



This project is funded by the European Union under  
the 7th Research Framework programme (theme SSH)  
Grant Agreement nr 266800



# **Transition to a sustainable energy system: the impact of the Great Recession**

Andreas Papandreou  
National and Kapodistrian University  
of Athens

# Questions

- Do crises give rise to innovations and transitions?
- How are past crises linked to energy transitions and what lessons can we draw for the present crisis?
- Does the Great Recession offer opportunities for a new "green golden age" or has it put the needed energy revolution on hold?

# Mind map

- The Great Recession
- Recessions, energy transitions and sustainability
- Recessions, emissions and targets
- The promise of green recovery
- Progress towards sustainable energy targets
- Attention and policy peaks

# The Great Recession

- Marked global decline in December 2007 (subprime mortgage market), precipitous downturn in September 2008 (Lehman Brothers)
- Deepest and most widespread contraction in global economy since WWII
  - 2.2% drop in world GDP in 2009
  - first truly global (simultaneous) crisis
  - Brazil, Russia, India and China resumed growth by July 2009 and helped drive recovery
- Unprecedented monetary and fiscal measures => signs of stabilization from mid-March 2009
- How was this time different?
  - global nature, speed of contagion
  - advanced economies most affected
  - “shadow banking”
  - global scale structural shifts
- Bounce cut short by emerging triple crisis in EU (banking, sovereign debt, productivity)

# Lessons from energy transitions

- Pre Industrial Revolution constraints: limited availability of mechanical power, low energy densities, lack of ubiquitous and cheap transport systems
- Steam power relying on coal helped overcome with more than a century for this first technological transition to fully unfold (1920s coal = 2/3 of global energy system)
- 2<sup>nd</sup> transition to electricity and petroleum-based technologies

# Lessons from energy transitions

- ‘Grand’ patterns characterize technological transitions:
  - End-use applications drive supply side transformations
  - Transition takes decades to well over a century
  - Involve far reaching changes across different dimensions (cars: roads, service stations, traffic rules, housing)
  - Price signals (resource scarcity) were not what drove energy transitions (though influential): better services drive and price follows

Major departure to sustainability transition is that it is predominately policy-driven (no precedent), though transitions in the past were policy-enabled

# Past energy transitions were policy enabled

- New technologies => new vested interests
- Cotton industry and rise of coal
  - British ruling elites (unlike French counterpart) protected new industry and was active in building supportive transportation infrastructure (turnpikes and canals)
- Coal, steam and iron (industrial complex behind IR):
  - Scarcity in charcoal prompted use of coal in Britain in face of increasing demand for iron (despite its prohibitive price)
  - Britain government supported railroads against vested interests of canal supporters (French bureaucracy sided with canal interests and also put tariffs on coal)
- Electricity: Germany was leading innovator
  - Key bottleneck in Britain was massive lack of electrical engineers, state failed to provide mass education (aristocratic vested interests), local standards differed, municipal gas networks opposed while cheap coal dampened enthusiasm
  - Germany did not face vested interests, strong education system, network integrated

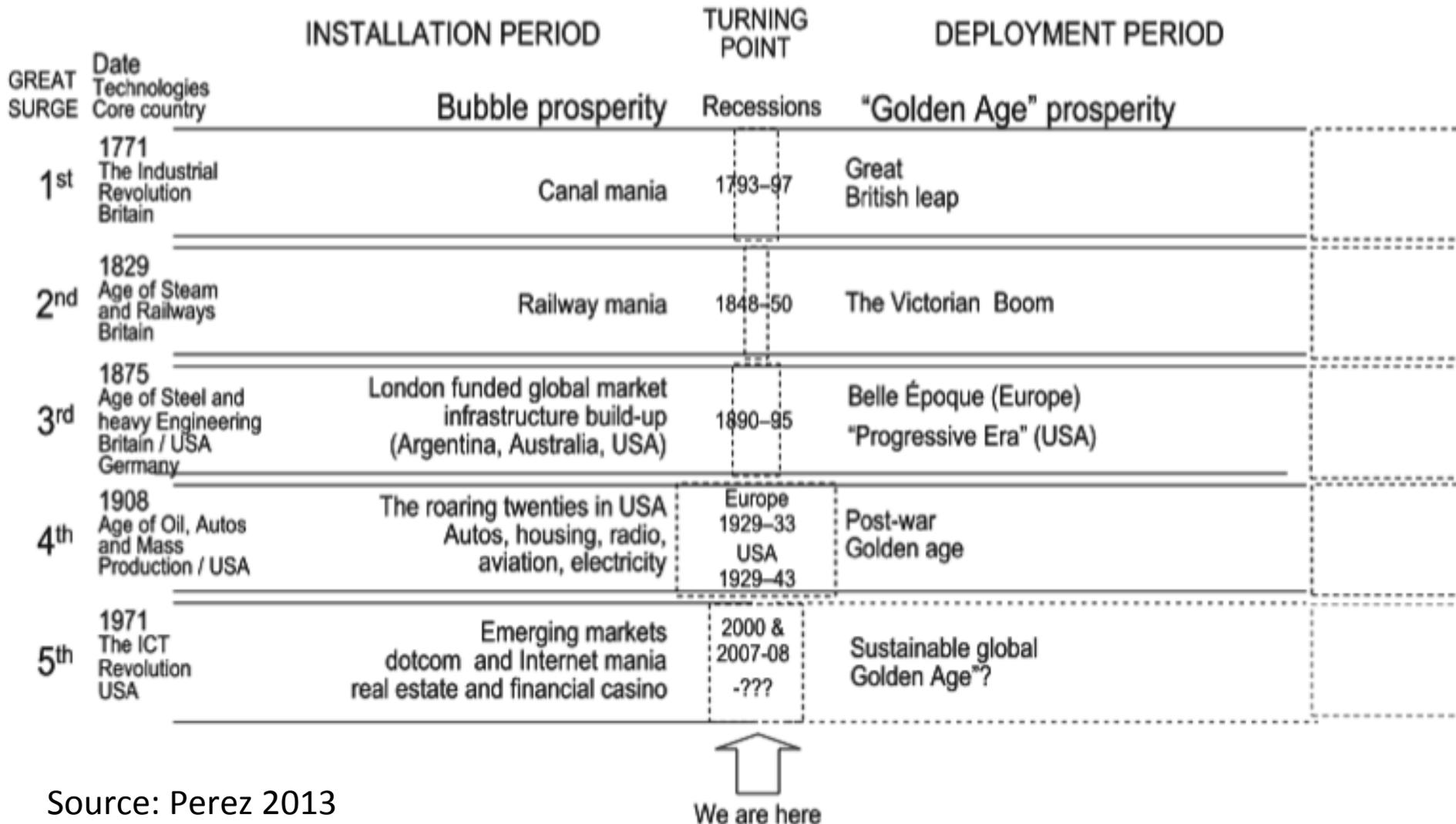
# Sustainability Transition

- Challenge to sustainability transitions is presence of strong path-dependence and lock-ins in existing sectors
- Established technologies highly intertwined (life styles, business models, value chains, organizational structures, regulations, institutional structures, political structures)=> incremental change rather than radical change
- A number of theoretical frameworks focus explicitly on transition studies
- Socio-technical transition involves a far reaching changes across different dimensions
  - E.g., transportation systems with automobile at core required complementary development of road infrastructure, fuel supply systems, traffic rules, services, user practices.
  - They also affect related societal domains: living, housing and working, production and trade, planning and policymaking
- Sustainability transitions are socio-technical transitions towards more sustainable modes of production and consumption
  - Climate change challenge special in comprehensiveness of sectors involved most of which have been molded by fossil fuel energy system
  - Also special because of comprehensiveness of required response within a very short time frame

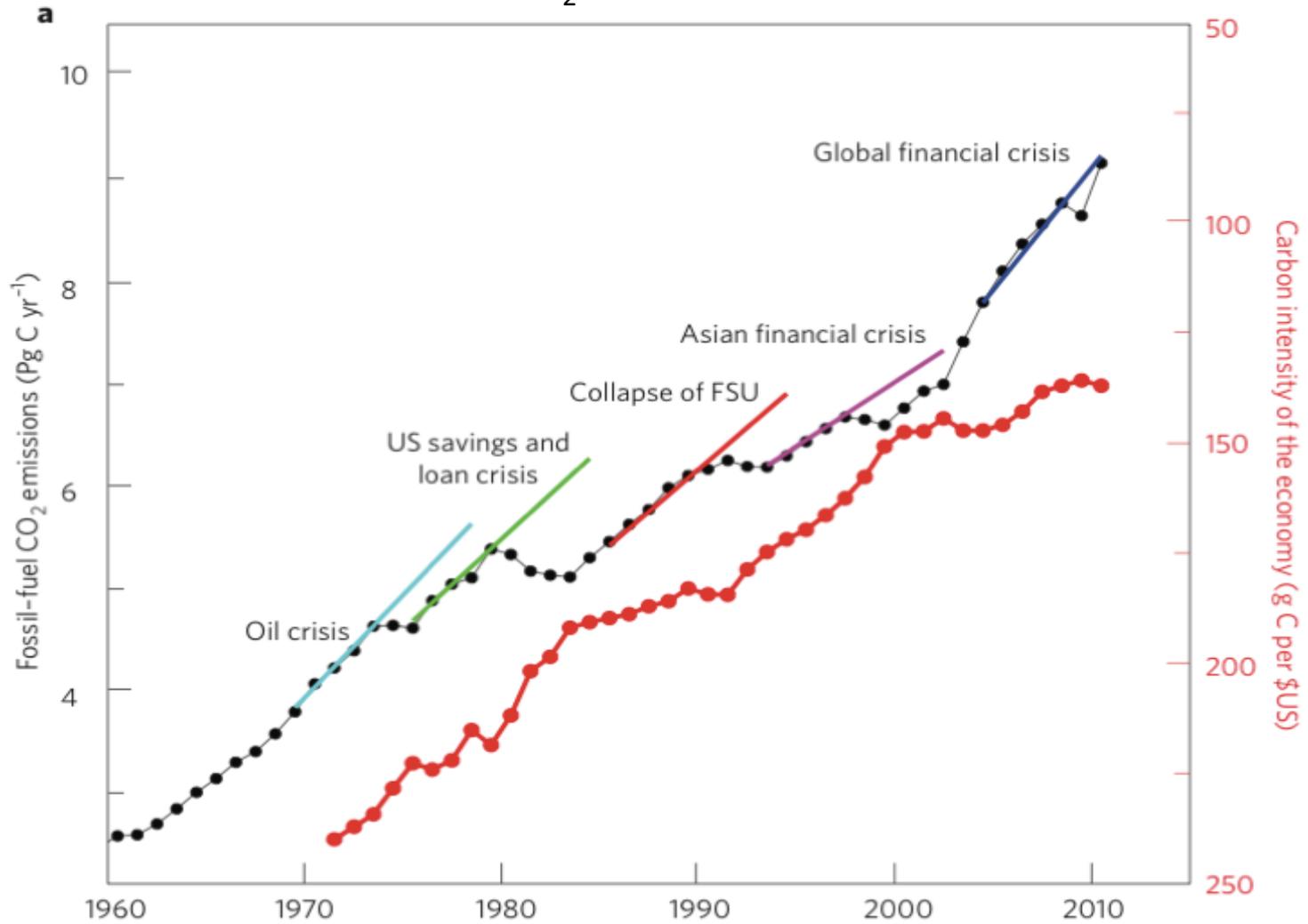
# Crises, socio-economic transitions and sustainability (three narratives)

- 1. Modern societies facing 'triple crisis' in which financial, socio-economic and environmental problems converge
  - Deeper root cultural problem with capitalist societies, planetary breaking points, zero or de-growth
- 2. Kondratieff long-wave dynamics: five techno-economic paradigm shifts (long waves) over last 200 years (next slide)
- 3. Multi-level perspective: financial-economic crisis is a shock that creates pressure on regimes affecting investor confidence, availability of capital, public concerns, and political will to act in favor of sustainability
  - Green niche innovations gaining momentum but need to move into take-off phase of widespread deployment
  - Require funding therefore financial regulation and investor confidence
  - Policy and institutional frameworks (including standard set of green policies and pricing)
  - Wider public support to incentivize politicians

# Crises and socio-economic transitions



## Great Recession and CO<sub>2</sub> emissions



# Brief overview of meeting targets

- Global GHGs projected at 4°C >>2°C target
- Cancun (2010) pledges still leave “emissions gap”
- Missing 2020 target: costs ↑ chance of failure ↑
- Industrialized countries all likely to meet 2008-2012 reduction targets (collapse in transition economies late 90s, Great Recession, CDM low price)
- Ex Soviet Union and Eastern European countries collectively 36% below 1990 level in 2008
- While industrialized likely to achieve targets (due to overestimating growth) total global emissions growing at dangerously high rates

# Promise of a green recovery

- With FEC terms like “Green Economic Growth” and “New Green Economy” became popular
- How ‘New’? (Sustainable Development)
- “New narrative” perhaps: recasting environmental protection as opportunity and reward rather than constraint
- Rhetoric? Partly reflects a broadening of scope (Bowen and Fankhauser 2011):
  - Keynesian perspective (newest): green growth connecting to SR macro
  - Pigouvian perspective: augmenting traditional externalities with network externalities, information failures and innovation constraints
  - Schumpeterian perspective: beyond marginal to systemic changes “creative destruction”
  - Georgian perspective: green policies (governance and ingenuity) can ignite technical progress

# Green Keynesianism

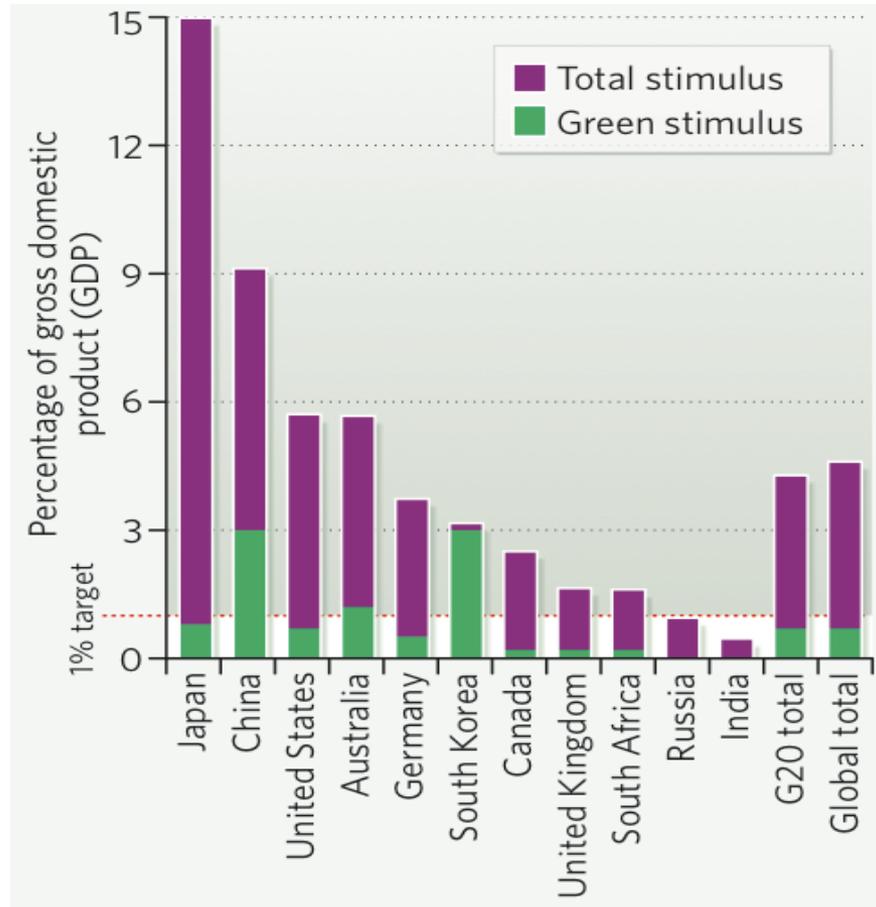
- Tie short run imperative with long term need for sustainability
  - Possible coincidence between short-term AD boost to employment and GHG mitigation expenditures (numerous studies but evidence still scant)
- Need to consider implications of ‘boom and bust’ cycles for long term trajectories of GHGs:
  - recessions lower emissions but may increase carbon intensity
  - ‘booms and busts’ in policy damage investor confidence
- Global green recovery help alleviate ‘global imbalances’
  - Reduce volume of oil imports into deficit economies and stem rise in fossil fuel prices
  - Could also help shift output structure of emerging market economies from labor-intensive goods to skills, capital and technology-intensive production, with higher LC imports and less reliance on exports

# Matrix of Green programs by criteria

Impact of US\$1 billion additional spending on "direct green stimulus"

“Green” program	Overall employment impact, job years, initial year	Energy cost saving, US\$ million annually, 2012-2020	CO <sub>2</sub> emissions reduction, 1000 tons annually 2012-2020	Private share, overall generated, average
Household weatherization	25100	207.8	440.7	0
Federal building retrofits	25300	386.7	546.9	0
Green school construction	25200	609.2	905.8	0
PTC extension	39100	562.5	727.7	76.1
ITC increase	33300	208.7	213.4	47.0
CCS demo projects	28500	225.3	341.6	68.8
“Cash for clunkers”	46900	433.0	1112.5	86.8
Hybrid tax credit	11100	-	-	0
Battery R&D	22500	1278.8	1332.8	0
Mass transit	34500	23.6	87.3	27.4
Smart metering	40000	918.0	207.4	50.0
Average for green stimulus	30100	450	593	-
Road investment	25200	-32.8	-35.4	0

# Was there a fiscal green stimulus?

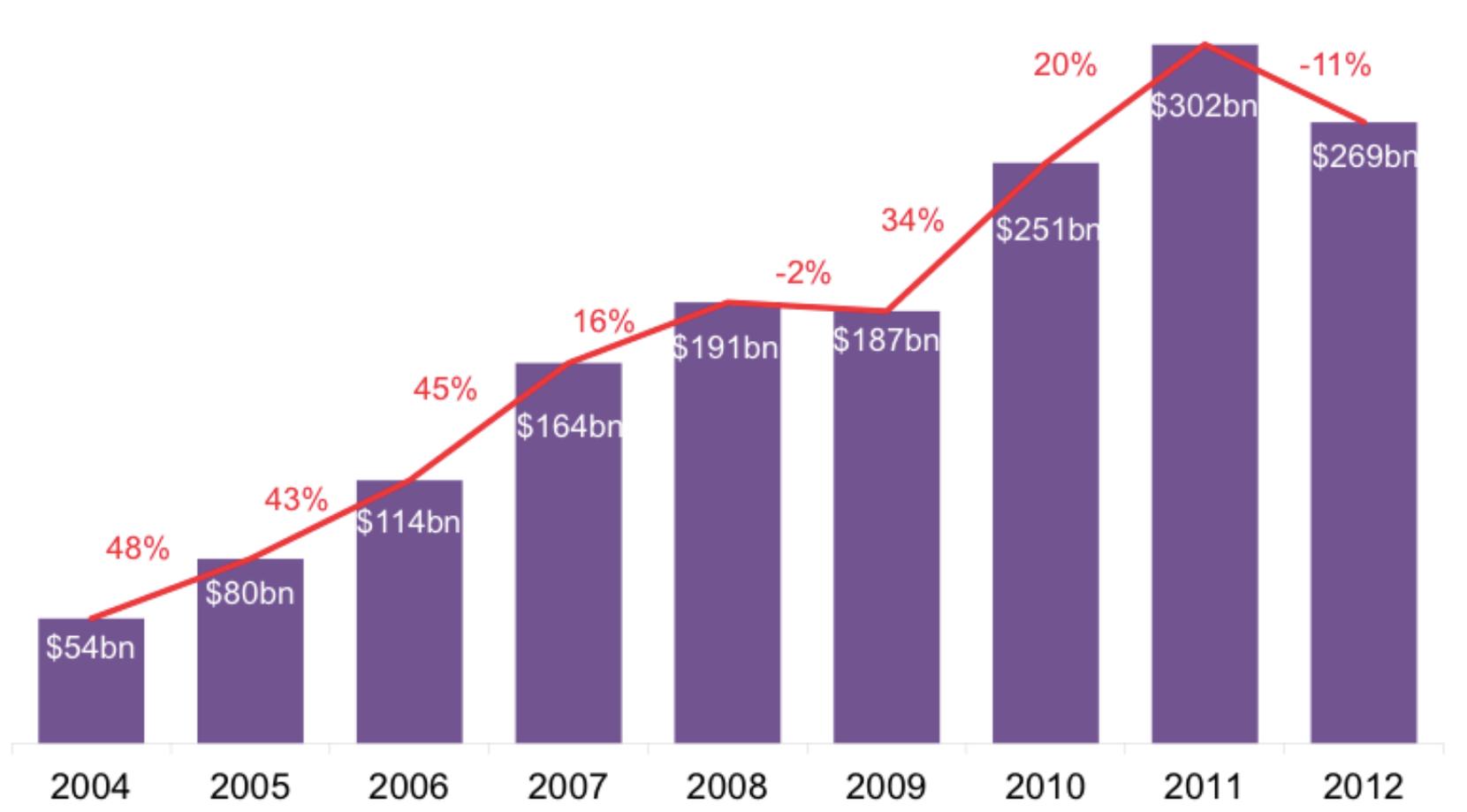


1/6 overall stimulus green

# Progress towards sustainable energy targets and the impact of the FEC

- No reliable index of sustainable GDP => numerous indicators for LCE transition
- For most technologies that could provide energy savings and reductions in GHGs progress is alarmingly slow (IEA 2013)
- According to IEA only sectors on track to reach 2°C goal are renewable power and electric-hybrid vehicles with solar photovoltaic, onshore wind, biomass and hydro most dynamic
- Rest off track: nuclear, gas, and coal fired power, buildings, smart grids, CCS, industry, fuel economy, biofuels

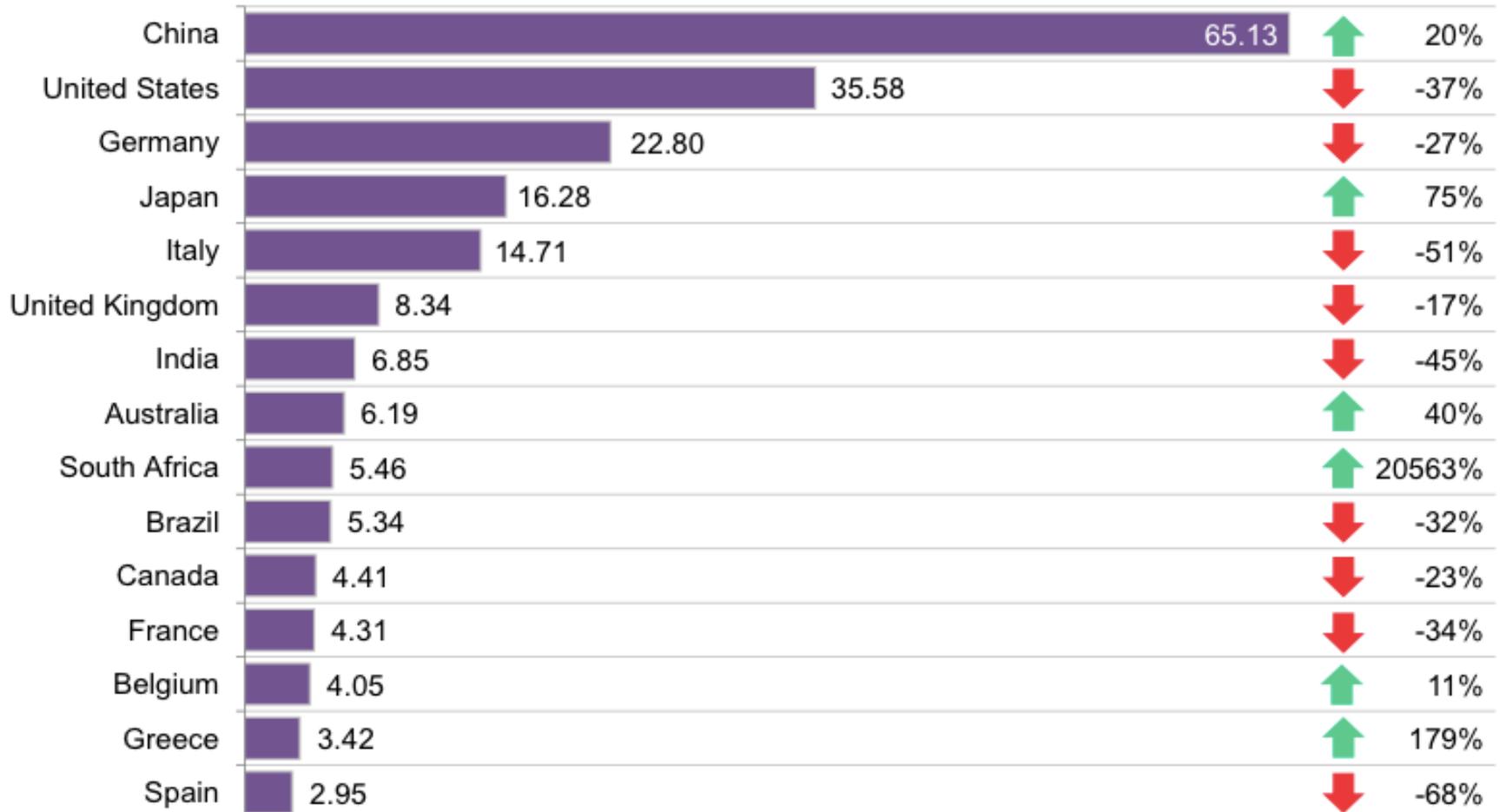
# Annual clean energy investments



# Total renewable investments by region

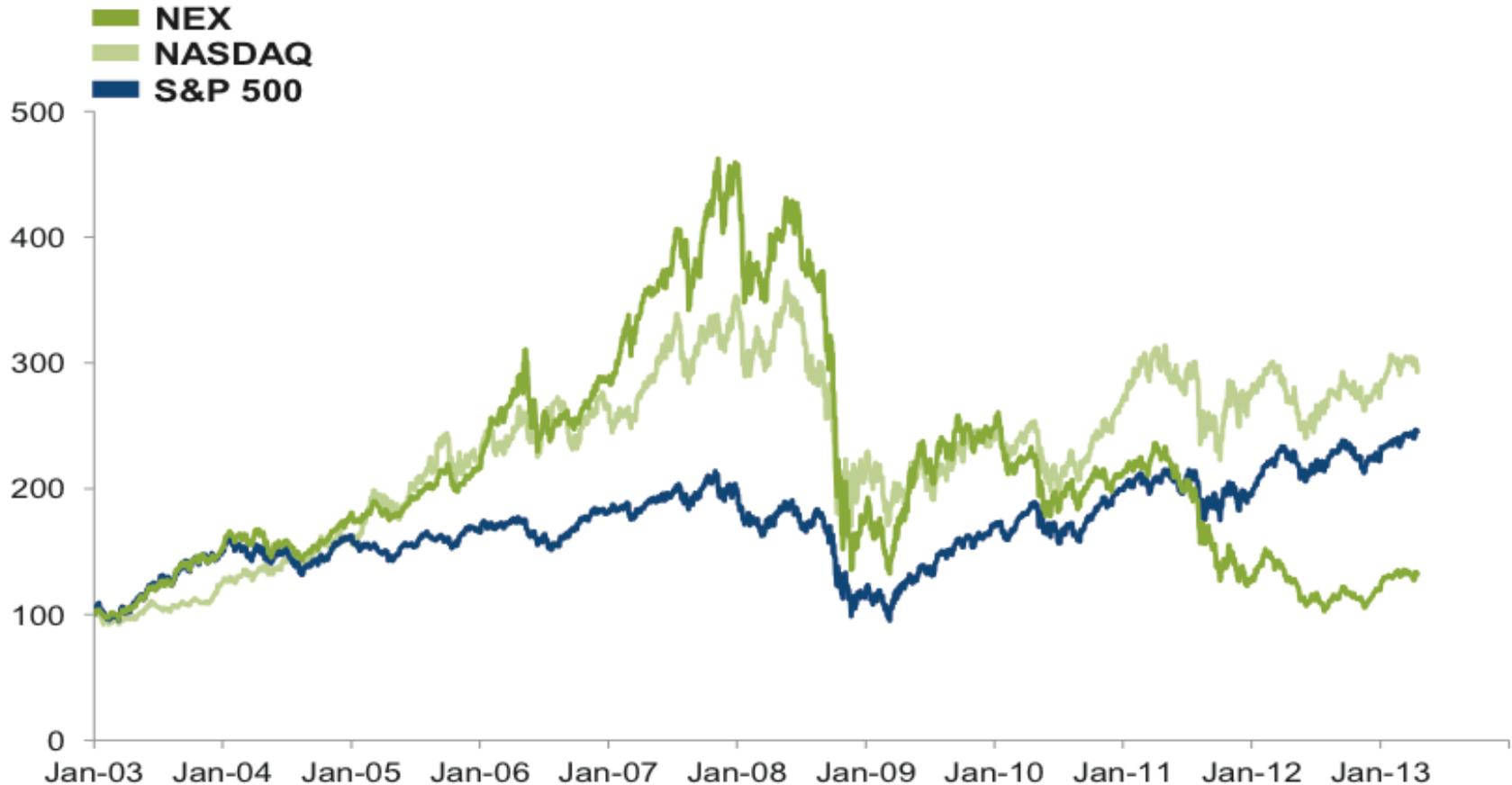
	2004	2005	2006	2007	2008	2009	2010	2011
Europe	18.6	27.7	37.4	57.8	67.1	67.9	92.3	101
United States	7.4	11.2	27.2	28.5	37.7	22.5	32.5	50.8
China	2.2	5.4	10.0	14.9	24.3	37.4	44.5	52.2
India	2.0	2.9	4.7	5.6	4.7	4.2	7.6	12.3
ASOC (excl. China and India)	7.2	8.0	8.0	10.1	11.0	12.1	18.4	21.1
Middle East and Africa	0.3	0.4	1.6	1.9	3.7	3.1	6.7	5.5
Brazil	0.4	1.9	4.3	9.3	12.7	7.3	6.9	7.5
AMER (excl. US and Brazil)	1.3	3.3	3.3	4.7	5.4	6.4	11.0	7.0
<b>Total</b>	<b>39.5</b>	<b>60.8</b>	<b>96.5</b>	<b>132.8</b>	<b>166.6</b>	<b>160.0</b>	<b>219.8</b>	<b>257.5</b>

# Total renewable energy by country



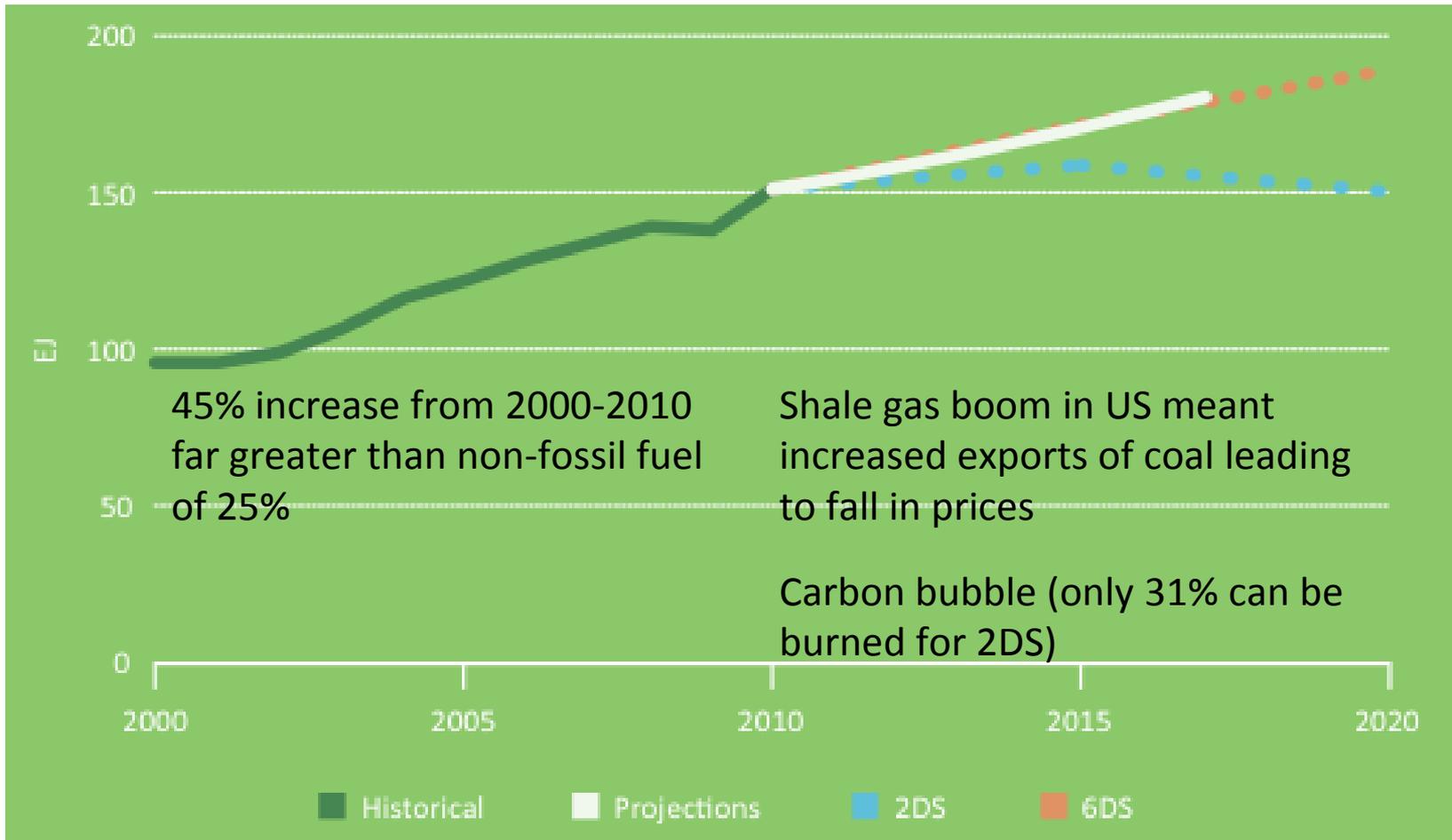
Total renewable investments in 2012 by country

# Index of global clean energy companies compared to other indices

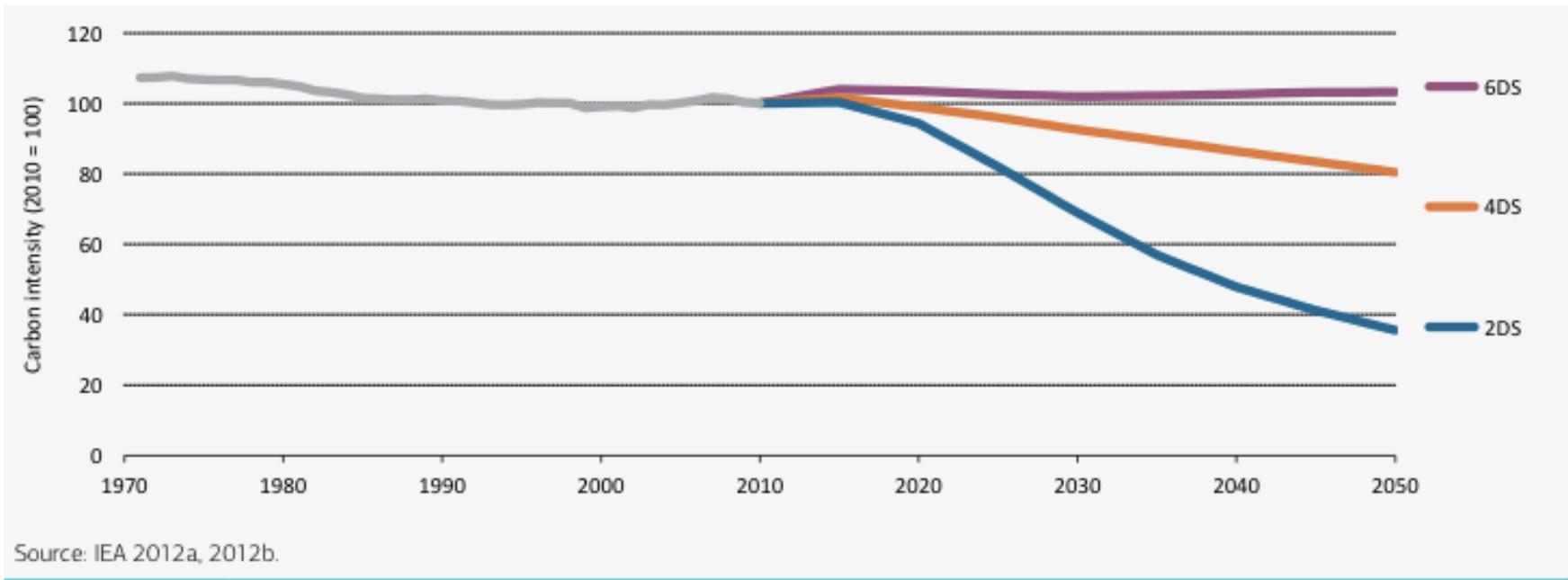


Source: Frankfurt School of Finance and Management gGmbH (in collaboration with Bloomberg New Energy Finance). (2013). *Global trends in renewable energy investment 2012* [G]. UNEP.

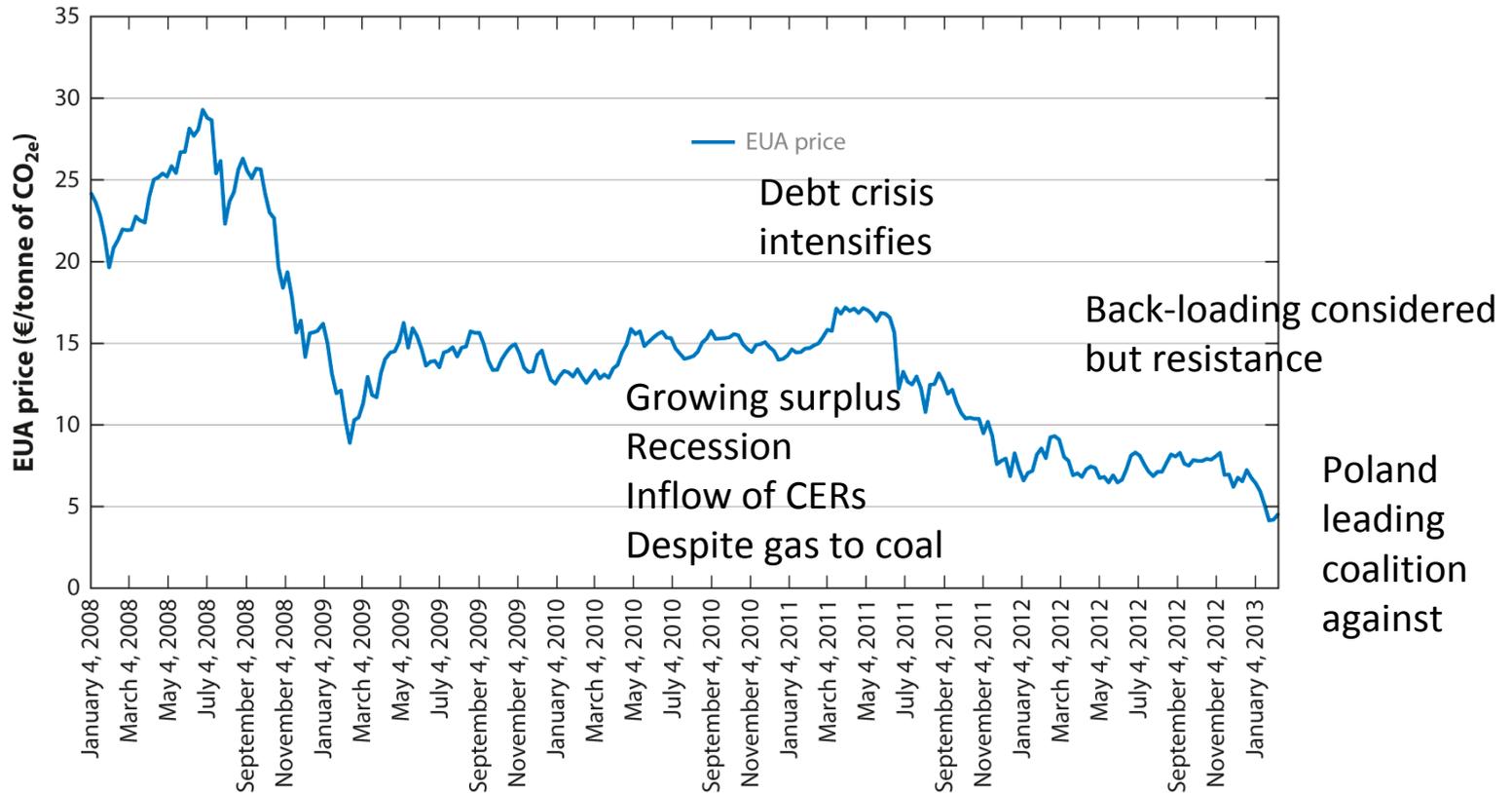
# Growth in coal-fired generation



# Energy sector intensity index



# EUA price collapse



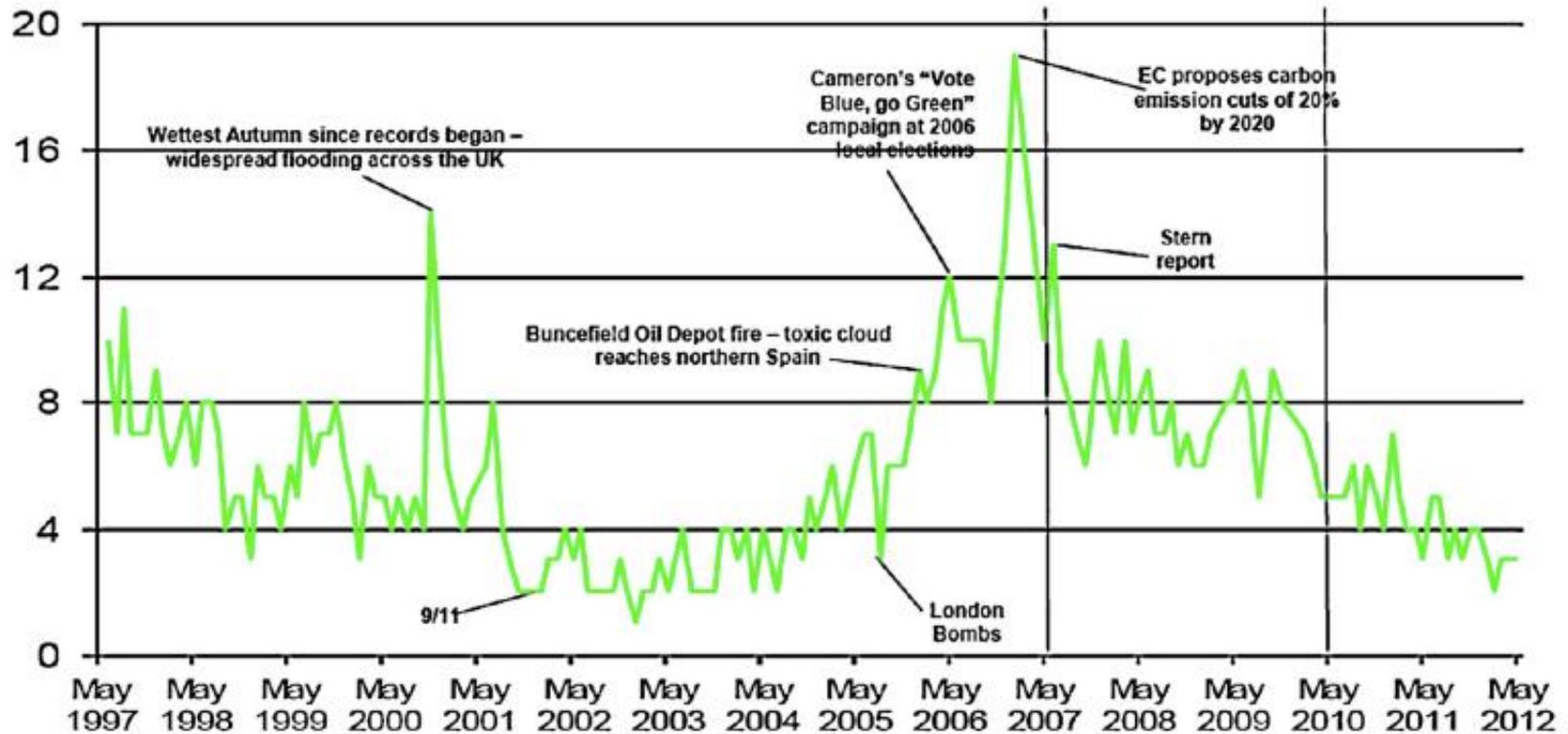
Convery FJ. and Redmond L. 2013.

Ann. Rev. Resour. Econ. 5:301–324

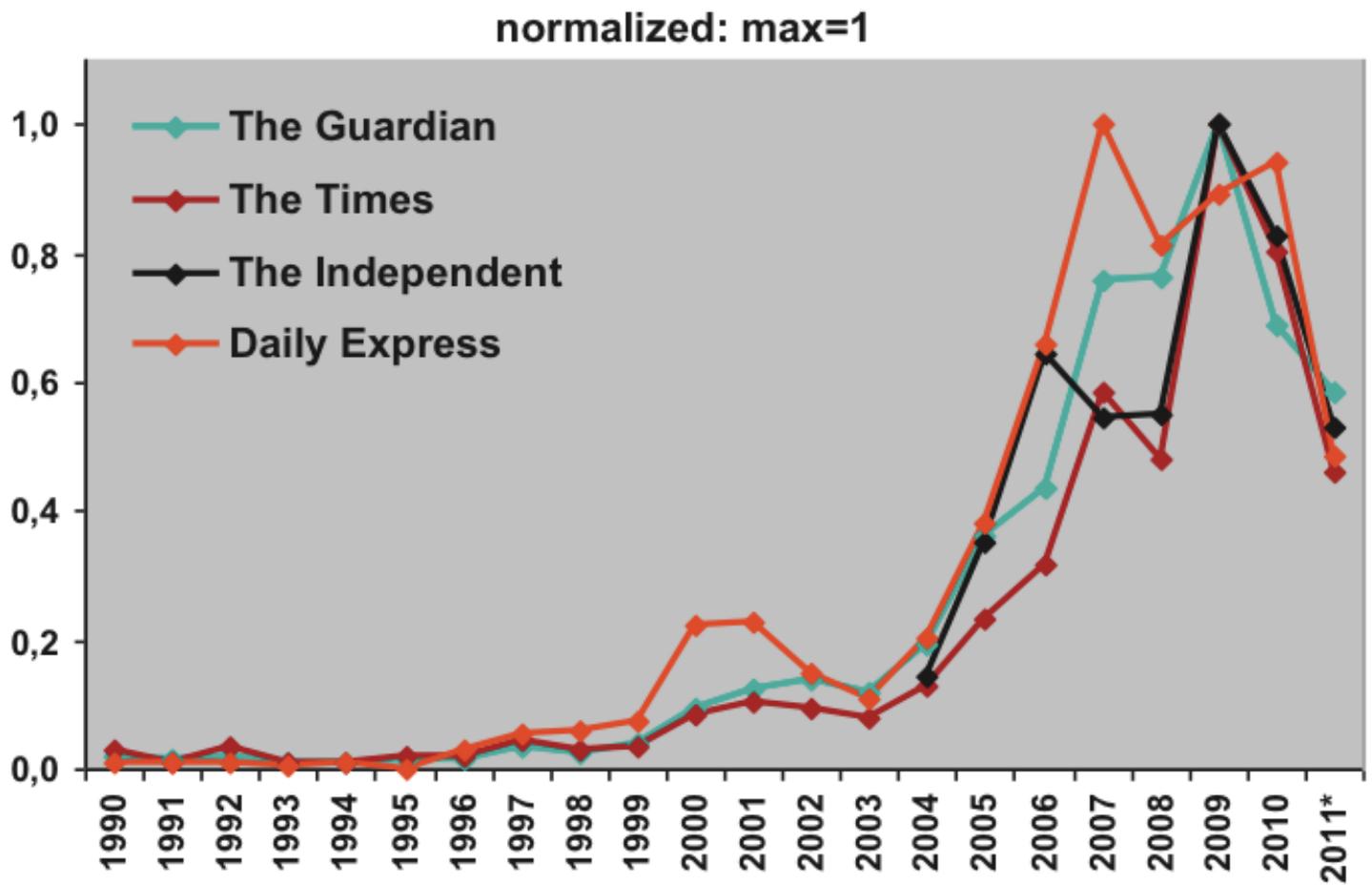
# Shifting priorities

- Recent IEA proposal for “GDP-neutral” strategy to keep 2°C target window open indicative
  - Keep world on track till 2020 through measures like energy saving and efficiency and limits on inefficient coal power plants, “without harm to national economic growth”
- International climate change negotiations clearly peaked in “traumatic” Copenhagen summit, though there has been some progress the focus has been how to postpone action(till 2015) or keep the process from dissolution
- Polling results have generally shown a significant impact of the economic crisis on people’s priorities and attention:
  - surveys in the US show dramatic decline in public’s concern for CC following 2008-9
  - Opinion data in Europe also show attitudes toward climate change are affected by short-run economic conditions

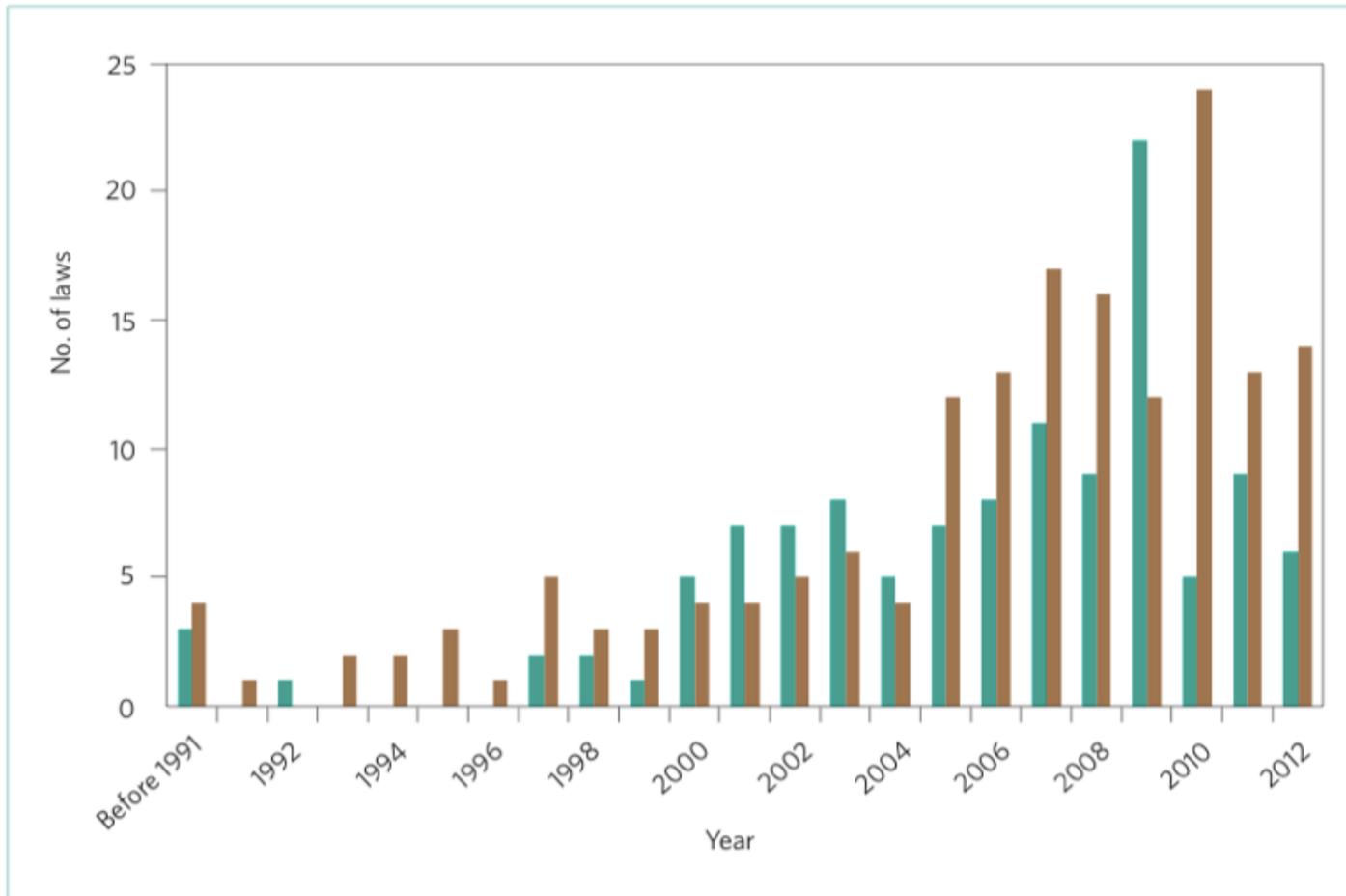
# Economist/Ipsos MORI Poll



# Articles containing the word “climate change”



# Climate change legislation trends



# Great Recession impact on sustainability transition

- Drop in concern: polls, government (words and deeds)
- Loss in time has not been made up by a fall in GHG emissions
- Policy uncertainty and falling equipment costs negatively impacted renewable investment
- Brown energy news bad: more money still being invested in new fossil-fuel generating capacity (coal, gas) compared to renewables
- Slowdowns generally linked to drops in CO<sub>2</sub> emissions the can also shift the energy mix away from clean energy
- The collapse of the EU carbon market: leadership resolve
- Initial 'Green Keynesian' little and short-lived
- Times of crisis can be opportunities (κρίσις) but this time transition must be policy-driven