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CITIES



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SWITZERLAND

Differentiating the costs of capital for low-carbon technologies

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Swiss Federal Office of Energy SFOE

Sweet Edge is a research project sponsored by the Swiss Federal Office of Energy's SWEET programme and coordinated jointly by UNIGE and EPFL

sweet swiss energy research
for the energy transition

EDGE 

Why care about costs of capital for renewable energy?

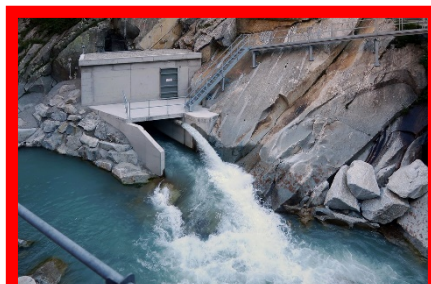
The main focus of research on financing and cost of capital for renewables is on large scale technologies



Research focus on onshore wind, offshore wind and utility-scale solar (>1MW)



Decentralized energy systems are composed of multiple low carbon technologies



Little or no empirical knowledge on CoC for other technologies



In many countries only smaller-scale low carbon technologies are feasible

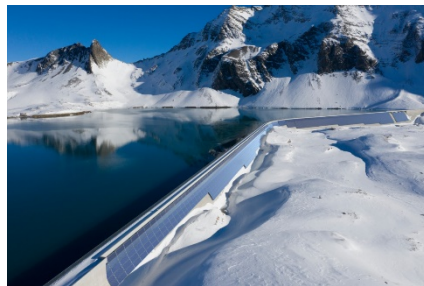


Reasons inhibiting large-scale technologies

- Local opposition
- Regulations
- Geography
- Visual impact
- Etc.



Energy system models use uniform cost of capital values for low-carbon technologies



Analysis leading to energy system scenarios that misrepresent investment risk

Vastly different investment risk!



The costs of capital for low carbon technology differs across three crucial dimensions

... difference between solar PV and green hydrogen

Investment risk (e.g., technology risk)

1st dimension

Investors have different risk profiles and return expectations (e.g., ENEL vs. ENI)

Investor types

2nd dimension

Project financing vs. balance sheet finance

Financing types

3rd dimension



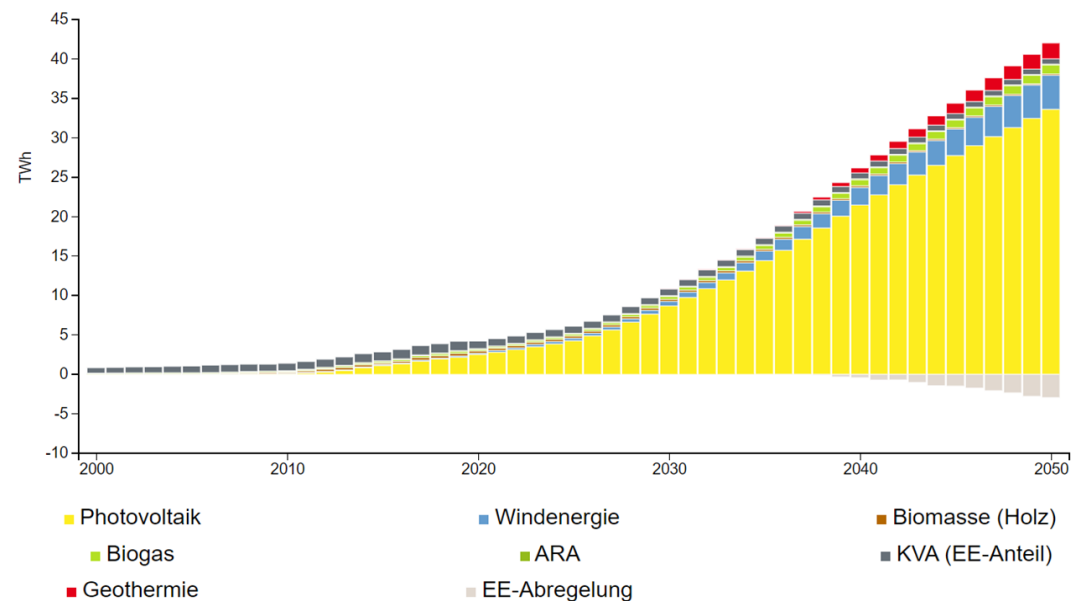
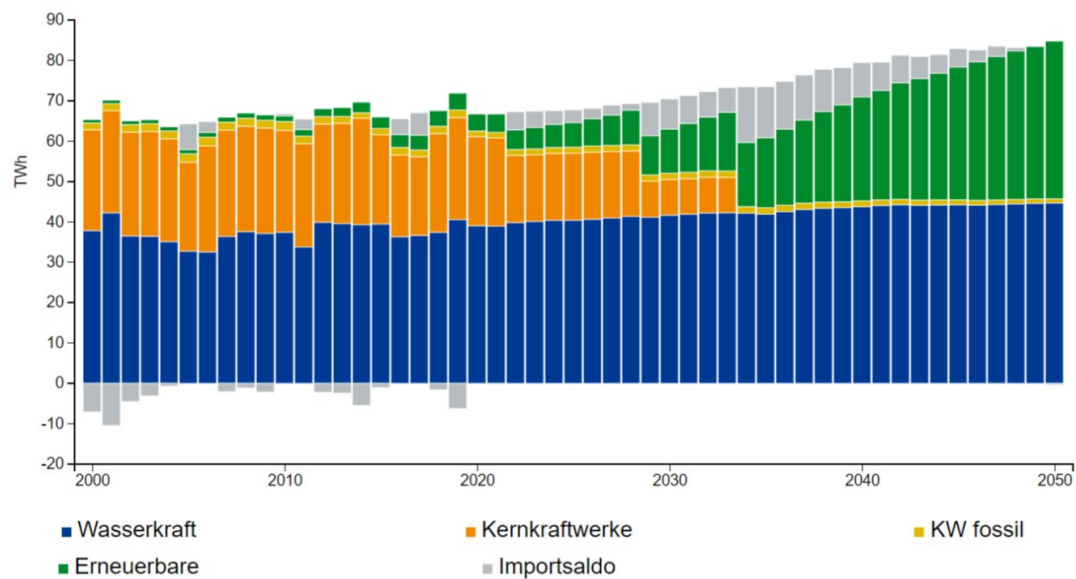
A decorative graphic on the left side of the slide, consisting of a right-pointing arrow shape with a gradient from orange to green and a thin white outline.

Research questions

1. What are the CoC for various low carbon technologies?
2. How do the CoC differ between investor types?
3. What financing structures do the different investors apply?

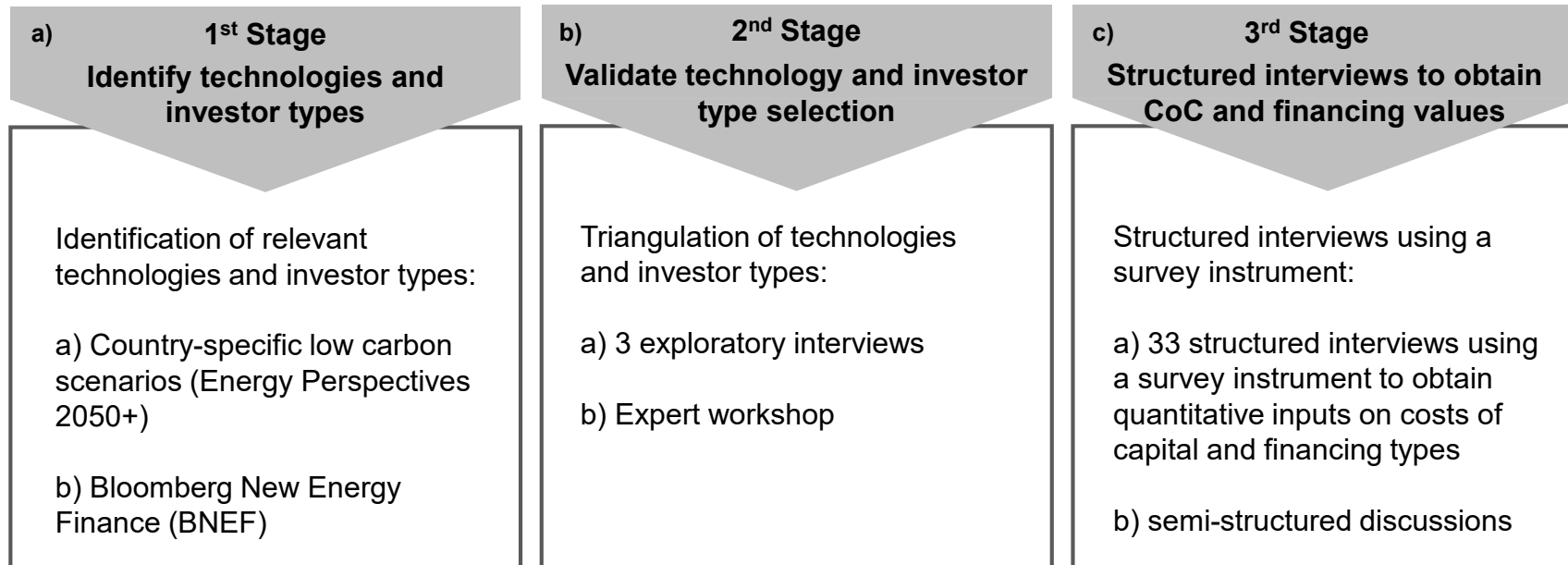


Research case



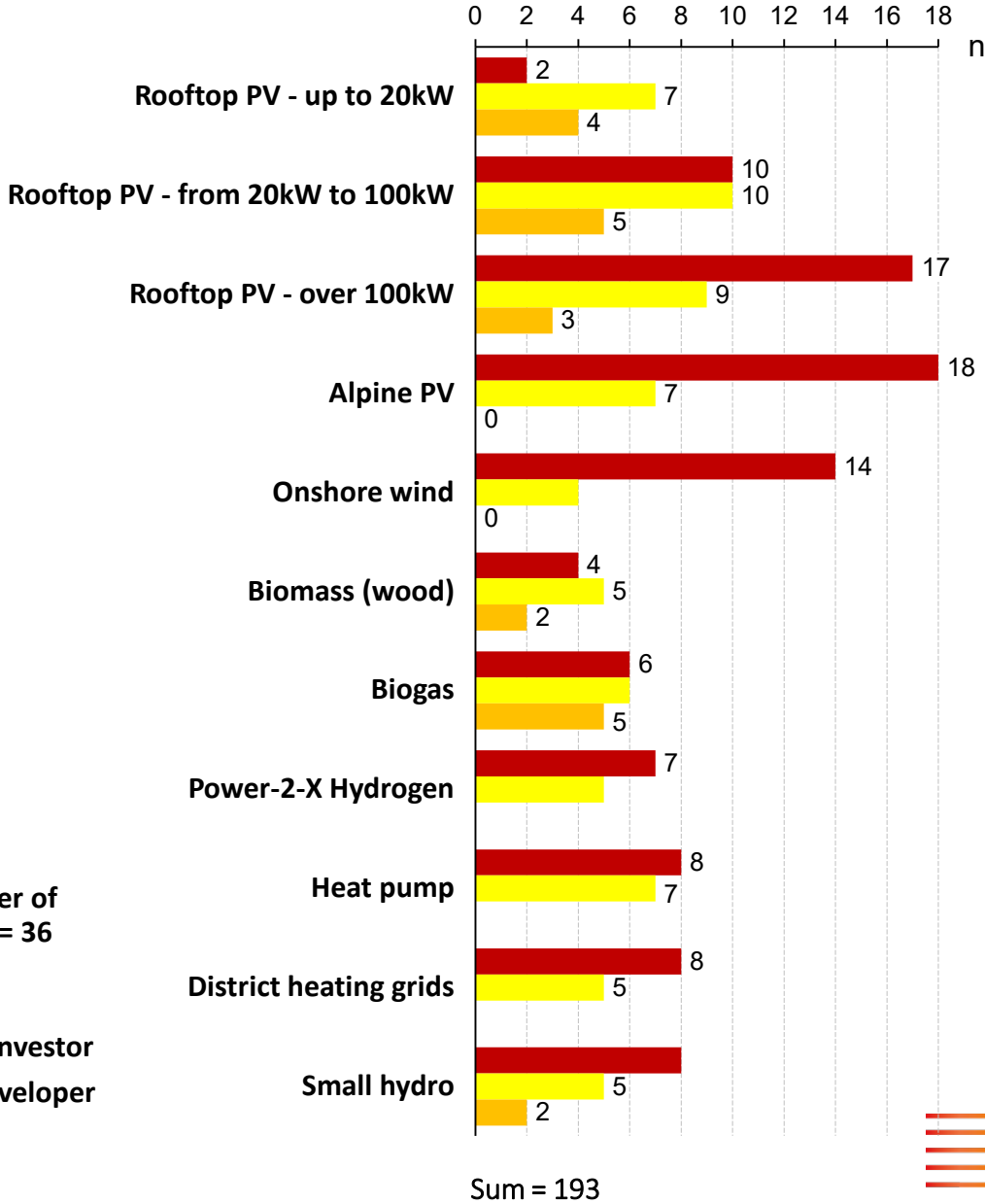


Methods



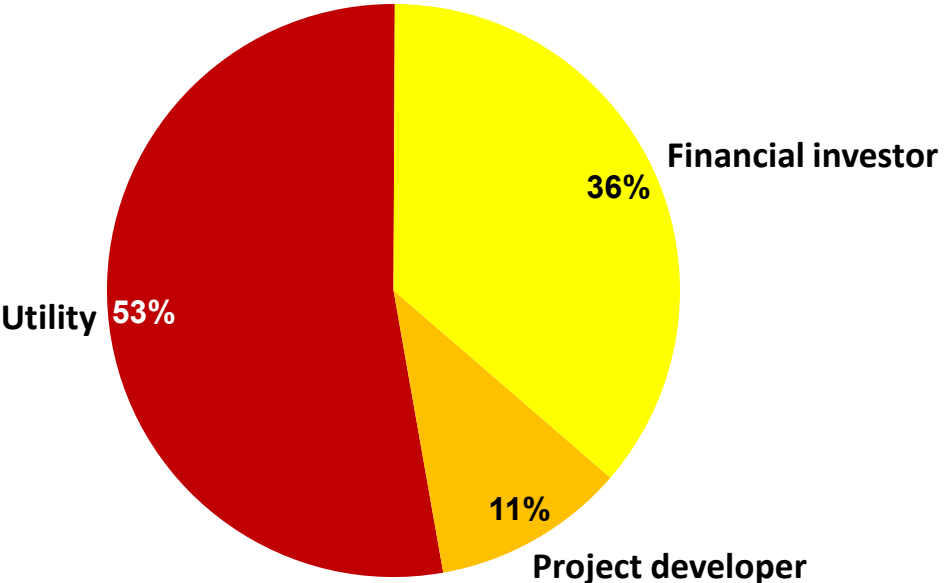
Collected cost of capital estimates

Number of estimates per technology and investor type



Total number of interviews = 36

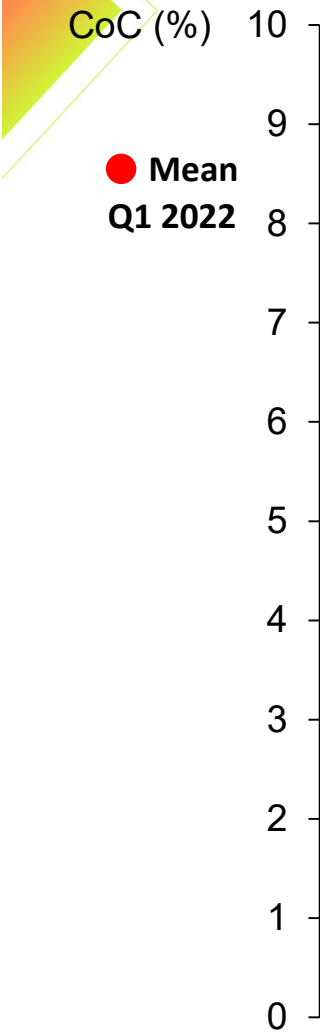
- Utility
- Financial investor
- Project developer



n – estimate. One interviewee can provide multiple estimates

Results

Cost of capital estimates between technologies

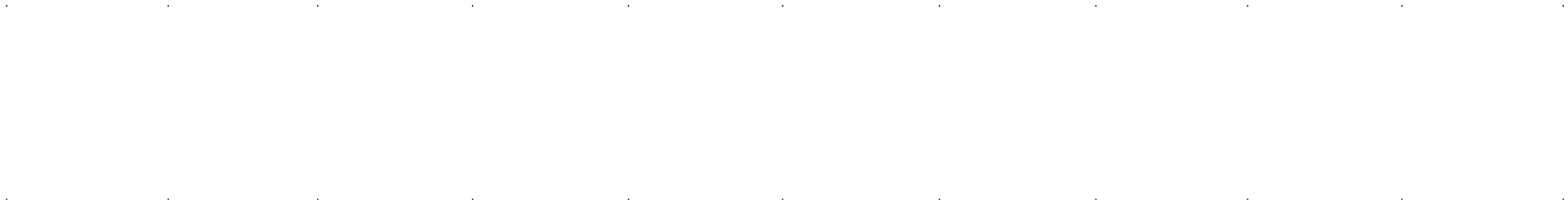


Results



- Project financing
- Balance sheet financing
- Household savings
- Other

Differences in financing types between investors and technologies



*in case of missing charts we collected less than two inputs



Discussion and conclusions

Key findings

1. large variance in CoC between technologies – 4.2 percentage point (pp) between small-scale rooftop PV and green hydrogen – **differentiate between technologies CoC in energy system analysis**
2. major variation in CoC within single technology categories – 6 pp difference for single rooftop PV categories, implying to **differences between business models.**
3. onshore wind markup indicates to **importance of local market maturity**, not just technology maturity (CH versus DE)





Discussion and conclusions

The generalizability of the findings to other countries

- the risk stacking from solar PV to more complex technologies similar to other studies (solar generally has lower risk than wind)*
- utilities in other markets also mainly use balance sheet financing**

Swiss specific aspects

- legal uncertainty and permitting time for onshore wind specific to CH
- small average project sizes limit involvement of banks in financing



*Steffen (2020), Egli et al. (2018), Roth et al. (2021), European Economics (2018)

** Steffen (2018)

Thank you for the attention!

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About the SWEET EDGE project and support slides



SWEET-EDGE project

EDGE wants to fast-track the growth of locally sourced decentralized renewable energy in Switzerland.

The project aims to ensure that by 2035 and 2050, when ambitious shares of renewable energy are reached, the Swiss energy system is designed and operated in a technically and economically optimal and secure way, and that it is well positioned in the European markets.

[Home - SWEET EDGE \(sweet-edge.ch\)](https://sweet-edge.ch)



Research partners



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Implementation partners



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SIEMENS





Our objectives in SWEET EDGE

Understand the **financing landscape** for renewable energy in Switzerland

- **Investors:** who invests in which technologies and regions?
- **Types of finance:** what financing sources and structures are used?
- **Costs of capital:** what are the costs of capital for individual technologies?

Inform the EDGE **energy system modeling**

- **Model discount rate:** what discount rates should our EDGE energy system model use?

Derive **policy implications** for provision of capital at low cost

- **Financing needs:** after the EDGE model derives the total investment needs required to decarbonize Switzerland, derive conclusions on who will provide this capital (financing needs)
- **Policy implications:** what can policymakers do to make capital cheaper?





Interview overview

- approximately **45 min**
- open questions
- data and anonymization
 - Chatham House Rule applies ^[1]: No statement will be linked to a respondent or institution
 - recording or note taking with option for subsequent review by participant
 - you can withdraw during the interview or any time prior to the publication of the results
- the interviews are held either in English or German

[1] When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed." - See more at: <https://www.chathamhouse.org/about/chatham-house-rule>



Interview questions and topics

Alps, Midlands, Cities

Investor type

- Commercial bank
- Public bank
- Pension fund
- Insurance company
- Private equity
- Project developer
- Technology provider
- Utility
- Household
- Family-owned farm
- Association
- Energy foundation
- Municipalities
- Other

Financing structure

- Project financing
- Balance sheet financing
- Other

Cost of capital

- WACC
- Cost of debt
- Cost of equity
- Loan duration
- Other

Solar PV

- Rooftop PV
- Alpine PV

Onshore wind

Biomass

- Agricultural (e.g biogas)
- Woody (e.g pyrolysis)

Power-2-X

- Electrolyser (H_2)

Small hydro

Heat pumps

District heating

QUESTIONS

Market

1. In which **Swiss regions** and **tech** are investments taking place?
2. Which **investor types** invest into these technologies?
3. What **revenues** or **remuneration** do these projects have?

Financing

4. Could you estimate the **costs of capital and financing conditions** for technologies in CH?

([see online survey](#))

