



Europe and Nuclear: Challenges Ahead

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Europe and Nuclear: *Challenges Ahead*

- **Who Are We?**

Member Fora



Belgium Nuclear Forum
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Dutch Atomic Forum
info@nrg.eu
http://www.nrg.eu (clo)



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Swiss Nuclear Forum
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www.nuklearforum.ch



Ukrainian Nuclear Forum Association
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www.atomforum.org.ua



16+ Associations
800+ Companies
900,000 Jobs
70 x 10⁹ €/y

[source: FORATOM, PwC]

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European Nuclear at the Top



HITACHI

FENNOVOIMA



ŠKODA JS a.s.



Rolls-Royce®



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Europe and Nuclear: *Challenges Ahead*

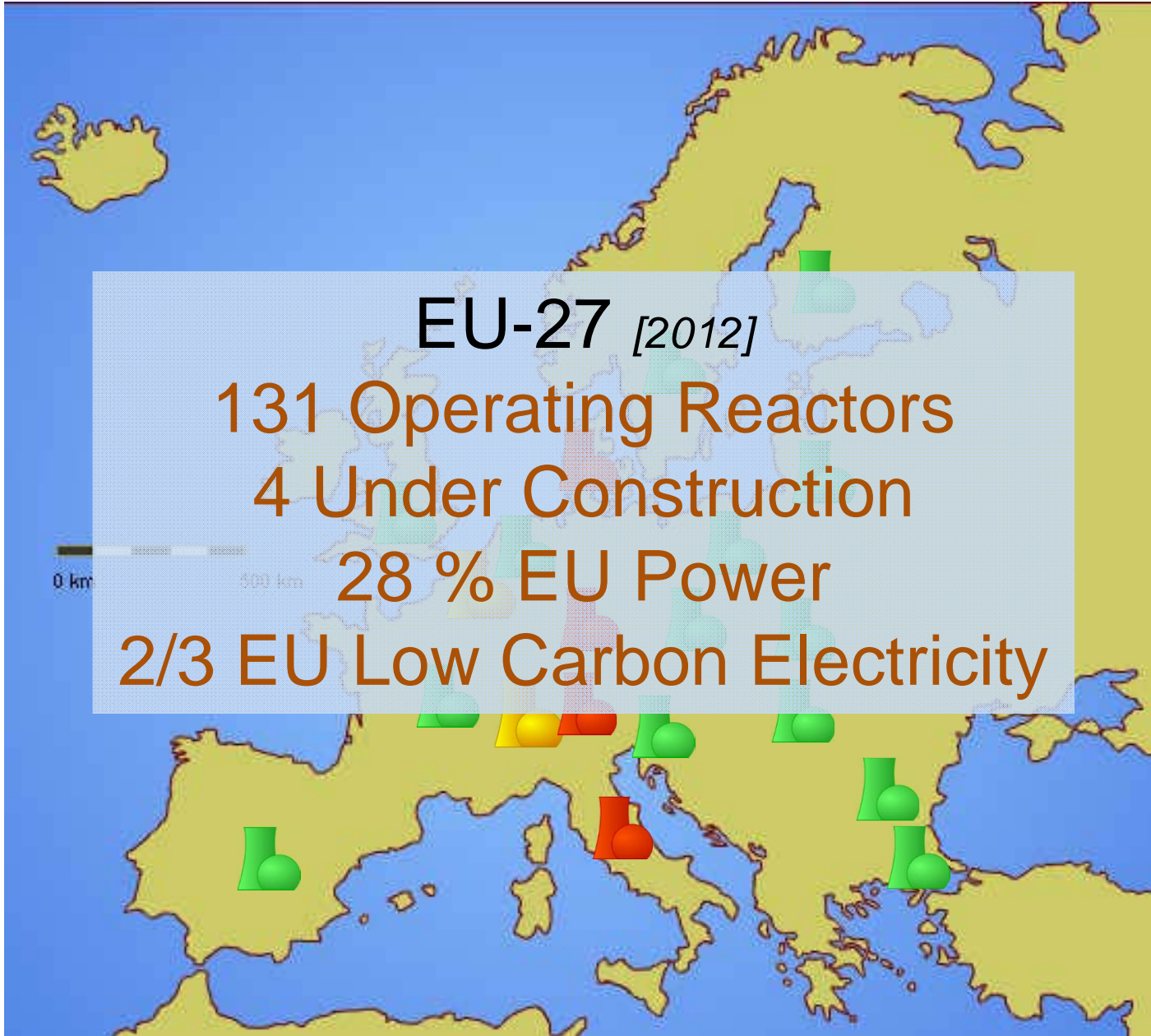
- Who Are We?
- **EU: No Single Energy Policy**

A Vision: EURATOM

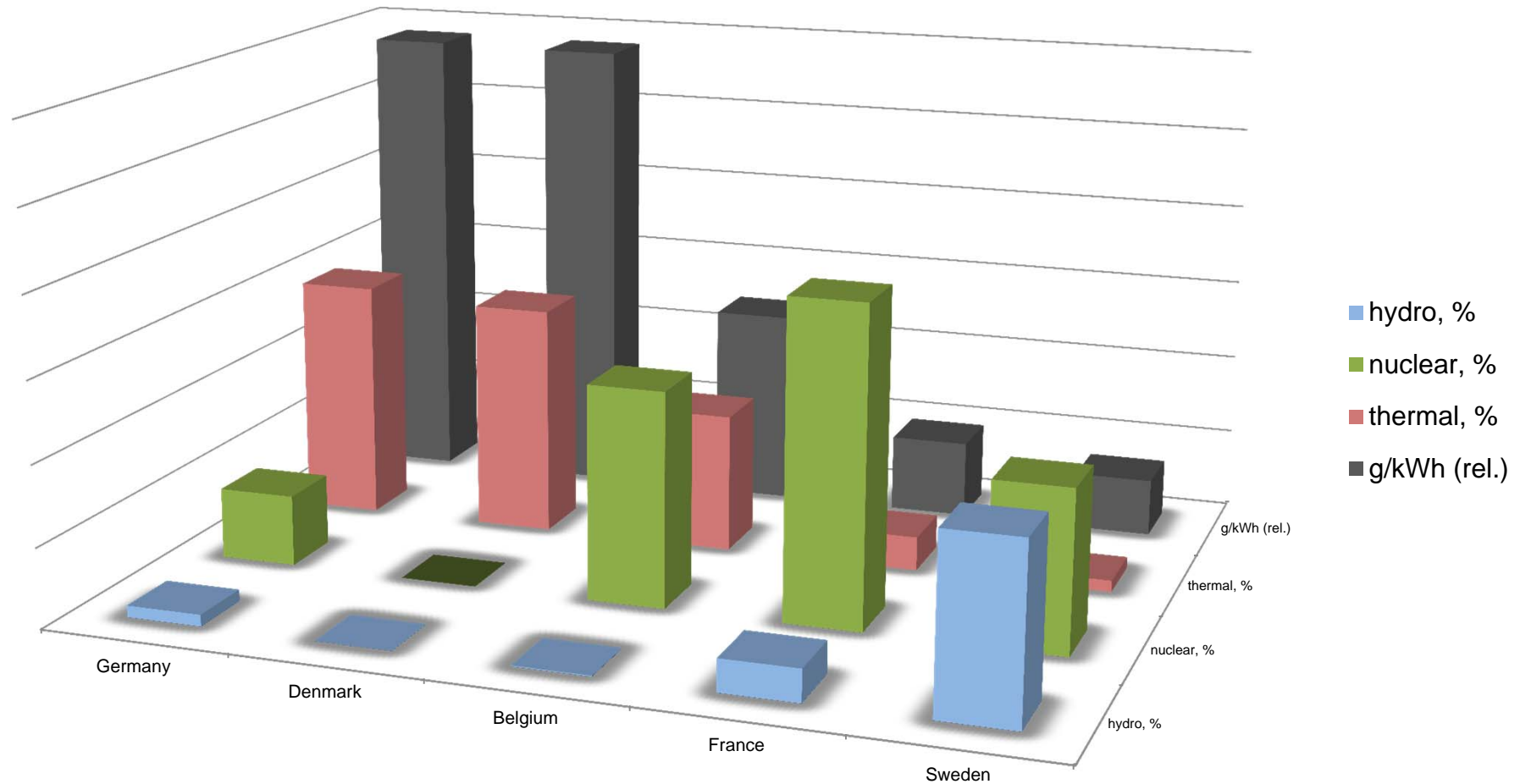


There is no doubt indeed that nuclear energy is one of tomorrow's energy solutions, and if we don't argue that it will be the very final one, it is simply because we must anticipate the role of solar energy, so plentiful, of such a high quality, the technical implementation of which having barely started.

Louis Armand, *Euratom and Europe's Energy Issues* (1958)



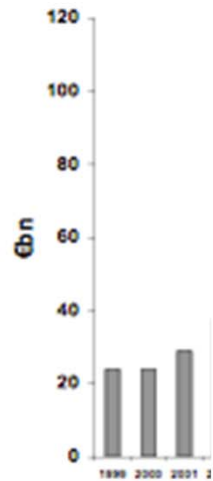
Electricity Mix and GHG



Gross electricity generation and CO₂ eq emissions, 2011

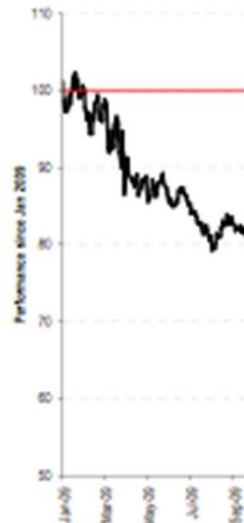
Market Structure & Organisation

Annual Capex – actual and required



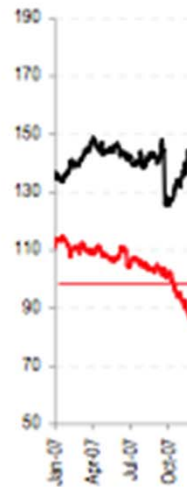
Source: Citigroup Investment Research

European Utility Sector has been de-rated



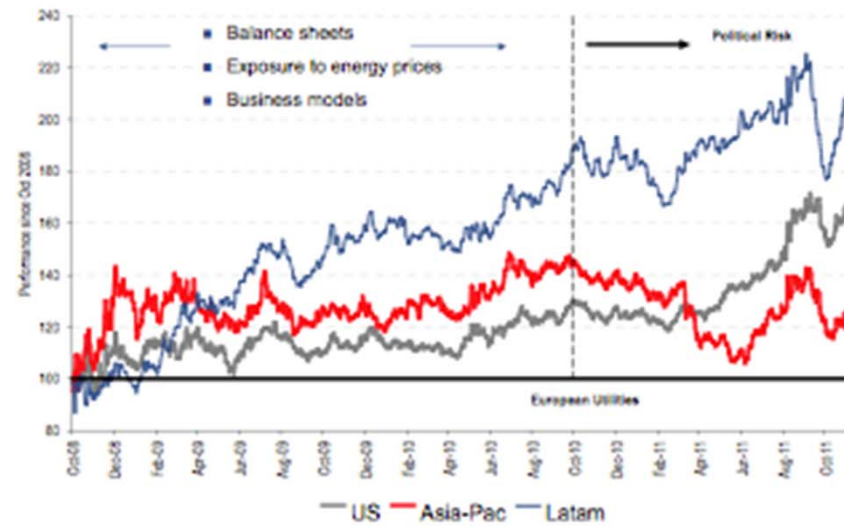
Source: Bloomberg, Citigroup Investment Research

Yield Relative and P/E Moving in Wrong Direction



Source: Datastream, CMA

Europe De-rated Relative to ROW



Source: Datastream, CMA

source: P. Hatherton,
EURELECTRIC, Feb 2012

10 CEOs: "Rebuild Europe's Energy Policy"

Magritte Club, Brussels, October 2013

- FAILURE of *competitiveness*:** energy bills up +17-21 % in 4 years
- FAILURE of *security of supply*:** 51 GW capacity mothballed (= B, CZ, P)
- FAILURE of *climate change*:** CO₂ emissions +2,4 % (2011-2012)

put EU Policy back on track by:

fostering the integration of mature renewables
into the regular market

giving priority
to the utilization of existing competitive power capacity
rather than subsidizing new constructions

strengthening fundamentally
the European carbon market

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Europe and Nuclear: *Challenges Ahead*

- Who Are We?
- EU: No Single Energy Policy
- **EU's 2050 Roadmap and Challenges**

EU's 2050 Energy Roadmap

COM(2011) 885 final, 15/12/2011

- 80-95 % economy-wide GHG emission reduction by 2050 (vs. 1990)
- **structural changes** ahead: increased reliance on electricity, renewables, gas, nuclear ("a key source of low carbon electricity generation"); investments, costs; market structure
- **nuclear** ranges from 2.5% ("Low Nuclear") to 19% ("Delayed CCS")
- **the low end:**
 - units phased out at the end of their lifetime
 - no replacement
 - completing 4 units under construction (FI, FR, SK)
- **the high end:**
 - about 140 GWe of nuclear capacity (100 new units) by 2050



High Nuclear in 2050 and the global economy

time period	activities	investment (G€/a)	jobs
2012-2020	safety upgrades LTO (first step)	10.0	10,000
2015-2035	LTO	4.5	50,000
2025-2045	New Build	25.0	250,000
2012-2050	decommissioning	3.0	20,000
	fuel/waste management	5.0	10,000

[internal analysis - 20% nuclear power share]

EU's 2050: How to Get There?

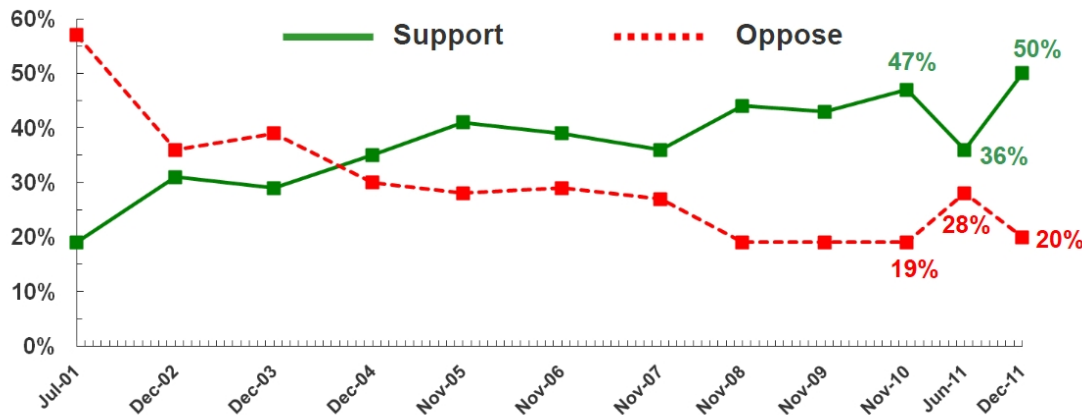
- public understanding / acceptance / support
safety, waste disposal, proliferation: *"can nuclear survive democracy?"*
- which **regulation**: national, EU-wide?
towards more harmonization, peer reviews; how to keep consistency, effectiveness?
- **how (and who) to finance?**
support mechanisms to long-term investments (feed-in tariffs, contract for difference, "Mankala" model, long-term supply contracts, etc.) vs. EU's single market competition rules
- which **foreign dependence?**
the Russian case: uranium, fuel, technology

The Public: How Safe is Safe Enough?

- before **March 2011**:

56 % of EU citizens wanting nuclear energy to be maintained or increased [*Eurobarometer on Nuclear Safety, April 2010*]

- in the **UK**, the Netherlands, Spain, Switzerland and France, after a dip just after the accident, public acceptance of nuclear has recovered



UK: Support for Nuclear New Build
source: Ipsos MORI, 2012

EU: Nuclear Safety Directive

- **Council Directive** (25 June 2009): a Community Framework for the nuclear safety of nuclear installations [2009/71/EURATOM]
- 13 June 2013: EC's proposal for a revised Directive (post-Fukushima)
- 17 October 2013: final proposal, EP and Council to decide
- June 2014 (?): **European Council** to conclude
- some **issues of concern**: too early? / too many detailed prescriptions / *peer reviews* are powerful and should be kept, but... kept under control to provide added-value
- at the end, **who's ruling?**

EU: the Back End

COUNCIL DIRECTIVE 2011/70/EURATOM

of 19 July 2011

establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste

Member States' responsibility:

*“MS shall establish and maintain a **national legislative, regulatory and organisational framework**”*

“MS shall ensure that...”

- regulatory authority
- financial resources
- transparency
- reporting:

Aug 23, 2015 for the first time, thereafter every 3 years

*“It is broadly accepted, at the technical level that, at this time, **deep geological disposal represents the safest and most suitable option** as the end point of the management of high-level waste and spent fuel considered as waste.”*

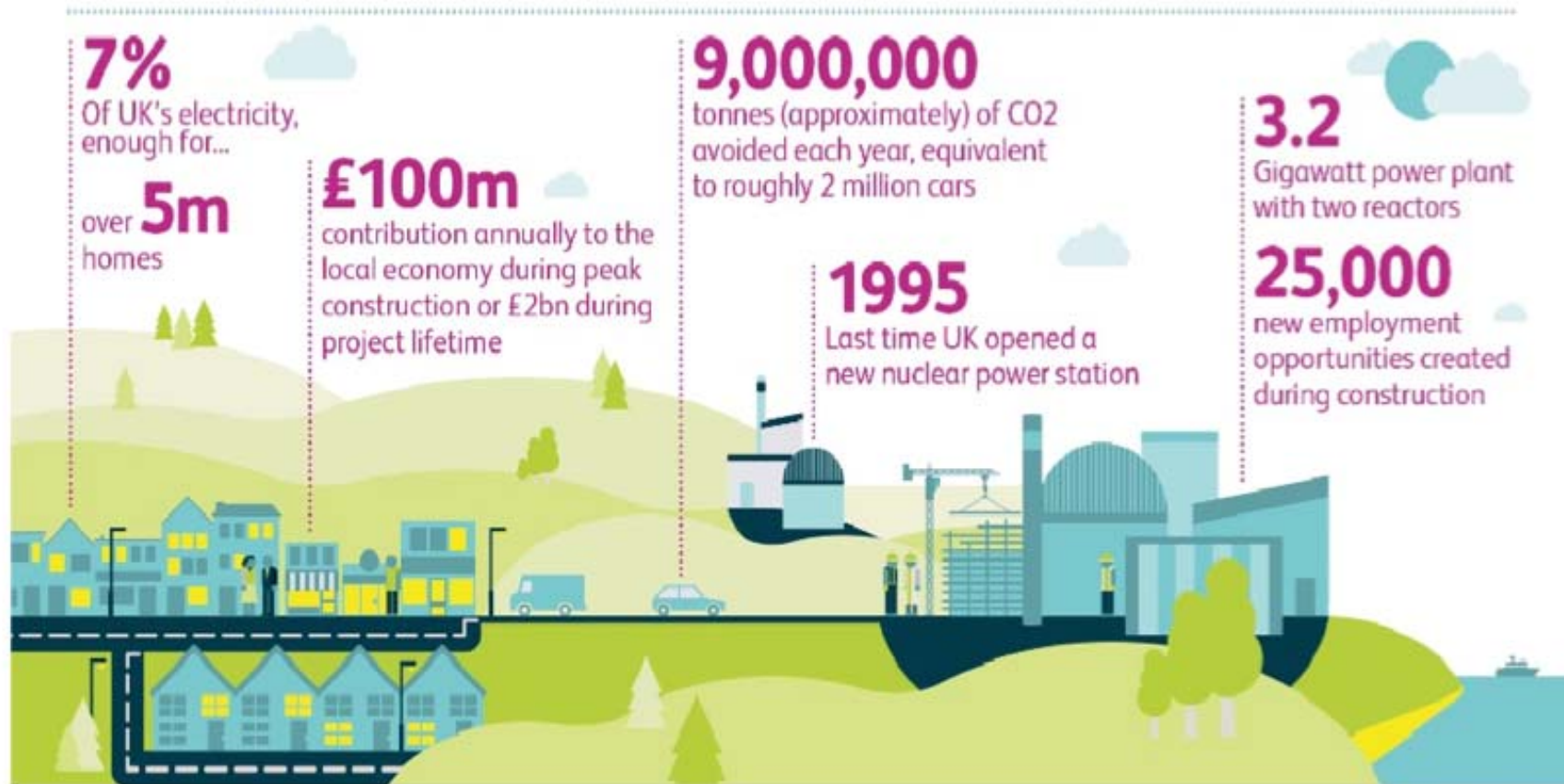
Directive 2011/70/EURATOM, (in the whereas...23rd)

EU: Ruling Third Party Liability?

- severe accident (INES 6-7): never a single example in the EU
- **Paris (1960) and Vienna (1963) Conventions:** all of the EU MS operating NPPs adhere to either the one or the other
 - ensuring that victims can claim and obtain compensation
 - ensuring that nuclear energy can continue to be used, defining a minimum limit of operator's liability
- **strict liability:** not to prove fault or negligence
 - channelled liability:** exclusively the operator's
 - limited liability:** in time and in amount, backed by insurance or financial security ensuring the full amounts are available
- **= a sound set of principles:**
 - robust regulatory regime, continuous improvement by operators
 - availability of adequate compensation for victims
 - firm foundation for investments, strong contribution to security of supply

UK Nuclear Case: Hinkley Point C

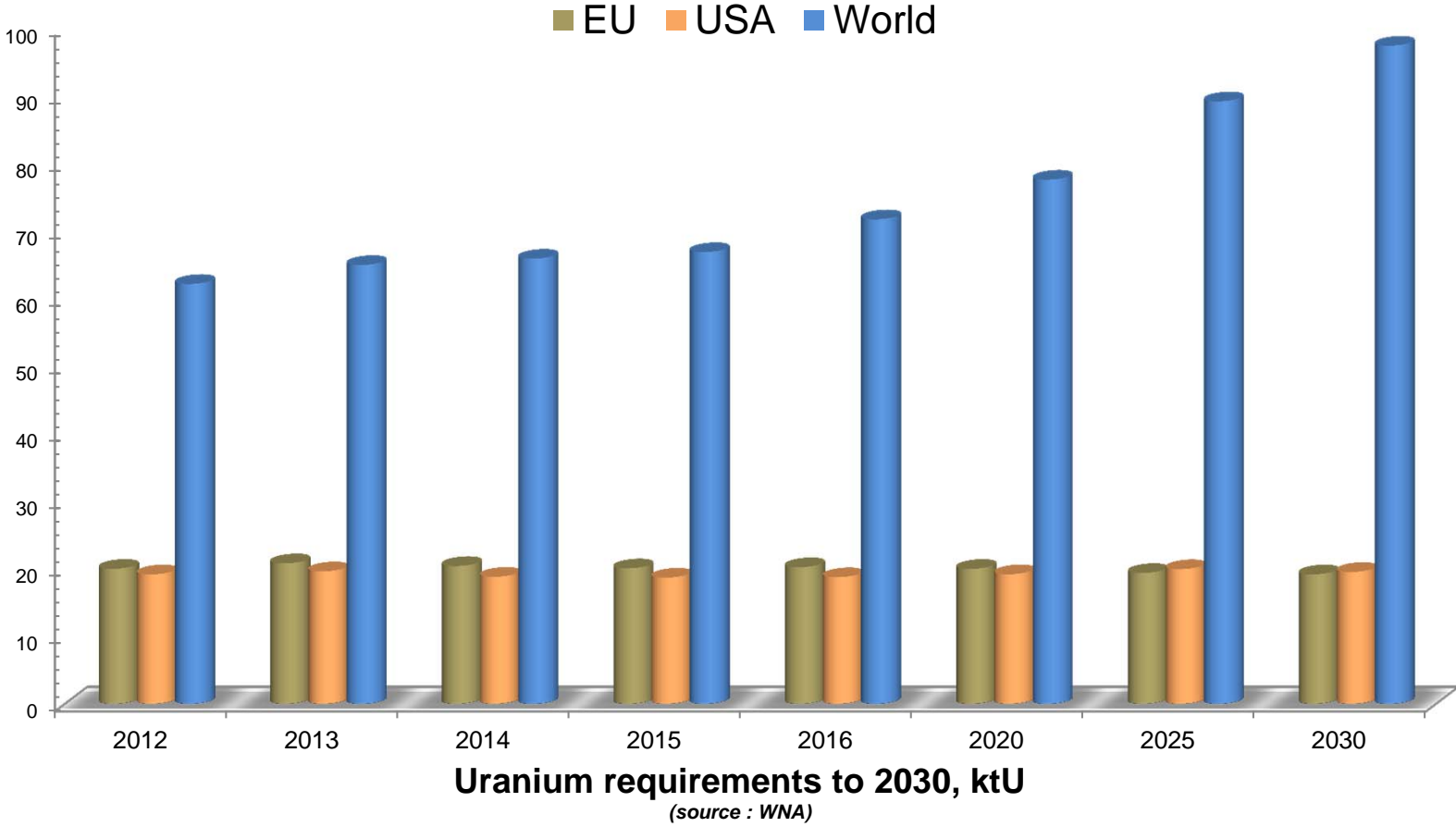
Hinkley Point C: Number power



<https://www.gov.uk/government/news/hinkley-point-c>

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Uranium Requirements: EU vs. the World



EU: Enrichment Capacity

Enrichment Capacity + Development Plans (kSW)			
<i>operator</i>	<i>end 2011</i>	<i>max. target [1]</i>	<i>share, %</i>
AREVA (F)	12050	8200	
URENCO (D, UK, NL)	14200	15700	
Europe	26250	23900	27
AREVA (USA)	0	3300	
URENCO (USA)	400	5700	
USEC	6000	3800	
USA	6400	12800	15
CNCC	2250	8000	
GLE	0	3000	
TVEL/TENEX	27600	37100	
others	76	2250	
World	62576	87050	100

[1] up to 2022

[source: WNA]

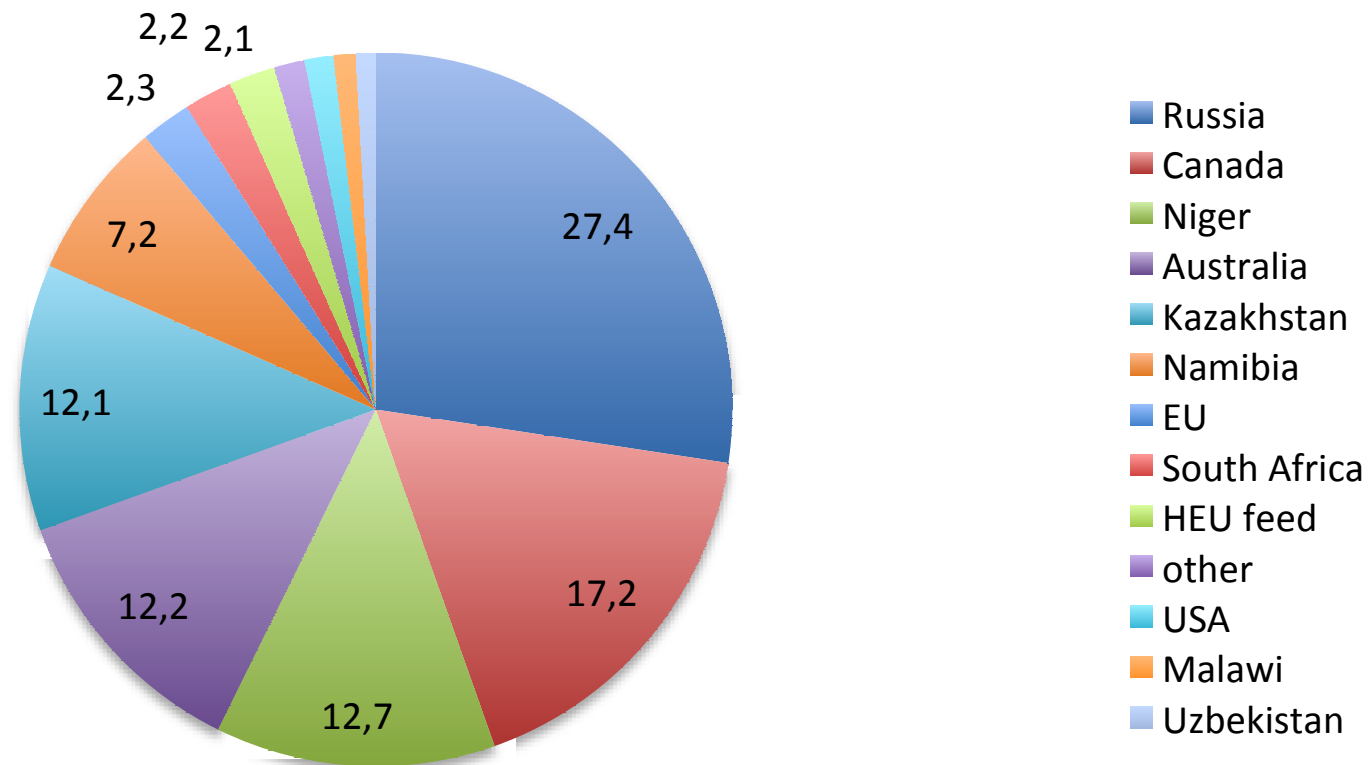
EU: Fuel Fabrication

LWR fuel fabrication capacity, tHM/y							
<i>country</i>	<i>fabricant</i>	<i>conversion</i>		<i>pelletizing</i>		<i>rod/assembly</i>	
France	AREVA	1800		1400		1400	
Germany	AREVA	800		650		650	
Spain	ENUSA	0		500		500	
Sweden	Westinghouse AB	600		600		600	
UK	Westinghouse [1]	950		600		860	
Europe		4150	30	3750	26	4010	31
USA	AREVA Inc	1200		1200		1200	
USA	GNF	1200		1000		1000	
USA	Westinghouse	1500		1500		1500	
USA		3900	28	3700	26	3700	29
World		13708	100	14418	100	12772	100

[1] incl. 200 tHM for AGR reactors

[source: WNA]

Origin of EU-delivered Uranium, %



source: ESA 2012

EU vs. Russian Technology

Russian-made Reactors in Europe			
country	site	type	(MWe)
Bulgaria	Kozloduy-5	VVER V-320	953
	Kozloduy-6		953
Czech Republic	Dukovany-1	VVER V-213	468
	Dukovany-2		471
	Dukovany-3		468
	Dukovany-4		471
	Temelin-1	VVER V-320	1003
	Temelin-2		1003
Finland	Loviisa-1	VVER V-213	496
	Loviisa-2		496
	<i>Pyhäjoki</i>	<i>VVER-1200</i>	<i>1200</i>
Hungary	Paks-1	VVER V-213	470
	Paks-2		473
	Paks-3		473
	Paks-4		473
Slovakia	Bohunice-3	VVER V-213	472
	Bohunice-4		471
	Mohovce-1		436
	Mohovce-2		436
	<i>Mohovce-3</i>		<i>440</i>
	<i>Mohovce-4</i>		<i>440</i>
total			12566

source: PRIS data base (IAEA)

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- EU's 2050 Roadmap and Challenges
- **A German way?**

Energiewende

Frankfurter Allgemeine
SONNTAGSZEITUNG

1,10 Euro D56112 11.1.2014

BEREICHLEITUNGEN VON WERNER D'INKA, BERTHOLD KOHLER, GÜNTHER SONNENHAGER, FRANK SCHERAGATHE, HOLGER VITZTHUM

Nobelpreis
Ein Frosch hebt ab
WISSENSCHAFT, S. 58

Amerika
Ein Land ist tief gespalten
SEITEN 12, 14 UND 17

Das große Rätsel
Wie heißt der Diktator?
POLITIK, S. 8

Chefkontrolleurin
Die Frau für Daimler
WIRTSCHAFT, S. 40



Die Energiewende wird teurer

Ökumlage steigt auf 6,3 Cent. Dabei bleibt es nicht. Gewerkschaft warnt vor sozialer Unwucht

bedampfen Passivhaus: Am Montag werden die Stromerzeugerkosten vorläufig mit der Deckung zur Finanzierung der erneuerbaren Energien für den Rest des Jahres festgelegt. Die Stromerzeugerkosten werden nach fünfjährigen Mittelfristprognosen des Bundesverbandes der Energie- und Wasserwirtschaft (BDEW) auf 6,3 Cent pro Kilowattstunde (KWh) im Jahr 2014 geschätzt. Das ist ein Anstieg um 0,3 Cent gegenüber dem Vorjahr. Die Kosten für die Erneuerbare-Energien-Umlage (EEU) werden auf 3,7 Cent geschätzt, die Kosten für die EEG-Umlage auf 2,6 Cent. Die Kosten für die EEG-Umlage sind die Summe der EEG-Umlage für die Erneuerbare-Energien-Umlage (EEU) und der EEG-Umlage für die Erneuerbare-Energien-Umlage (EEU). Die Kosten für die EEG-Umlage sind die Summe der EEG-Umlage für die Erneuerbare-Energien-Umlage (EEU) und der EEG-Umlage für die Erneuerbare-Energien-Umlage (EEU).



Erdogan attackiert die UN

ML-Anw. FAZNET: Die türkische Ministerpräsidentin Recep Tayyip Erdogan hat am Sonntag die Vereinten Nationen scharf kritisiert. Sie seien nicht mehr neutral und China sei ein Feind der UN. Sie seien nicht mehr neutral und China sei ein Feind der UN. Sie seien nicht mehr neutral und China sei ein Feind der UN.

FAZ.NET FAZJOB.NET FAZSCHULE.NET FAZ-ES.NET

HERAUSGEGEBEN VON WERNER D'INKA, BERTHOLD KOHLER, GÜNTHER NO...

Frankfurter Allgemeine
Wirtschaft

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Politik **Wirtschaft** Feuilleton Finanzen Gesellschaft Sport Lebensstil

Home > Wirtschaft > Wirtschaftspolitik

EEG-Umlage Ökostrom kostet jeden Deutschen 240 Euro im Jahr

09.01.2014 · 2013 erreichte die EEG-Umlage mit 19,4 Milliarden Euro einen Rekordwert. Wirtschaftsminister Gabriel wirbt in Brüssel für eine weitere Begünstigung der deutschen Industrie - sonst drohe der Bundesrepublik die Deindustrialisierung.


Von ANDREAS MIHM und HENDRIK KAFSACK, BERLIN/BRÜSSEL



DEUTSCHER SPIEGEL

WIRTSCHAFTSZEITUNG

LUXUS STROM



Warum Energie immer teurer wird – und was die Politik dagegen tun muss

Weitersagen Empfehlen (43)

Merken Drucken

f t x

Anzeige

Germany: *Energiewende* priorities

- ***ideological***: phasing out nuclear
- ***commercial***: reducing energy imports + lowering the country foreign dependency
- ***industrial***: developing new technologies – re-industrialization – jobs creation
- ***environmental***: reducing greenhouse gas emissions
- ***geopolitical***: Germany as a world model, exporting its successes

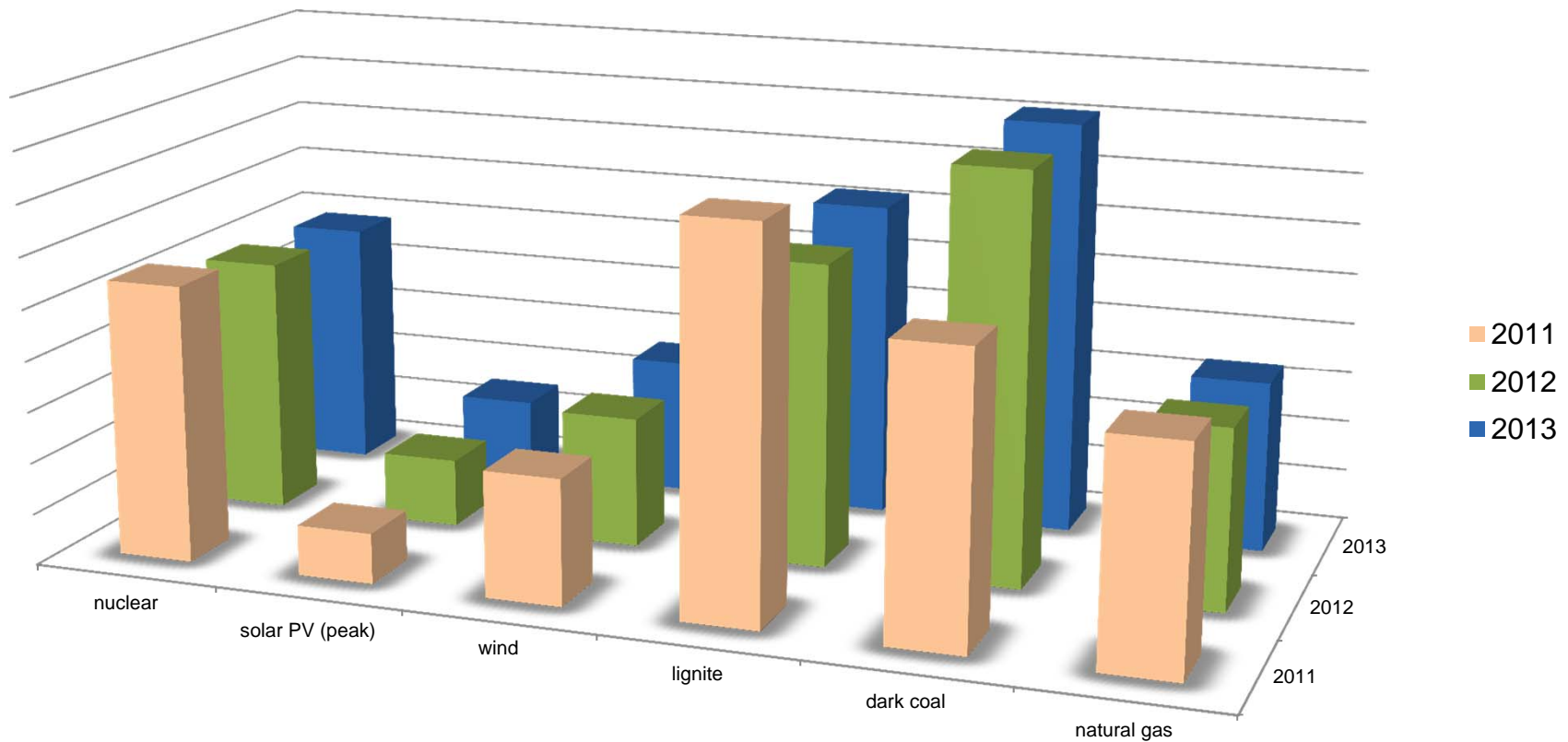
source: the German Vice-Chancellor, Berlin Energy Forum, 10 February 2014

electricity surcharge: 52.8 €/MWh (2013), 62.4 €/MWh (2014)

total costs: 13.2 G€ (2011), 23.6 G€ (2014)

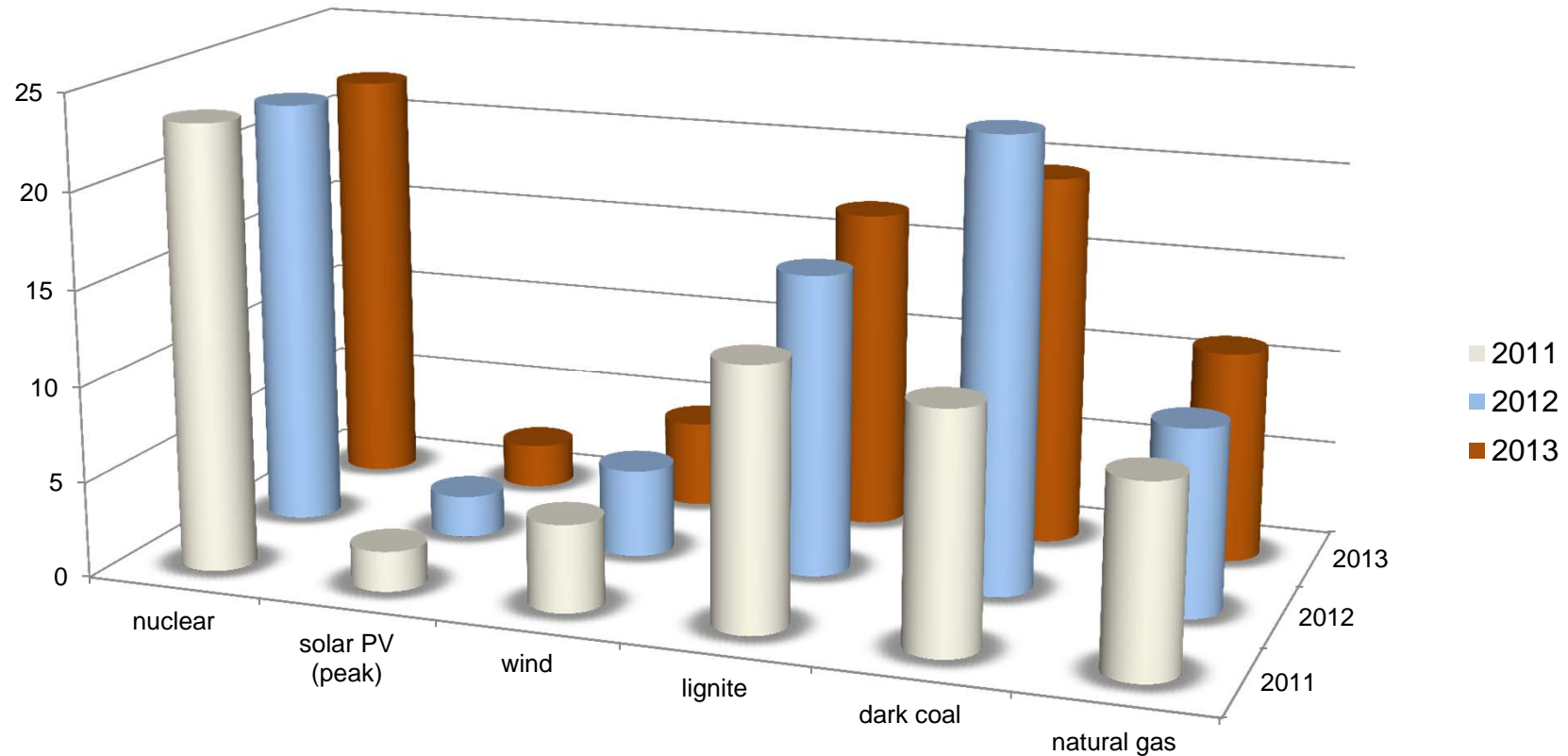
GHG emissions: +1.2 % (2011-2012)

Germany: Electricity Production



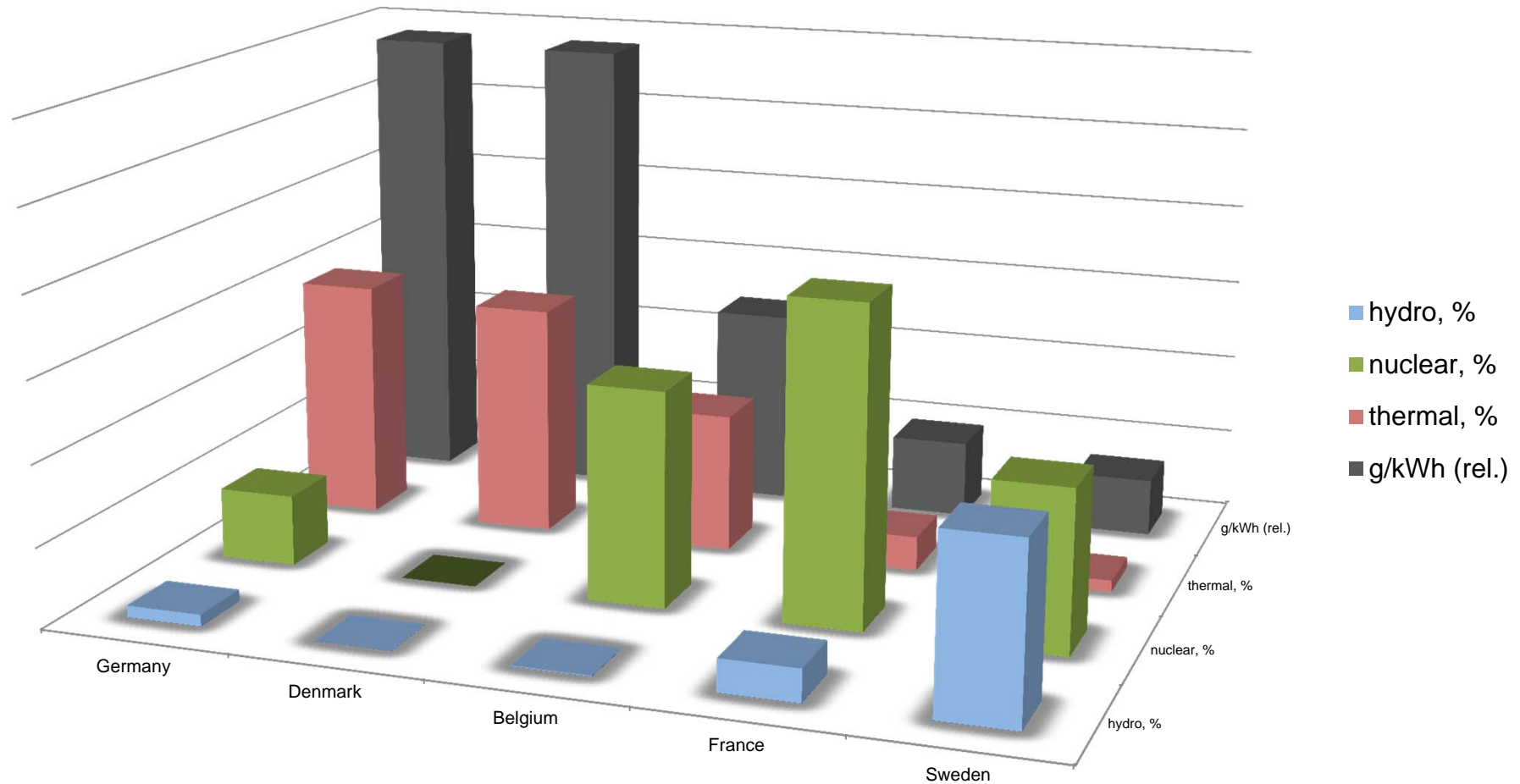
Electricity production by energy source (relative), 2011-2013

Germany: "Availability" of Energy Sources



Equivalent Full Power Use by Energy Source (hours/day), 2011-2013

Electricity and GHG



Gross electricity generation and CO₂ eq emissions, 2011

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- EU: No Single Energy Policy
- EU's 2050 Roadmap and Challenges
- A German way?
- **Science, R&D, Technology**

European Science at the Top

It all started with Physics...



SOLVAY International
Conferences, Brussels, Belgium

European Science at the Top

...went on with Physics and Technology...



The Nobel Prize in Physics
2013 François Englert, Peter Higgs



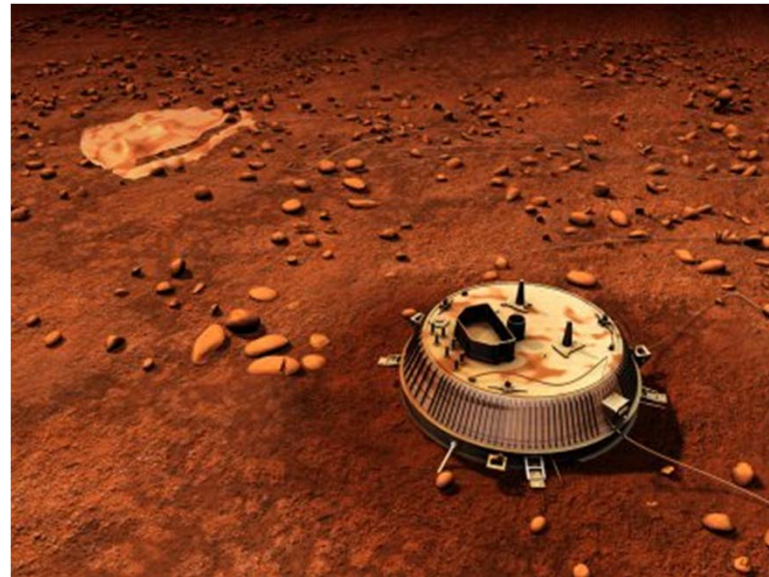
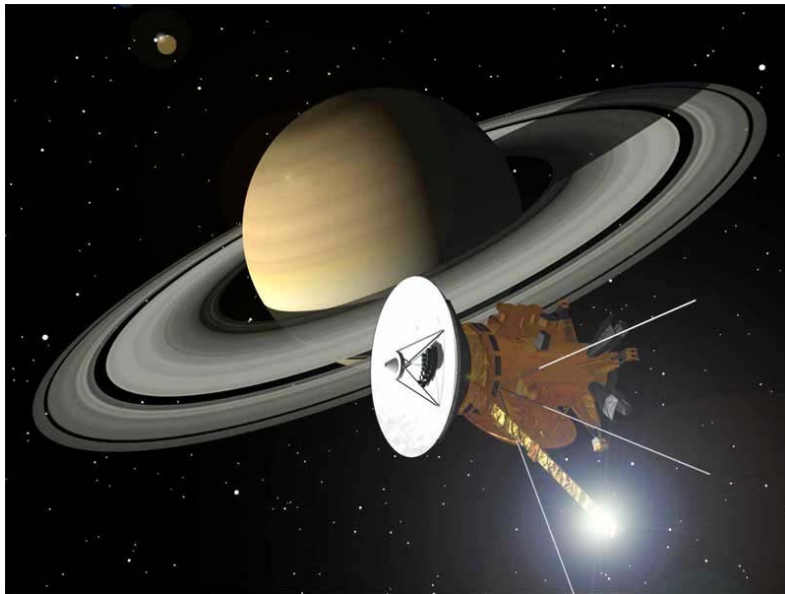
European R&D at the Top

...flew to space...

Cassini-Huyghens

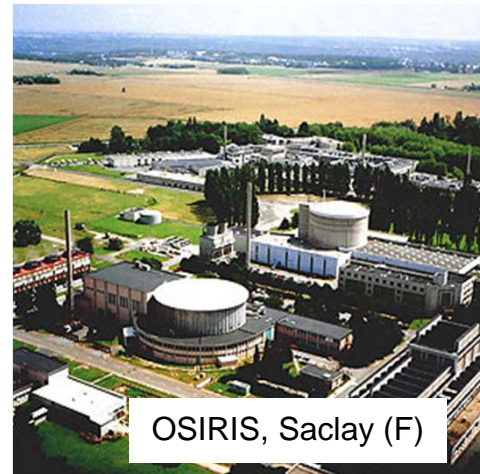
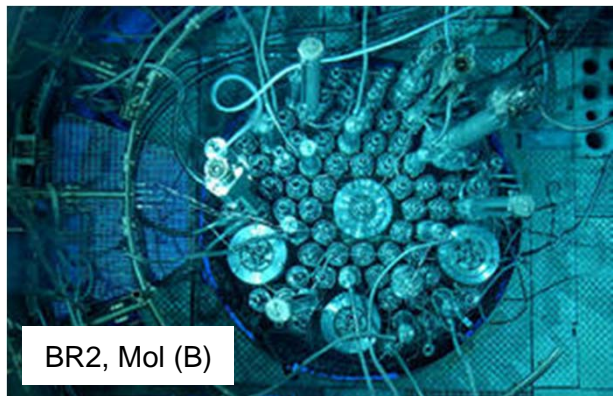
(NASA/ESA/ASI)

*Pu²³⁸-powered to Titan,
Saturn's largest moon*



European R&D at the Top

...now supports diagnosis and therapy...



^{99m}Tc
used by 10,000 hospitals
40 M procedures annually



EU: Science, R&D, Technology

...and now?...

- GEN-IV reactors, SMRs, new concepts(modularity)?
- partition of actinides, transmutation at industrial scale?
- nuclear fusion: still a dream for long?
- a leap in renewables (artificial photosynthesis, CO₂ cracking, battery technology, PV material, others)?

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