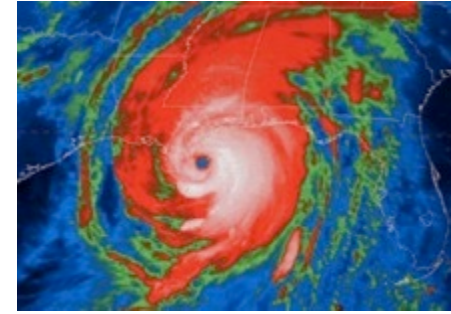


Good Energies Chair for
Management of Renewable Energies



University of St.Gallen



Renewable energy – from niche to mass market

Overcoming energy path dependence in a boundedly rational world

Prof. Dr. Rolf Wüstenhagen

Good Energies Chair for Management of Renewable Energies
Director, Institute for Economy and the Environment
University of St. Gallen

St. Gallen, 3 September 2012

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<http://goodenergies.iwoe.unisg.ch>

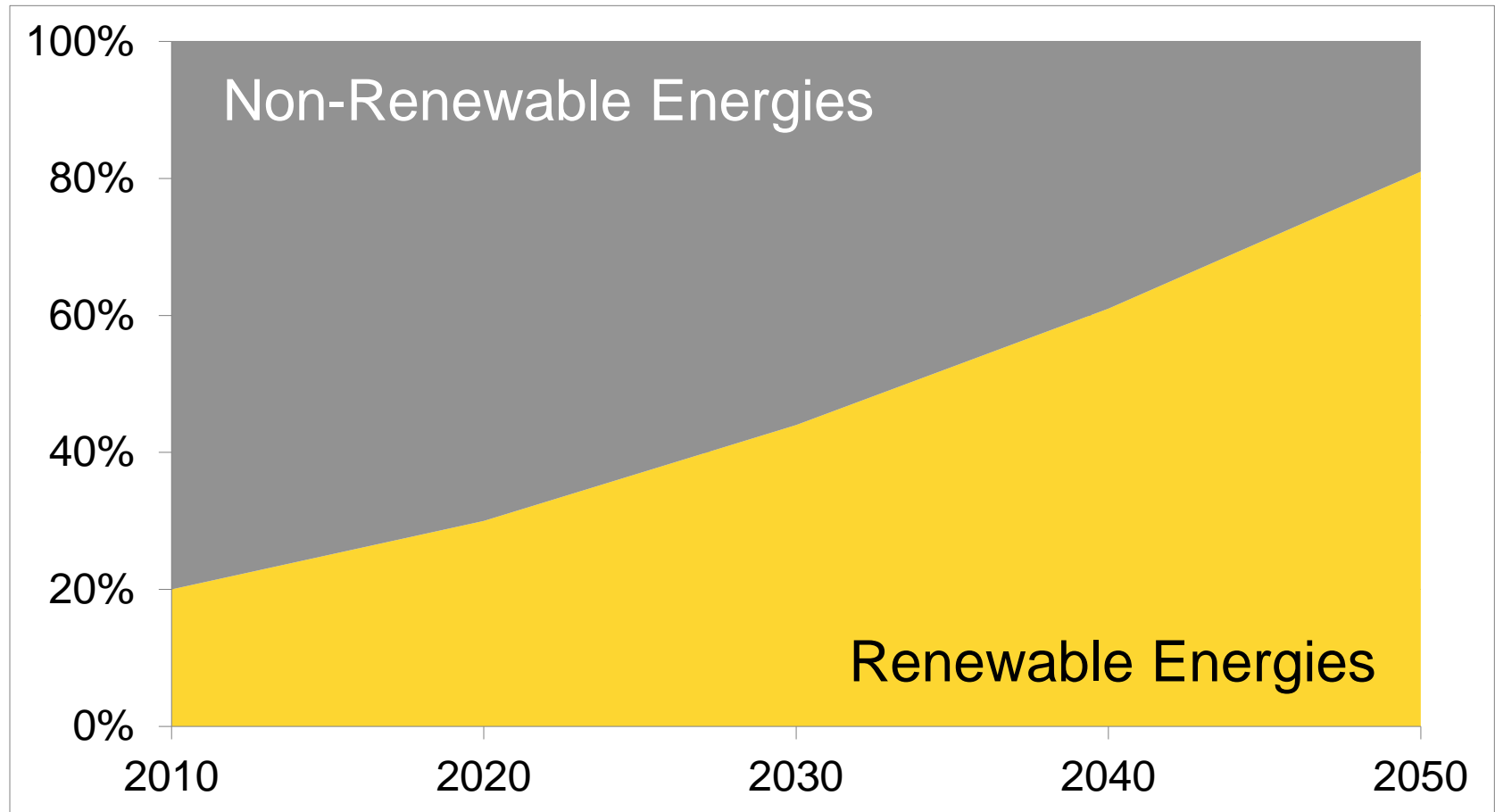


Good Energies Chair for Management of Renewable Energies at the University of St. Gallen



- Established in 2009 with support from Good Energies Inc.
- Part of one of Europe's leading business schools
- Dedicated team (approx. 15 people)
- 30+ Bachelor/Master Theses, \approx 3-4 PhD dissertations p.a.
- Teaching in M.A. & PhD programmes of University of St. Gallen and within CEMS-MIM Programme
- Research focus: Decision-making under uncertainty by energy investors & consumers
- 3rd Forum for Management of Renewable Energies 24/25 May 2012
- Executive Education Programme REM-HSG

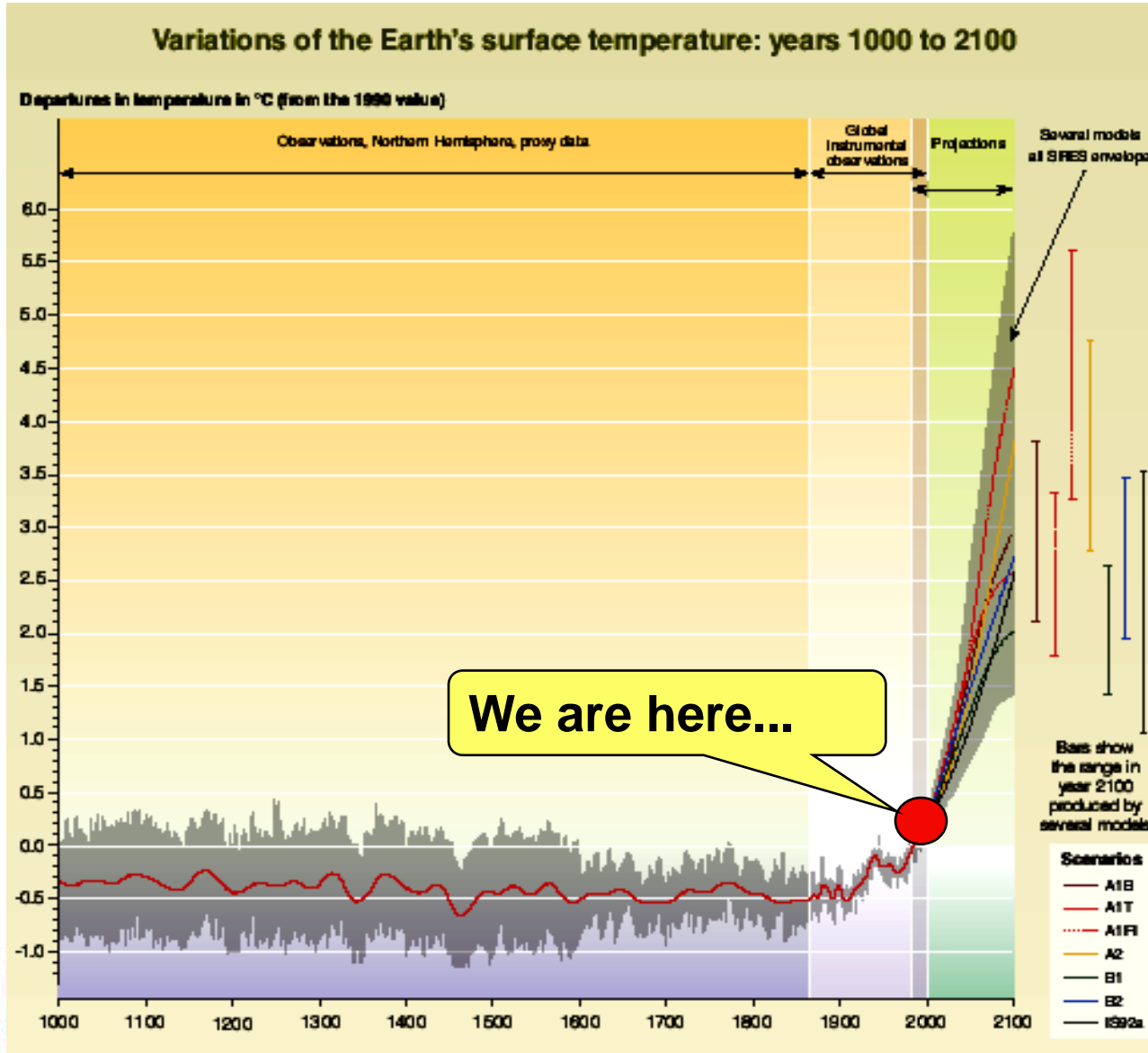
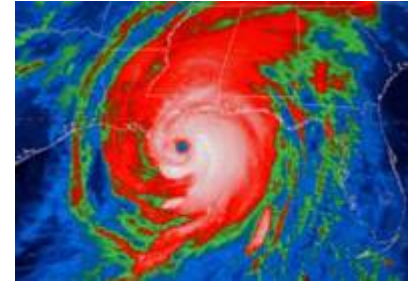
Vision of our Chair: From 20:80 to 80:20



Outline

- 1. From 20:80 to 80:20 – the case for scaling up clean energy**
- 2. Scaling up clean energy in a world of bounded rationality (Part I: the problem) – disentangling path dependence**
- 3. Scaling up clean energy in a world of bounded rationality (Part II: the solution) – love, convenience & a happy end**
- 4. Conclusions**

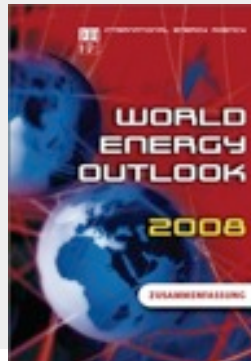
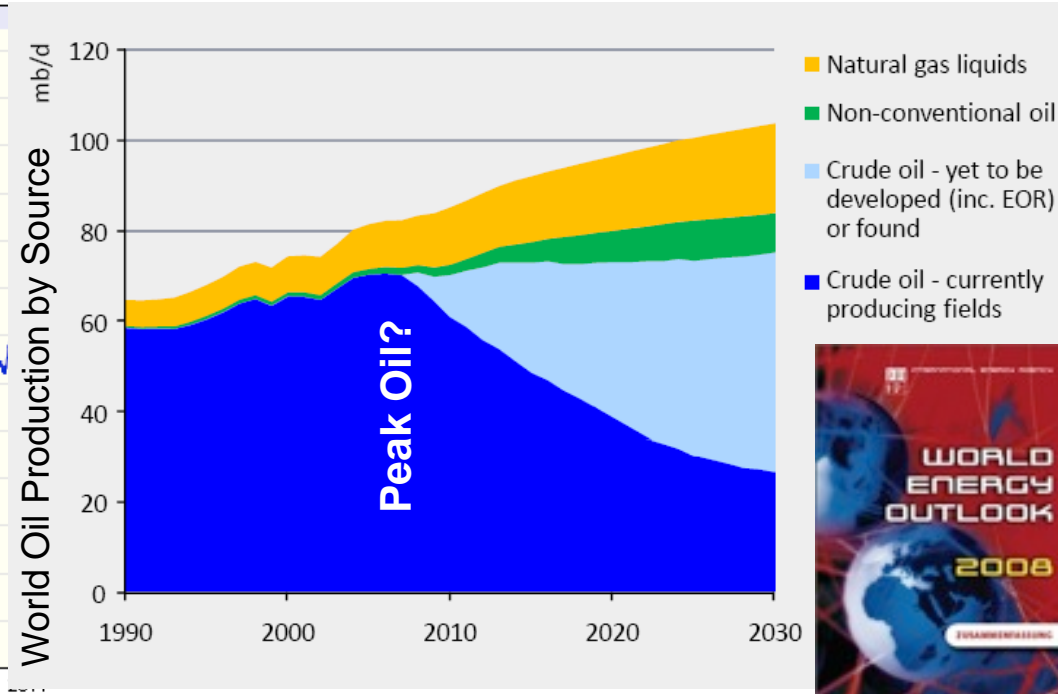
The Climate Crisis: fossil fuels messing up the atmosphere



Price & availability of non-renewable energies

1) Short-term price volatility

2) Long-term resource availability?



NB: Oil sands, shale gas appear to have reversed price trend, at least in US, but what about long-term risk-return profile?

Risk premium of non-renewable resources



20-40 bn. \$



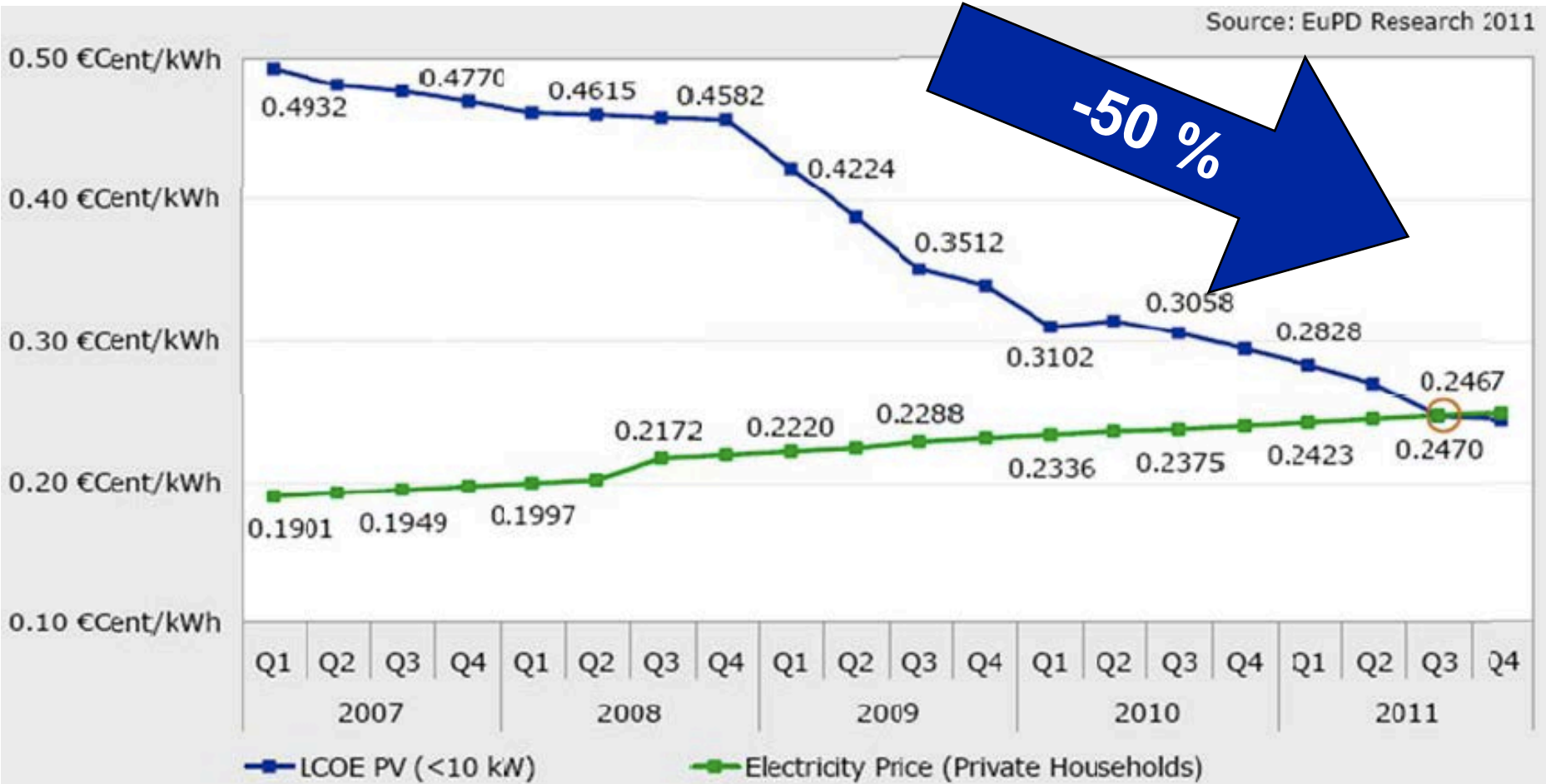
40-50 bn. €

Deepwater Horizon 2010

Fukushima 2011

Cost estimates: BP (June 2010): Aid fund for people affected by Deepwater Horizon: 20 bn. \$, BP's estimate of overall damage 41 Mrd \$. Announced state aid of Japanese government for TEPCO (May 2011): 45 bn. €. For comparison: 3-month difference in market capitalization BP ca. 100 bn. \$, TEPCO ca. 30 bn. €

Cost of rooftop PV & retail electricity prices have converged in Germany



In a fully rational world, there would be lots of good reasons for scaling up clean energy

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From classical economic models of energy-related decision-making...

$$\text{Choice} = \frac{\text{Risk}}{\text{Return}} + \varepsilon$$

...to a more realistic model of energy-related decision-making

$$\text{Choice} = \frac{\text{Risk}}{\text{Return}} + \mathcal{E}$$

A more realistic model of economic choice

$$\text{Choice} = \underbrace{\frac{\text{Risk}}{\text{Return}}}_{\text{„Rationality Land“}} + \underbrace{\mathcal{E}}_{\text{Areas of Bounded Rationality, collectively resulting in Path Dependence}}$$

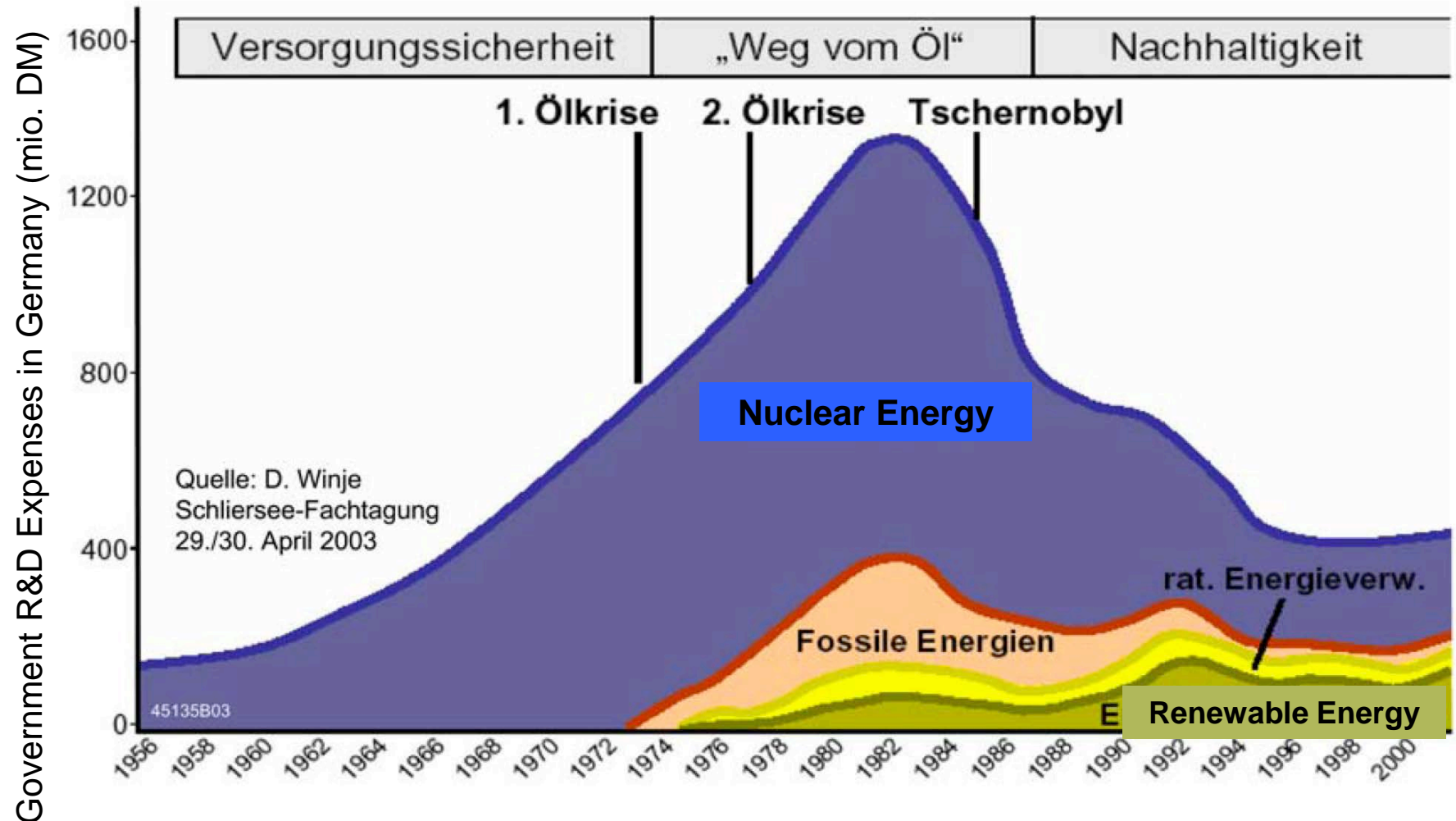
- Status Quo Bias
- Affective Influence
- Peer Effects
- etc.

Status Quo Bias in Energy R&D Investment

- Where has the Swiss government invested more research and development money in 2004-2010: nuclear energy research or wind energy research? And why?
- Solution: ca 240 Mio CHF on nuclear, 2 Mio CHF on wind energy
- > What does this tell us about **market attractiveness** of nuclear vs. wind energy technology? About **risk-return-ratio** of investing in nuclear vs wind energy?...or perhaps rather about the budget allocation 7 years ago?

Many energy investment decisions are biased towards the status quo.

Path dependence in Energy R&D budgets: Example Germany



Institut für Wirtschaft und Ökologie

Path dependence in energy subsidies

**\$400-
600bn**

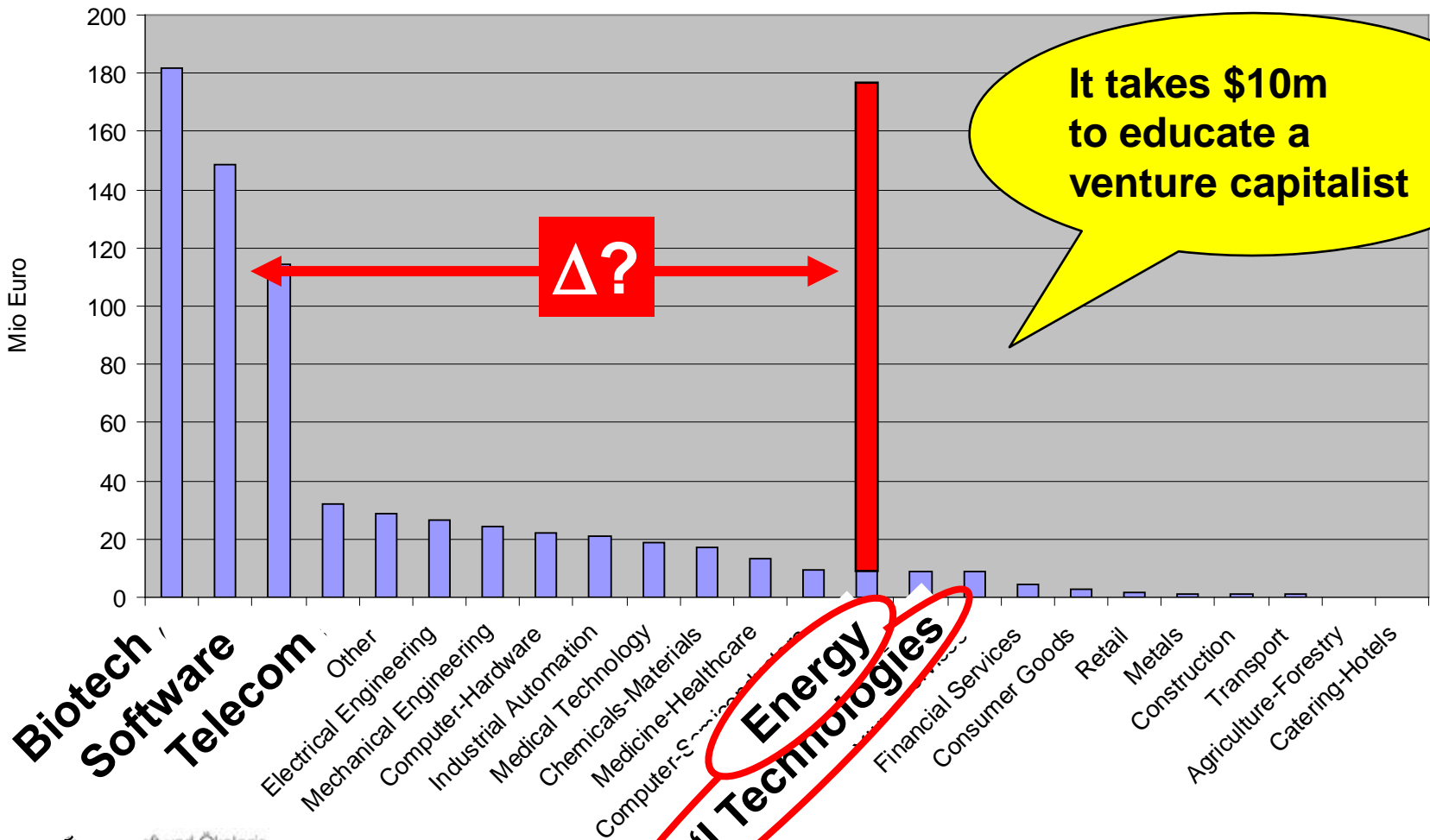
Annual global subsidies for
fossil fuels

\$66bn

Annual global subsidies for
renewables

Venture Capital: Slow growth of clean energy investment partly reflecting path dependence

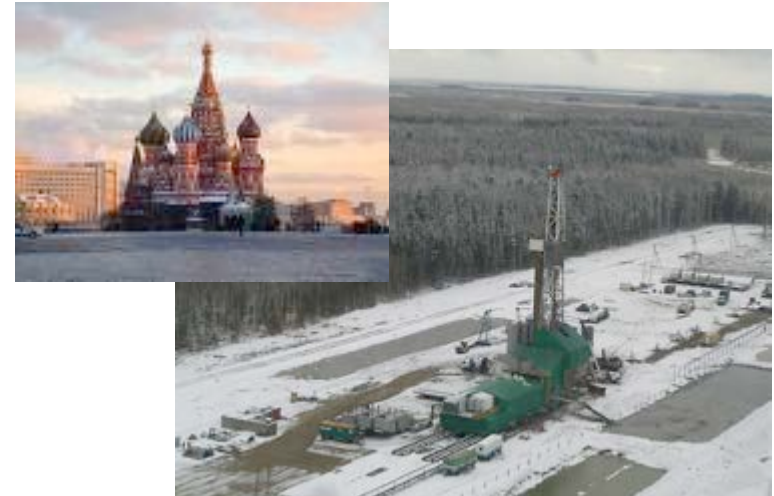
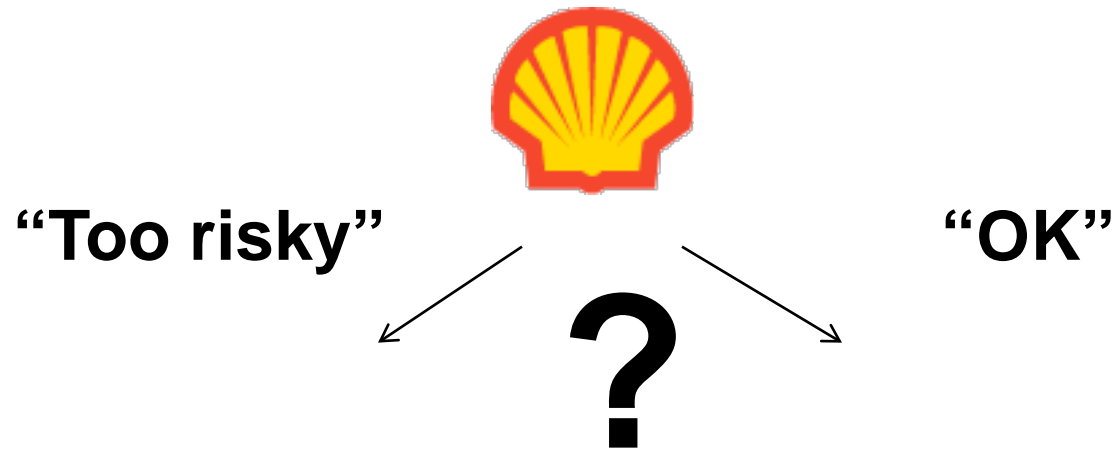
German VC investments 2002



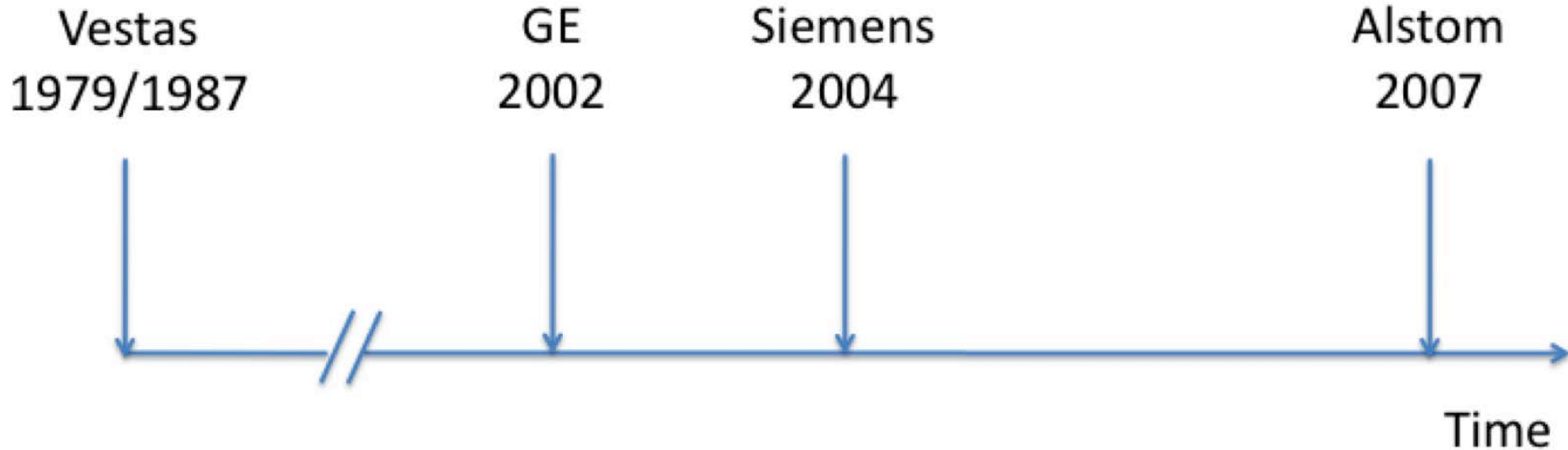
It takes \$10m to educate a venture capitalist

Energy
Env'i Technologies

Status quo bias and affective influences on the evaluation of risk and return in corporate investment decisions



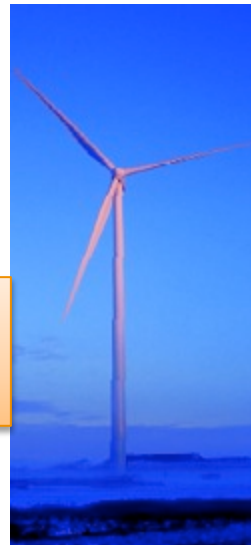
Corporate investment in wind energy showing surprising time lags



GE
Energy

SIEMENS

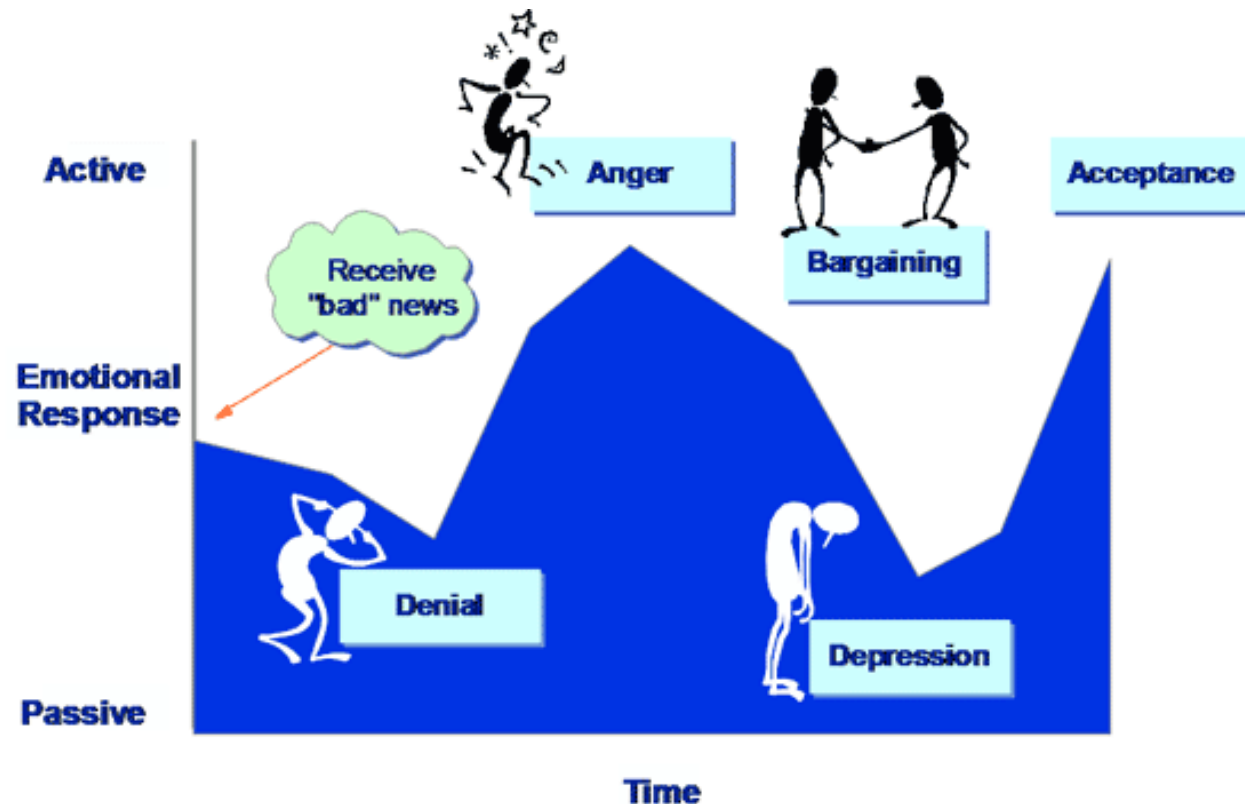
- **Explanation: Cost-Benefit? Risk-Return?...**
- **...or path-dependent decision-making in organisations?**



Affective influences give incumbents a headache when trying to embrace transition

„Stages of grief“ in corporate transformation processes

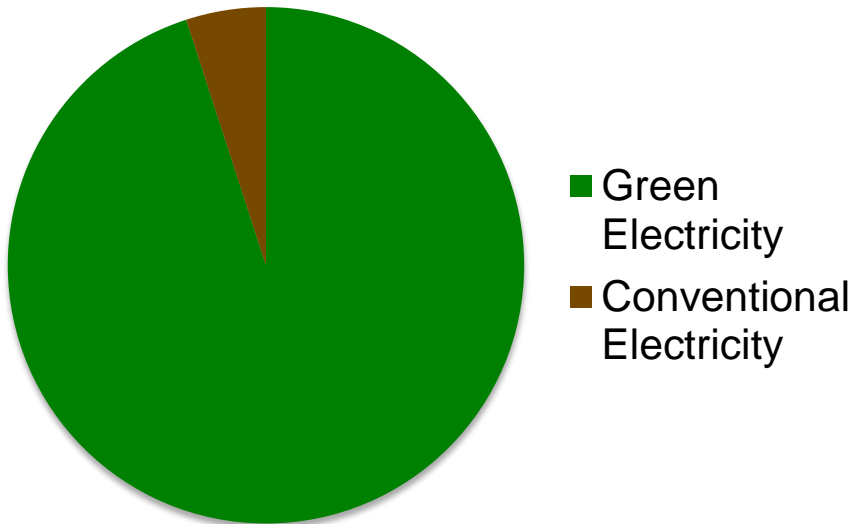
1. Denial
2. Aggression
3. Depression
4. Bargaining
5. Acceptance



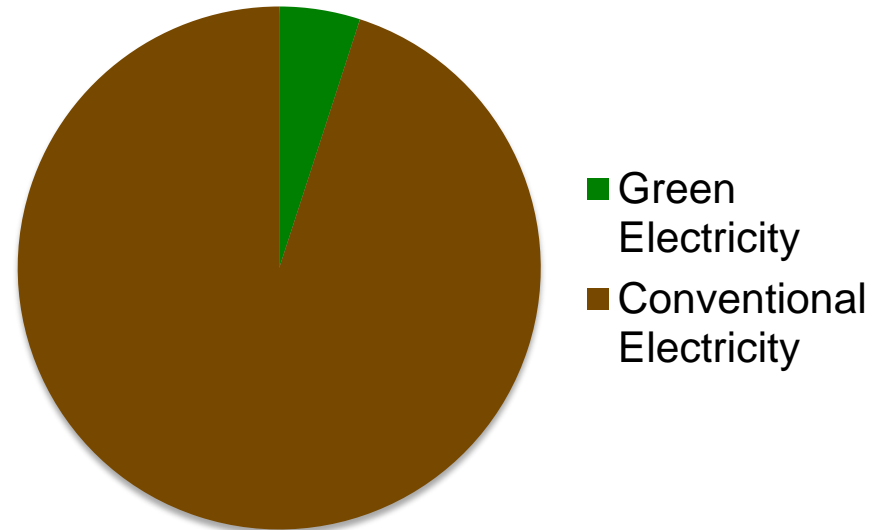
Source: Elisabeth Kübler-Ross (1969)
 Institut für Wirtschaft und Ökologie

Path dependence in consumer choice: Overcoming inertia is key

City of Zürich (2010)



City of St. Gallen (2010)



Net positive energy houses („Plusenergiehäuser“):²¹ technology is there, but investors remain hesitant



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How can path dependence be overcome in a world of bounded rationality?

1. **Patience:** After going through stages of grief, incumbents will eventually embrace new realities
2. **The Skunk Works approach:** Innovate far away from corporate HQ
3. **Empowering competition:** energy policies should not only focus on incumbents
4. **Green defaults & nudges:** make the “good” choice the easy choice
5. **Peer pressure:** Marketing solar cells like Tupperware (or iPhone)
6. **The upside of affect:** leverage love of the sun 😊

„Beyond Grief“ (1): Incumbents eventually embracing the energy transition

Handelsblatt

GROSSBRITANNIEN

29.03.2012, 15:20 Uhr, aktualis

Eon investiert in Erneuerbare statt in Atomkraftwerke

EXKLUSIV Eon und RWE haben ihre Atompläne in Großbritannien gestoppt. Das Gemeinschaftsunternehmen soll verka
Eon-Chef Johannes Teyssen kündigt stattdessen Investitionen in erneuerbare Energien an.

Düsseldorf. Eon will in Großbritannien statt in Kernkraftwerke in grüne Technologien investieren. **„Wir sind zu dem Ergebnis gekommen, dass Investitionen in Erneuerbare, dezentrale Erzeugung und Energieeffizienz attraktiver sind - für uns ebenso wie für unsere britischen Kunden“, sagte Vorstandschef Johannes Teyssen** im Gespräch mit dem Handelsblatt.

von Jürgen Flauger



Eon-Chef Johannes Teyssen will in Großbritannien auf erneuerbare Energien setzen.

Quelle: dpa

GESCHÄFTSAUSSTIEG WEGEN FUKUSHIMA

18.09.2011

Siemens schließt das Atom-Kapitel

Der Münchner Siemens-Konzern will sich komplett aus dem Atomgeschäft verabschieden. „Das Kapitel ist für uns abgeschlossen“, sagte Konzernchef Peter Löscher dem „Spiegel“.

KONZERNSPARTE

24.03.2012

Siemens erwartet Plus bei erneuerbaren Energien

Für das Jahr 2012 rechnet Siemens „Energy“ dank der Technik für die regenerative Energiegewinnung
Konzernspartenchef Süß ruft zudem die deutschen Netzbetreiber zu mehr Zusammenarbeit auf.

„Beyond Grief“ (2)



Jürgen Großmann
20.1.2012

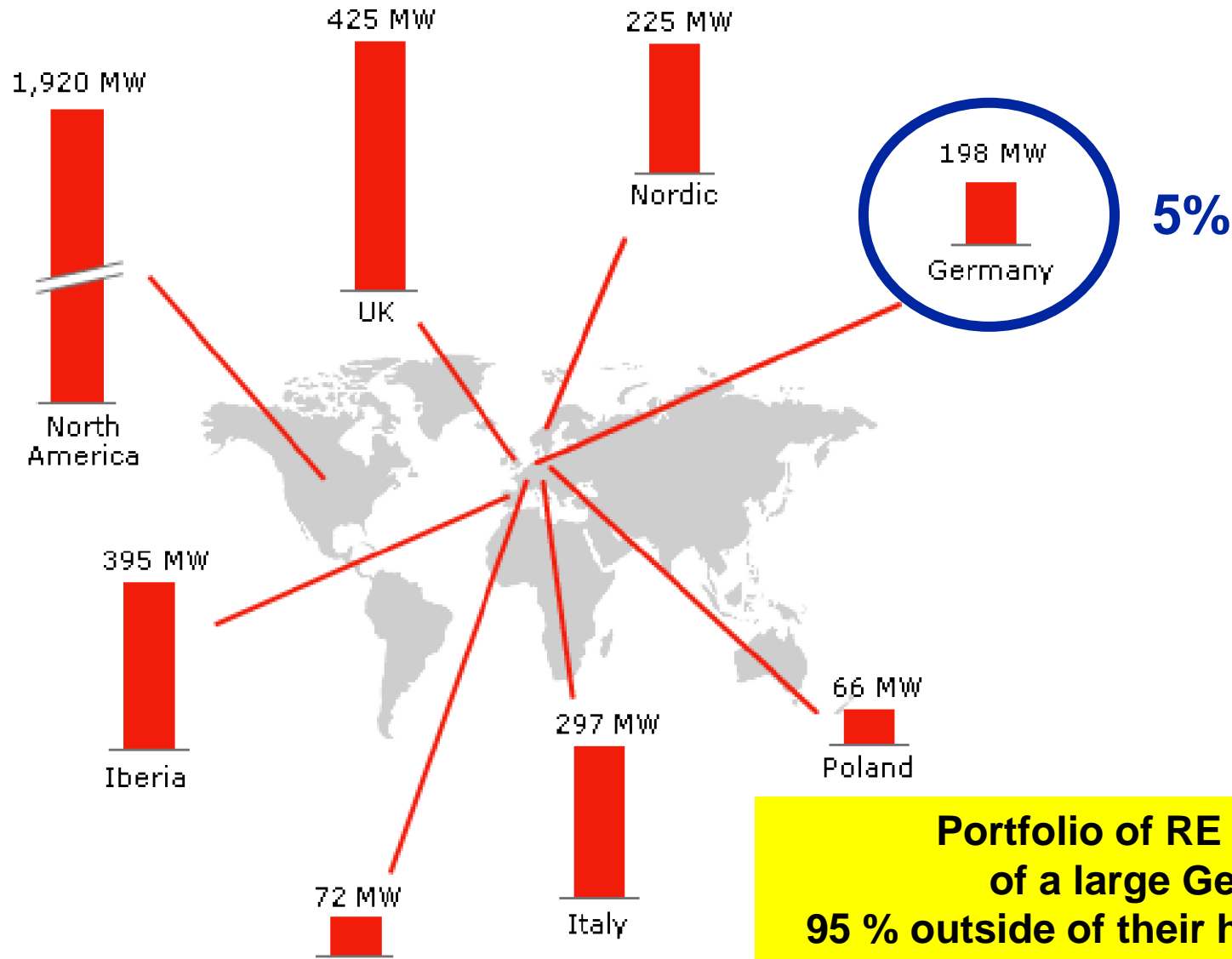
Peter Terium
21.5.2012

Solar energy in Germany makes as much sense as growing pineapples in Alaska.

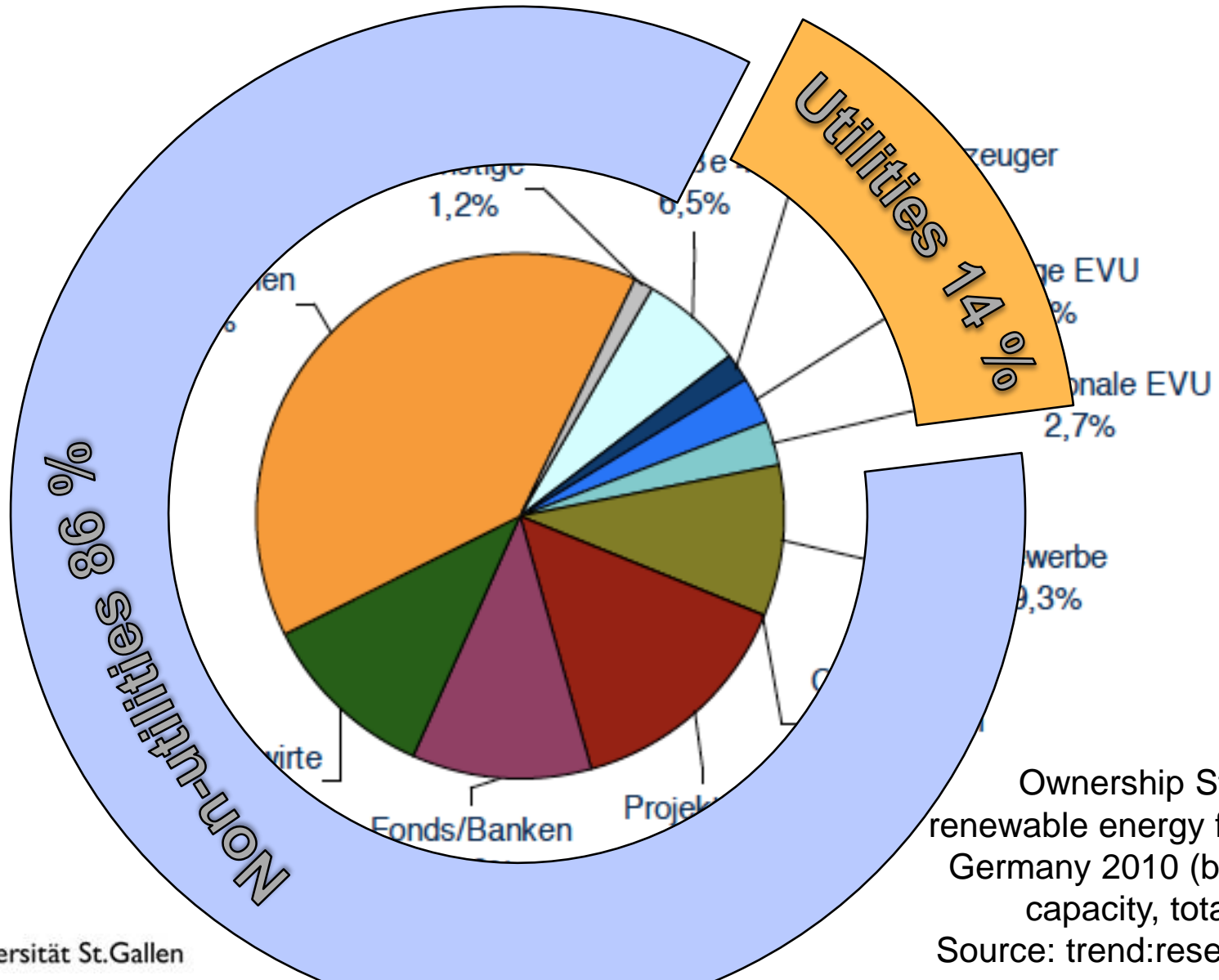
With regard to PV, we are in the process of re-evaluating our strategy. Module prices have come down to an extent that RWE has not deemed possible. Therefore, it would be unwise if we were not to address this topic.

The skunk works approach:

Overcoming path dependence may be easier far away from corporate headquarters



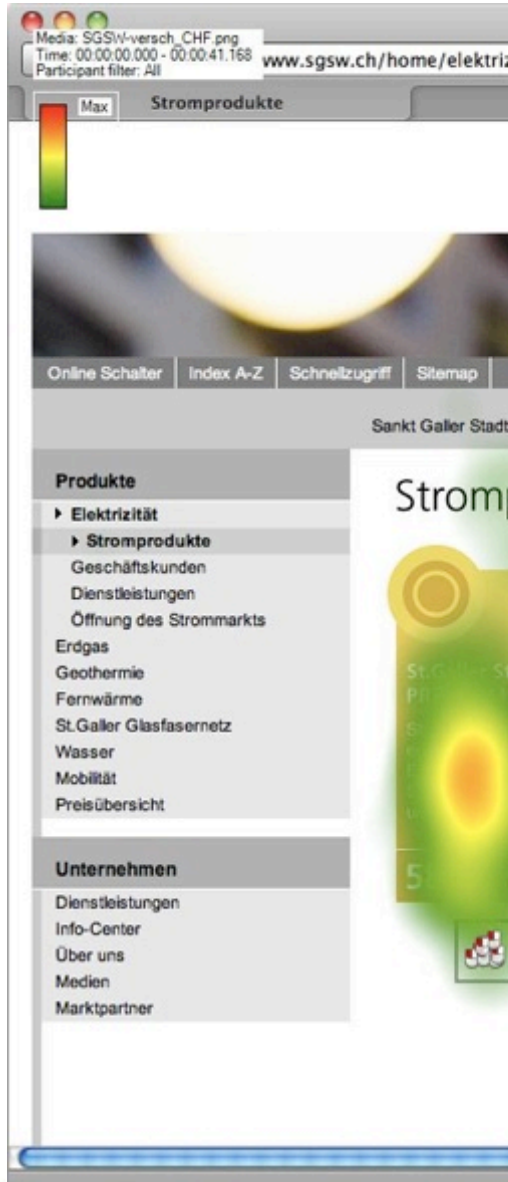
Empowering competition: German Feed-in Tariff picked up by new players more than utilities



Ownership Structure of renewable energy facilities in Germany 2010 (by installed capacity, total: 53 GW)
Source: trend:research 2011

Research on Green Default...

Source: Master Thesis Nicole Fahr (2011)



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sg | s | w | Sankt Galler Stadtwerke

Schalten Sie jetzt um auf St.Galler Strom

DM6H9XXXX OK Das hat geklappt. Wählen Sie unten Ihr Stromprodukt auf Basis der geschätzten Kosten.

0001505 kWh Ihr Verbrauch der letzten 12 Monate.

...and its implementation

ST. GALLER STROM BASIS

St.Galler Strom Basis
ist das Stromprodukt, das sich am Schweizer Strom-Mix orientiert, jedoch mit einem reduzierten Anteil an Kernenergie.

Zusammensetzung:

- 50% Wasserkraft
- 30% Kernenergie
- 10% Kehrichtverbrennung

Energiepreise:
Hochtarif 11.7 Rp./kWh
Niedertarif 8.0 Rp./kWh

Ihre monatlichen Kosten mit St.Galler Strom Basis
ca. CHF 34.60*

*basierend auf aktuellem Verbrauch; Hoch-/Niedertarif berücksichtigt

Netznutzungskosten	CHF	20.10
Abgaben	CHF	2.35
Energiekosten	CHF	12.15

Bestellen

ST. GALLER STROM ÖKO

St.Galler Strom Öko
ist das Stromprodukt ohne Kernenergie, das aus erneuerbarer Energie und Strom aus ökologisch sinnvoller Produktion besteht.

Zusammensetzung:

- 70% Wasserkraft
- 22% Kehrichtverbrennung
- 6% Windenergie
- 2% Solarenergie

Energiepreise:
Hochtarif 13.7 Rp./kWh
Niedertarif 10.0 Rp./kWh

Ihre monatlichen Kosten mit St.Galler Strom Öko
ca. CHF 37.10*

*basierend auf aktuellem Verbrauch; Hoch-/Niedertarif berücksichtigt

Netznutzungskosten	CHF	20.10
Abgaben	CHF	2.35
Energiekosten	CHF	14.65

Bestellen

ST. GALLER STROM ÖKO PLUS

St.Galler Strom Öko Plus
ist das Stromprodukt, das aus Wasser-, Wind- und Solarenergie und somit vollständig aus erneuerbaren Energien besteht.

Zusammensetzung:

- 60% Wasserkraft
- 30% Windenergie
- 10% Solarenergie

Energiepreise:
Hochtarif 15.7 Rp./kWh
Niedertarif 12.0 Rp./kWh

Ihre monatlichen Kosten mit St.Galler Strom Öko Plus
ca. CHF 39.65*

*basierend auf aktuellem Verbrauch; Hoch-/Niedertarif berücksichtigt

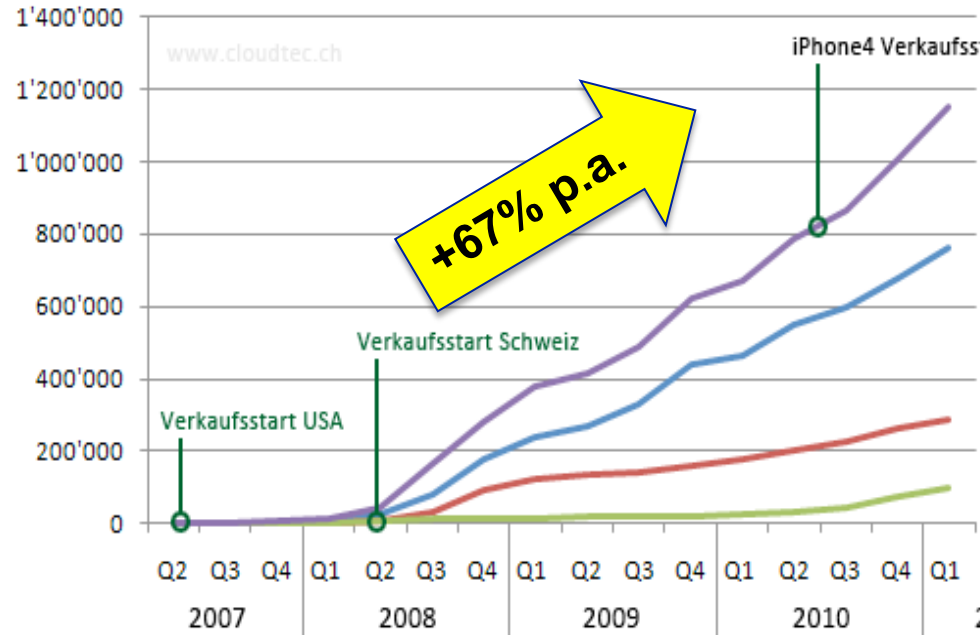
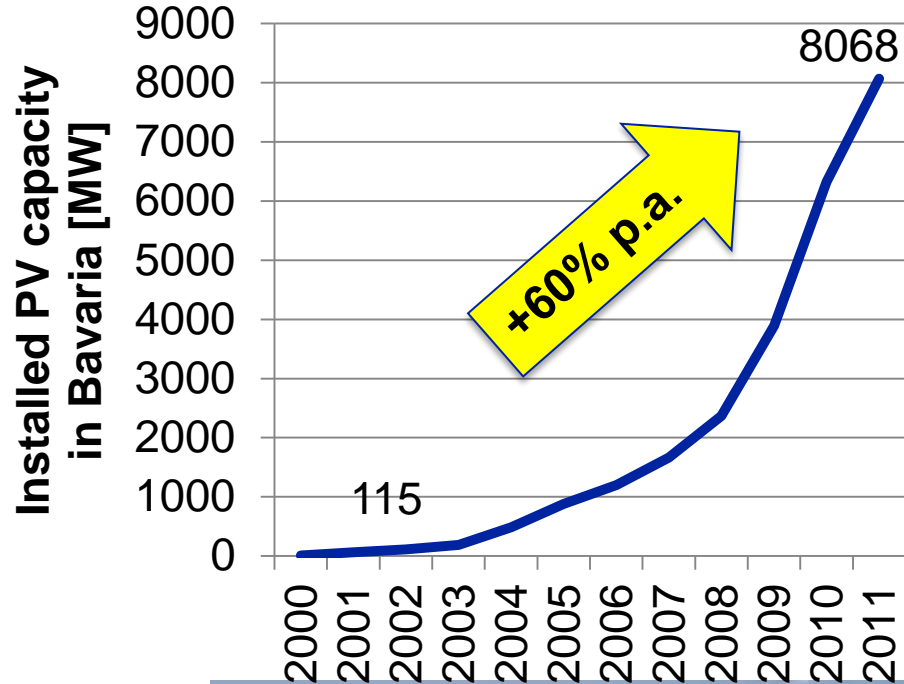
Netznutzungskosten	CHF	20.10
Abgaben	CHF	2.35
Energiekosten	CHF	17.20

Bestellen

KERNSTROM MIX

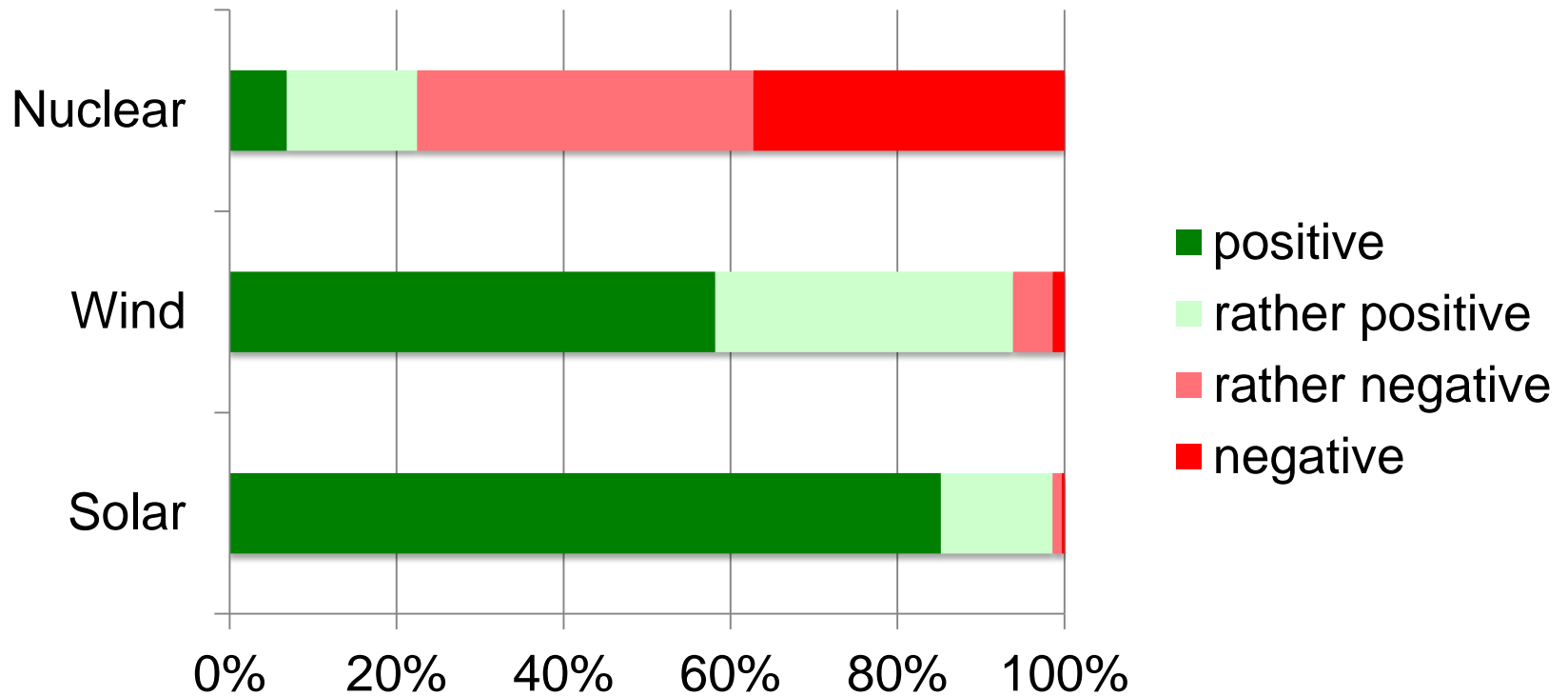
Result: From 10% to 90 % green electricity customers

Peer pressure & tech diffusion: From Bavarian solar farmers... .. to the Swiss iPhone market



Positive affect: Consumers love solar 😊

„How do you evaluate the following energy sources?“
N=1261



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Conclusions

- Energy decision-making is subject to „Epsilon“, such as status quo bias, peer group effects and emotional influences.
- This results in path dependence, slowing down the scaling up of clean energy.
- There are six ways to overcome path dependence in a world of bounded rationality
- If further research, policy design and marketing strategies are taking into account how real-life decisions are taken, the energy transition will come to a happy end 😊



Questions?

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<http://goodenergies.iwoe.unisg.ch>

