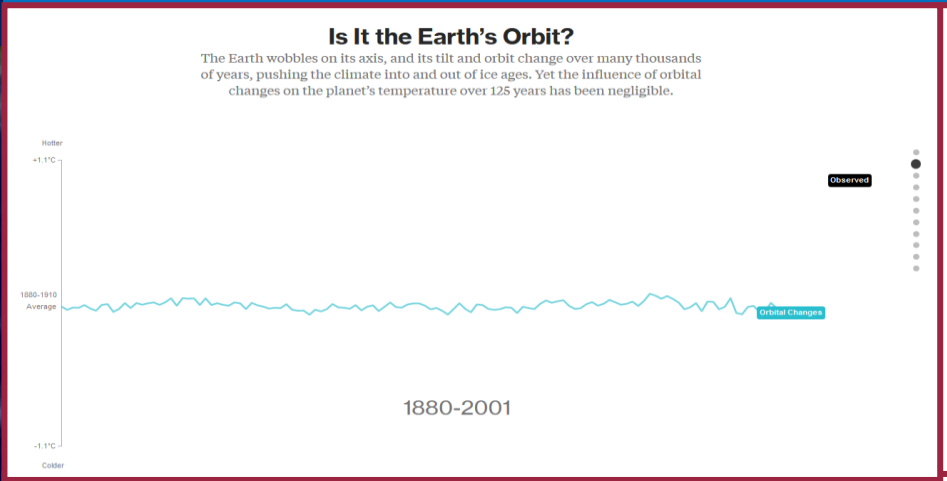
Skeptics of manmade climate change offer various natural causes to explain why the Earth has warmed 1.4 degrees Fahrenheit since 1880. But can these account for the planet's rising temperature? Scroll down to see show how much different factors, both natural and industrial, contribute to global warming, based on findings from NASA's Goddard Institute for Space Studies.

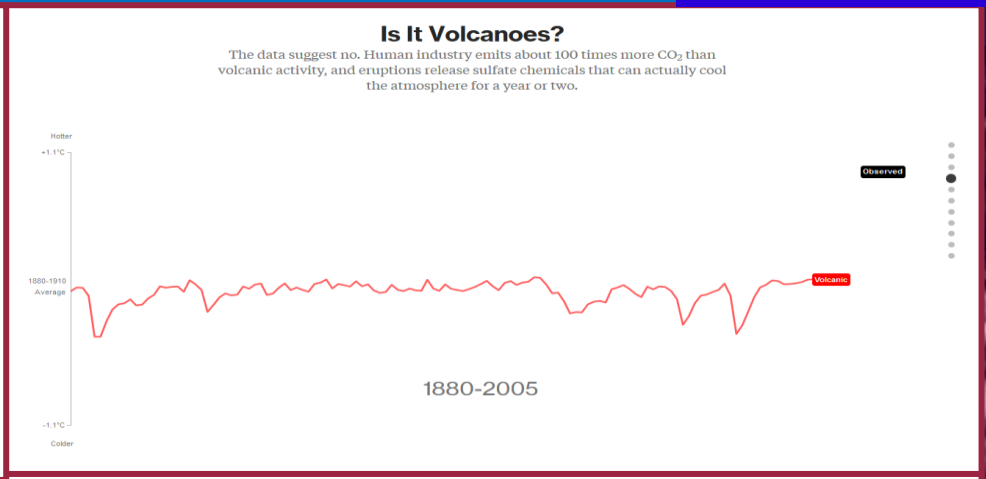


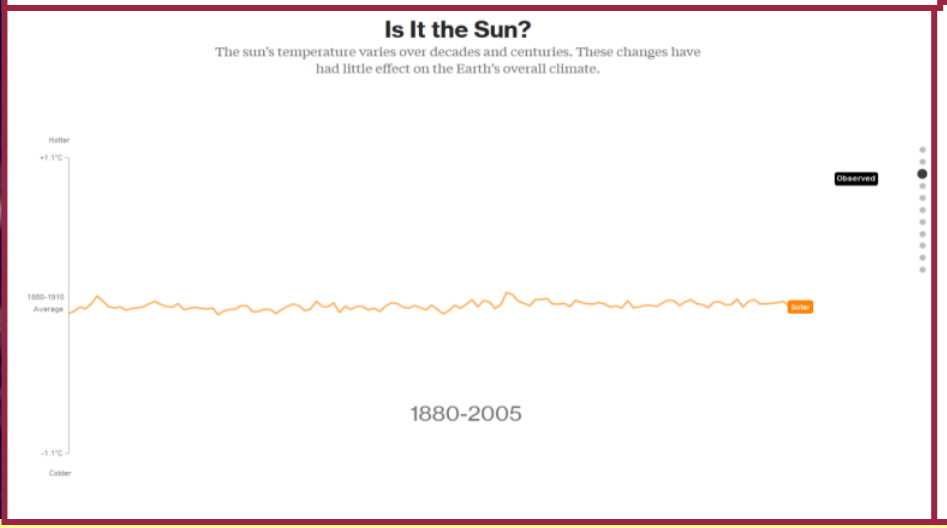
http://www.bloomberg.com/graphics/2015-whats-warming-the-world/

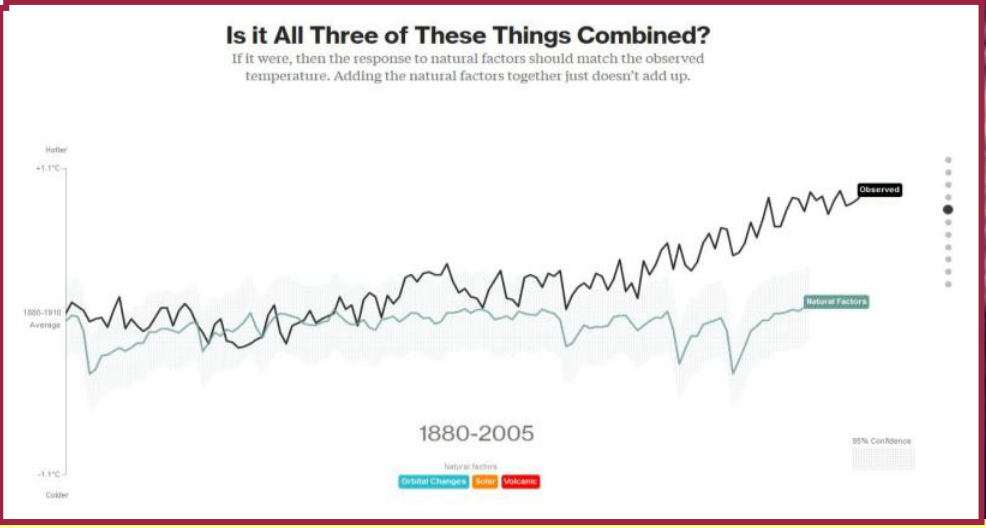
Changes in Earth orbit? volcanoes? Solar flares? All three together? No, because there remains a deviation from the recorded rise in average global temperature

Bloomberg Business









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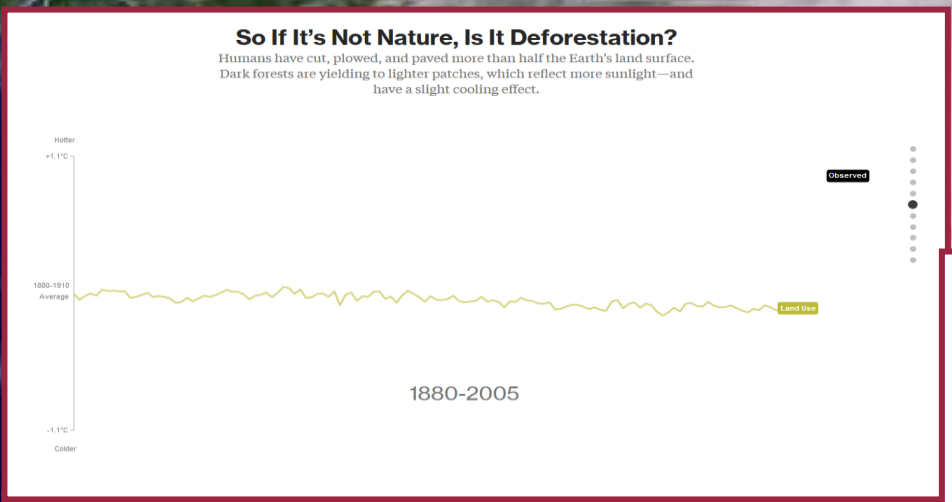
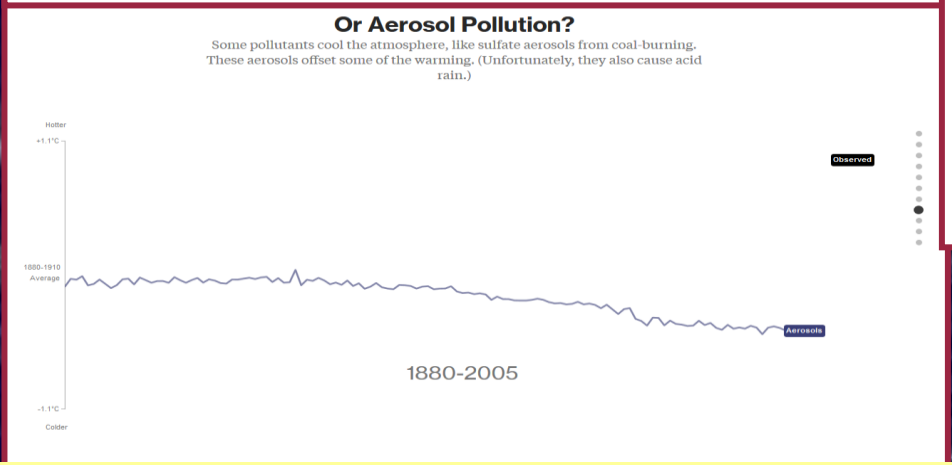
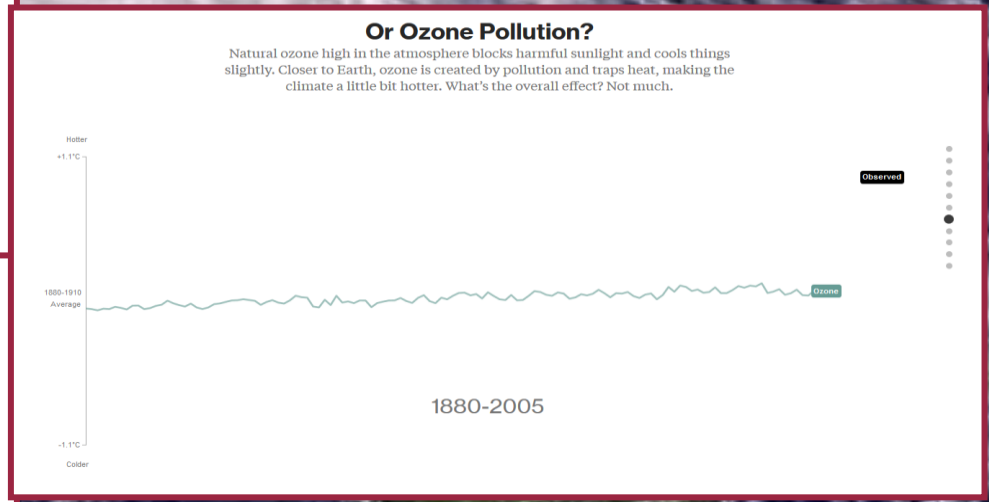
Deforestation? Aerosols?
The ozone hole?
No, because they have zero or negative effect on the average global temperature.

Bloomberg Business







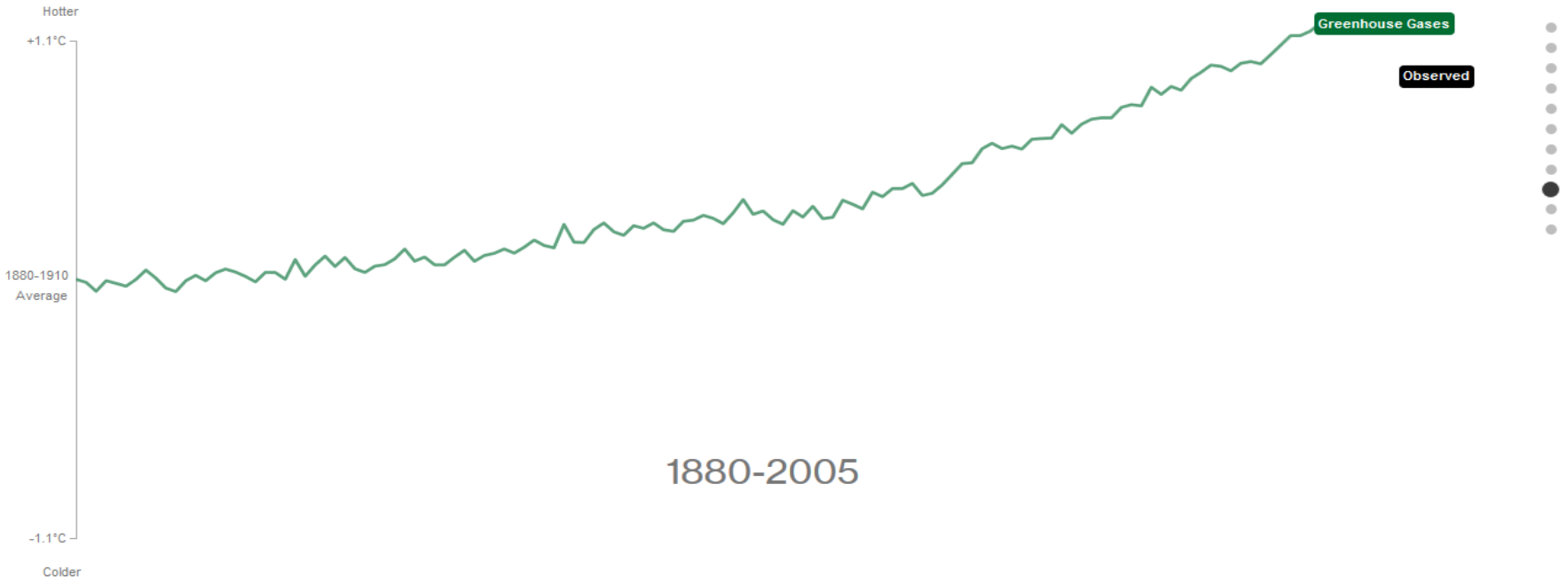
http://www.bloomberg.com/graphics/2015-whats-warming-the-world/

It’s the Greenhouse Gases

Bloomberg Business

No, It Really Is Greenhouse Gases.

Atmospheric CO_2 levels are 40 percent higher than they were in 1750. The green line shows the influence of greenhouse gas emissions. It's no contest.



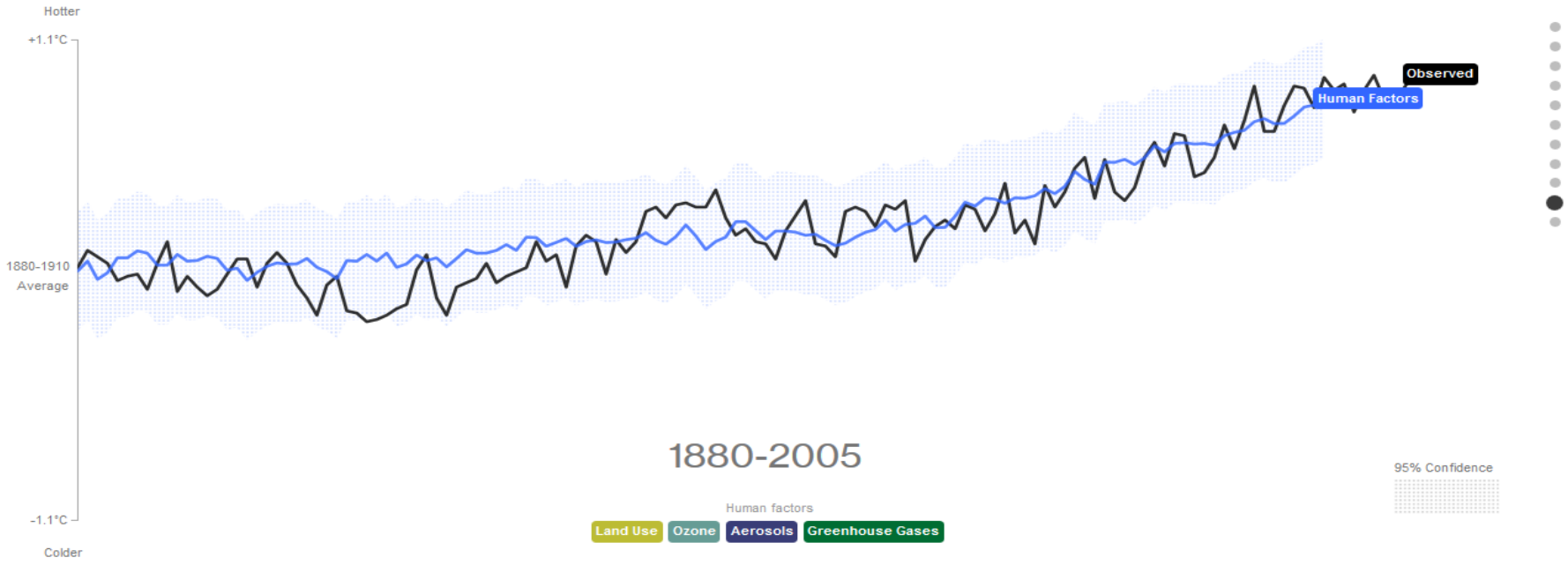
http://www.bloomberg.com/graphics/2015-whats-warming-the-world/

When taking into account all the human factors the discrepancy between recorded and calculated rise in the average global temperature disappears.

Bloomberg Business

See for Yourself

Greenhouse gases warm the atmosphere. Aerosols cool it a little bit. Ozone and land-use changes add and subtract a little. Together they match the observed temperature, particularly since 1950.

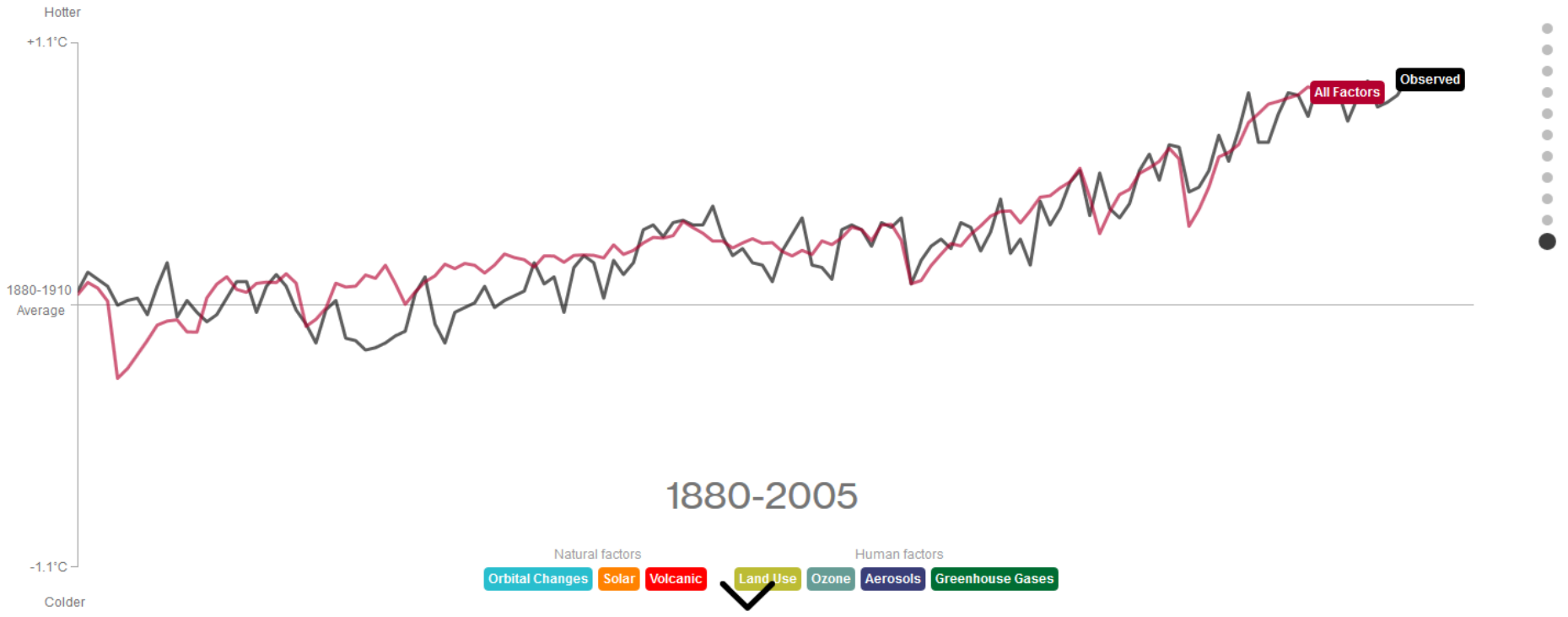


http://www.bloomberg.com/graphics/2015-whats-warming-the-world/

The comparison of the effect of natural and man-made (anthropogenic) factors underlines the key role greenhouse gases play in the rise of the average global temperature. The question is "What do we do about it?"

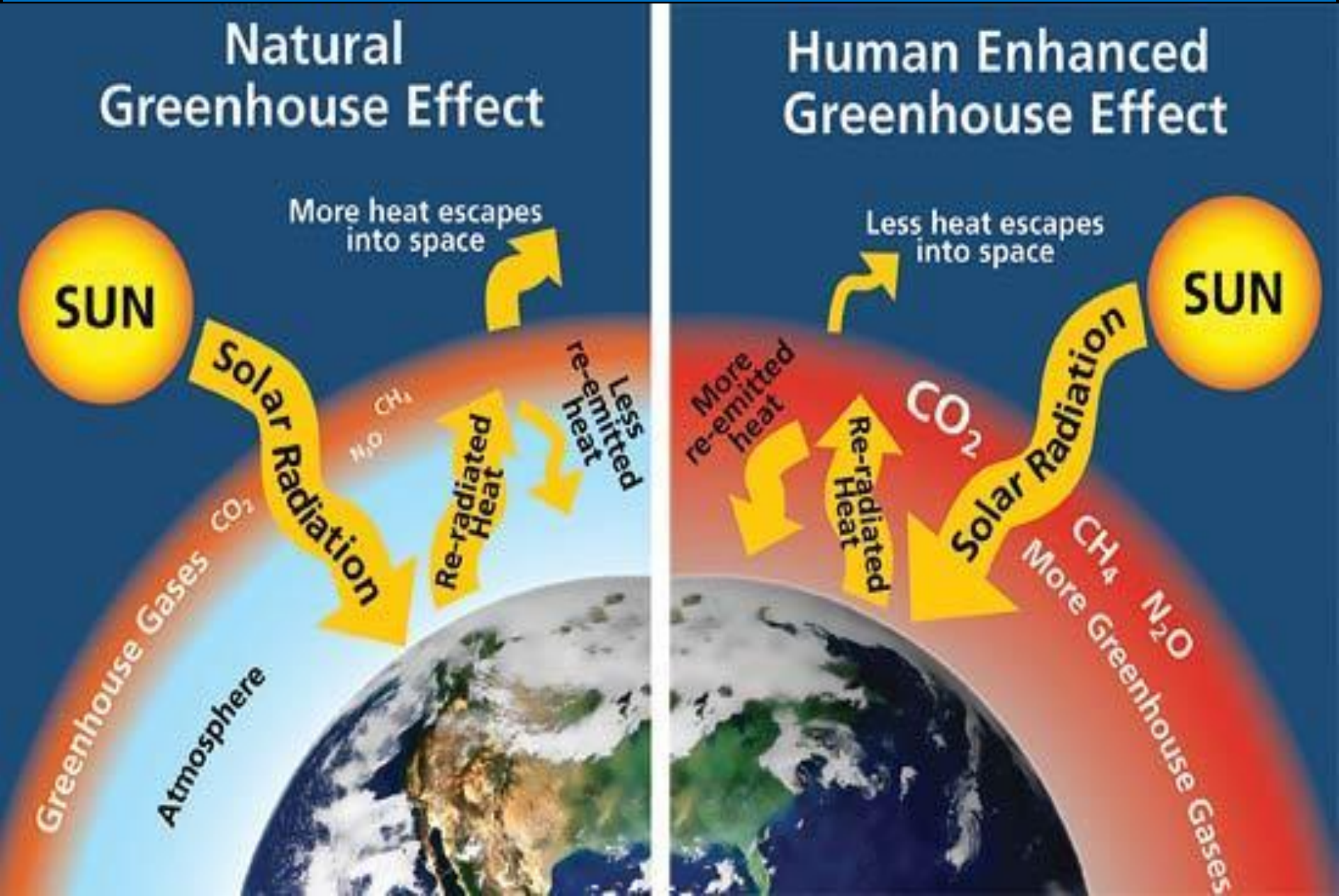
Compare and Contrast

Putting the possible natural and human causes of climate change alongside one another makes the dominant role of greenhouse gases even more plainly visible. The only real question is: What are we going to do about it?

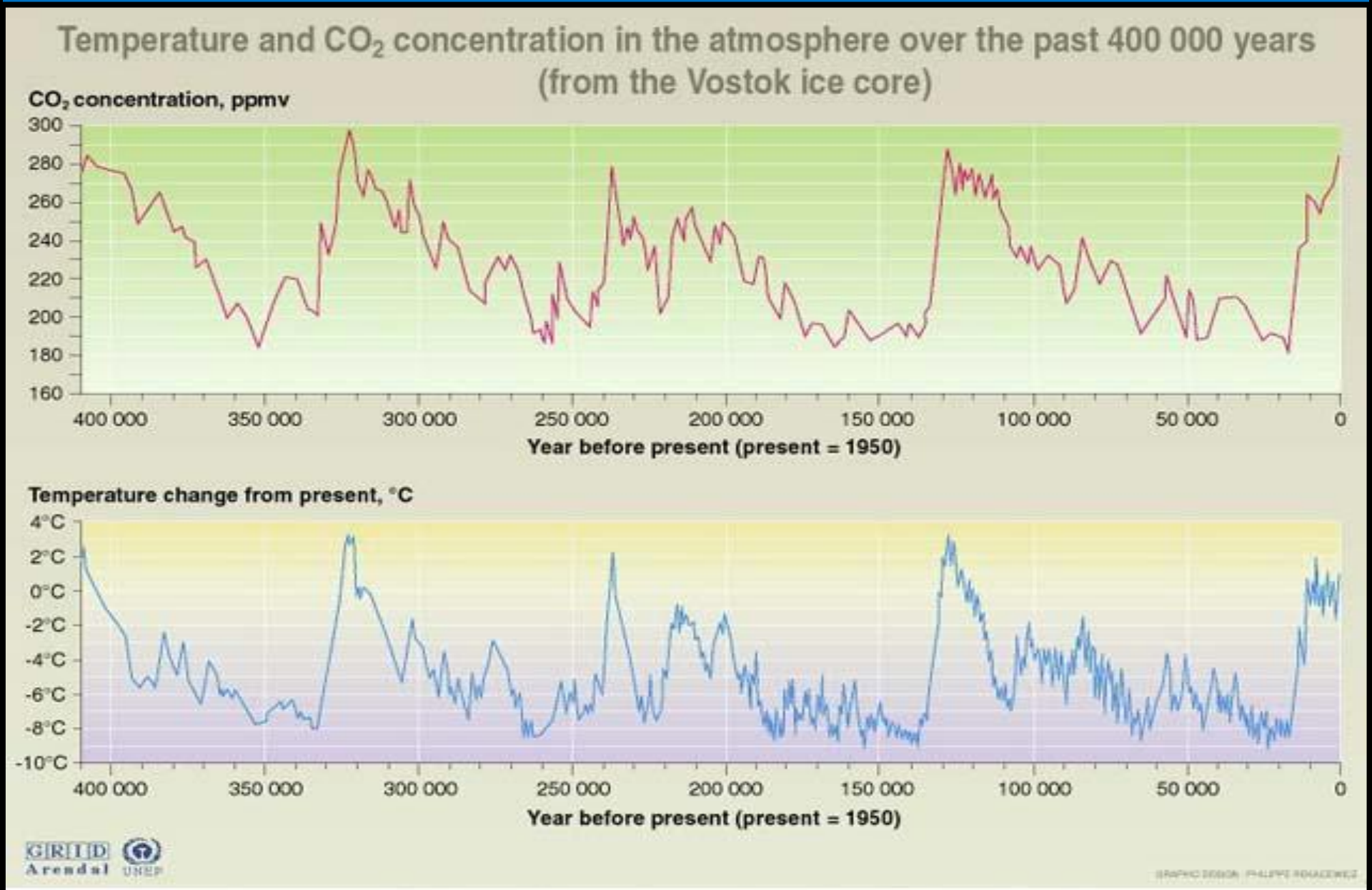


http://www.bloomberg.com/graphics/2015-whats-warming-the-world/

Greenhouse Gases (GHG) - CO2, methane, water vapor cause and enhance the greenhouse effect

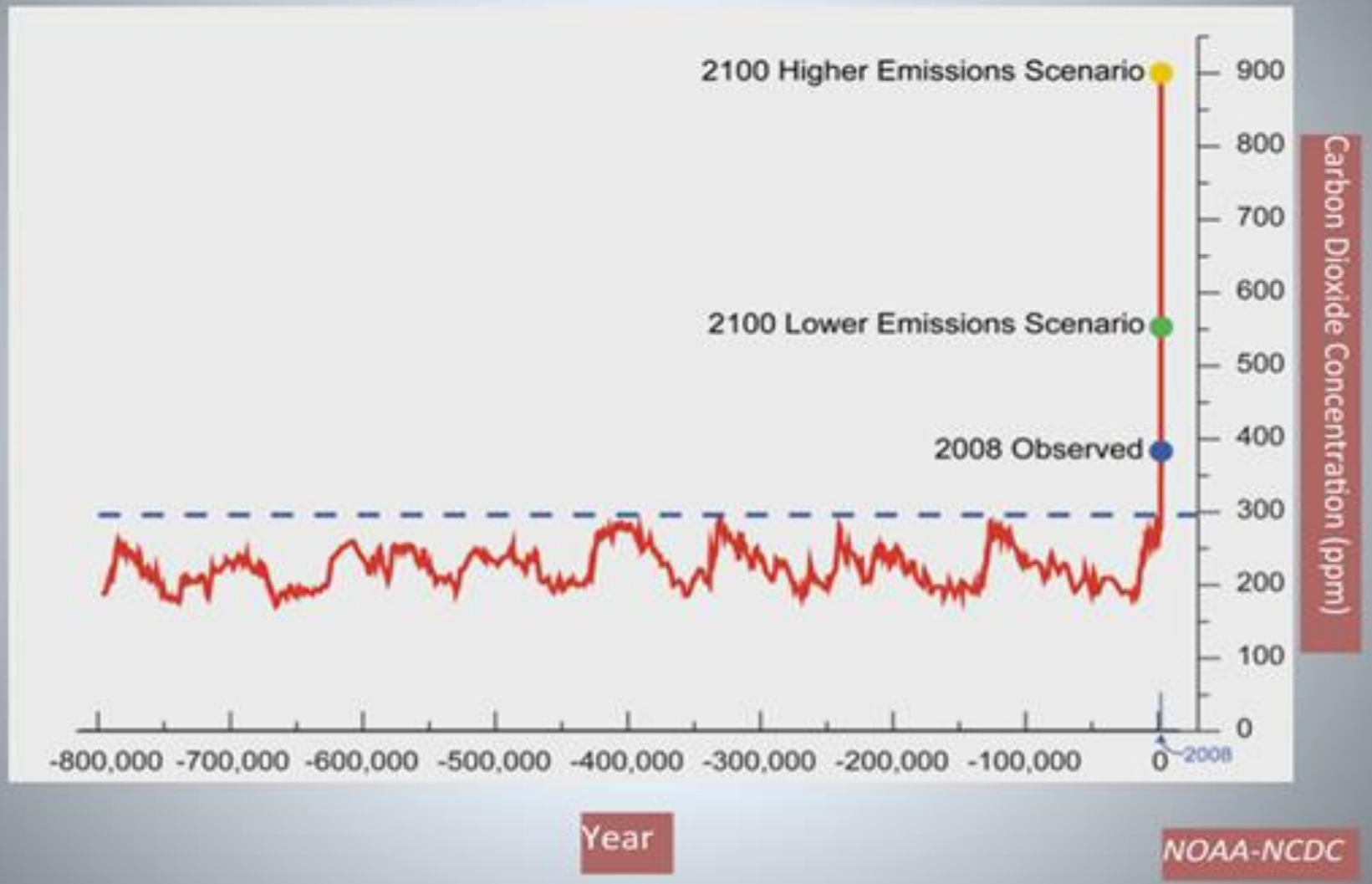


Temperature and CO_2 concentration in the atmosphere over the past 400.000 years



Source: J.R. Petit, J. Jouzel, et al. Climate and atmospheric history of the past 420 000 years from the Vostok ice core in Antarctica, Nature 399 (3/June), pp 429-436, 1999.

The significant increase in CO_2 concentration in recent years (after the industrial revolution)……



……. causing the rise in average global temperature

Temperature Rise Since 1880.

Mon Mar 21, 2016 12:11pm EDT

Carbon emissions highest in 66 million years, since dinosaur age

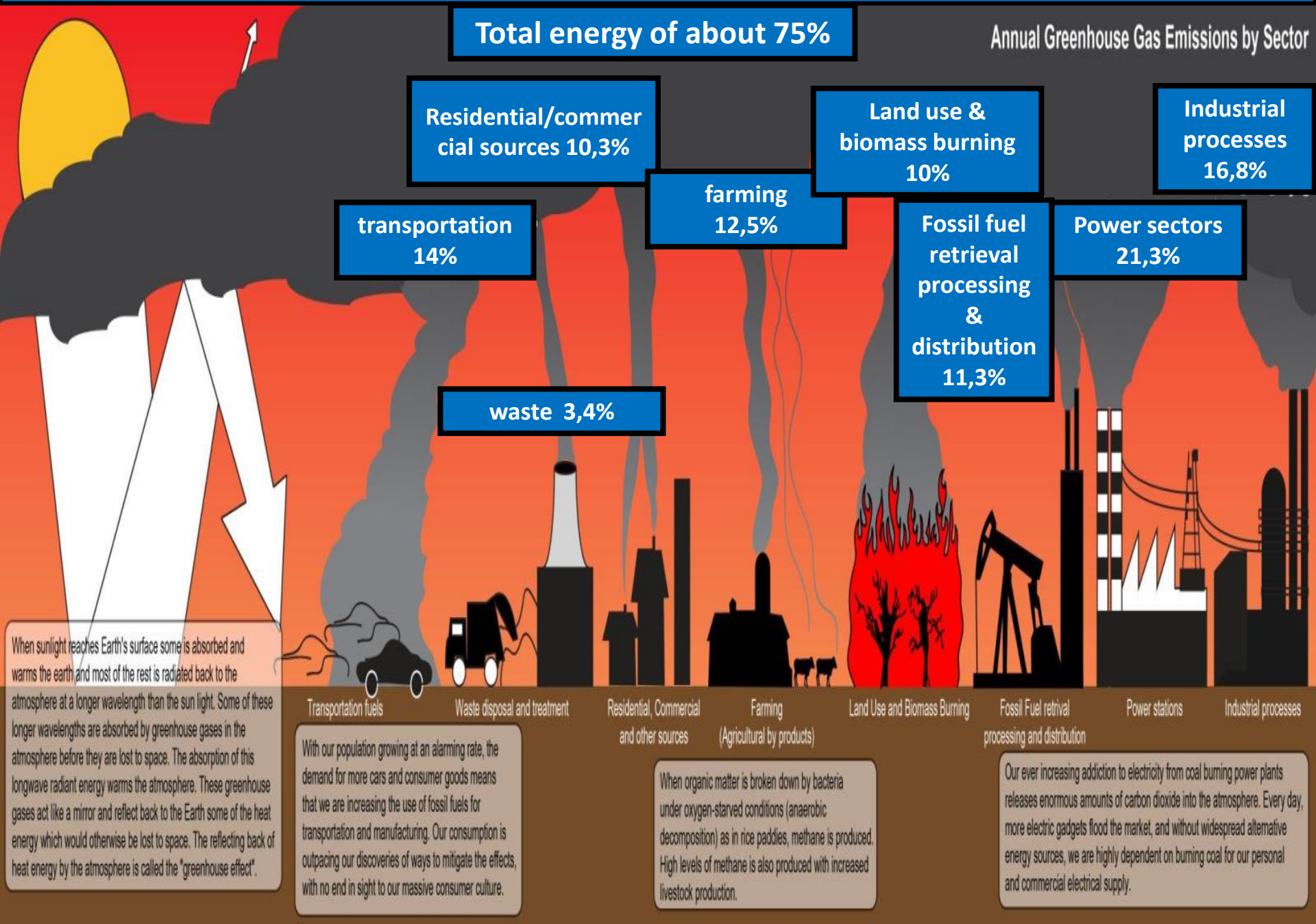
OSLO | BY ALISTER DOYLE

A chimney is seen in front of residential buildings during a polluted day in Harbin, Heilongjiang Province, China, January 21, 2016.
REUTERS/STRINGER

The rate of carbon emissions is higher than at any time in fossil records stretching back 66 million years to the age of the dinosaurs, according to a study on Monday that sounds an alarm about risks to nature from man-made global warming.

The carbon emissions are higher that at any time in fossil records stretching back 66 million years, since dinosaur age

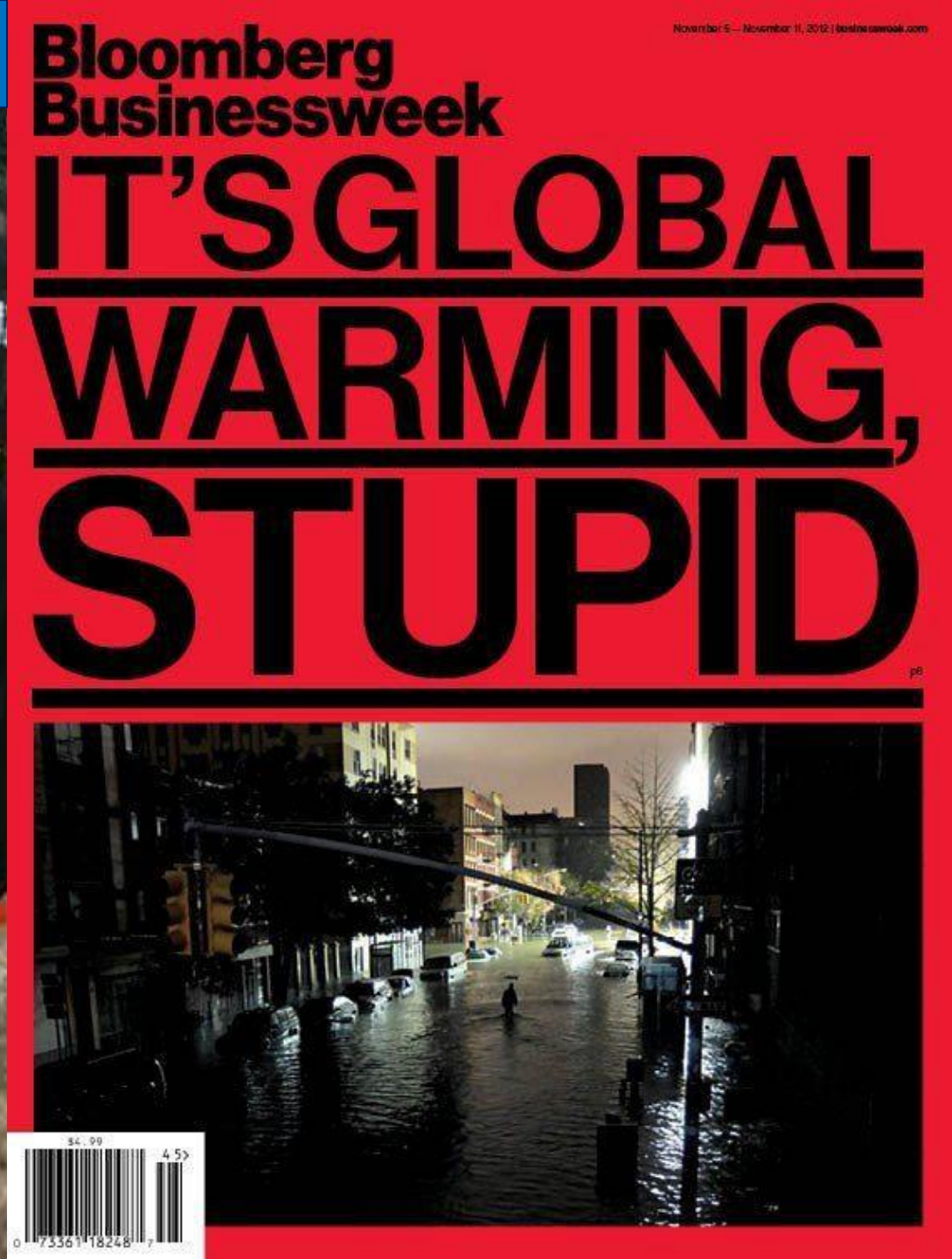
The main sources of greenhouse gases.



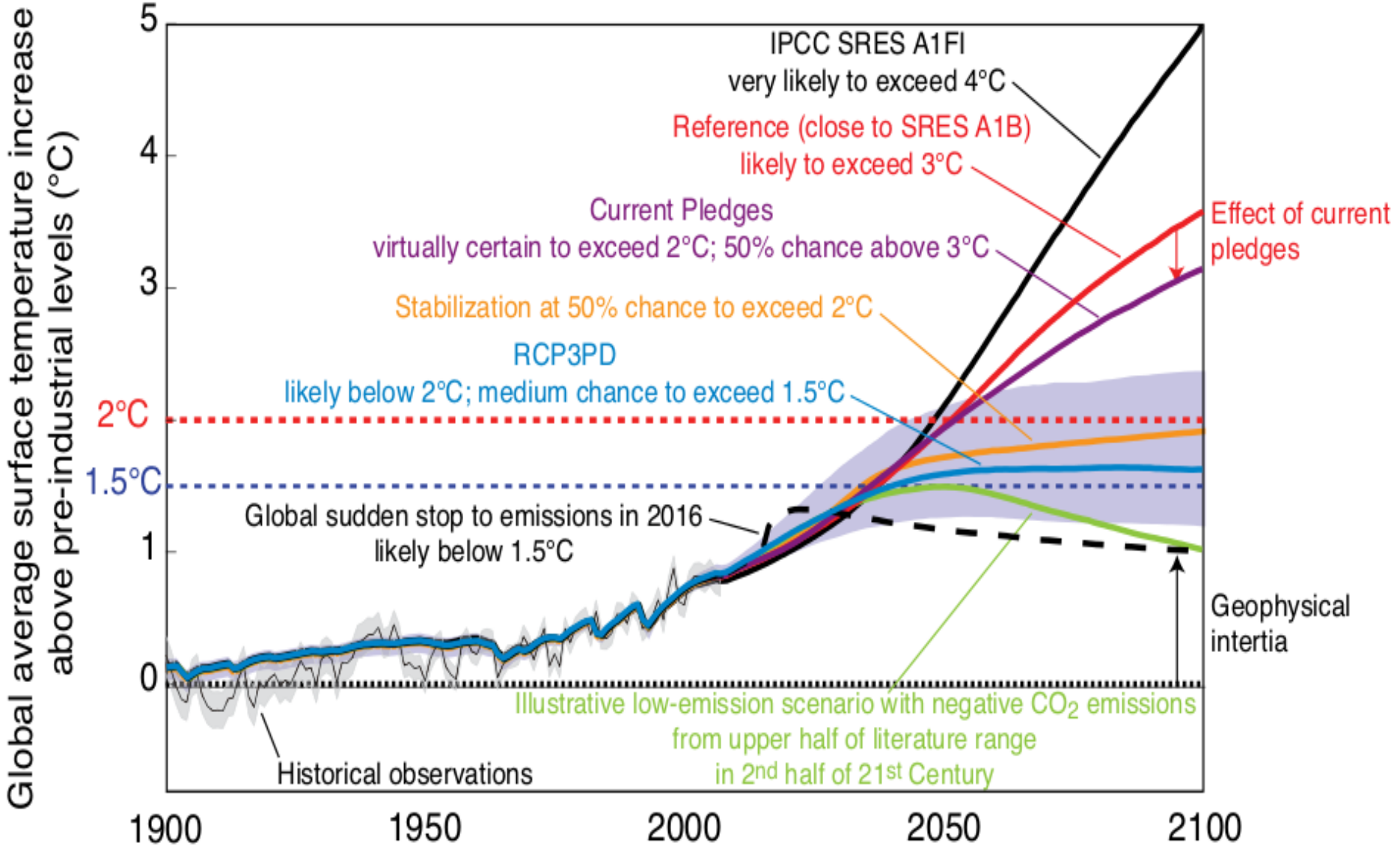
CLIMATE CHANGE

- ✓The Scientific Evidence
  - ✓ Global average temperature rise
  - ✓ Sea level rise
  - ✓ Shrinking ice sheets, Declining Arctic sea ice, Glacial retreat
  - ✓Scientific consensus
- ✓**The inevitable consequences**
- ✓The way out
- ✓Epilogue

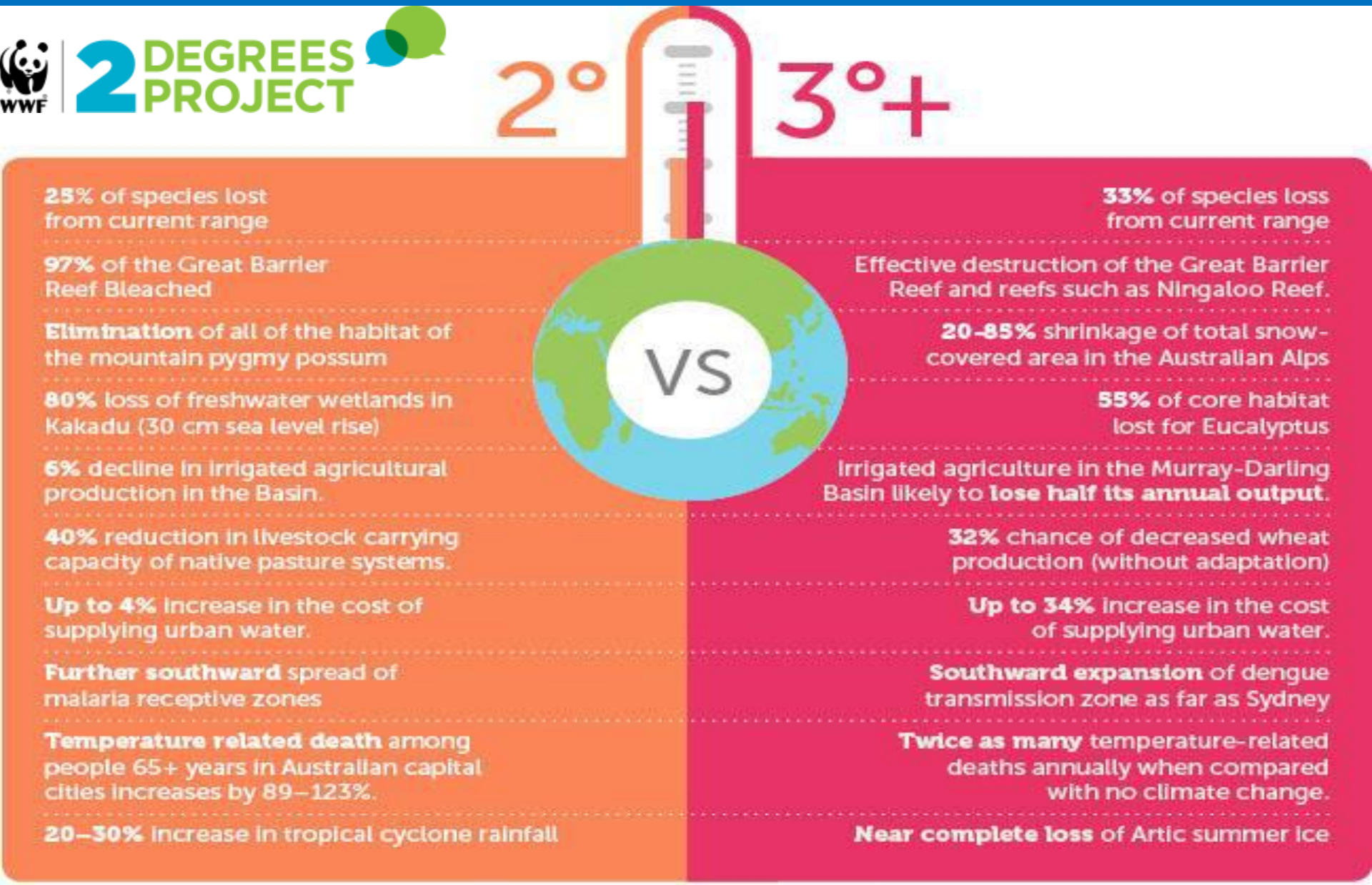
What awaits us?



There are many scenarios because it is unknown how humanity will react. Despite individual successes (the Paris agreement in December was a great success) short-term interests may prevail long term.



What difference does one degree Celsius make?



CSIRO Marine and Atmospheric Research (2006), Climate Change Impacts on Australia and the Benefits of Early Action to Reduce Global Greenhouse Gas Emissions.

Garnaut (2008) Garnaut Climate Change Review, Chapter 6.

What impact will warming by + 4 C have?

- **Droughts**

Reduction of agricultural production. Africa reduction between 15% to 35%. World reducing production by 10% .

- **Increasing floods - level rise at 59cm**

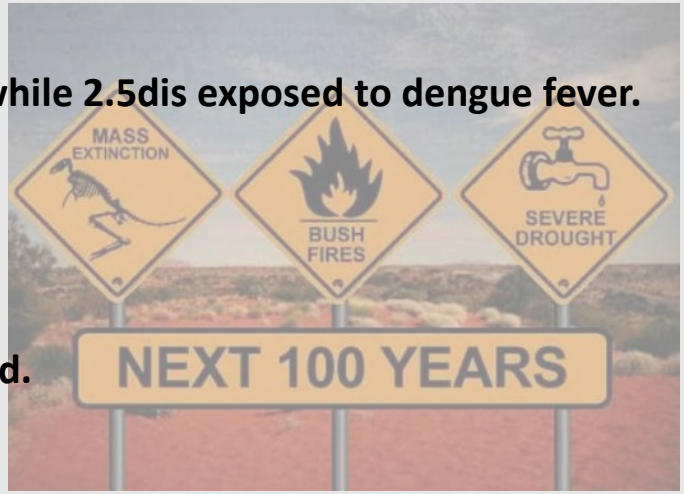
Bangladesh & Vietnam and coastal cities such as London, New. York, Tokyo, Hong Kong, Calcutta, Karachi 1.8 million people at risk only in Britain.

- **Ice melting**

Half of the Arctic tundra is in danger. Europe losing 80% of Alpine glaciers. The icebergs of Antarctica and Greenland start to melt.
Complete melting of Arctic sea ice in summers in the late 21th century. Melting of the Greenland glacier will lead to an increase in sea level of 7 m

- **more diseases**

Mosquitoes party, 80 million. people exposed to malaria in Africa, while 2.5dis exposed to dengue fever.



- **Extinction**

20-50% of the land species are threatened with extinction.

- **Lack of drinking water**

The availability of drinking water in Africa and Mediterranean halved.

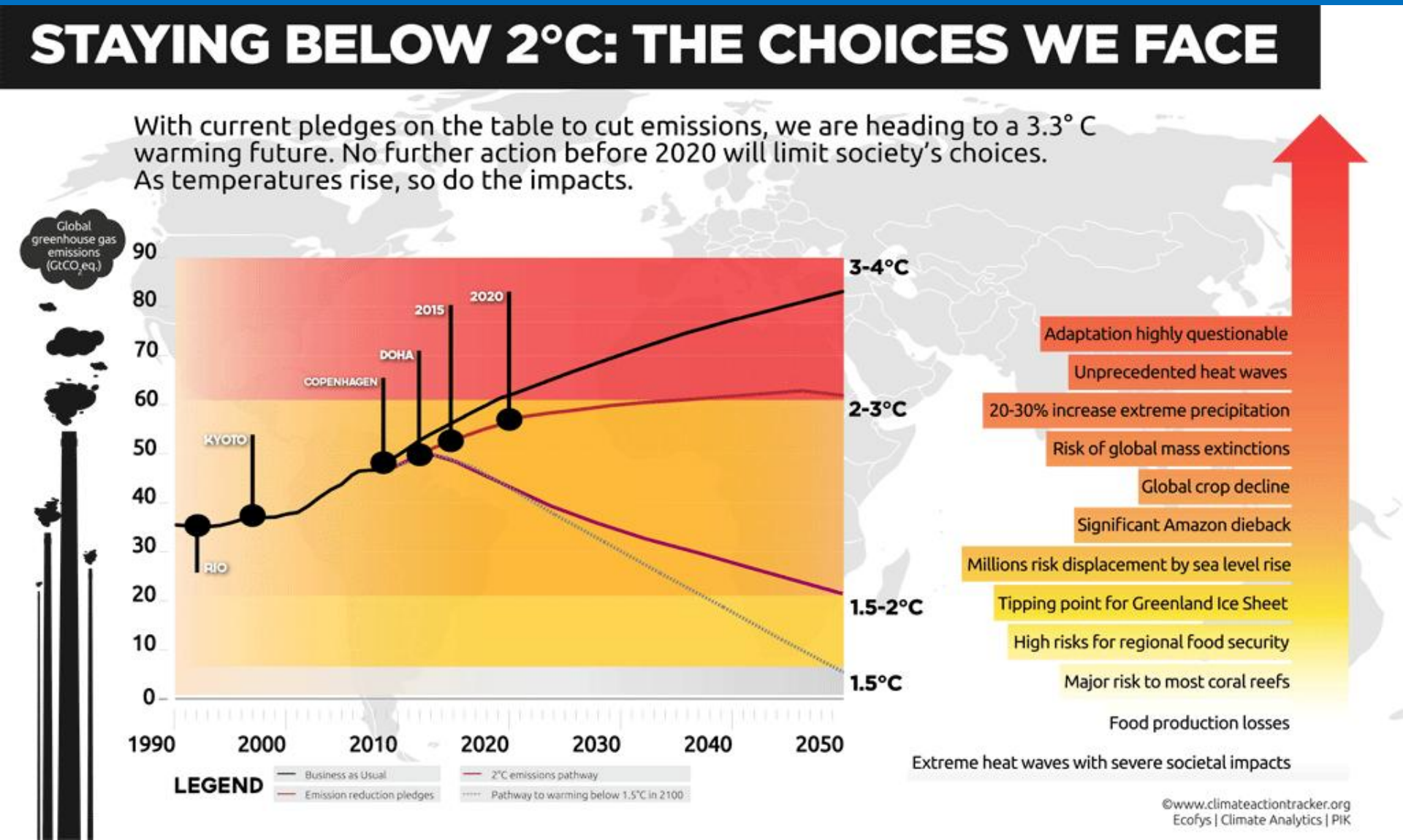
- **Stronger hurricanes**

The wind speeds are increased by 15-25%. Major damage to infrastructure. More often extreme temperatures, heat waves and heavy rain.

- **Gulf Stream**

It is likely that the thermoregulatory circulation of the Atlantic will slow the 21st century.

Scientists are convinced that any rise above the threshold of 2 ° C will result in irreversible changes.
In Paris that threshold was strongly contested and therefore the final decision was a desired limit of 1,5° C



The civil war in Syria was accelerated by climate change which caused the draught.

Climate Change Hastened Syria's Civil War

Human-induced drying in many societies can push tensions over a threshold that provokes violent conflict

SCIENTIFIC AMERICAN™

By Mark Fischetti | March 2, 2015

Climate change can make storms stronger, cold spells longer and water supplies drier. But can it cause war? A new study published today in *Proceedings of the National Academy of Sciences* says drought in Syria, exacerbated to record levels by global warming, pushed social unrest in that nation across a line into an open uprising in 2011. The conflict has since become a major civil

Destruction from 2012 bombing in Azaz, Syria. *Still image from video courtesy of Voice of*

Failure to control climate change will result to greater refugee waves. Climate refugees will be a new category.

theguardian

Failure to act on climate change means an even bigger refugee crisis

Global warming does not cause the conflicts that have caused mass movement of people, but it would be wrong to say it does not contribute

A tornado in the centre of Athens.

CLIMATE CHANGE

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Because there is no planet B!

Paris December 2015

The world recognizing that the reform of the global energy system is the back bone of climate action, joined forces in the Paris Climate Summit COP21.

The energy sector responsible for 2/3 of carbon emissions must be in the heart of the effort to keep the rise in the average global temperature below 2o Celsius.

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

The greatest global mobilization ever led 196 countries to agree on the new climate deal, a historic agreement.

Renewable Energy Sources and Energy Efficiency unlock the solution to the climate crisis.

The energy reform

- ✓Meets the climate crisis,
- ✓Increase energy access,
- ✓And achieves global sustainability targets

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

Scientists concluded that any rise in global average temperature of more than

2° C, can lead to irreversible climatic developments.

To keep the temperature below that safety limit GHG emissions must be stabilized by 2015 - 2020 and then fall by 70-90% by 2050.

It must be understood that the effort is aimed only to reduce the impact of

climate change and not prevent it .

Obama.

Obama on Climate Change: Act Now or Condemn World to a Nightmare

by HALIMAH ABDULLAH and M. ALEX JOHNSON

NBC NEWS

Obama Urges Action on Climate Change 2:32

President Barack Obama challenged fellow world leaders in unusually blunt language Monday to act boldly on climate change or "condemn our children to a world they will no longer have the capacity to repair."

The Pope

Pope Francis calls for urgent action on climate change in White House speech

Addressing a crowd of nearly 15,000 on the south lawn, pope invokes Martin Luther King Jr in speaking of the moral need to protect our 'common home'

Have you met the pope? Share your experiences

Pope Francis struck an unashamedly political tone at the White House during his first public event of a six-day US tour.

Pope Francis addressed one of the thorniest issues in American politics on Wednesday with a White House speech explicitly supporting Barack Obama's plan to cut carbon emissions and chastising climate change deniers for failing in their duty to protect our "common home".

In a tougher-than-expected call for action on global warming, the spiritual leader of more than 70 million American Catholics defied calls among some Republicans to steer clear of politics by making clear he believed this was a moral issue.

"Climate change is a problem which can no longer be left to a future generation," said the pope, who invited contrast with the civil rights struggle by invoking the spirit of Martin Luther King Jr in support of his argument.

Islamic leaders

Islamic leaders issue bold call for rapid phase out of fossil fuels

Arthur Neslen

Religious scholars, experts and teachers from around the world unite to make emotive declaration on climate change ahead of crucial Paris summit

Islamic leaders launch climate change declaration in Istanbul. Photograph: Islamic Relief

Tuesday 18 August 2015

Islamic leaders have issued a clarion call to 1.6bn Muslims around the world to work towards phasing out greenhouse gas emissions by 2050 and a 100% renewable energy strategy.

The grand mufti's of Lebanon and Uganda endorsed the Islamic declaration on climate change, along with prominent Islamic scholars and teachers from 20 countries, at a symposium in Istanbul.

Leo calls for climate action during Oscars acceptance speech

Like Page

Di Caprio

The Climate Council

That time Leo won an #Oscar and talked about the need for urgent action on climate change... Yep, that just happened. Legend.

Shared with: Public

6,163,083 Views

The carbon budget.

In order to keep the possibility of the average global temperature rising above 2o C, below 20%, the carbon budget for :

The period **2000-2050 is 886 GT CO2.**

Up to 2011 emissions were 282 GT CO2 or 1/3 of the affordable.

Hence only **565 GTCO2 can be emitted in the nest 40 years.**

The proven fossil fuel reserves are estimated at **2.795 GT CO2**

Therefore only

20% of the fossil fuel reserves (565/2.795) can be used

The rest must stay underground.

PS. If the temperature rise target is set at 1,5 º C the "allowed" carbon budget will be lowered even further.

Carbon Tracker Initiative

Financial specialists making carbon investment risk

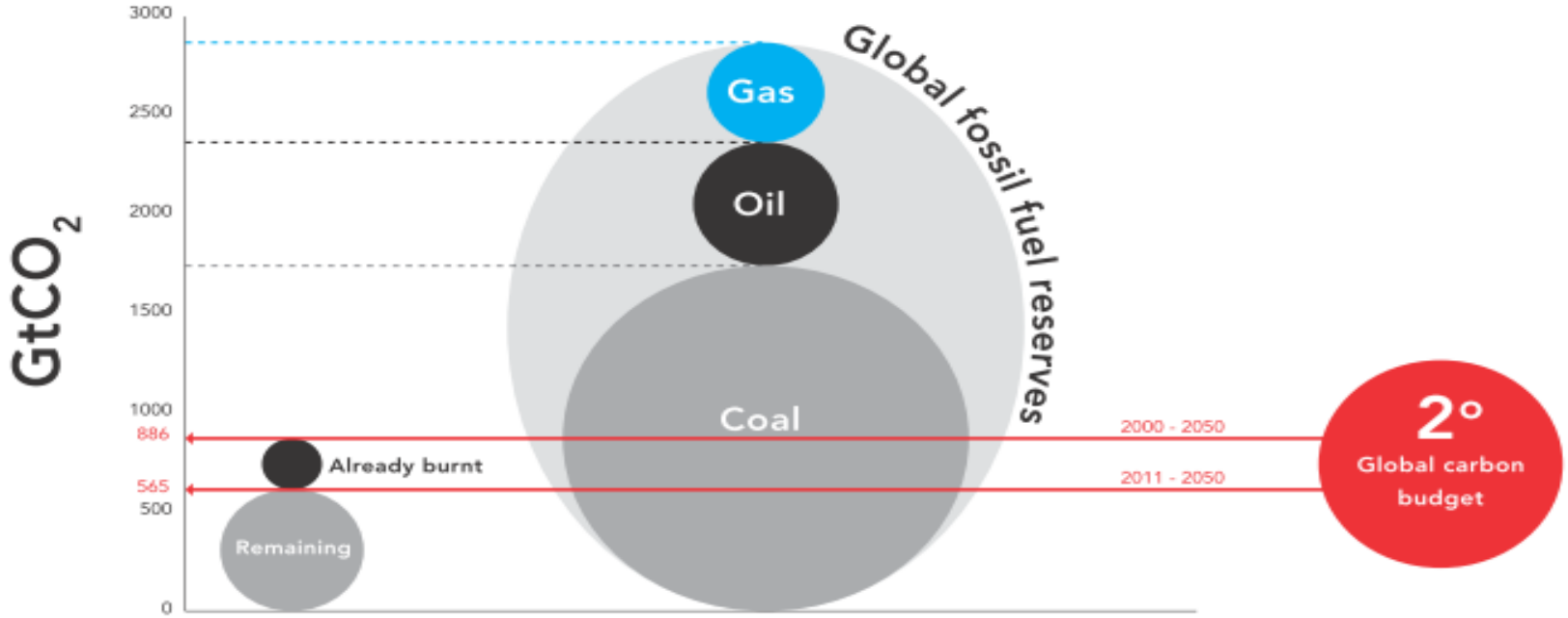
The carbon budget for 2º C and the carbon bubble.

Carbon Tracker Initiative

Financial specialists making carbon investment risk real today in the capital market.

Comparison of the global 2°C carbon budget with fossil fuel reserves CO_2 emissions potential

Fig.1



Only 20% of the total reserves can be burned unabated, leaving up to 80% of assets technically unburnable


Keep it in the ground
2 DEGREES
The threshold for dangerous climate change
4–15 MAY:
JOIN A GLOBAL WAVE OF RESISTANCE TO KEEP COAL, OIL + GAS IN THE GROUND ↓

Already $2,6 trillion carbon disinvestment decisions have been realised

Even Rockefellers, who became rich from oil, are to divest from oil and invest in RES

Rockefellers to switch investments to 'clean energy'

Valerie Rockefeller Wayne, chair of the Rockefeller Brothers Fund, spoke to the BBC about the decision

Rockefellers Dump Exxon Holdings That Made Family's Fortune

Barclays: German coal generation to be worthless by 2030

By Giles Parkinson on 16 March 2016

The 46,000MW of black and brown coal fired generation currently in service in Germany will be worthless in little more than a decade if the country adopts the targets embraced at the Paris climate change conference, a new analysis from Barclays says.

The analysis, from leading energy analyst Mark Lewis, says coal fired power generation would have to be almost completely eliminated by 2030 in a scenario that would require a substantial carbon price (€45/t) and the end to the current energy market design.

The conclusions of the report should not be a surprise, but are important because the fossil fuel industry appears to remain in complete denial, hoping that the Paris climate agreements amount to a "fell-good" gathering that will have no follow through.

But the latest data on soaring global temperatures, and the biggest jump in greenhouse gas emissions on record, suggests this hope is misplaced. Or at least should be. The analysis has implications too, for Australia, which faces a similar transition to Germany, which a growing level of renewables on top of a huge surplus in coal generation, and no effective carbon price to influence energy choices.

Even the most ambitious fossil fuel generators in Australia, such as AGL Energy, say their coal assets, particularly their brown coal assets, will continue generating as late as 2048. The Barclays scenario shows that this would be impossible. Indeed, The Climate Institute says all coal fired generation must cease by 2035 at the latest.

According to Barclays the 46 GW German coal generation capacity will be worthless by 2030.

Business | Fri Mar 11, 2016 8:45am EST

Sweden's Vattenfall struggles to lure buyers for lignite sale

OSLO/FRANKFURT | BY NERIJUS ADOMAITIS AND ARNO SCHUETZE

Vattenfalls CEO Magnus Hall presents the company's sales report during a news conference at the headquaters in Stockholm, Sweden February 3, 2016.
REUTERS/MAJA SUSLIN/TT

Swedish utility company Vattenfall is struggling to attract buyers for its lignite mines and power plants in eastern Germany with less than a week left to submit binding offers, sources close to the matter said on Friday.

The sale, launched at the end of 2014, includes roughly 8,100 megawatt (MW) of lignite-fired plants, which generate about 10 percent of Germany's total electricity, as well as mining activities.

Vattenfall unable to find buyers for its 8.1 GW of lignite powered plants. The sale was launched in 2014!

A woman in her garden near a coal-fired power plant in Shijiazhuang, Hebei province. REUTERS/Kim Kyung-Hoon

China to shut down 1,000 coal mines this year

grist

By James West on 23 Feb 2016 7 comments

This story was originally published by Mother Jones and is reproduced here as part of the Climate Desk collaboration.

The world's top coal producer, and the biggest emitter of greenhouse gases, will shut down 1,000 coal-fired ~~power plants~~ mines* this year. It's a move that will simultaneously cool off China's over-supply of dirty coal and help tackle the country's air pollution crisis — with even deeper cuts to come.

The news was confirmed on Monday by China's National Energy Administration, and first reported by Xinhua, the state-run outlet, after detailed plans to slash coal

China announced it will shut down 1.000 coal mines this year.

JPMorgan Won't Back New Coal Mines to Combat Climate Change

by Tim Loh
TimLoh

March 7, 2016 – 10:08 PM EET *Updated on* March 7, 2016 – 11:39 PM EET

- JPMorgan pledge similar to ones by Morgan Stanley, Citigroup
- Bank won't finance coal-fired power plants in some countries

JPMorgan Chase & Co. became the latest big bank to pull back from coal.

The New York bank will no longer finance new coal mines around the world and will end support for new coal-fired power plants being developed in "high income" countries of the Organisation for Economic Co-operation and Development, JPMorgan said in a policy statement on its website.

JPMorgan is joining a growing list of financial institutions including Bank of America Corp., Citigroup Inc., Morgan Stanley and Wells Fargo & Co. that have pledged to stop or scale back support for coal projects. It's part of a broader divestment campaign led by environmental groups including San Francisco-based Rainforest Action Network looking to move the world's economies beyond fossil fuels.

JPMorgan Bank will not finance new coal mines nd coal power stations.

Coal

World's largest coal producer files for bankruptcy protection

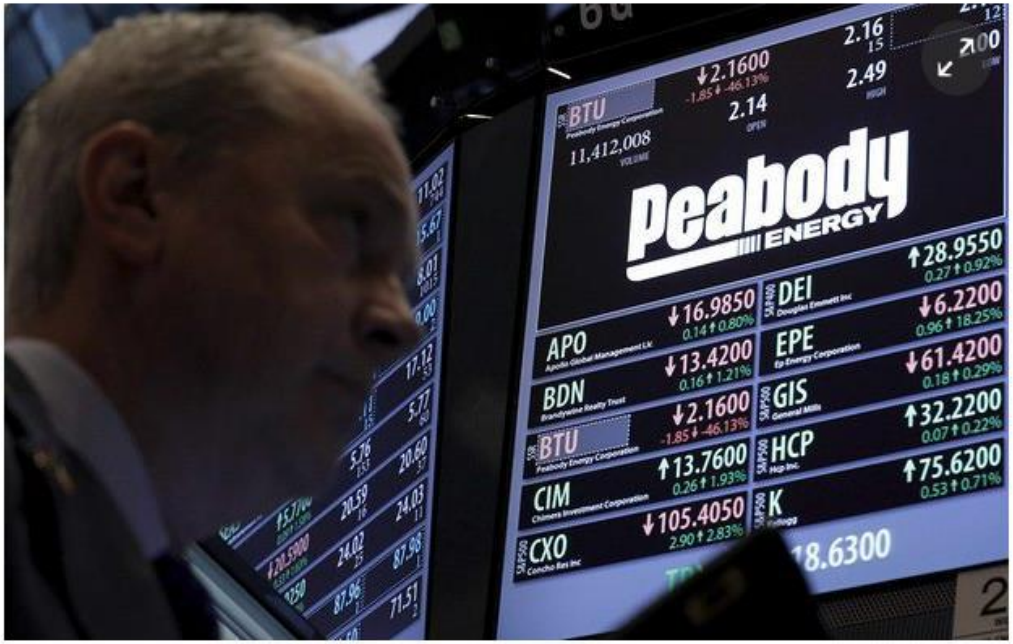
Peabody Energy's decision seen as sign that fossil fuel is threatened by tightening environmental regulation

Terry Macalister Energy editor

@TerryMac999

Wednesday 13 April 2016 20.56 BST

theguardian



Traders work at the post where Peabody Energy is traded on the floor of the New York stock exchange. Photograph: Brendan Mcdermid/Reuters

Peabody Energy, the world's largest privately owned coal producer, has filed for bankruptcy protection in the US following a collapse in commodity prices.

The move was blamed by financial analysts partly on a mistimed and debt-fuelled expansion into Australia, but others saw it as a sign that the most carbon-intensive fossil fuel was threatened by tightening environmental regulation.

Coal is increasingly being replaced as a fuel for generating electricity by gas-fired plants or wind farms in some countries. Britain has promised to phase out such coal use by 2025 although China and India continue to build new plants.

The inevitable.

Surge in renewable energy stalls world greenhouse gas emissions

theguardian

Falling coal use in Ch… …hift towards renewable energy globally saw energy emissions level for the second year running, says IEA

Wednesday 16 March 2016

Wind power installations raced ahead in 2015, accounting for more than half of all new electricity generation

The rise in Renewable Energy Sources halted the rate of carbon dioxide emissions for the second year in a row.

This May Be One $4.2 Trillion Reason to Double Green Energy

by Jessica Shankleman
Jess_Shankleman

March 17, 2016 – 1:01 AM EET *Updated on* March 17, 2016 – 12:29 PM EET

- Doubling renewables will mitigate climate costs, Irena Says
- Hitting 36 percent renewable share would create 6 million jobs

Boosting renewable energy generation to meet global climate goals could save as much as $4.2 trillion a year by 2030, according to a new report asking lawmakers to strengthen clean energy policies.

Doubling the share of renewables in the world's energy mix to 36 percent between now and 2030 would cost $290 billion a year and limit global warming to below two degrees Celsius, according to the Abu Dhabi-based International Renewable Energy Agency report published Thursday. Mitigating against the harmful effects of global warming accounts for much of the savings.

Doubling Renewable Energy Sources by 2030:

✓Is technically feasible,

✓Will create 6 million jobs,

✓Will contribute to achieving the 2° C target

✓ and is by far the cheaper choice since it will result to $4,2 trillion savings annually

What more can one ask?

The biggest scandal of the 20th century!

To 2050

CLIMATE CHANGE

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Turning to renewables is not the best solution.

It’s the only solution


WWF
REPORT
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2011
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THE ENERGY REPORT
100% RENEWABLE ENERGY BY 2050
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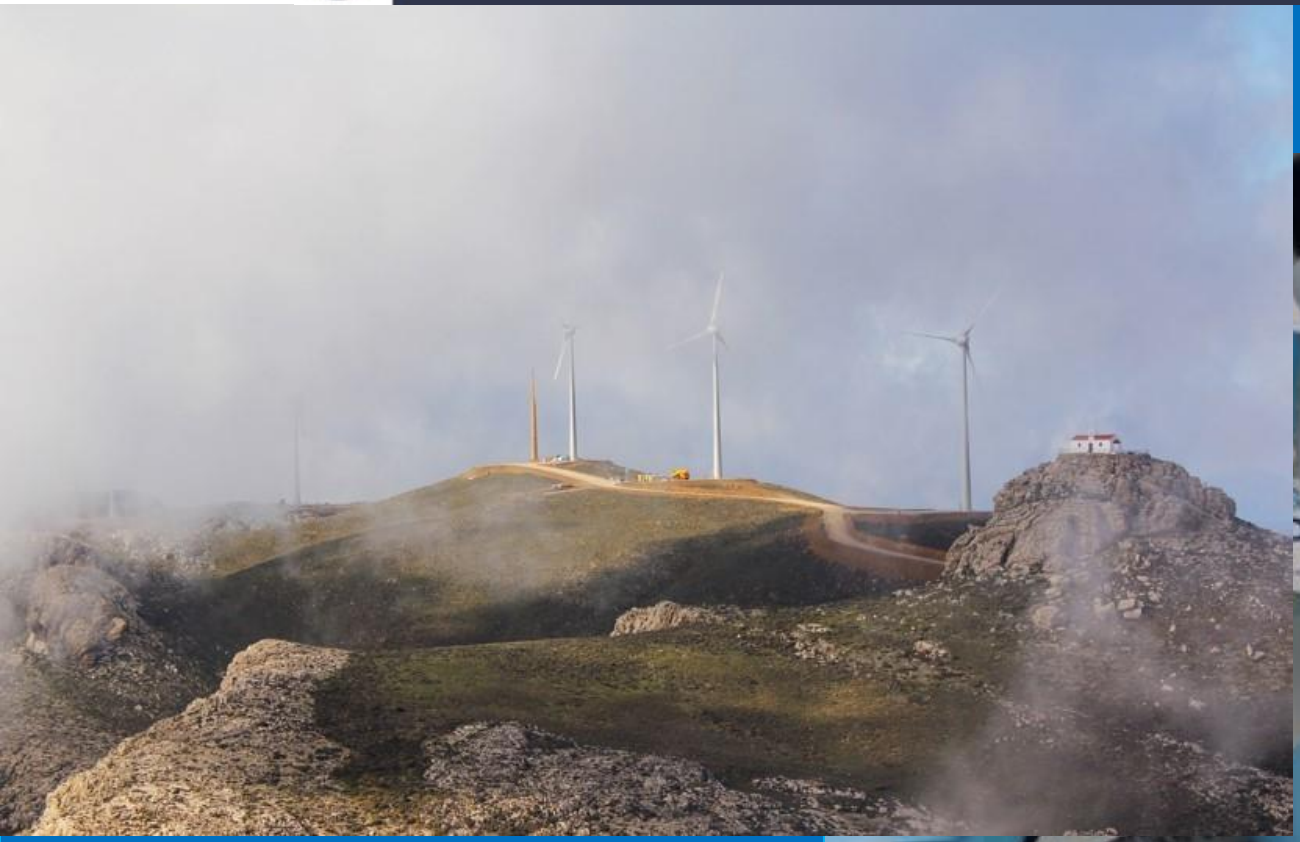
[r]evolution
A SUSTAINABLE WORLD ENERGY OUTLOOK 2015
100% RENEWABLE ENERGY FOR ALL
GWEC
SolarPower Europe
GREENPEACE
REPORT 5TH EDITION 2015 WORLD ENERGY SCENARIO


100% RENEWABLE



Thank you
for your attention.

Dr. Ioannis Tsipouridis

Chairman & CEO
Hellenic Wind Energy Association

Editor of "ANEMOLOGIA“