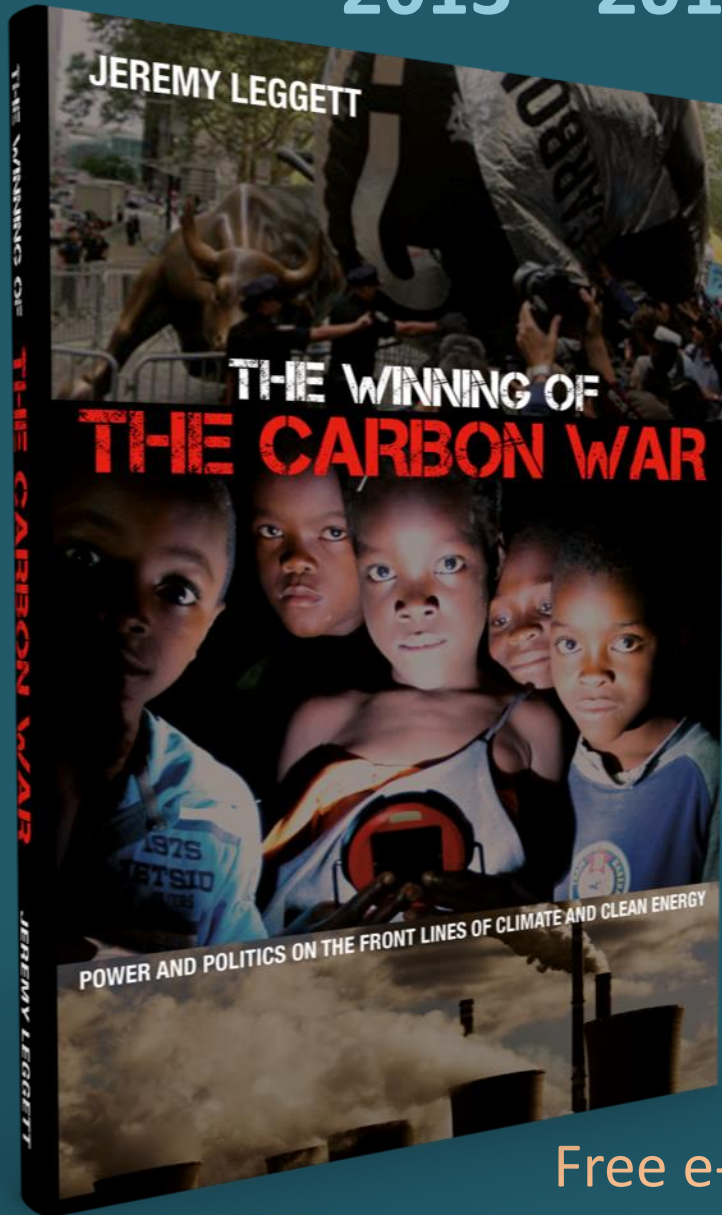


2013 – 2015: the turnaround years

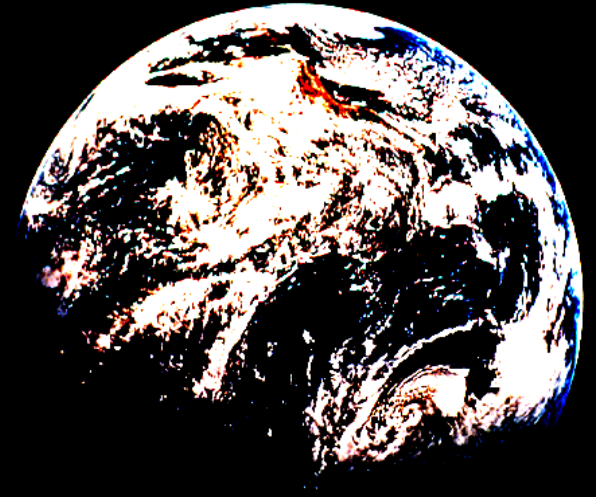


Three meta-narratives:

1. Global society awakening to a threat to civilisation
1. An insurgency disrupting an incumbency fast
1. An incumbency facing multiple threats

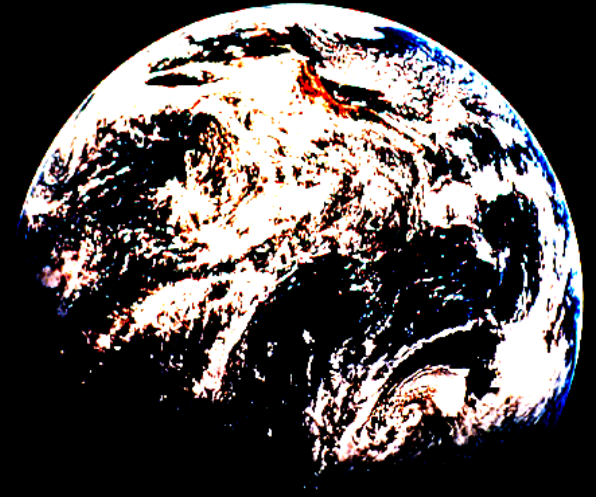
Free e-book download: www.jeremyleggett.net

Book orders: on amazon etc – all £ to SolarAid



Personal perspective

Global perspective



Personal perspective

Global perspective

My background



Baluchistan, 1984

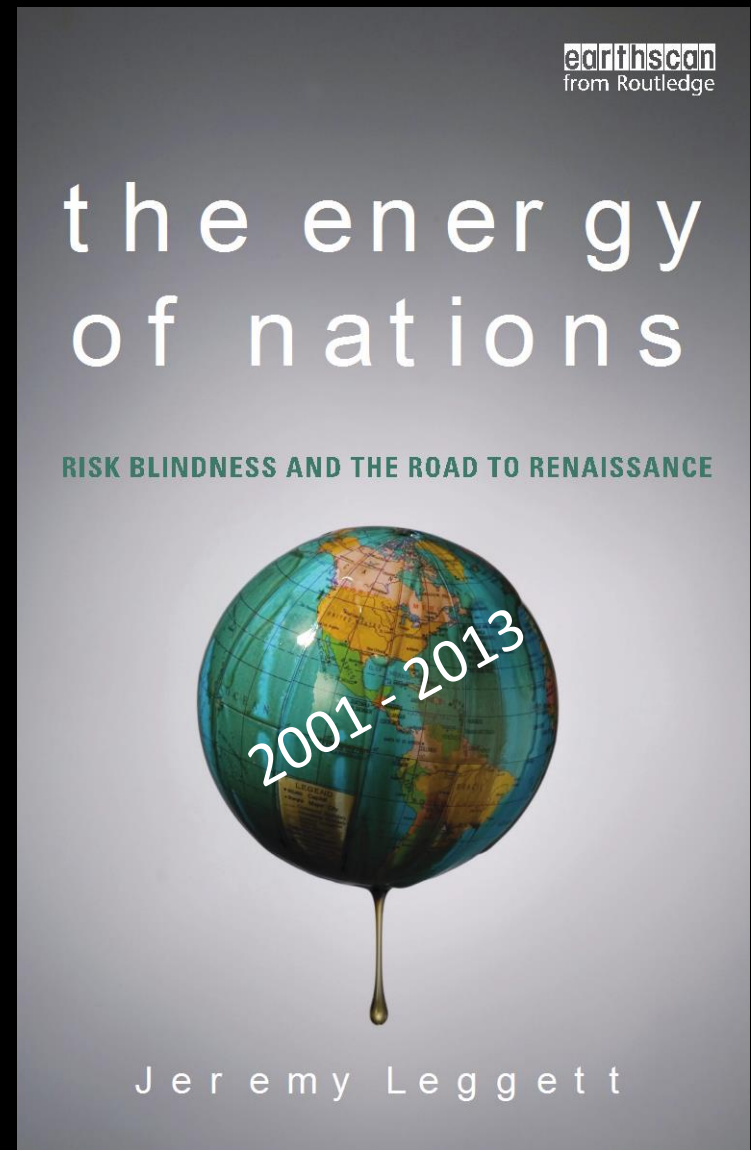
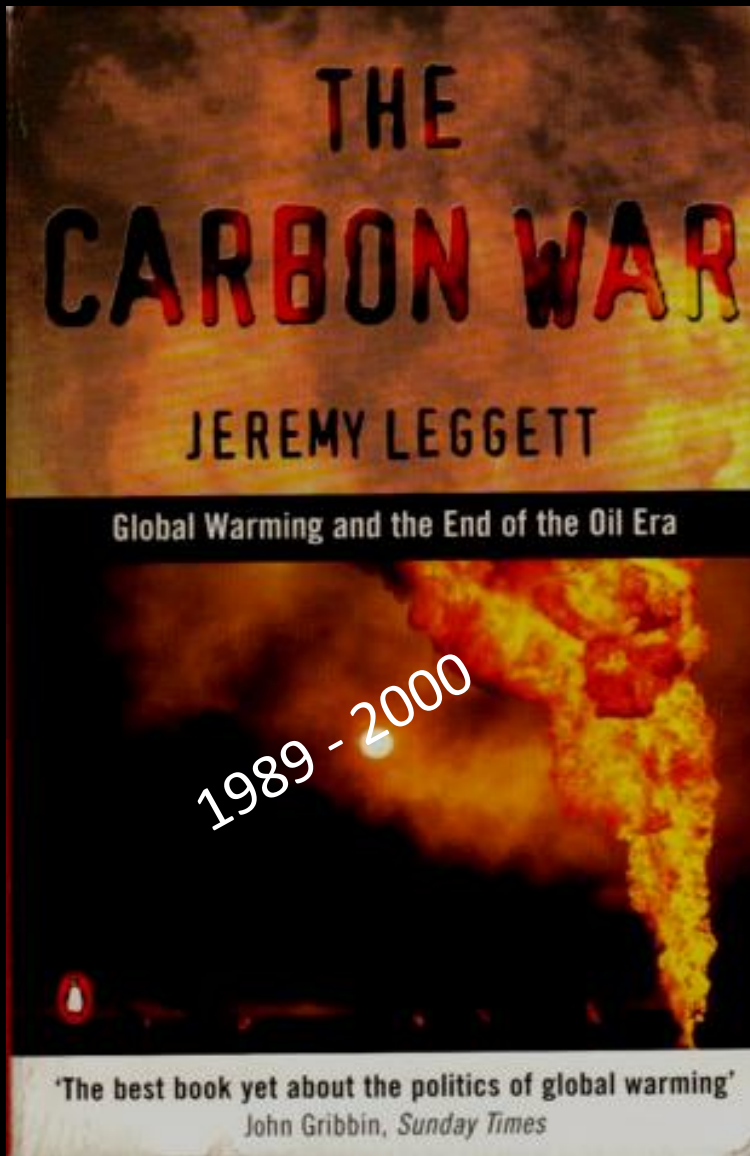
Oil research & exploration, 1980s



Environmental campaigning, 1990s



Social entrepreneurship, 2000s-2010s



...and writing along the way

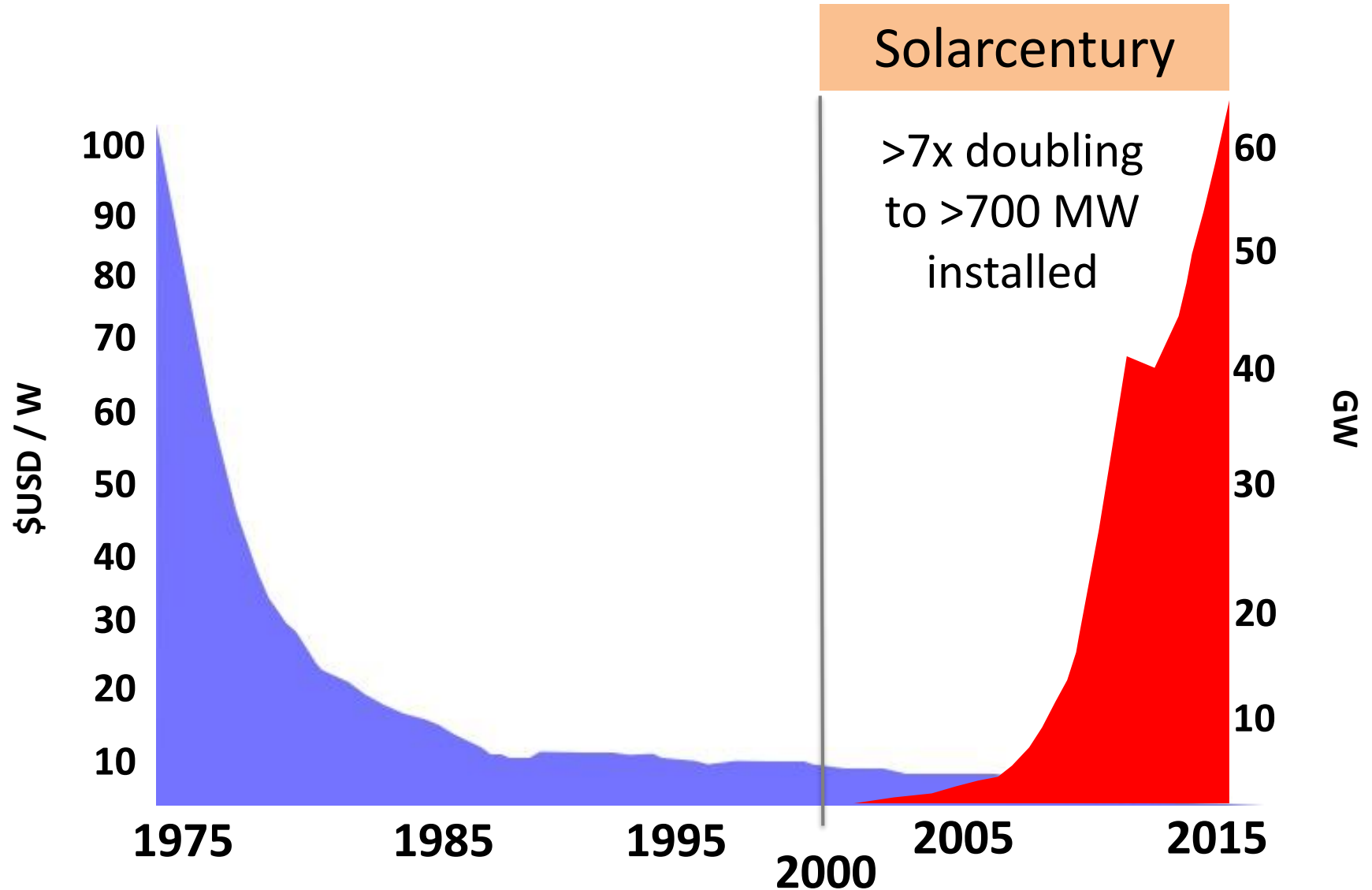
A sense of the excitement on the frontlines

Middleweight (c \$250m turnover) downstream player ***with a difference*** In 9 countries in Europe, Africa, S. America, C. America

Solarcentury
roof on a
Sainsbury's
store

1975 to
2015

40 years in solar PV: 7 doublings since 2000



**11th May
2016**

Solarcentury releases new BIPV roofing product cost competitive with bolt-on PV modules



**13th June
2016**

Onshore wind and PV to “win the cost race”: cheapest two options in many nations by 2020



Bloomberg NEF New Energy Outlook 2016



5% of profits





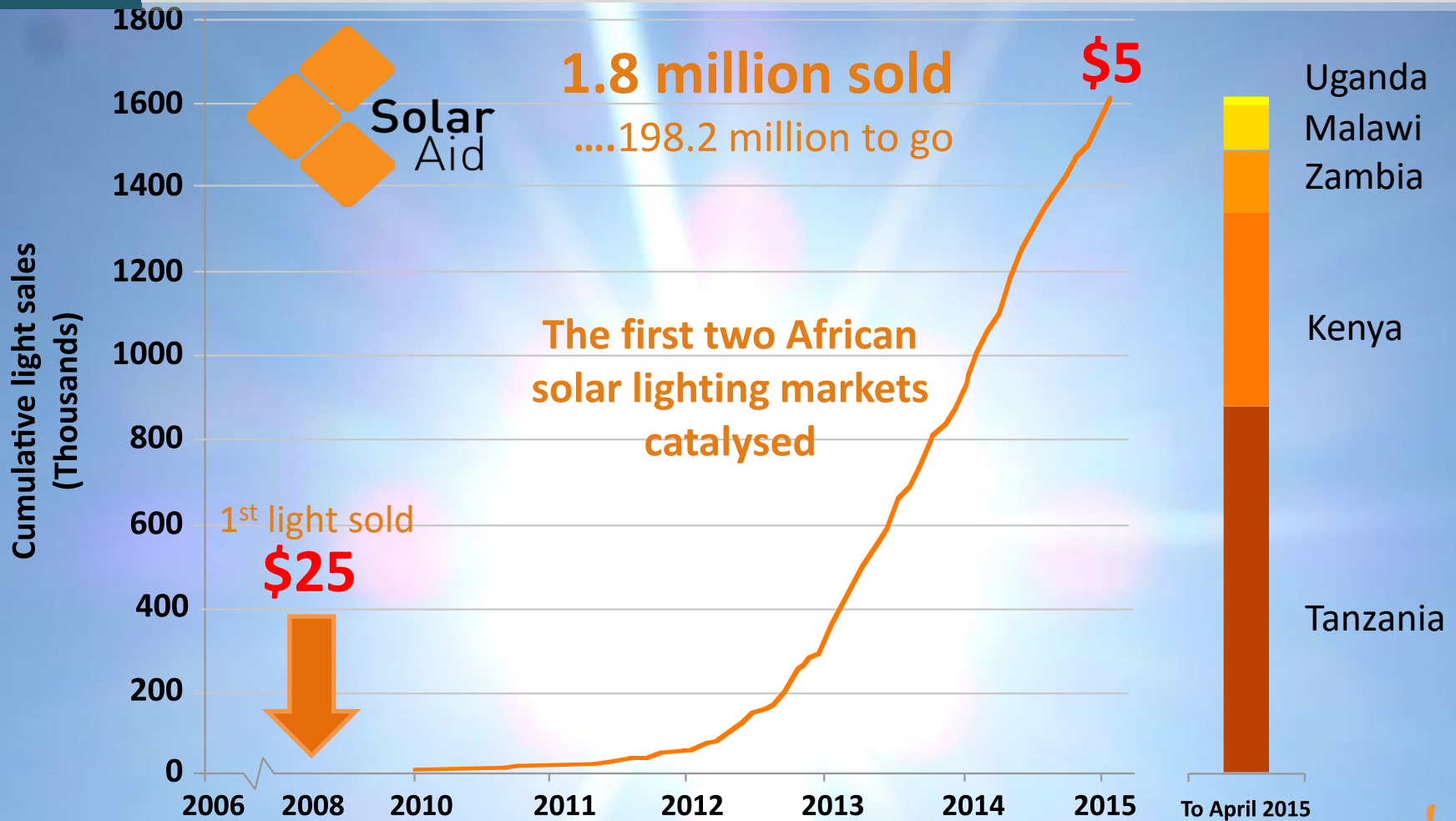
Average savings: \$70 per year

1 tonne of carbon dioxide



2006 to
2015

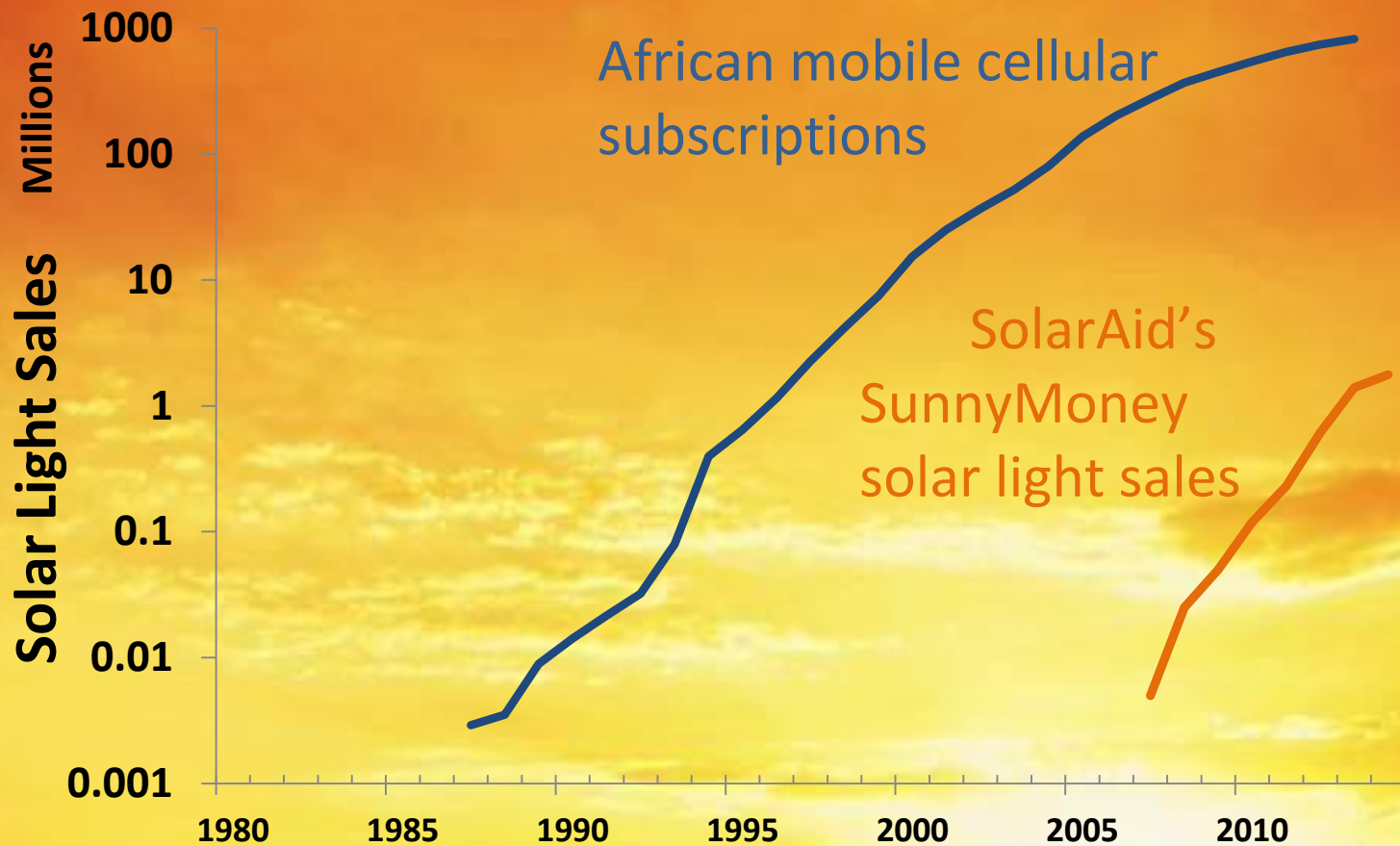
SolarAid's history: finding and hitting an updraft to become Africa's largest solar lighting retailer



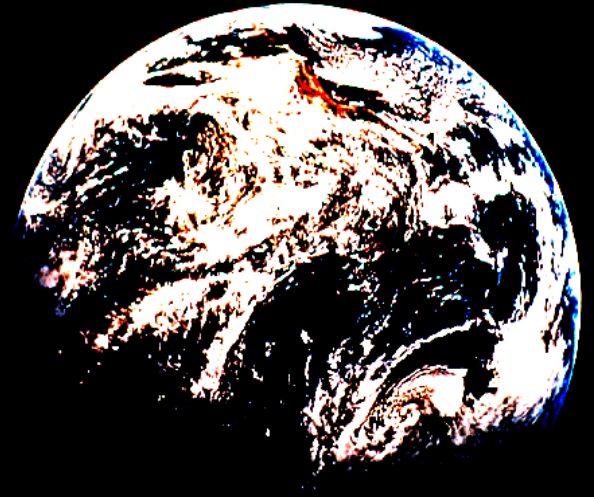
theguardian

"Few, if any, other businesses have launched a sustainable brand and enabled thousands of people to live more sustainably in such a short space of time"





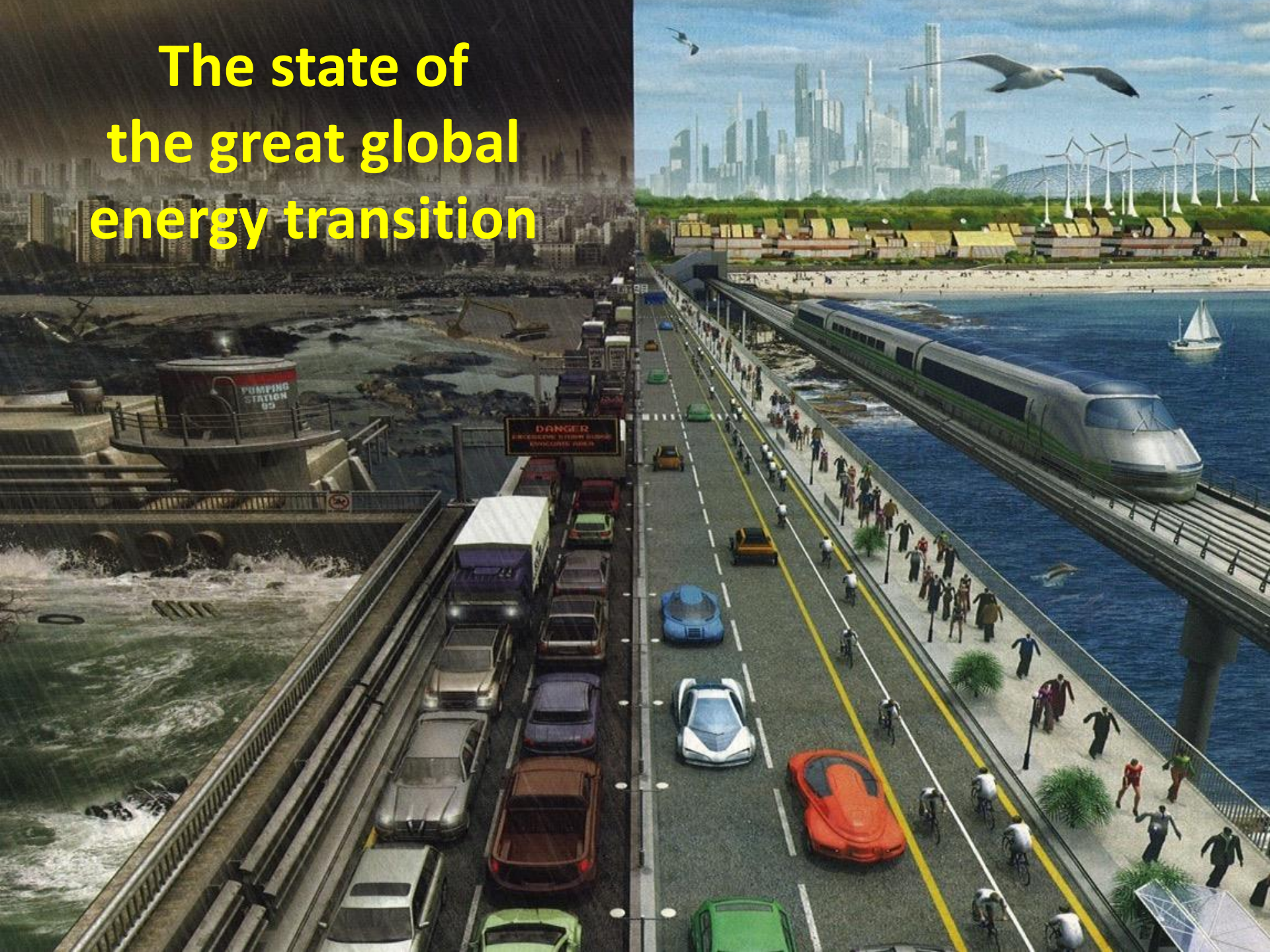
The prize remains, and is potentially huge



Personal perspective

Global perspective


The state of the great global energy transition



or alternatively...

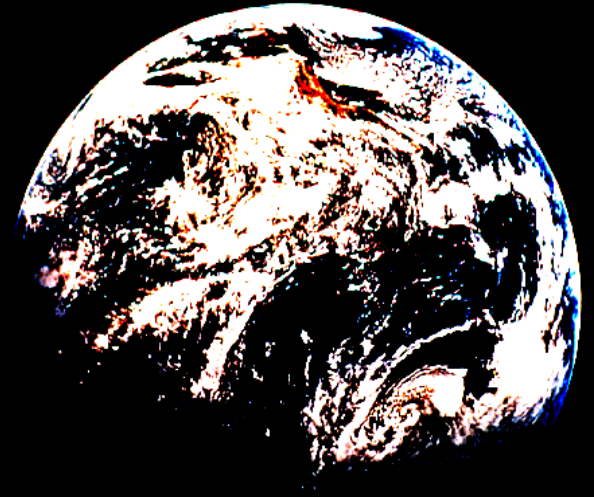
given our human love of stories,
and the stakes



A fantastical landscape featuring a bright sun rising over a vast sea of white clouds. In the foreground, dark, jagged mountains with patches of snow are visible. In the distance, a tall, spire-like structure rises from the clouds. The sky is a mix of blue and orange, suggesting a sunrise or sunset.

**An epic drama...
(choose own title)**

spanning three meta-narratives



The top dozen stories

META-NARRATIVE 1

Global society awakening
to a threat to civilisation
....and responding in critical mass



A photograph of Angela Merkel and Barack Obama in a scenic mountain landscape. Angela Merkel, wearing a red blazer, stands with her arms outstretched, gesturing towards the mountains. Barack Obama, in a dark suit, is seen from the back, leaning on a wooden fence. The background features lush green forests and majestic, snow-capped mountains under a cloudy sky.

Story

1

Governments getting serious about climate change and air pollution

8th Jun
2015

Obama, Merkel & Hollande push for total energy decarbonisation in the Paris Agreement

FINANCIAL TIMES
TUESDAY 9 JUNE 2015 WORLD BUSINESS NEWSPAPER UK £2.50 Channel Islands £2.80; Republic of Ireland €3.00

Tiger Mums tamed
China's rethink on the school curriculum — NOTEBOOK, PAGE 12

Why is Isis winning?
How coalition air strikes have failed to deter the jihadis — BIG READ, PAGE 11

Wired workers
Using wearable gadgets to keep tabs on staff — PAGE 14

G7 in historic accord to phase out fossil fuel emissions this century

◆ \$100bn pledge to poor countries reaffirmed ◆ Huge challenge for energy companies

PILITA CLARK — LONDON
STEFAN WAGSTYL — KRON

The Group of Seven industrial powers has agreed that the world should phase out fossil fuel emissions this century, in a move hailed as a historic decision in the fight against climate change.

G7 leaders meeting in Bavaria, Germany, said that in line with scientific findings, "deep cuts in global greenhouse gas emissions are required with a decarbonisation of the global economy over the course of this century".

The leaders of the US, Germany, France, the UK, Japan, Canada and Italy said they supported cutting greenhouse gases by 40-70 per cent by 2050 from 2010 levels — the first time they have backed such a precise long-term target.

Angela Merkel, the German chancellor, said that the cuts would have to be at the upper end of this target because "40 per cent is clearly not enough".

The leaders also reaffirmed a pledge to mobilise \$100bn a year from public and private sources by 2020 to help poorer nations tackle climate change.

Climate campaigners said the decisions taken by the wealthiest democra-



Briefing

- **Cameron's return on 'Brexit' vote**
David Cameron has retracted a threat to ministers that they would have to quit if they wanted to campaign to leave the EU, scuppering an apparent bid to force discipline on Tory eurosceptics. — PAGE 3;
EDITORIAL COMMENT, PAGE 12; GIDEON RACHMAN, PAGE 13
- **Apple launches music streaming service**
Apple has made its biggest push into digital music since it began selling downloads on iTunes 12 years ago, launching a streaming service that will compete with the likes of Spotify. — PAGE 17
- **Ex-Centrica chief to lead oil and gas push**
Former Centrica chief Sam Laidlaw is to take the helm of a private equity push into oil and gas that is backed by Carlyle and CVC Capital Partners and is to spend up to \$50bn. — PAGE 17;
LOMBARD, PAGE 22; NORTH SEA DEALS, PAGE 23
- **Relief as Tories shelve paid leave drive**
The prime minister's plans to revive his push to give bigger companies' employees three days of paid leave each year for voluntary work are being quietly axed, to the relief of some business leaders. — PAGE 2
- **Bids invited for military fire service**
Companies including Serco, Babcock and Capita have been invited to bid to run the military fire and rescue services, the latest Ministry of Defence outsourcing deal in its search for savings. — PAGE 4
- **Syngenta rejects fresh Monsanto move**
US agricultural seeds and chemicals company Monsanto's latest move in its pursuit of a "tax inversion" acquisition of Syngenta was rejected as "inadequate" by the Swiss group. — PAGE 17
- **Iceland poised for big step to recovery**

...and up to **70% cuts by 2050**, 34 years from now

30th Nov
2015

3 possible outcomes entering the Paris Climate Summit (COP21)

- No signal
- Contested signal
- Clear signal



12th Dec
2015

**A clear signal in the Paris Agreement:
decarbonisation, as soon as humanly possible**





Adopted by every independent nation on the planet: all 195

**3rd Sep
2016**

**At G20 Summit US and China announce they have
ratified the Paris Agreement**



9th Nov
2016

Trump wins the US presidency with smallest vote
for any candidate in the last 3 US elections



17th Nov
2016

195 nations issue Marrakech Action Proclamation deeming Paris commitments an “urgent duty”



“Momentum is irreversible – it is being driven not only by governments,
but by science, business and global action of all types at all levels”

16th Nov
2016

More than 360 US businesses urge Trump not to back out of Paris Agreement

DuPont, Hewlett
Packard, Kellogg,
Mars, Nike, Starbucks +

*“failure to build a low-carbon
economy puts American
prosperity at risk”*





And this story isn't “just” about climate change...

**12th May
2016**

**Air pollution up 8% in last 5 years, WHO reports:
now single biggest killer in world, 3m deaths a year**



**6th Nov
2016**

Indian government declares Delhi air pollution an emergency



**31st Aug
2016**

Chinese public overwhelmingly backs renewables push: 92% willing to pay more for green power



6th Sep
2016

Renault sees diesel cars being "forced out the market" in view of post-VW emissions-control costs





Story
2

Civil society
increasingly campaigning
in multiple sectors

2009 to
2015

The UN builds a “Groundswell” of climate action by
states, cities, companies, churches, communities



8th Sep
2016

California's Gov. Brown signs toughest US climate law: 40% GHG cuts (from 1990 levels) by 2030



**Dec
2015**

1,000 cities commit to 100% renewable power at the Paris climate summit



15th Aug
2016

16 US cities now target 100% renewable power and 4 have achieved it



Aspen, Colorado
Burlington, Vermont
Columbia, Maryland
Greensburg, Kansas

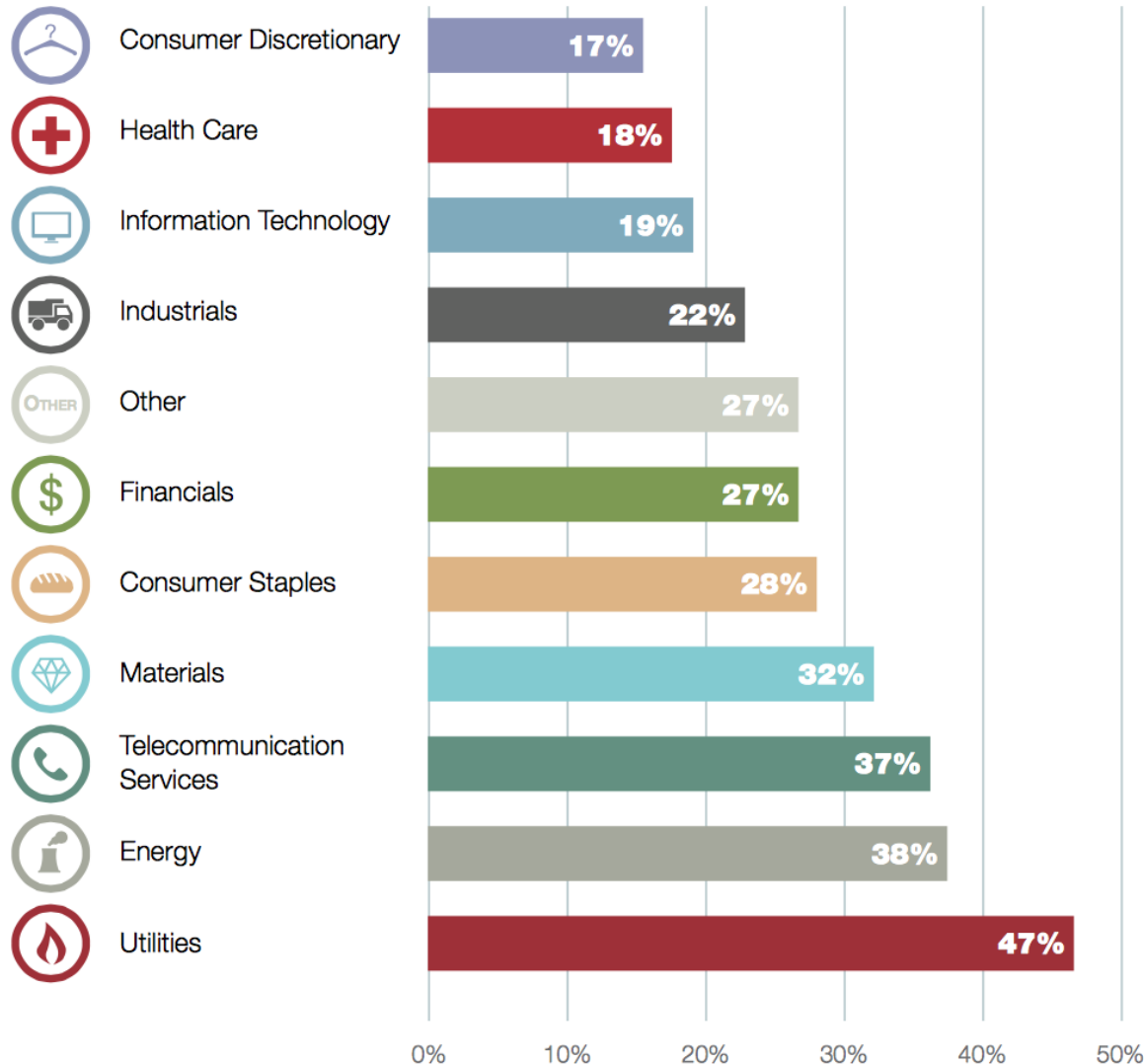
Nov
2015

50 major corporations commit to 100% renewable power ahead of the Paris climate summit



19th Sep
2016

600 multinational companies factor Paris Agreement into business plans



- Over the next 15 years, **\$90 trillion** will be invested globally in infrastructure where emissions are currently concentrated
- The national climate plans under the Paris Agreement represent at least a **\$13.5 trillion** market for the energy sector alone

Source: CDP

**Dec
2015**

Investors worth £350 billion pledge to pressure FTSE companies to go 100% renewable



18th Jun
2015

In his Papal Encyclical Pope Francis urges rich world to “replace fossil fuels without delay”

He also exhorts rich nations to “pay back their debts” to poor nations....



6th Sep
2015

“Massive support for community renewable energy”

ECOLOGIST

- ICM UK poll: 67% support, 8% oppose
- 65% Conservatives support



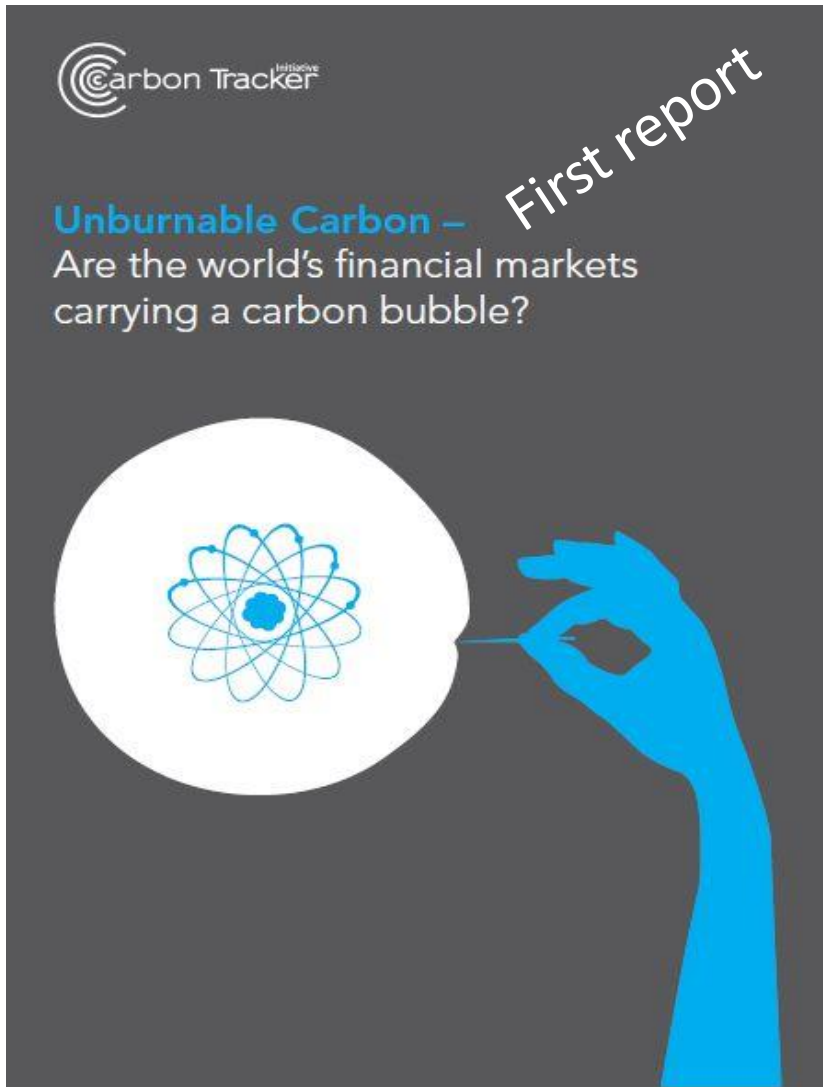


Story
3

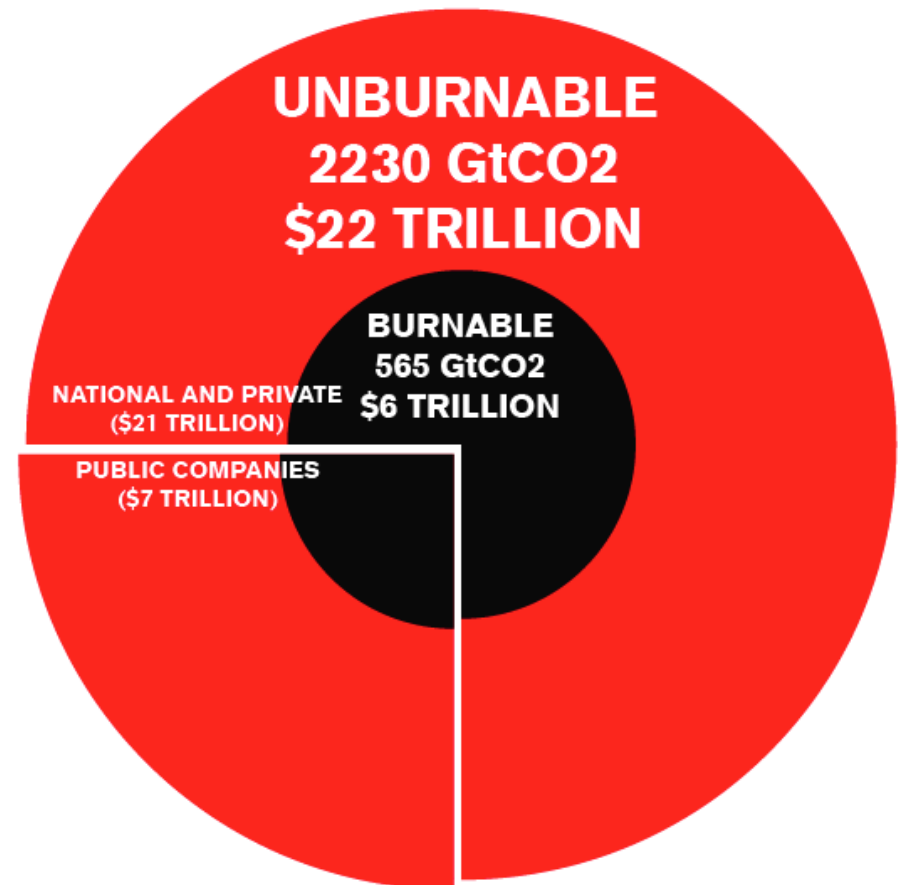
**Regulators
beginning
to regulate**
climate risk

11th Jul
2011

The “carbon bubble” of “unburnable carbon” can lead to “stranded assets”



**Proven fossil fuel reserves:
2,795 GtCO₂ \$28 trillion**



13th Sep
2015

Bank of England speaks out on climate risk to capital markets and stranded assets

*“Climate
change is the
biggest issue
for the future”*

*Stranded assets:
“..investors must
be given the data
to “invest
accordingly”*



Mark Carney
Governor

4th Dec
2015

Launch of G20 Financial Stability Board's Taskforce on Climate-Related Financial Disclosures

Michael Bloomberg
Chairman

...to report Dec 2016



28th June
2016

Moody's to use Paris Agreement in future credit assessments, and calls for rapid approval of deal



7th Sep
2016

Suncor Energy seeks permission to abandon some oil-sands assets

THE WALL STREET JOURNAL.





The story continues...

A wide-angle photograph of an industrial landscape under a cloudy sky. In the background, several tall smokestacks are visible, with one emitting a thick plume of white smoke. A network of high-voltage power lines stretches across the middle ground. In the foreground, there are large piles of dark material, likely coal, and a dirt road. A yellow piece of heavy machinery is visible on the right side of the road, and another piece of machinery is on the left. The overall scene suggests a transition from fossil fuel extraction to cleaner energy production.

4

Story
4

Capital beginning to switch
from fossil fuel to clean fuel

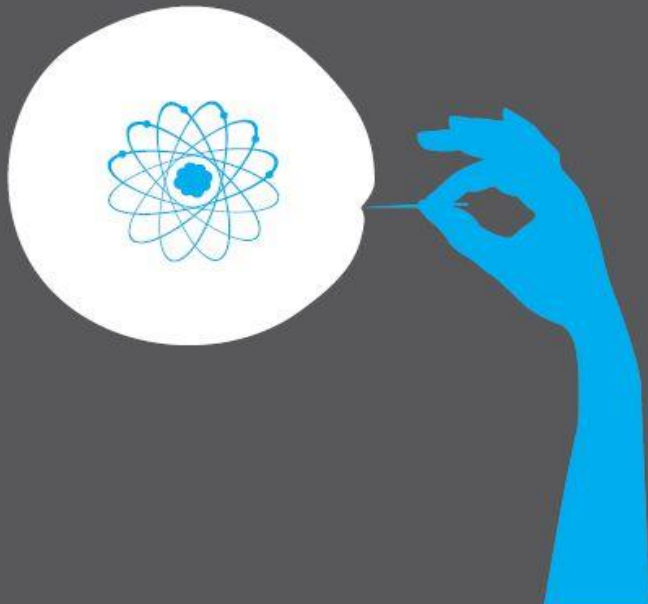
July
2012

The origin of the divestment movement: the “terrifying math” in Carbon Tracker’s first report



Unburnable Carbon –

Are the world's financial markets
carrying a carbon bubble?



4th Dec
2015

>500 institutions, worth \$3.4 trillion,
have divested, or pledged to

- foundations ...including Rockefeller Brothers Fund
- faith-based groups ...including World Council of Churches
- pension funds ...including Norway's State Pension Fund
- educational institutions ...including many top universities
- professional institutions ...including BMA
- and many cities ...including Newcastle

**18th July
2016**

Swedish pension fund AP4 makes biggest divestment move of any institution to date

The \$35bn pension scheme will:

- decarbonise its \$14.7bn global equity portfolio by 2020
- invest \$3.2bn in investment tracking low carbon benchmarks



META-NARRATIVE 2 of 3

**An insurgency disrupting
an incumbency**
....faster than most appreciate

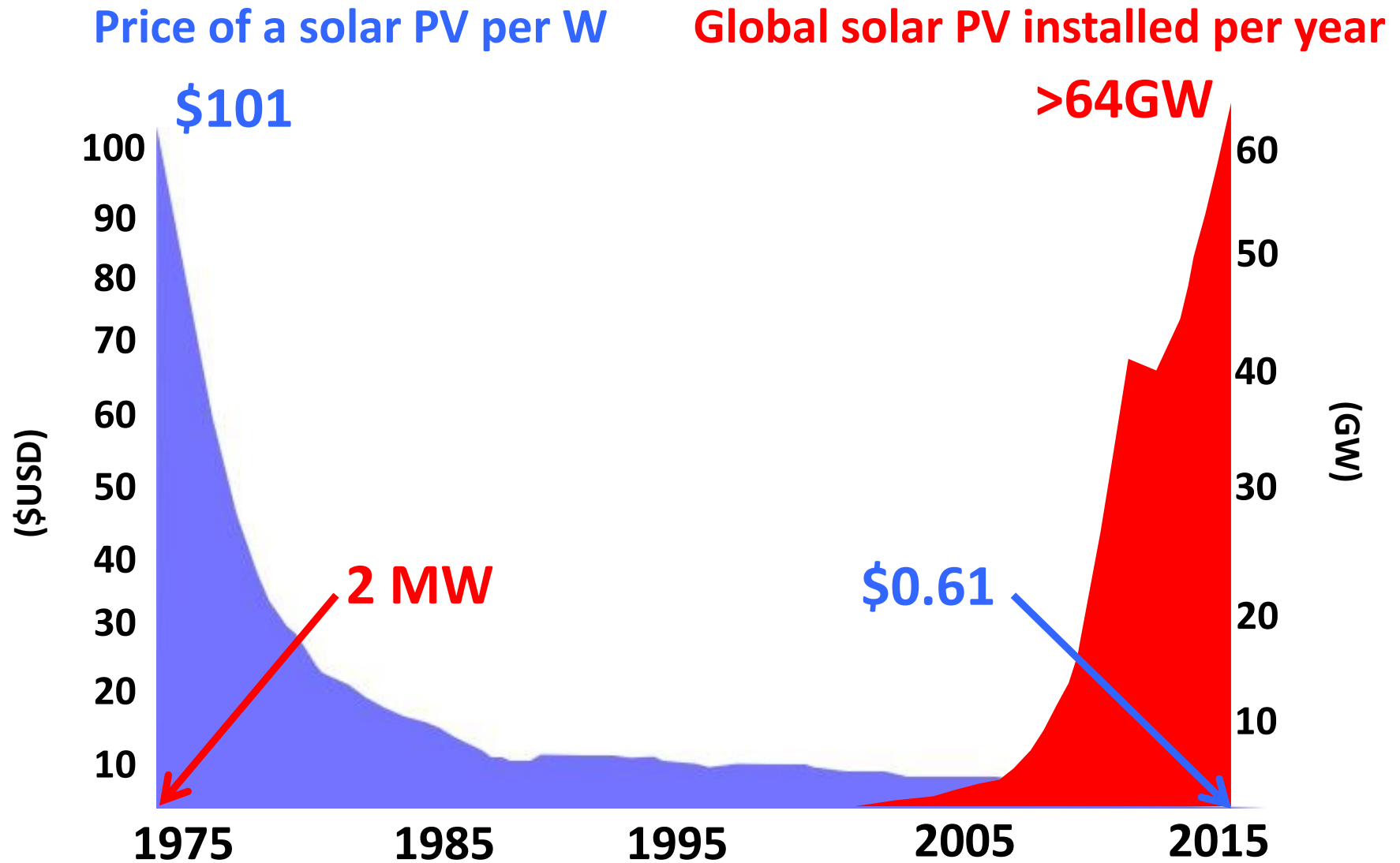
A row of wind turbines of increasing size against a sunset sky. The turbines are silhouetted against a warm, orange-hued sky, and their heights increase progressively from left to right, creating a sense of exponential growth.

Story
5

Renewables going exponential

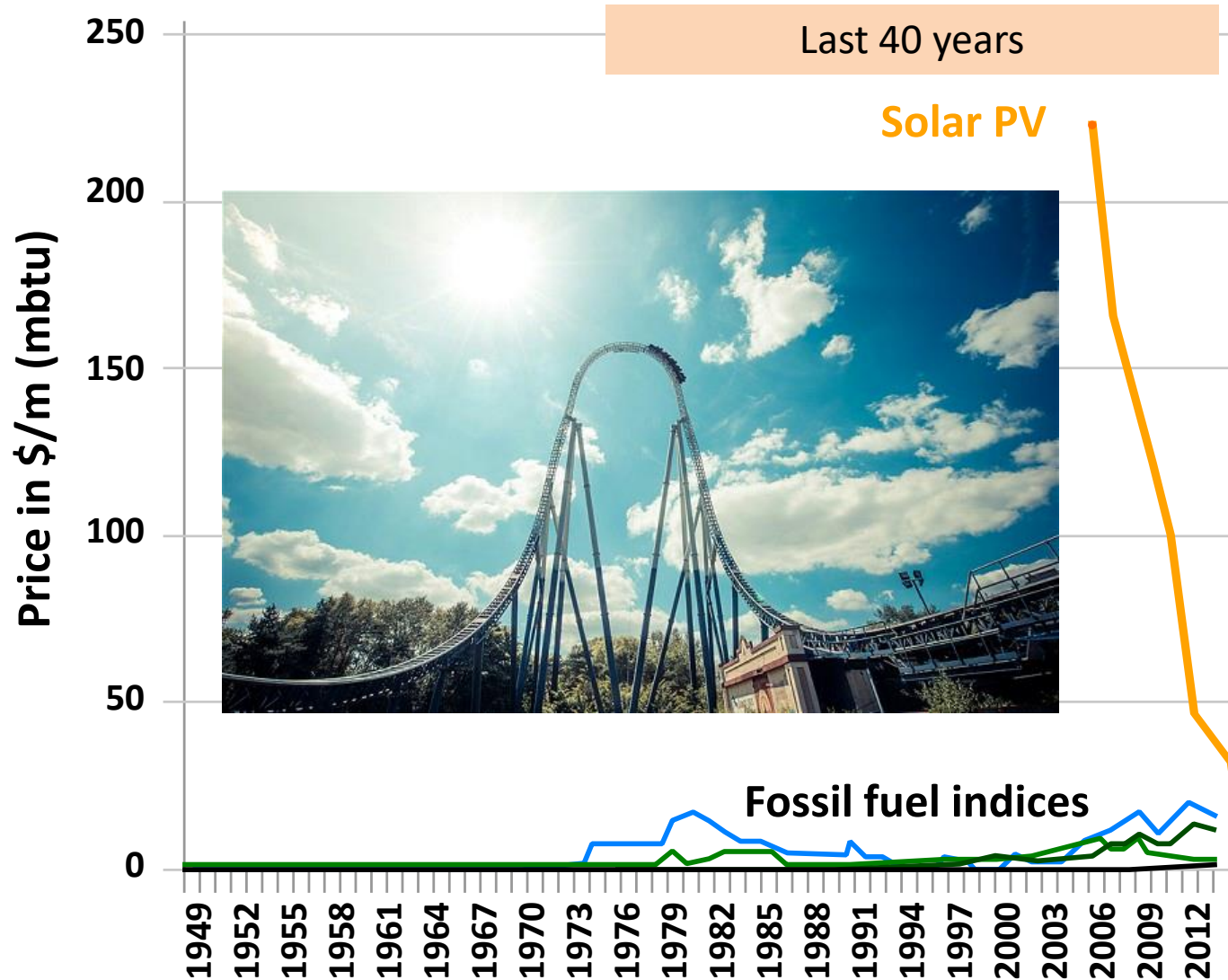
1975 to
2015

40 years in solar PV



4th Apr
2014

The last eight years in solar: welcome to the Terrordome



Source: Alliance Bernstein

1st Jun
2016

More jobs in US solar now than in either coal
or oil and gas extraction



**5th July
2016**

**Dong Energy wins offshore wind auction
with lowest ever price: €72.70 (\$80.60) MWh**



**25th Oct
2016**

Renewables overtake coal as world's largest source of power capacity: 500,000 solar panels a day now



16th May
2016

Portugal's electricity 100% from renewables for four straight days



**7th Sep
2016**

All China's new power demand in 2015 met with wind and solar



10th June
2016

Apple Energy set up, and applies to FERC to supply
excess solar electricity from its installations



New Apple "Campus 2"
HQ, Cupertino

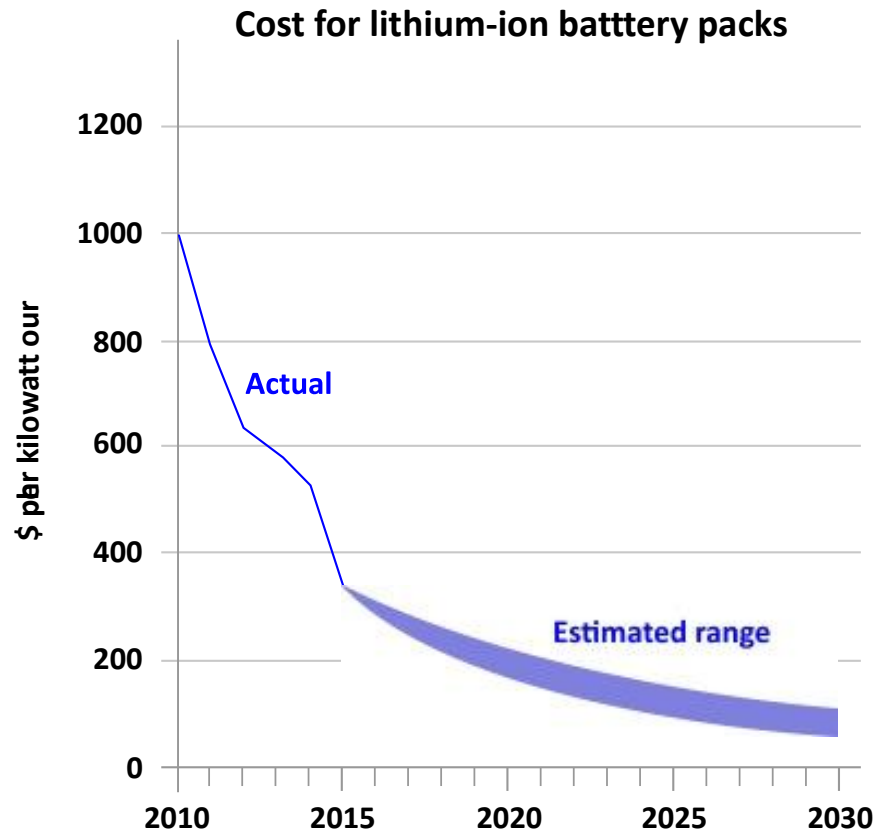


Story
6

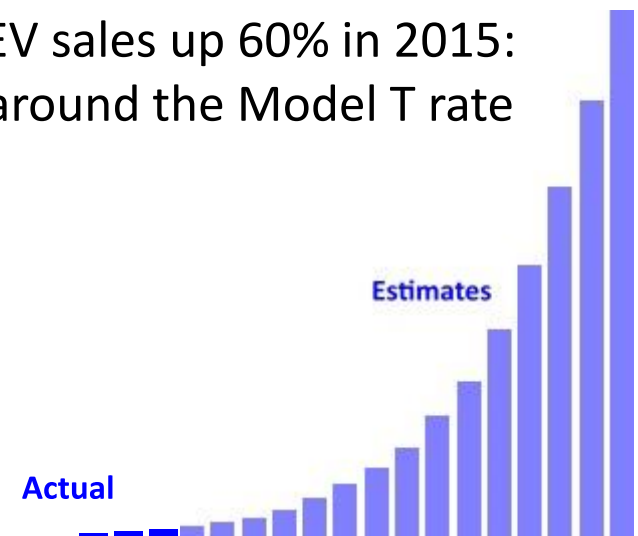
**Batteries and electric vehicles
going exponential**

24th Feb
2016
\$31

Batteries and EVs are heading the same way as solar and wind



EV sales up 60% in 2015:
around the Model T rate



13th Oct
2016

Electric cars set to pass 2m landmark globally by end of 2016



2nd Oct
2016

Carmakers embrace an electric future at Paris motor show

Daimler CEO Dieter Zetsche
unveils the Mercedes-Benz EQ



7th Nov
2016

Mercedes-Benz to introduce residential energy storage product in US in 2017

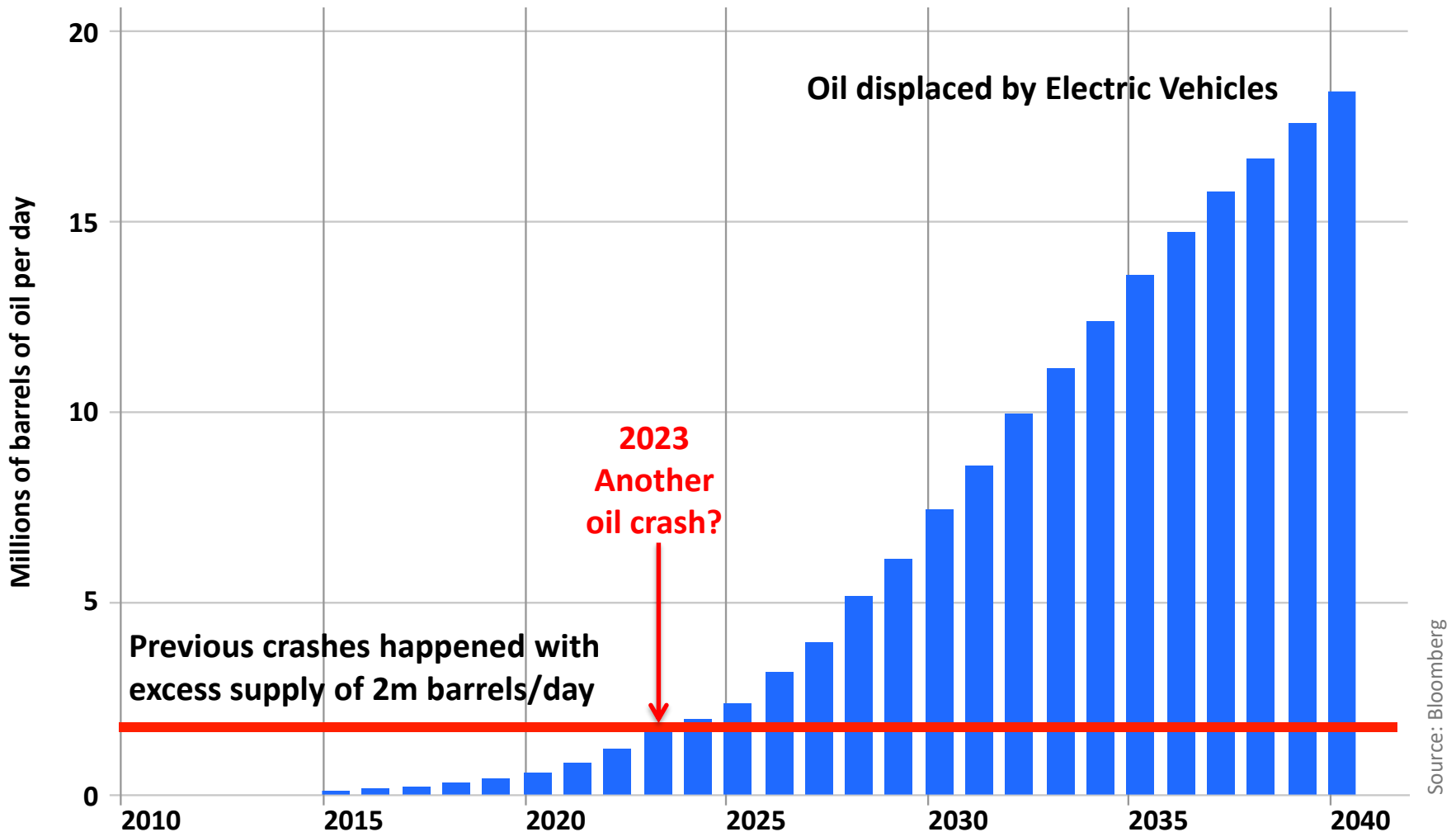
- Energy content 2.5 kWh combinable up to 20 kWh
- Stand alone or with solar
- Mercedes Benz Energy Americas, a new company to be set up for the launch



24th Feb
2016
\$31

“Another oil crash is coming
and there may be no recovery”

Bloomberg



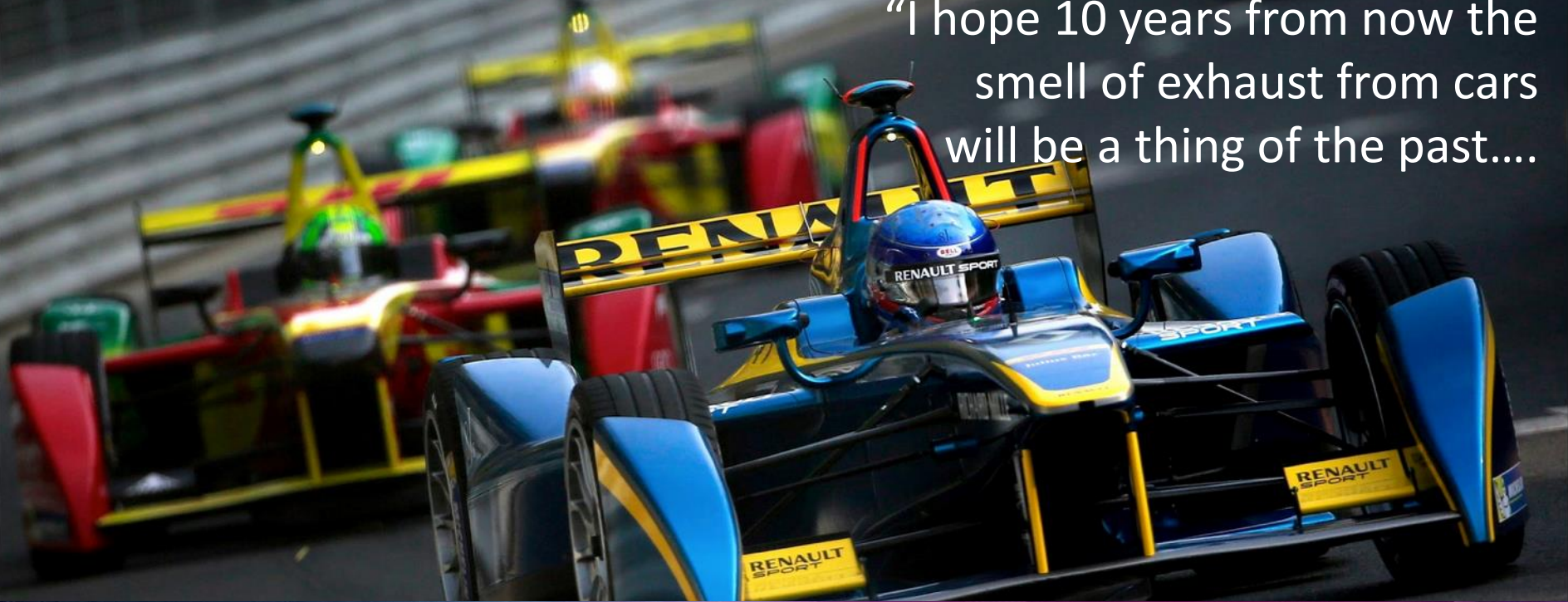
16th Jan
2016

“In 50 years, when we ship off the last barrel
of petrol, we will not be sad”



“I promise you, my brothers and sisters, we will be celebrating.”
Crown Prince Shaikh Mohammad Bin Zayed Al Nahyan
Abu Dhabi

"I hope 10 years from now the
smell of exhaust from cars
will be a thing of the past....



.....much like the smell of
cigarettes in restaurants"
Richard Branson



It has happened before

1900



Spot the car

1913



Spot the horse



Story
7

Data revolution in the wings

And then there is the information revolution, largely yet to manifest in energy. A flavour:



Use of real
time data



People-power
financing



Peer to peer
bypassing



Others' assets
& workforce



Megadata
processing



Shared assets



Hyper-
personalisation



Outsource data
processing



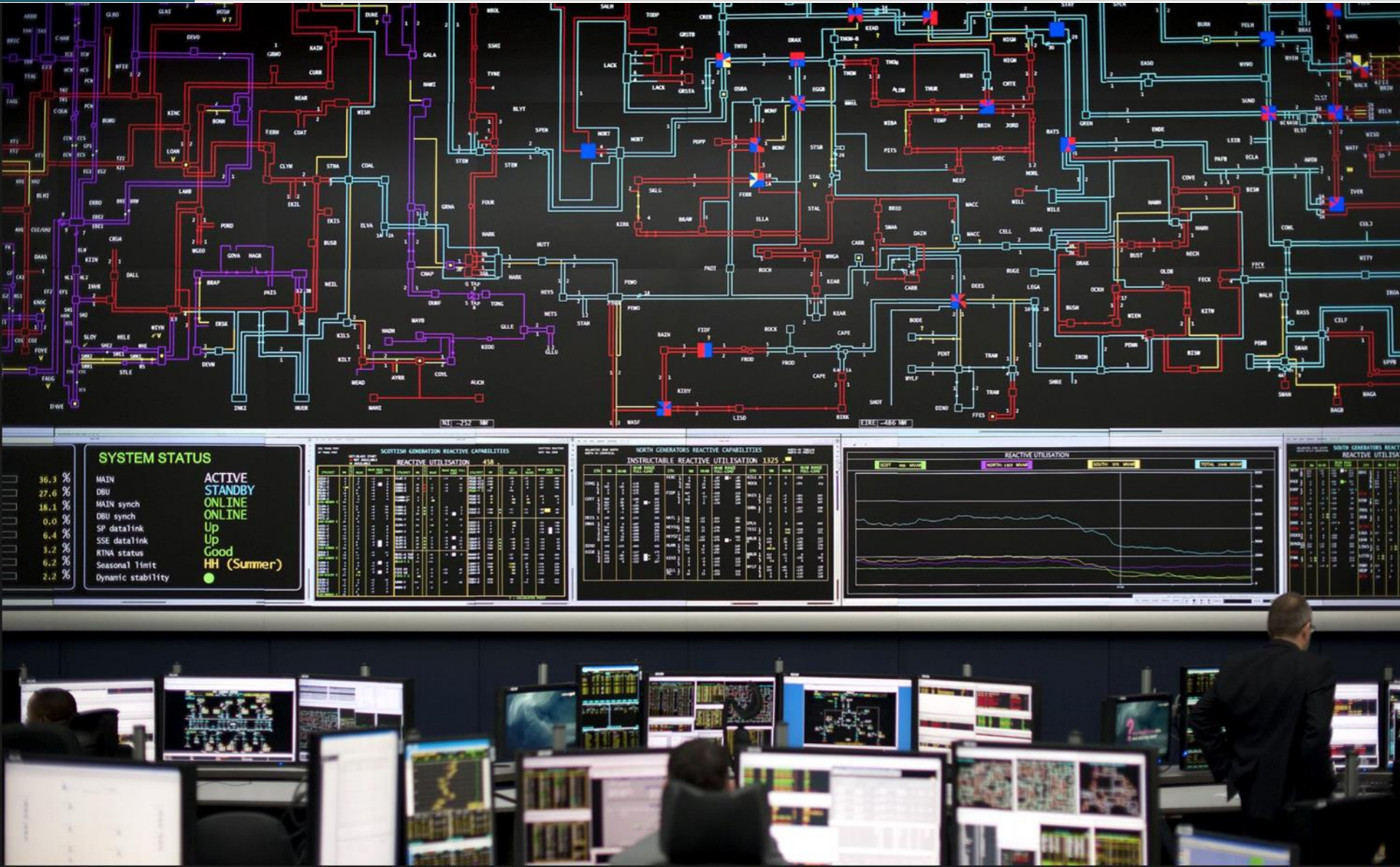
Leveraging
others' assets



21st century
marketing

**11th Oct
2016**

An energy first as UK successfully transmits data via national electricity grid



META-NARRATIVE 3

**An incumbency facing
multiple threats**
...increasingly existential





Story
11

Utilities racing to escape
a death spiral

Until
1st Dec
2014

First major utility business model U turn



15th Jan
2015

Second utility U-turn: GdF Suez



Coal and Gas Power Dying Out in Europe says Energy Chief

FINANCIAL TIMES

23rd Sep
2015

“Coal is in terminal decline”

Goldman Sachs



**29th Aug
2016**

Utilities doing the obvious in M&A: RWE's Innogy acquires Belectric Solar & Battery



24th Aug
2016

Nearly all £200bn+ UK energy investment needed by 2030 should go to disruptive tech, Barclays now says



45GW increase in overall capacity required,
the majority of it coming from renewables such
as wind and solar

Story
12

The oil and gas industry entering its twilight years



27th May
2016

“The long twilight of the big oil companies”

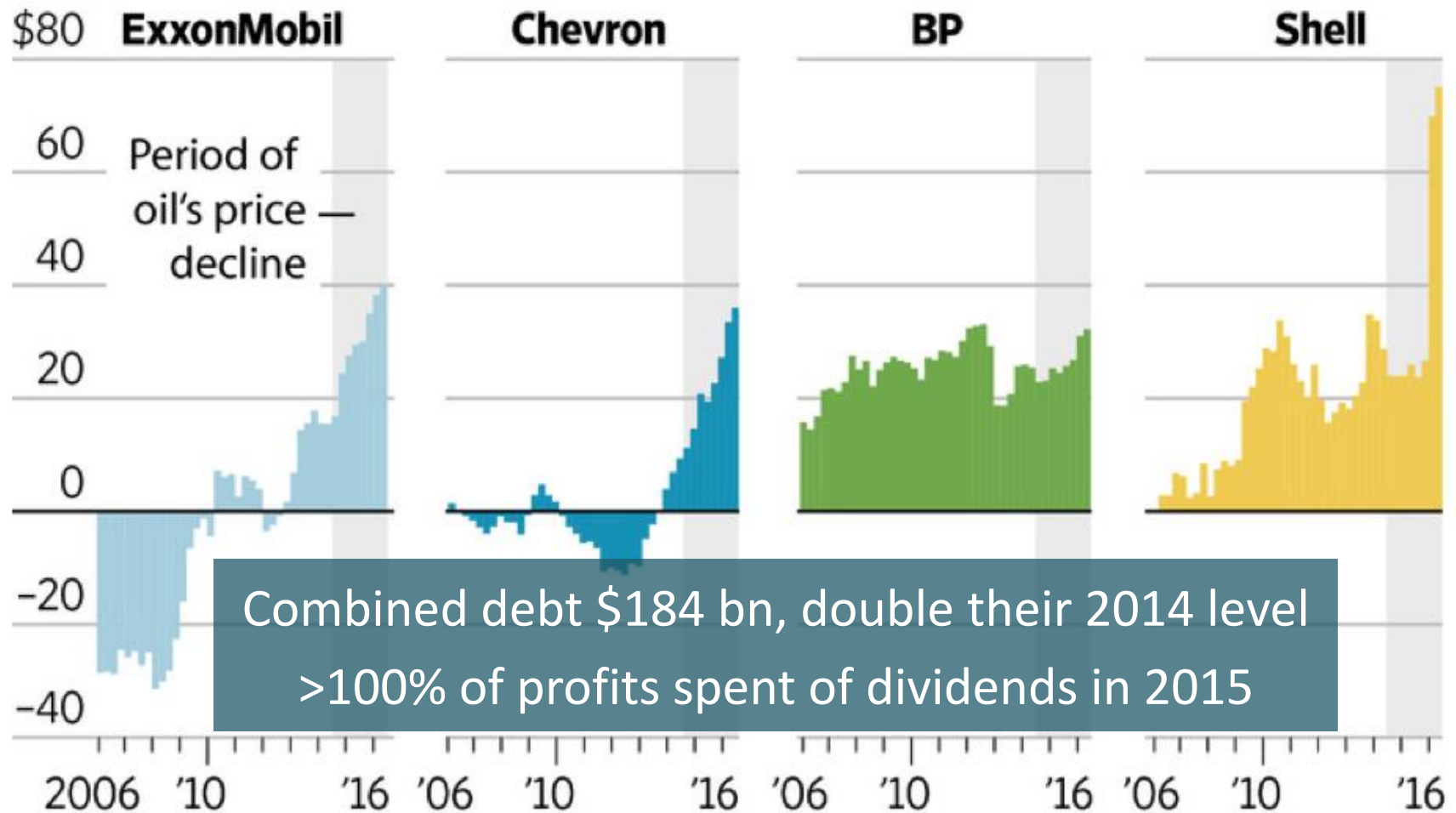
FINANCIAL TIMES



24th Aug
2016

“Big oil companies binge on debt”

THE WALL STREET JOURNAL.



Combined debt \$184 bn, double their 2014 level
>100% of profits spent of dividends in 2015

Source: Wood Mackenzie

21st Mar
2016
\$39

“Oil and gas: debt fears flare up”

FINANCIAL TIMES



Total debt in 2006: \$1.1 trillion

In 2014: \$3 trillion

29th July
2016
\$41

“Oil giants find there’s nowhere to hide from doomsday market”

Bloomberg

“The industry cannot survive on current oil prices.”

Fadel Gheit, analyst
Oppenheimer & Co



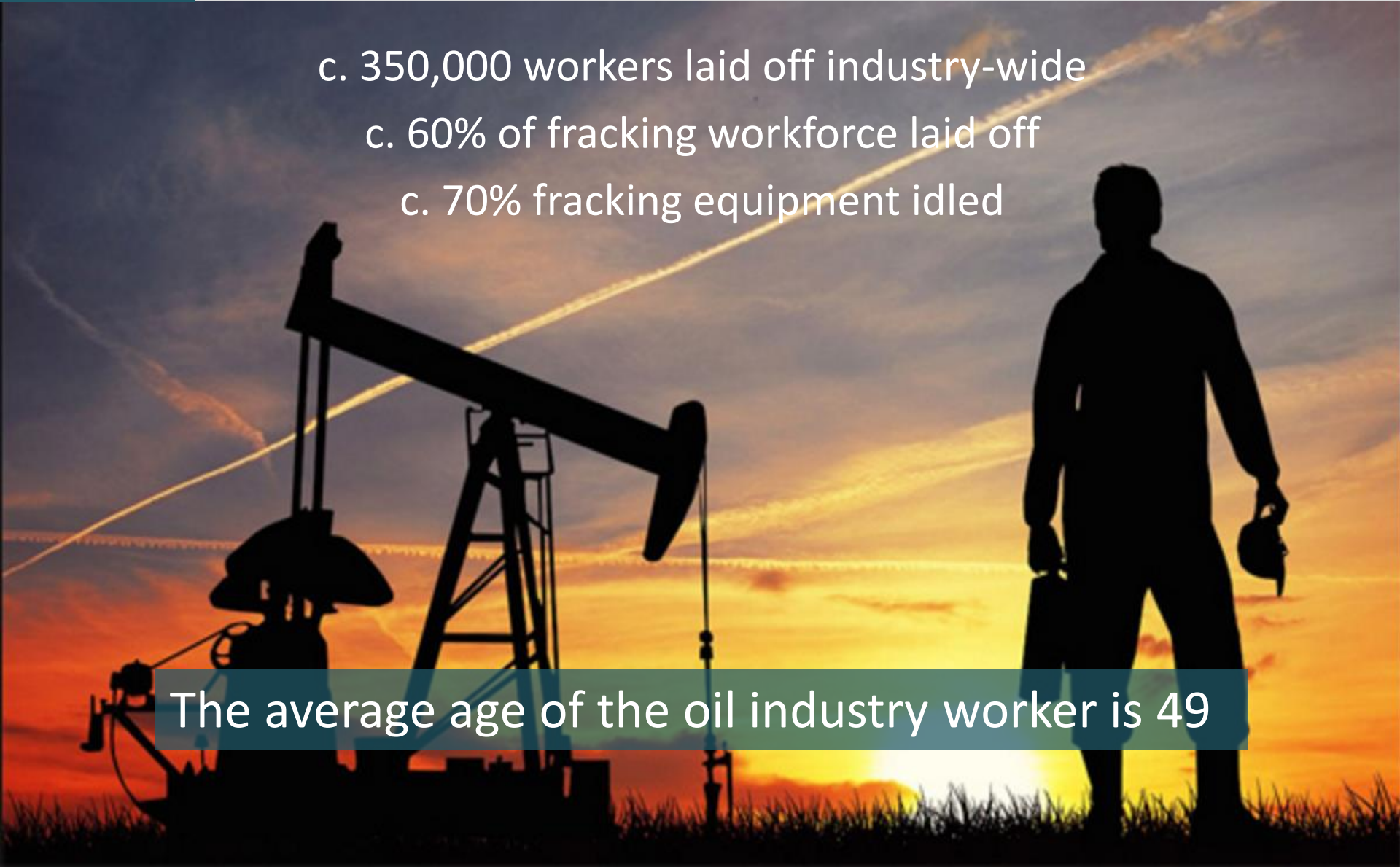
8th July
2016

“Oil industry faces huge worker shortage”

OILPRICE.com

- c. 350,000 workers laid off industry-wide
- c. 60% of fracking workforce laid off
- c. 70% fracking equipment idled

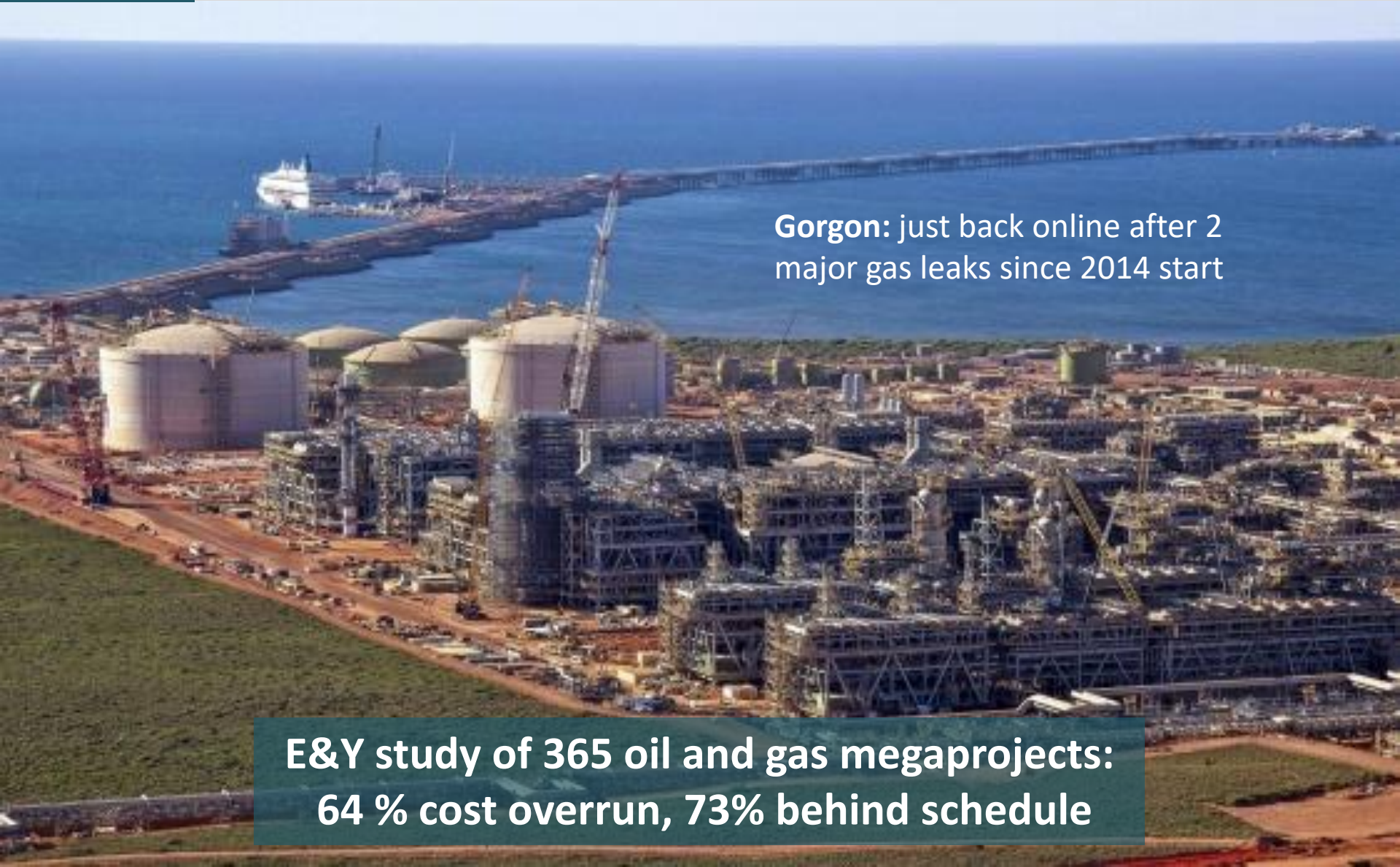
The average age of the oil industry worker is 49



25th July
2016
\$43

“Dismal delivery puts big oil and gas energy projects at risk”

FINANCIAL TIMES



Gorgon: just back online after 2 major gas leaks since 2014 start

**E&Y study of 365 oil and gas megaprojects:
64 % cost overrun, 73% behind schedule**

20th Sep
2016

Fossil fuels investment takes nosedive: IEA on 2015



“Anyone who does not understand what is going on - governments, companies, markets – is not in the right place”

Volvo XC90s

Fatih Birol, ED, IEA

**Oil companies vary in their
responses to the risks**



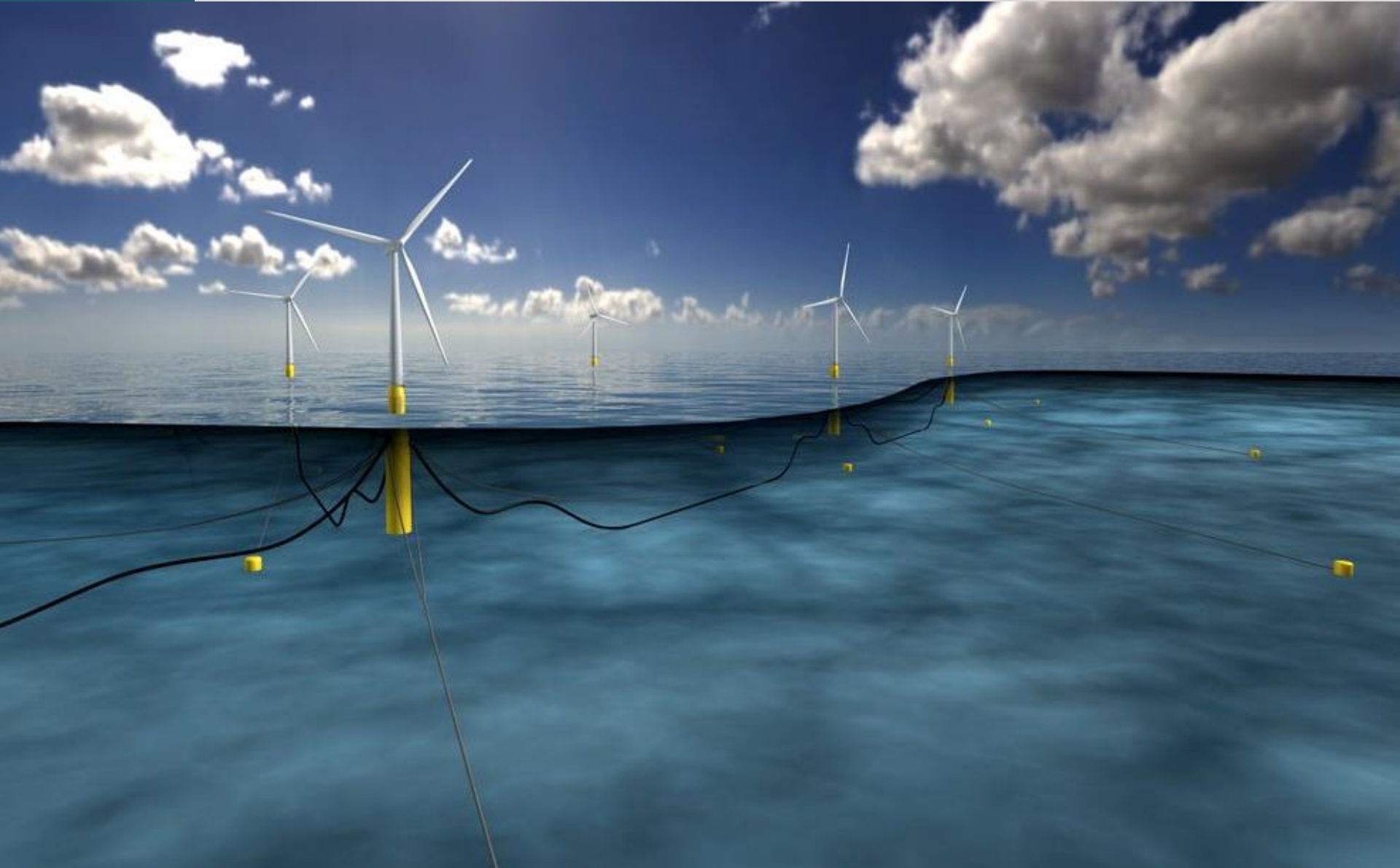
11th May
2015
\$62

Statoil sets up a renewable energy division



16th May
2016

Statoil to build the world's largest floating windfarm off Scottish coast



15th May
2015
\$64

Shell heads for the Arctic



28th Sep
2015
\$46

Shell abandons Arctic drilling, writing off \$7 bn



Ben van Beurden, CEO

"Shell continues to see important exploration potential in the basin"



Story
13

**The shale boom
in danger of going bust**

11th Apr
2011
\$126



22nd Apr

2014

\$108

“Is the U.S. Shale Boom Going Bust?”

Bloomberg



“Shale Drillers Feast on Junk Debt to Stay on Treadmill”

30th Apr 2014

Google

(data from Drillinginfo, February, 2014)

© 2013 Google

17th Jun
2015
\$60

“The coming shale bust?
IOU now well over \$200 bn”

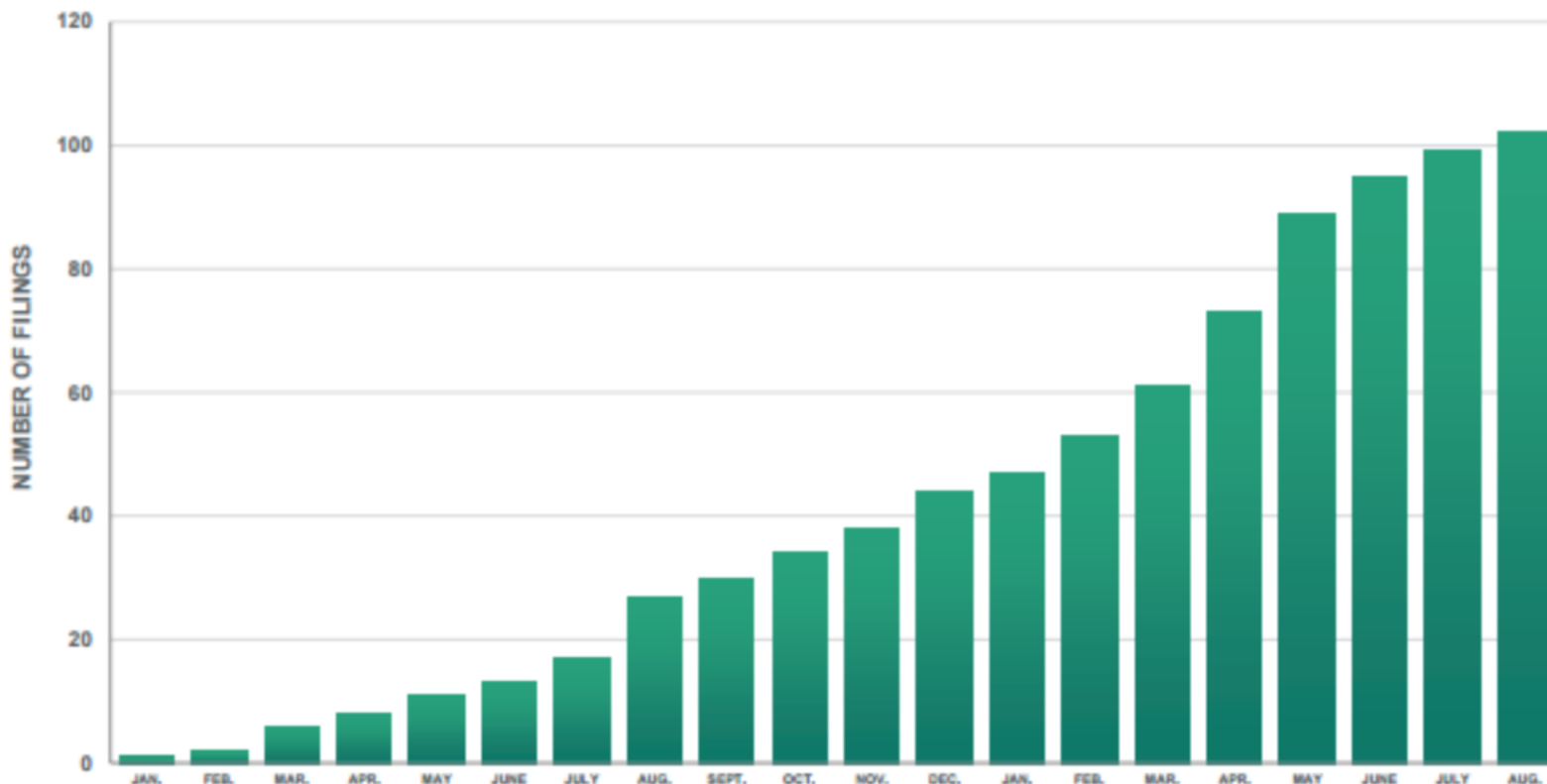
Bloomberg

The Shale Industry Could Be Swallowed By Its Own Debt

16th Sep
2016

North American oil & gas bankruptcies climb beyond 100, on of debts \$67bn

Filings 2015 & 2016 through August



Some are emerging with new capital structures within months
....reportedly on conservative assumptions about future production

10th Feb
2016
\$30

It will take more than an oil rally to restart the US shale boom

*"It's not really like just turning on
the light switch."*

Bill Thomas, chief executive
EOG Resources



21st Apr
2016

“As Oil Jobs Dry Up, Workers Turn to Solar Sector” THE WALL STREET JOURNAL.



Alamo 6 solar farm

24th June
2016

Germany bans fracking after years of dispute





The story continues...

United Nations

Framework Convention on
Climate Change

FCCC/CP/2015/L.9

Distr.: Limited
12 December 2015

Original: English

Conference of the Parties
Ninth session
30 November to 11 December 2015

Under item 4(b)
Durban Platform for Enhanced Action (decision 1/CP.19)
Adoption of a protocol, another legal instrument, or
any other agreed outcome with legal force under the Convention
applicable to all Parties

ADOPTION OF THE PARIS AGREEMENT

Proposal by the President

Draft decision -/CP.21

The Conference of the Parties,

Recalling decision 1/CP.17 on the establishment of the
Durban Platform for Enhanced Action,

Also recalling Articles 2, 3 and 4 of the Convention,
Further recalling relevant decisions of the Conference of the Parties, including
decisions 1/CP.16, 2/CP.18, 1/CP.19 and 1/CP.20,

Welcoming the adoption of United Nations General Assembly resolution
A/RES/70/1, "Transforming our world: the 2030 Agenda for Sustainable Development", in
particular its goal 13, and the adoption of the Addis Ababa Action Agenda of the third
International Conference on Financing for Development and the adoption of the Sendai
Framework for Disaster Risk Reduction,

Recognizing that climate change represents an urgent and potentially irreversible
threat to human societies and the planet and thus requires the widest possible cooperation
by all countries, and their participation in an effective and appropriate international
response, with a view to accelerating the reduction of global greenhouse gas emissions,
Also recognizing that deep reductions in global emissions will be required in order
to achieve the ultimate objective of the Convention and emphasizing the need for urgency
in addressing climate change,

Acknowledging that climate change is a common concern of humankind, Parties
when taking action to address climate change, respect, promote and consider their
obligations on human rights, the right to health, the rights of indigenous peoples,

To the Paris Team -
You've given future
generations a fighting
chance!

We are in a
race against
time

Please recycle




Conclusions



A close-up, low-angle shot of a massive blue wave curling over, creating a large barrel. The water is a deep, vibrant blue, and the wave's face is textured with white foam and spray. A person is visible inside the barrel of the wave, providing a sense of scale. The background shows a clear blue sky and distant palm trees on a shoreline.

These three emerging megatrends
will mutually reinforce




**Solar will be in the heart
of the action**



**Prospering will need to involve mastery of
the digital frontiers**

**There will be wondrous opportunities
in riding the wave....**

A photograph of a dolphin leaping from a green wave. The dolphin is in mid-air, its body arched, with a splash of white water behind it. The wave is a vibrant green color, contrasting with the yellowish-brown water of the rest of the scene. The background shows a vast expanse of water with gentle ripples.

energy independence, peace, clean air, health, ...renaissance

...also enormous threats



Those with vision who can move fast are best placed to profit / prosper / protect civilisation





Thank you

jeremy.leggett@solarcentury.com

www.jeremyleggett.net