ETH zürich

Renewable Energy Investment Risks: Dynamics over Time and Drivers

16th IAEE European Conference

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Background on INNOPATHS

- EU Horizon 2020 Project

  "generate new, state-of-the-art low-carbon pathways for the European Union"
- Cross-cutting finance work-stream
- Project partners

Utrecht PIK Allianz

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Agenda

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Low-carbon electricity generation is key to lower emissions

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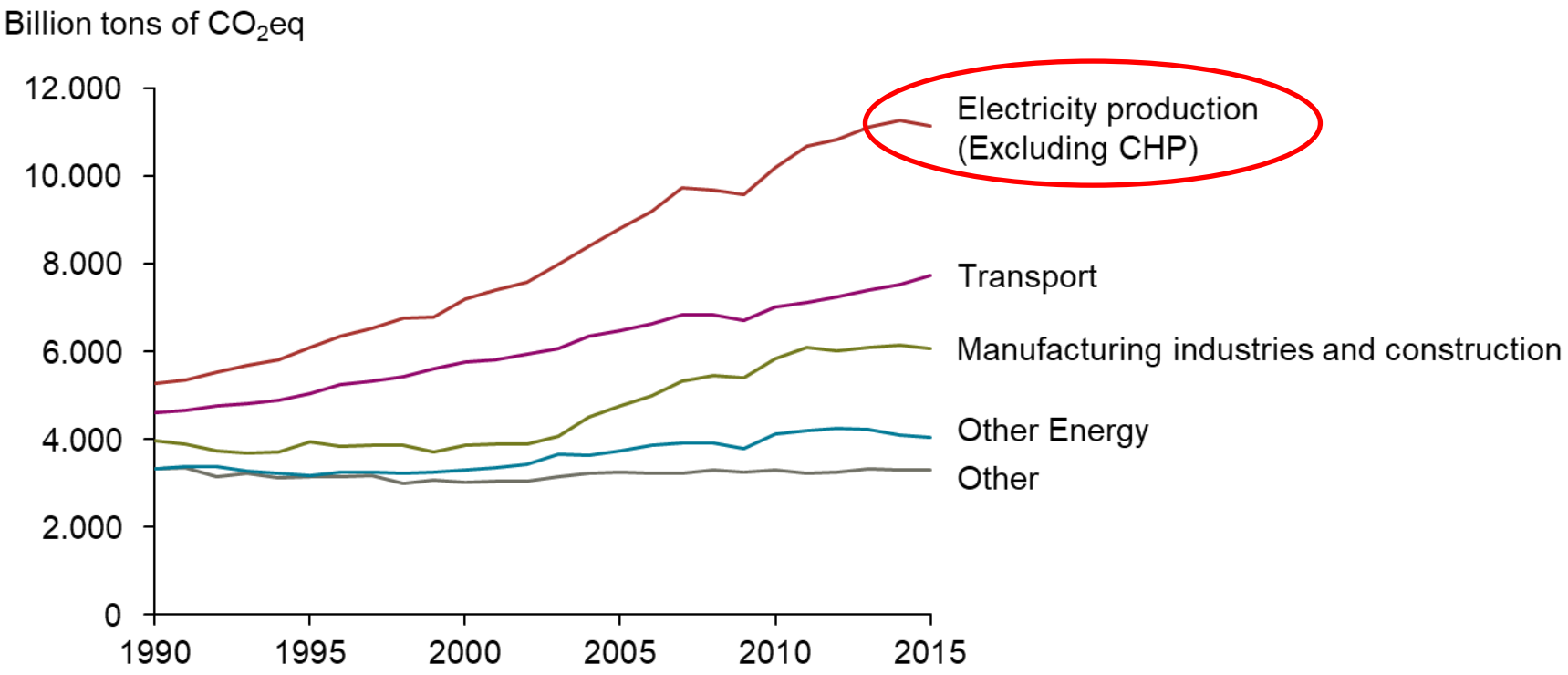
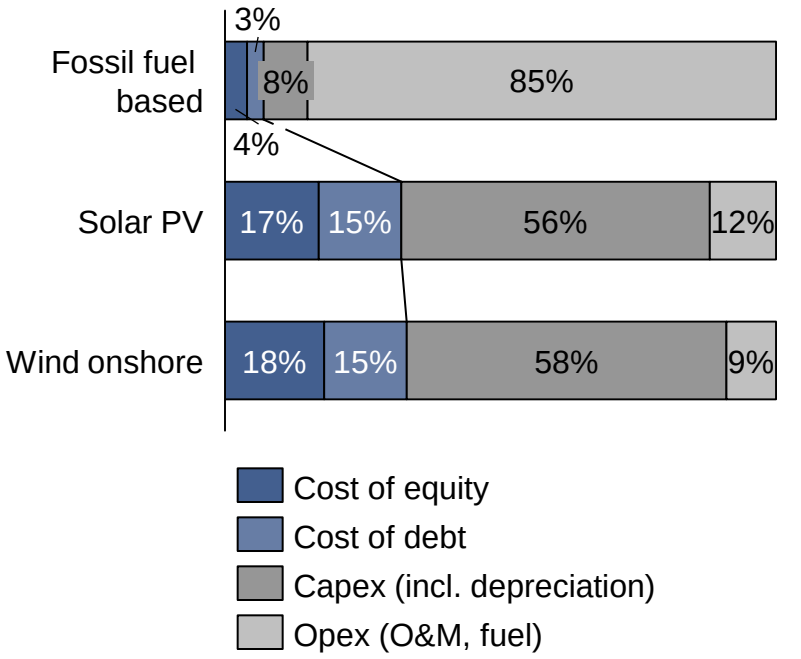


Source:
IEA, own calculations
Note:
Other Energy includes CHP plants, hearing plants and other energy industry own use.

Financing conditions matter – especially for RETs

Large upfront investment costs…



Note that this illustration assumes 5% cost of debt, 10% cost of equity, European fuel costs; fossil fuel based is the average of hard coal, natural gas and diesel.

Financing conditions improved strongly

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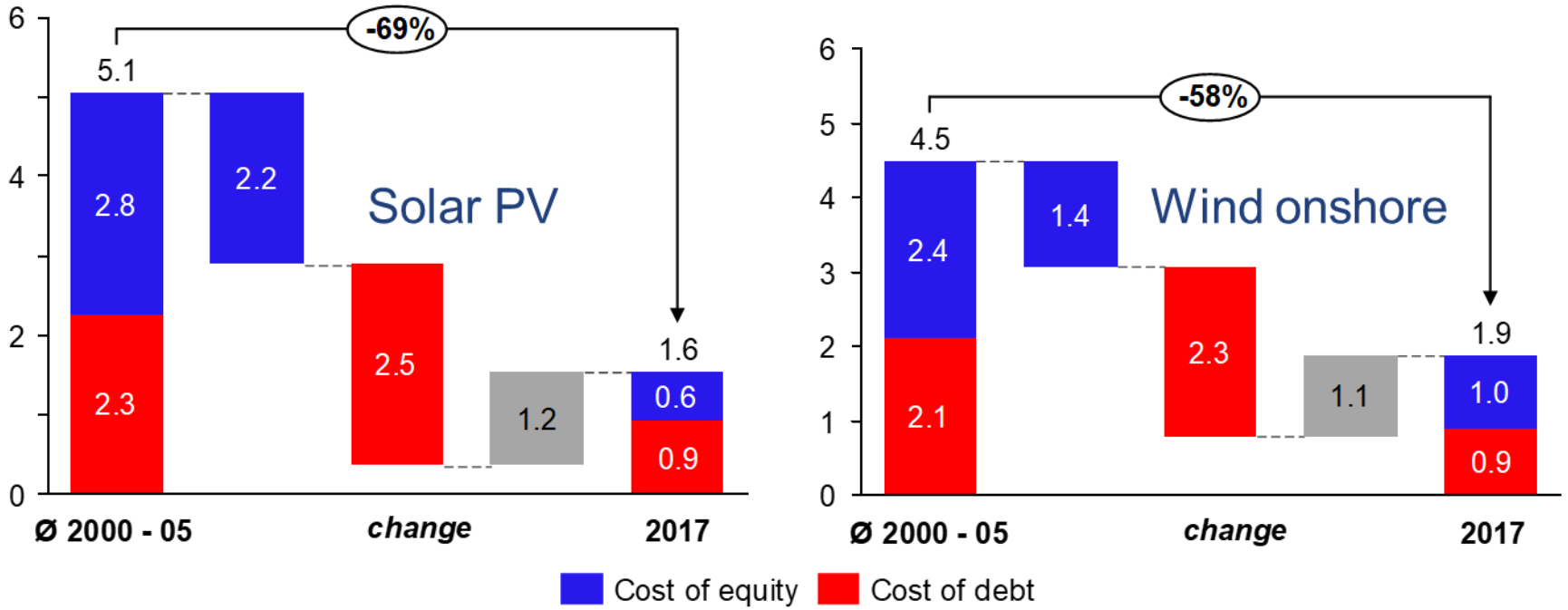

Source: Egli, Florian, Bjarne Steffen, and Tobias S Schmidt. 2018. “A Dynamic Analysis of Financing Conditions for Renewable Energy Technologies.” *Nature Energy*, November. Nature Publishing Group. doi:10.1038/s41560-018-0277-y.

Research question

What we know

- Risk premiums have decreased (Egli et al, 2018)
- These premiums should reflect market risk (cf. Merton, 1973)
- Especially for RET projects (cf. Steffen, 2018; Wüstenhagen & Menichetti, 2012)
- Public support policy enabled RET deployment, but is phasing-out (cf. McKinsey 2018; Pahle & Schweizerhof, 2016; May & Neuhoff, 2017)

What we do not know

- How has RET risk evolved over time?
- What are these dynamics dependent on?

Research question

- Are there similar risk premium dynamics in markets other than Germany, and what are their drivers?

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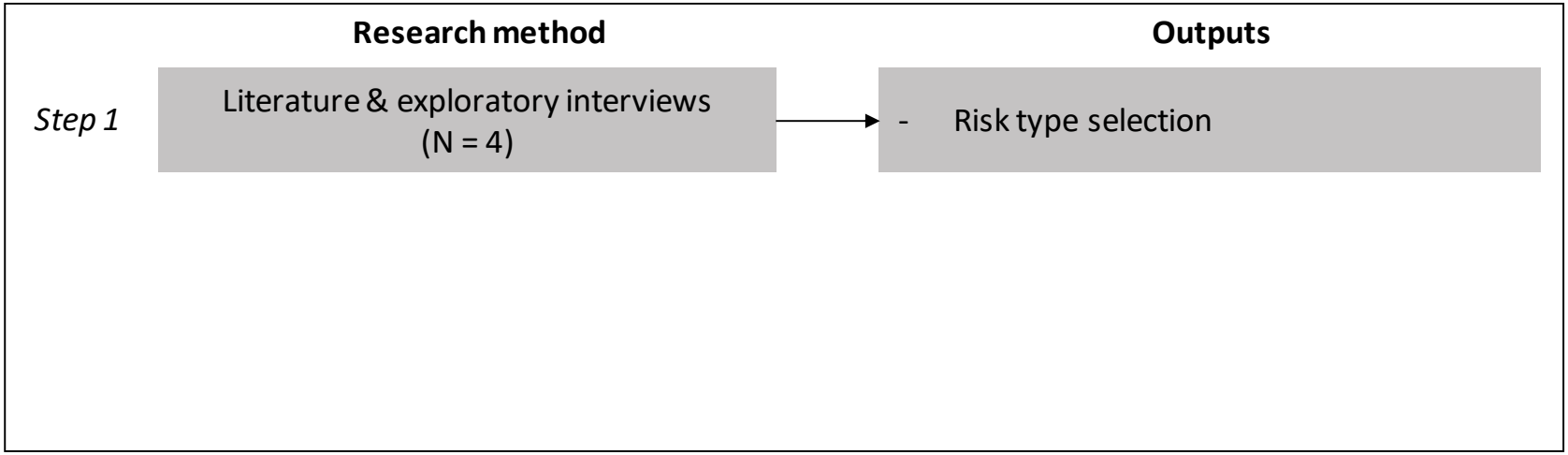
3-step research design



- Theoretical sampling (typical): Onshore wind and solar PV in Germany, Italy and the UK
- Time: Three points in time after financial crisis (2009, 2013, 2017)

Data

Sample

- 40 leading European RE investors.
- Average of 11 years of investment experience.
- 60 minutes interview (at least) per investor.
- Equally split between debt and equity.
- 869 coded interview segments.

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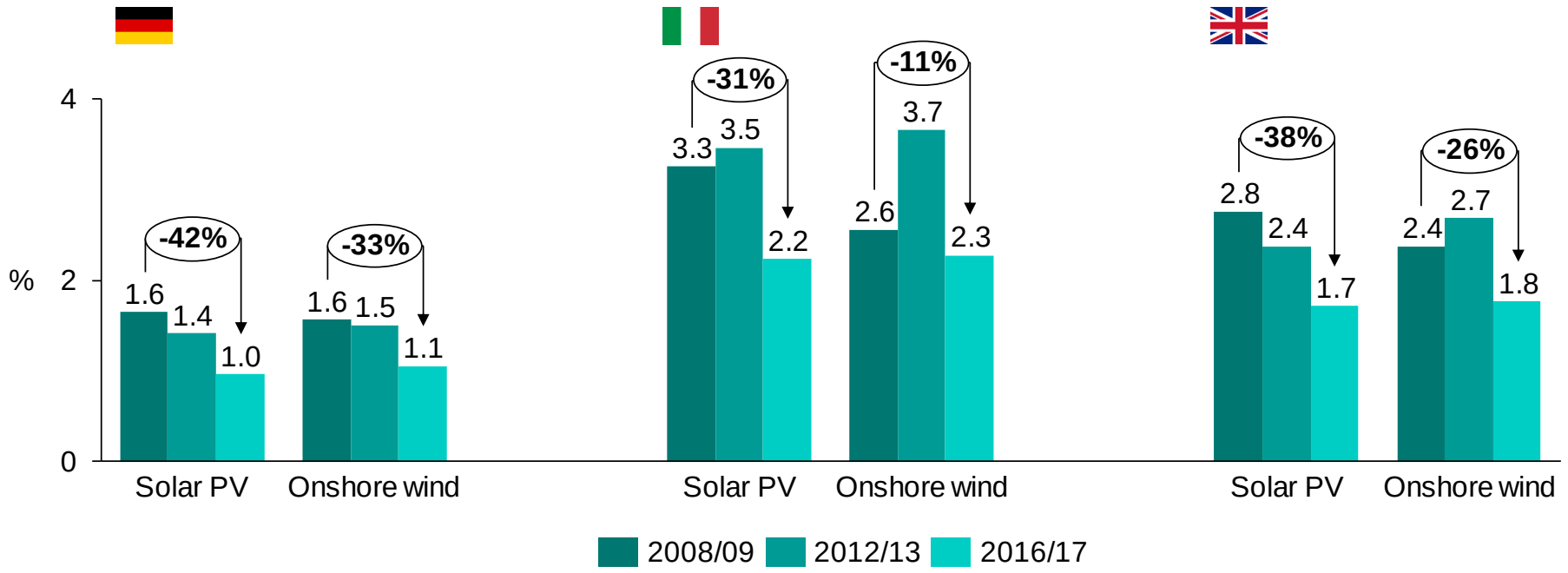
Debt margins over time



But what are the components of this risk?

22 peer-reviewed papers
&
4 exploratory interviews

Curtailment risk: The risk of lower revenues due to unexpected curtailment (e.g., grid bottlenecks).

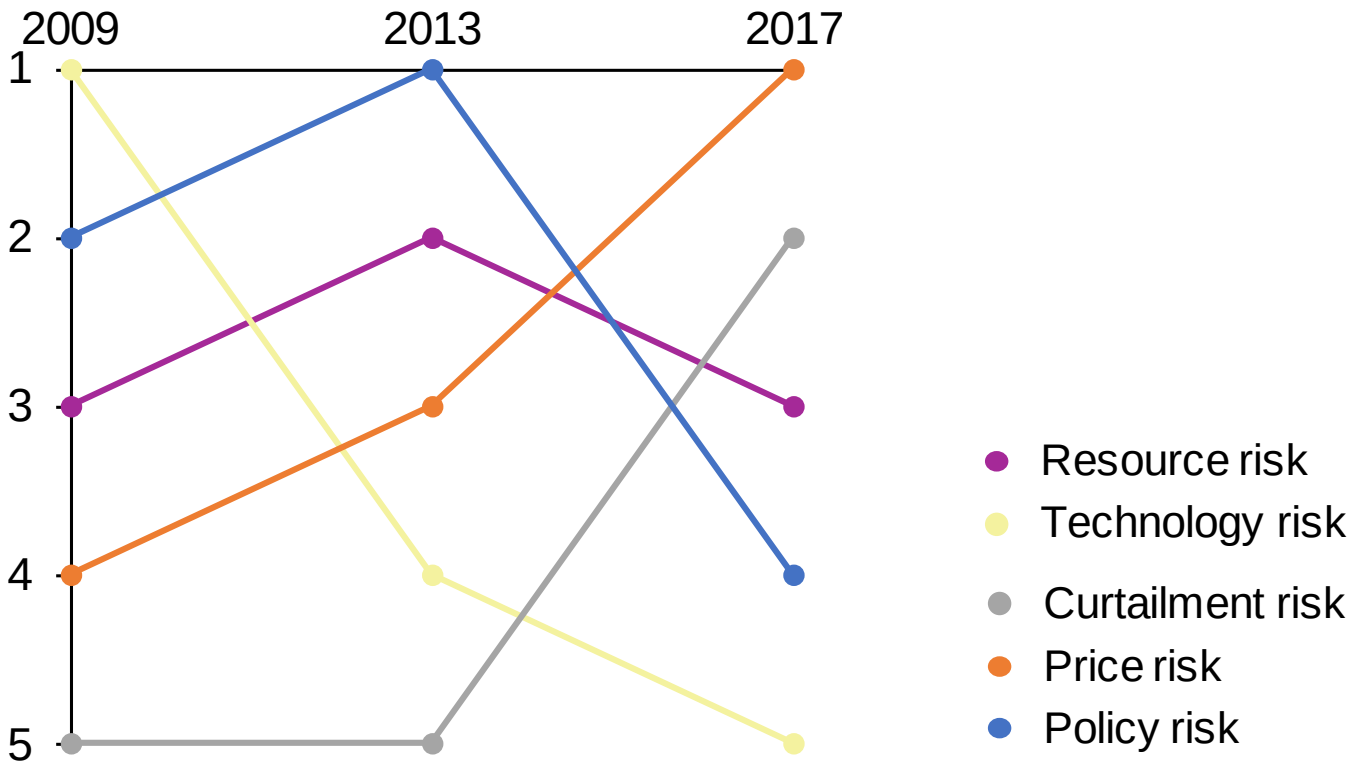
Policy (reversal) risk: The risk of lower revenues due to a retroactive change in a cornerstone RET policy, taxation or other policy measures (e.g., retroactive FiT change).

Price risk: The risk of price volatility within a stable policy regime (e.g., merchant price exposure under a feed-in premium policy).

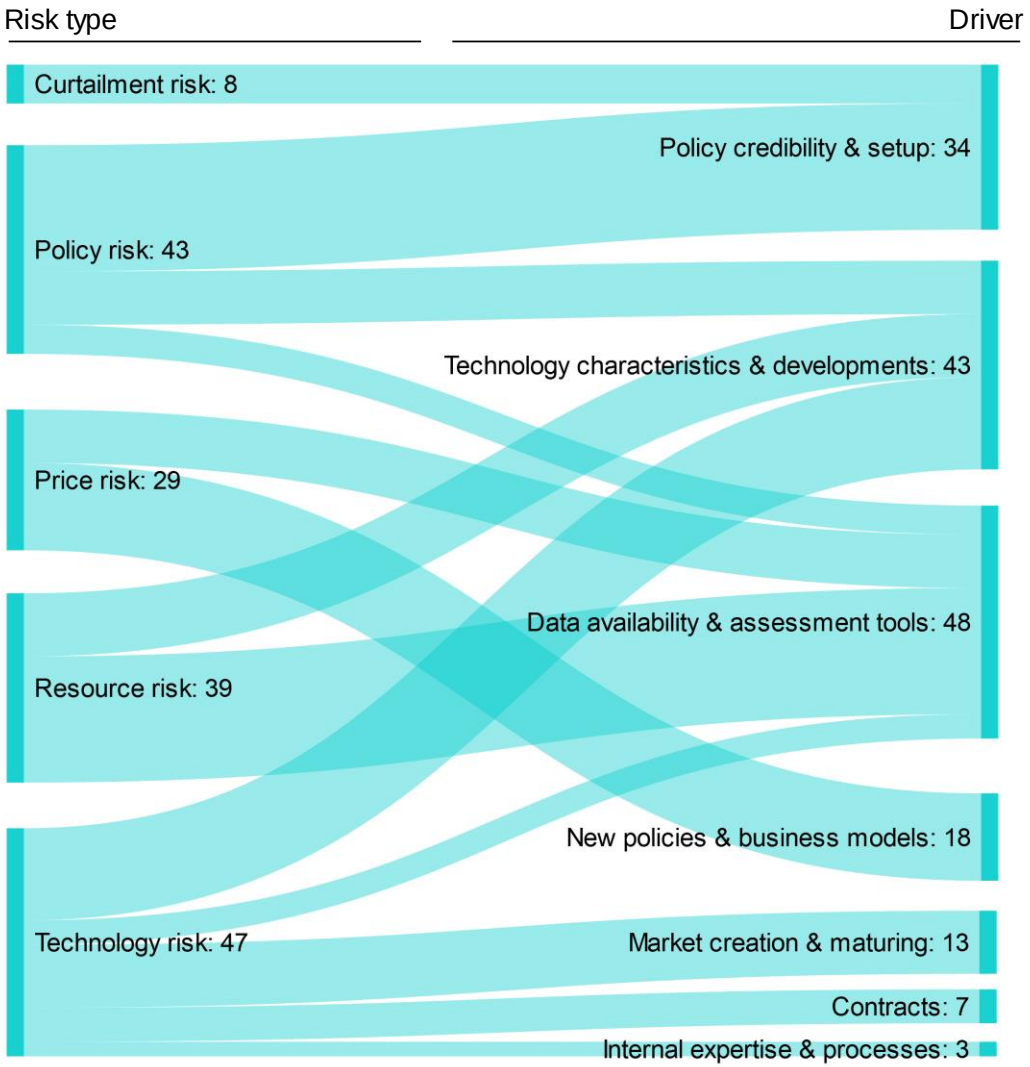
Resource risk: The risk of lower revenues due to inaccurate resource potential estimation (e.g., wind speed or solar irradiation).

Technology performance risk: The risk of lower revenues or higher maintenance costs due to the technology's novelty and unpredictability (e.g., faster degradation).

Ranking of risk types over time



Linking risk types to drivers



Risk driver quotes

- Curtailment risk
- Policy risk
- Price risk
- Resource risk
- Technology risk

- “The trend is that as you have more energy coming in at a given time, you are finding that the grid operator is going to shut you down […].”
- “The risk is decreasing the closer we get to competitiveness and market prices.”
- “You calculate project [revenues] over a long time, while you fully look into a black box regarding the future price [of electricity].”
- “Our solar PV portfolio is absolutely stable. […]. However, with wind resources, there is always an uncertainty that does not exist with solar irradiation, which is very stable calculable and predictable.”
- “The broader the phenomenon of renewable energy, the more cases you have and the more exchange [of experiences] happens across all levels (e.g., board members, conferences).”

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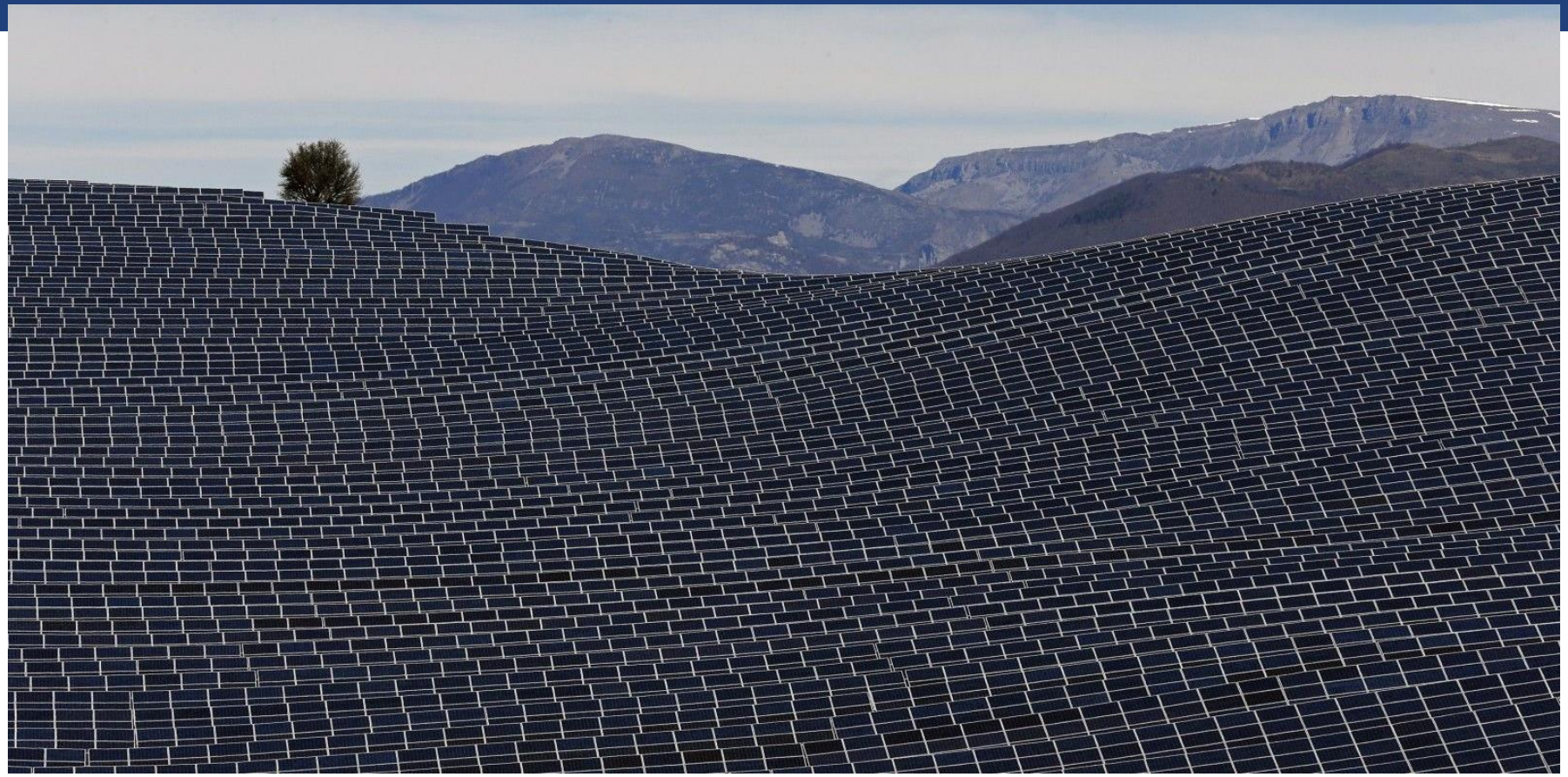
Some implications

For researchers:

- RET investment risks can be operationalised in a cash flow model.
- RET investment risks differ by technology and regulatory environment.
- Time lag between technical readiness and access to zero-premium finance needs to be investigated.

For policymakers:

- The cost of retroactive policy changes is higher in early deployment phases. This has implications on policy credibility.
- Lighthouse projects can create market confidence if data is shared and technical expertise provided.
- Exposing RET projects to market risks can threaten investment unless a proper investment ecosystem is in place.



Thank you very much!

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Backup: Interview sample

ID	Interview type	Current organisation	Current position	RET investment experience since
1	Structured	Debt provider	Head of Division Energy & Utilities	2006
2	Structured	Debt provider	Vice President	1990
3	Structured	Debt provider	Associate Director Project Finance & Capital Advisory	2011
4	Structured	Debt provider	Associate Director Infrastructure & Power Project Finance	2009
5	Structured	Debt provider	Executive Director Project Finance Renewable Energies	1997
6	Structured	Debt provider	Associate Director Global Infrastructure Debt	2013
7	Structured	Debt provider	Head Renewable Energies	1991
8	Structured	Debt provider	Project Finance Analyst	2007
9	Structured	Debt provider	Vice President Corporates & Small Business Project Finance	2007
10	Structured	Debt provider	Director Structured Finance Power & Renewables	2007
11	Structured	Debt provider	Director Structured Finance Utilities, Power & Renewables	2007
12	Structured	Debt provider	Senior Manager Structured Finance Renewable Energy	1999
13	Structured	Debt provider	Director Project & Structured Finance Utilities, Power and Renewables	2007
14	Structured	Debt provider	Director Corporate Strategy	1999
15	Structured	Debt provider	Head of Renewable Energies	1995
16	Structured	Debt provider	Head of Project Finance Origination Renewable Energies	2010
17	Structured	Debt provider	Managing Director Project & Acquisition Finance	2006
18	Structured	Equity provider	Head Risk Advisory	2005
19	Structured	Equity provider	CEO	2008
20	Structured	Equity provider	Founder and CEO	2013
21	Structured	Equity provider	Principal	2013
22	Structured	Equity provider	Partner	2009
23	Structured	Equity provider	Director Infrastructure Equity Investment Team	2006
24	Structured	Equity provider	Vice President Renewables	2015
25	Structured	Equity provider	CIO	2016
26	Structured	Equity provider	CEO	2016
27	Structured	Equity provider	Associate Director Energy & Cleantech	2006
28	Structured	Equity provider	Associate	2000
29	Structured	Public actor	Head Energy Services	2006
30	Structured	Public actor	Deputy Head Energy Management	2015
31	Structured	Public actor	CEO	2011
32	Structured	Public actor	Head Portfolio and Asset Management Renewable Energies	2010
33	Structured	Public actor	Vice President Origination and Structuring	2012
34	Exploratory	Equity provider	Founding Partner	2000
35	Exploratory	Equity provider	Investments Director	2006
36	Exploratory	Equity provider	Head Risk Advisory	2005
37	Exploratory	Equity provider	Partner	2009
38	Exploratory	Equity provider	Principal	2013
39	Exploratory	Other (former researcher)	Head Hybrid Power Solutions	2006
40	Exploratory	Public actor	Senior Investment Manager	2007
41	Exploratory	Public actor	Economist	2003

Sampling

- Exploratory interviews based on existing contacts
- Theoretical interview sampling
  1. Publicly available addresses of senior investment managers (BNEF)
  2. Innopaths networks (Allianz Climate Solutions)
  3. Snowball sampling

Sample

- 17 debt providers (13 commercial banks, 4 investment banks)
- 16 equity providers
- 7 public actors (4 utilities, 3 public investment banks)
- 1 former researcher

Backup: Risk types by country and technology

	Germany	Italy	UK
	2009 | 2013 | 2017	2009 | 2013 | 2017	2009 | 2013 | 2017
Curtailment risk	5th ↗ 4th ↗ 3rd	4th ↘ 5th ↗ 4th	5th → 5th → 5th
Policy risk	2nd → 2nd ↘ 5th	5th ↗ 1st ↘ 2nd	1st → 1st ↘ 2nd
Price risk	1st ↘ 3rd ↗ 2nd	3rd ↗ 2nd ↗ 1st	4th → 4th ↗ 1st

	Solar PV	Onshore wind
	2009 | 2013 | 2017	2009 | 2013 | 2017
Resource risk	4th ↗ 3rd ↘ 4th	1st → 1st ↘ 2nd
Technology risk	3rd ↘ 4th ↘ 5th	4th → 4th → 4th