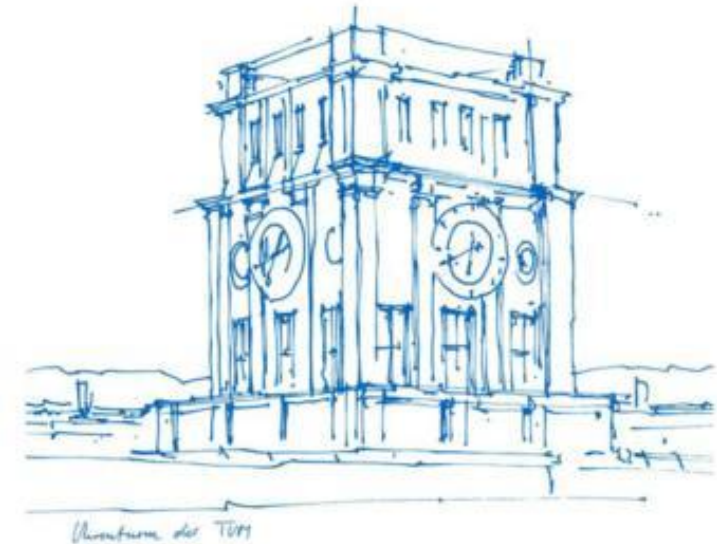


# Advancing Green Electricity Claims with Granular Matching: Motivations, Challenges and Pathways to Successful Implementation

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– 7. HKNR-Fachtagung, Umweltbundesamt Dessau, April 2nd 2025 –



## Motivation

**Academic literature calls for a revision of the current ‘electricity accounting system’ to improve transparency, better reflect physical availability, and support real emissions reductions.**

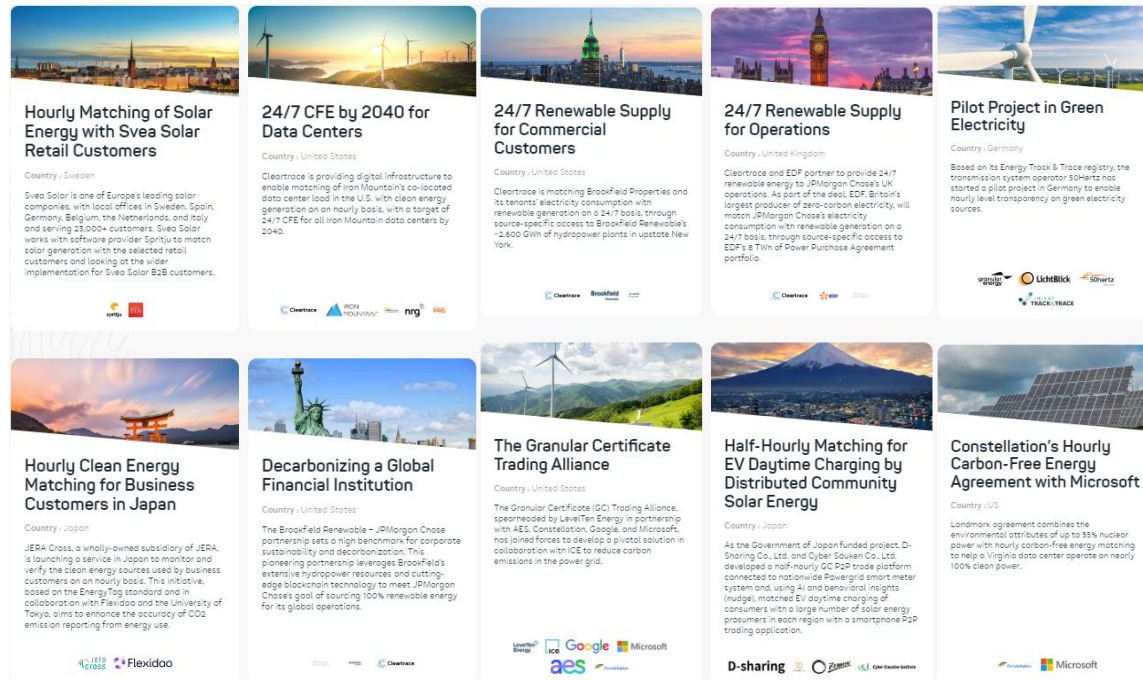
NON-EXHAUSTIVE

Prior Work	Focus	Proposed Solutions	Peer-reviewed Journal Paper	Published Working Paper
Mulder & Zomer (2016)	GOs	Impose <b>restrictions on international trade</b> <u>or</u> <b>restrict issuance of new certificates</b>		
Hamburger (2019)	GOs	<b>Consider physical barriers of electricity transport</b>		
De Chalendar (2019)	RECs	<b>Revision in corporate carbon accounting</b> to leverage benefits of different RES at certain times of day		
Herbes et al. (2020)	GOs	<b>Establish environmental standards</b> and minimum criteria for performance via state-led labeling		
Bjorn et al (2022)	EACs	<b>Revision of current accounting guidelines</b> , fearing inflated estimate of the effectiveness of mitigation efforts due to EACs		
Bjorn & Brander (2023)	EACs	<b>Proposal for revision of accounting guidelines</b> on basis of principles that include <b>better reflection of physical availability</b>		
Xu & Jenkins (2024)	RECs	<b>Hourly matching</b> of green electricity production and -demand <b>within same grid region</b> by corporates		
Riepin & Brown (2024)	GOs	beneficial in terms of emission reductions, yet costly		
Langer et al. (2024)	EACs	<b>Hourly matching to reduce system emissions</b>		
Holzapfel et al. (2024)	GOs	Impose <b>restrictions on international GO trade</b> to ensure that each country meets own renewable generation targets <u>or</u> <b>prohibit international GO trade</b> to prevent market distortions <u>or</u> <b>limit GO trade to actual physical electricity transmission</b> to better align EAC accounting with real-world energy flows.		
Scholta & Blaschke (2024)	GOs	Implement <b>seasonal matching as short-term solution</b> and <b>hourly matching as solution in the long run</b>		

## Motivation

There are already players in the market applying more granular matching practices. The shift towards this approach could further accelerate due to ongoing revisions of relevant regulatory frameworks.

### 29 EnergyTag Case Studies in 5 continents



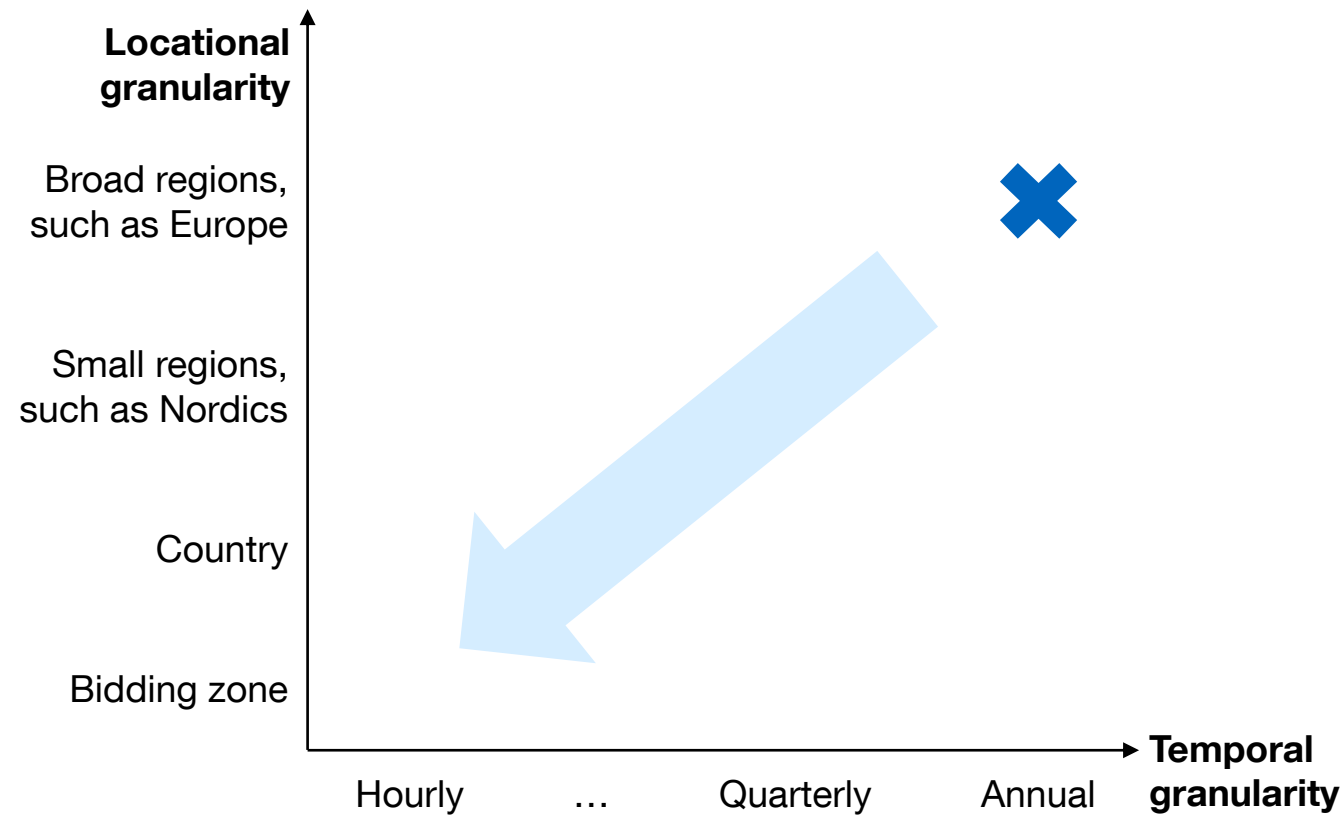
### Scope 2 Revisions GHG Protocol

- **As of now**, GHG protocol supports **annual matching without hardly any locational restrictions**
- On the agenda for the revision is amongst others the **future of this approach**
- **Strong lobbying efforts** by major tech companies in the U.S. are fueling **public discourse and education**, see exemplarily recent reporting of Financial Times (Bryan et al. 2024)

Source: EnergyTag (2024), WBCSD & WRI (2022), WRI (2015, 2024)

## Theoretical Background

The term *granular matching* refers to both a temporal and a locational dimension. It is often used interchangeably with 24/7 matching, typically referring to hourly intervals within the same country.



Source: Own Illustration

## Research Gap & Research Design

**Granular matching could emerge as the future of renewable energy accounting, but research on its implementation is lacking. Pilots in the field offer potential for qualitative case study research.**

### Research Gap:

Little prior literature on the implementation of granular matching

Several pilots on granular matching as of now unstudied in literature

Motivation	Theory	Method	Preliminary Results	Panel Discussion (DE)
<div>Motivation</div> <div>Academic literature calls for a revision of the current 'electricity accounting system' to improve transparency, better reflect physical availability, and support real emissions reductions.</div>	<div>100% RENEWABLE</div>	<div>Non-compliance</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>Prior Work</div>	<div>Focus</div>	<div>Proposed Solutions</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>Muller &amp; Zomer (2016)</div>	<div>GOs</div>	<div>Impose restrictions on international trade or restrict issuance of new certificates</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>Hamburger (2019)</div>	<div>GOs</div>	<div>Consider physical barriers of electricity transport</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>De Chalendar (2019)</div>	<div>RECs</div>	<div>Revision in corporate carbon accounting to leverage benefits of different RES at certain times of day</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>Herbes et al. (2020)</div>	<div>GOs</div>	<div>Establish environmental standards and minimum criteria for performance via state-led labeling</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>Bjorn et al. (2022)</div>	<div>EACs</div>	<div>Revision of current accounting guidelines, fearing inflated estimate of the effectiveness of mitigation efforts due to EACs</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>Bjorn &amp; Brander (2023)</div>	<div>EACs</div>	<div>Proposal for revision of accounting guidelines on basis of principles that include better reflection of physical availability</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>Xu &amp; Jenkins (2024)</div>	<div>RECs</div>	<div>Hourly matching of green electricity production and -demand within same grid region by corporates beneficial in terms of emission reductions, yet costly</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>Repin &amp; Brown (2024)</div>	<div>GOs</div>	<div>Hourly matching to reduce system emissions</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>Langer et al. (2024)</div>	<div>EACs</div>	<div>Impose restrictions on international GO trade to ensure that each country meets own renewable generation targets or prohibit international GO trade to prevent market distortions or limit GO trade to actual physical electricity transmission to better align EAC accounting with real-world energy flows.</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>Holzappel et al. (2024)</div>	<div>GOs</div>	<div>Implement seasonal matching as short-term solution and hourly matching as solution in the long run</div>	<div>Non-compliance</div>	<div>Non-compliance</div>
<div>Scholta &amp; Blaschke (2024)</div>	<div>GOs</div>	<div></div>	<div>Non-compliance</div>	<div>Non-compliance</div>

Hanna Scholta | Advancing Green Electricity Claims with Granular Matching: Motivations, Challenges and Pathways to Successful Implementation



Motivation	Theory	Method	Preliminary Results	Panel Discussion (DE)
<p><b>Motivation</b></p> <p>There are already players in the market applying more granular matching practices. The shift towards this approach could further accelerate due to ongoing revisions of relevant regulatory frameworks.</p>				
<p><b>29 EnergyTag Case Studies in 5 continents</b></p>				
<p><b>Scope 2 Revisions GHG Protocol</b></p> <ul style="list-style-type: none"> <li>As of now, GHG protocol supports annual matching without hardly any locational restrictions</li> <li>On the agenda for the revision is amongst others the future of this approach</li> <li>Strong lobbying efforts by major tech companies in the U.S. are fueling public discourse and education, see exemplarily recent reporting of Financial Times (Bryan et al. 2024)</li> </ul>				

### Research Design:

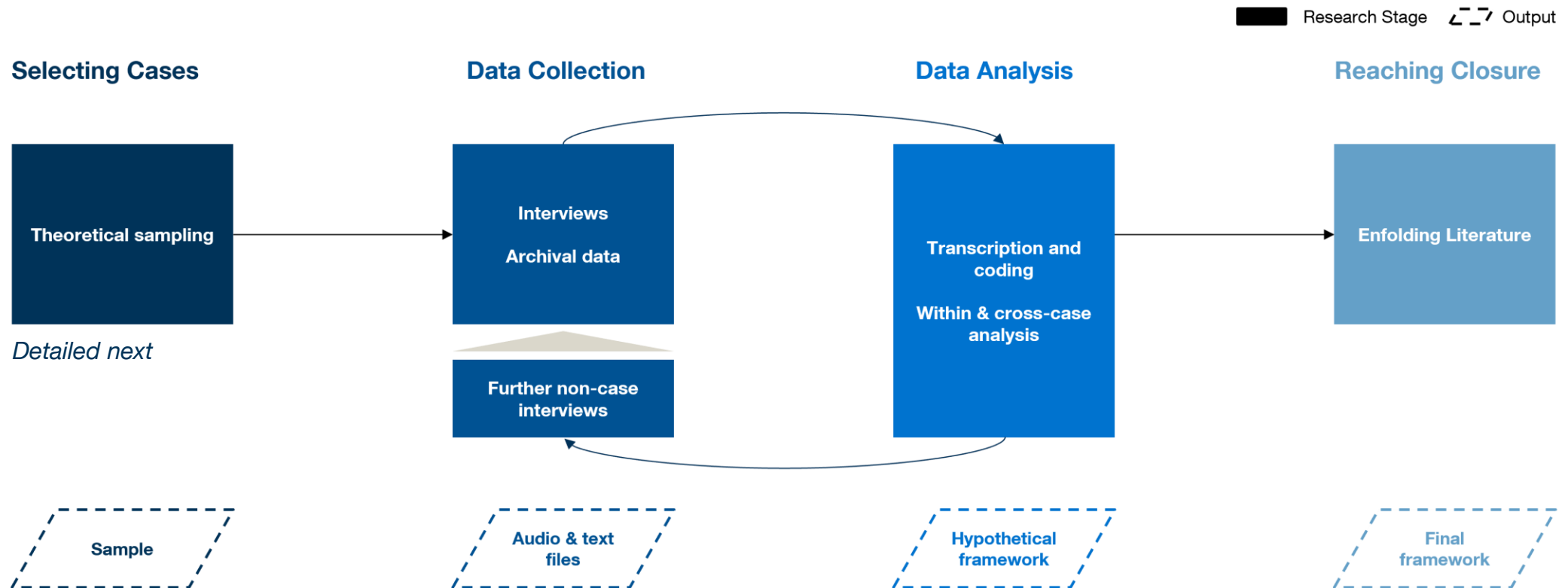
Qualitative multiple case study research on implementation of granular matching following Eisenhardt (1989, 2021) to build theory

- 1) What are the **main motivations** to adopt more granular matching for green electricity claims?
- 2) What are the **key challenges** when adopting more granular matching for green electricity claims?
- 3) **How could more granular matching** for green electricity claims be navigated and implemented successfully?



## Outline of Research Project

**Following the process of case study research, my research endeavor on granular matching passes the following research stages: case selection, data collection, data analysis & reaching closure**



Source: Own illustration based on „Process of Case Study Research“ by Eisenhardt (1989)

## Theoretical Sampling

**Building on key sampling principles within the field of qualitative case study research, I theoretically sample my cases via a two-stage process.**

*“There is **no specific formula for case selection**, but rather an appreciation of the need to consider whether the **focal phenomenon is likely to be present** and where **similarities and differences across cases** should best occur” (Eisenhardt, 2021)*

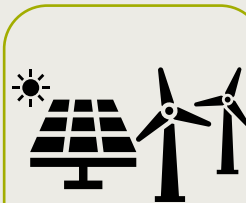
All cases where “the focal phenomenon is likely to be present”

All cases “where similarities and differences across cases should best occur”

All cases **with touchpoints to the implementation of granular matching worldwide**

Only cases **from Europe** 

from **within** and **across the different areas** of granular matching landscape



**Green Electricity Provision**



**Matching Solution Provision**



**Registering & Certification**



**Green Electricity Consumption**



**Standard Setting & Industry Alliances**

Source: Eisenhardt (1989, 2021); Goia et al. (2022)



## Current Sample and State of Data Collection

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**So far, I have conducted 13 expert interviews. My sample currently covers 11 cases from all areas except that of “Green Electricity Consumption” with the onboarding of further cases ongoing.**

Area	Company	First Touchpoint with Granular Matching	Interviewee Position at Company	Interview Date	Additional Data
Green Electricity Provision	Alpha	2015-2020	Energy Strategy Specialist	25.09.2024	Further documentation of granular matching efforts (where available), such as company press releases, press releases of project partners, EnergyTag case descriptions, company presentations
	Epsilon	2020-2025	Portfolio Specialist	19.11.2024	
	Eta	2010-2015	Business Development Expert	16.12.2024	
Matching Solution Provision	Theta	2015-2020	Partnerships & Policy Lead	17.01.2025	
	Iota	2020-2025	Commercial Operations Manager	31.01.2025	
	Kappa	2020-2025	Senior Executive	18.03.2025	
	Lambda	2020-2025	Commercial Operations Lead	19.03.2025	
Registering & Certification	Gamma	2020-2025	Energy Policy Analyst	15.10.2024	
	Delta	2020-2025	Business Analyst	31.10.2024	
	Zeta	2025-2020	Energy Certification Specialist <sup>1</sup>	10.12.2024	
Standard Setting & Industry Alliances	Beta	2020-2025	Board Representative	26.09.2024	
			Executive Director	25.11.2024	
			Advisory Board Member	12.12.2024	

Note: 1 Interviewee is former employee of case company



## Drivers of Granular Matching

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**Systemic, technological, and regulatory pressures challenge the function and impact of the current GO system.**

### Developments Driving the Adoption of Granular Matching



#### **Pressures on the GO- & Energy System:**

**Criticism** of the current GO system, worsening grid **congestion**, and growing pressure to **align renewable expansion with grid needs**



#### **Technological & Demand Shifts:**

Digitalization & greater **data availability**, and expected substantial **increases in energy demand** in specific sectors



#### **Regulatory & Societal-Driven Pressure:**

Increasing **environmental consciousness** among consumers, and stronger **sustainability regulations** and reporting requirements

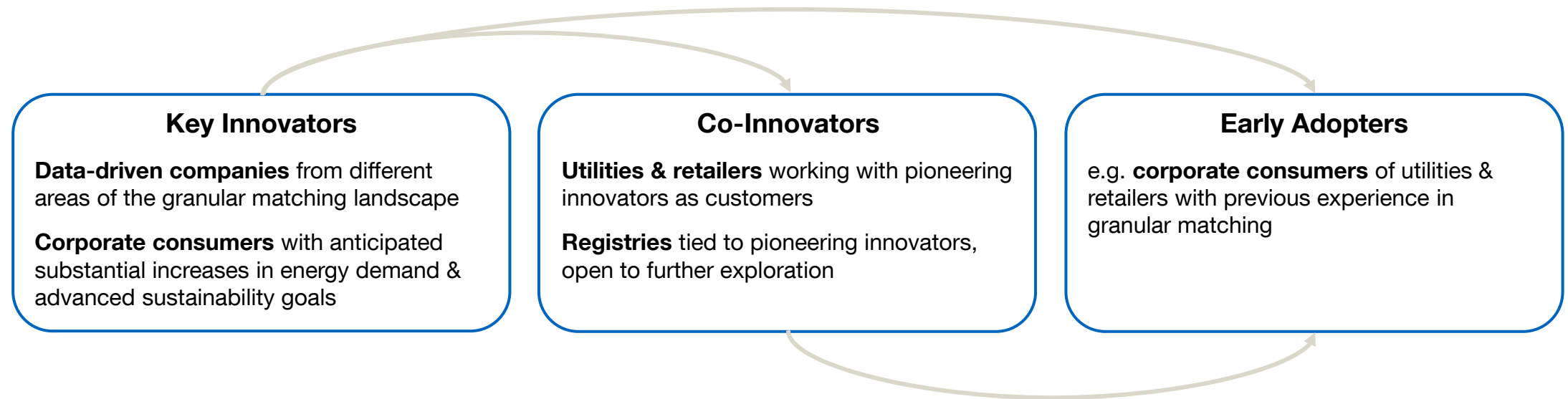
Source: Own Analysis

## Adopters of Granular Matching

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**Key innovators, co-innovators, and early adopters are shaping the emerging landscape, with innovators playing a leading role in initiating the shift toward granular matching.**

### Typology of Adopters in Granular Matching



Source: Own Analysis

## Opportunities of Granular Matching

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**Granular matching can raise awareness among green consumers and create price signals to drive RES expansion during times of scarcity, support storage adoption, and leverage demand flexibilities.**

### OPPORTUNITIES

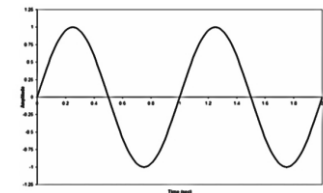
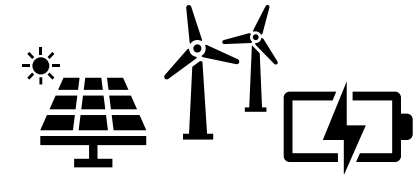
- **Raise awareness among green consumers** for dynamics of renewable supply and demand
- **Create price signals** that reflect real-time imbalances in renewable generation and green demand.

Price sensitivity,  
Environmental sensitivity

**FACILITATES**

### CONSEQUENCES

- **More renewable** energy generation during times of scarcity
- **Higher battery** & other storage adoption
- Usage of **demand flexibilities**



**Resilient and 100% renewable energy system**

Source: Own Analysis

## Challenges of Granular Matching

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**Granular matching encounters eight challenges across a wide range of areas that must be navigated successfully to allow for a broader adoption.**

### 1 Market Resistance & Institutional Inertia

*“there's a lot of stakeholders and organizations who have been set up to function in today's way of buying green electricity. And [...] then you'll always have [...] push back against change” – Beta 2*

### 2 Regulatory & Policy Challenges

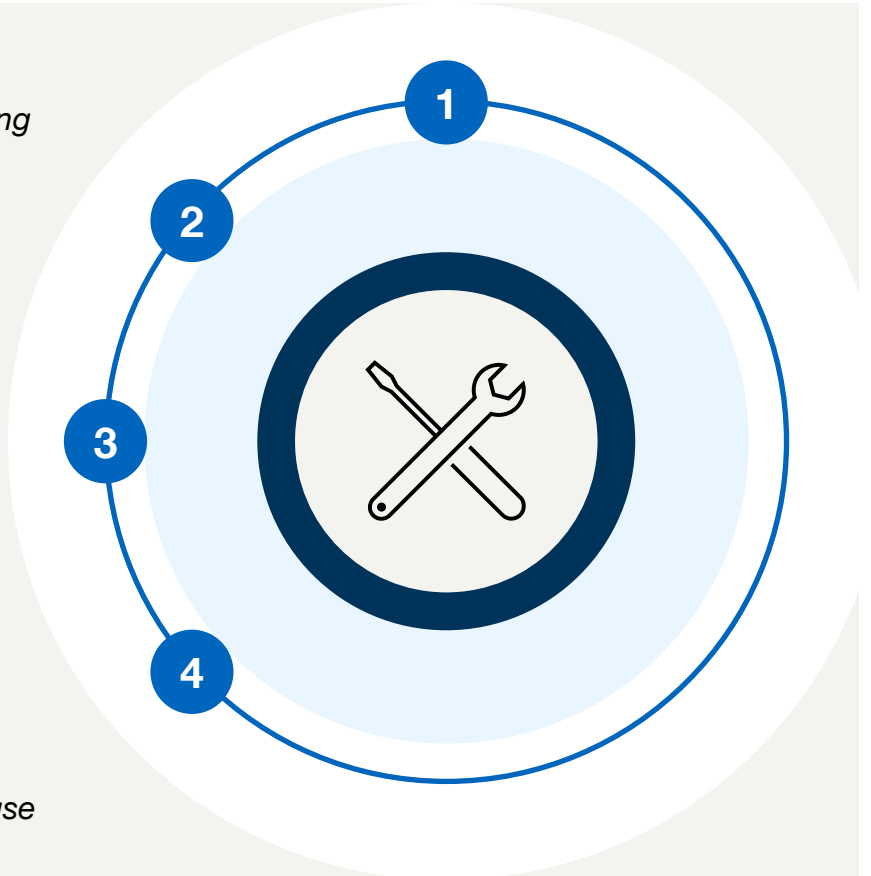
*“customer demand is not yet as high” – Iota; “I think we need a more systemic change there.” – Beta 2*  
**vs.** *“We must make sure that we don't cater this system for the most flexible and most energy-intensive consumers” – Zeta*

### 3 Awareness & Knowledge Gaps

*“Many companies also don't know what 100% green electricity means, or rather, doesn't mean, and would possibly do more to promote it if they knew.” – Iota; “It's complicated and it requires more of the consumers. So, it's more challenging to explain.” – Alpha*

### 4 Data Governance & Privacy Challenges

*“We need production and consumption data. Unlike the GOs at the moment, [...], we now need data broken down to quarter-hourly or hourly resolution. So, the data needs are exploding in particular because consumers are also coming on board.” – Delta*

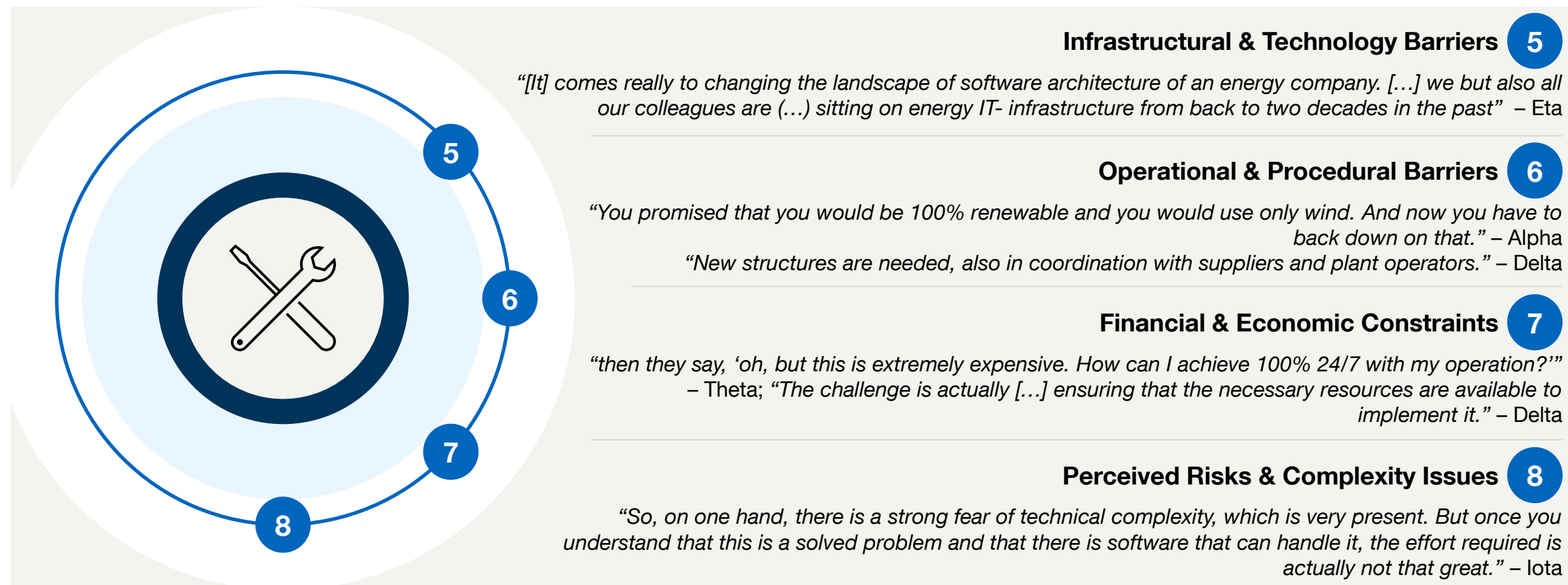


Source: Own Analysis

## Challenges of Granular Matching

WORK IN PROGRESS

**Granular matching encounters eight challenges across a wide range of areas that must be navigated successfully to allow for a broader adoption.**



Source: Own Analysis

## Enablers of Granular Matching

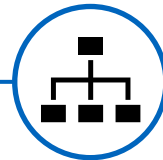
WORK IN PROGRESS

**While a phased approach creates a practical pathway toward implementing granular matching, internal transformation and strategic partnerships are essential to overcoming increases in complexity.**



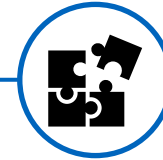
### Phased Approach

- **Derive hourly matching score to better understand current position**, instead of aiming to publicly claim 100% match on hourly level
- Use score internally to **strategically improve position**



### Transformation

- **Shift from manual to more automated processes** to avoid exponential increase in effort
- **Rethink IT infrastructure** to facilitate more data-driven way of working



### Smart Collaboration

- **Collaborate where internal knowhow/capabilities are scarce** (especially for first time implementation)
- **Leverage demand from large customers** to overcome firm internal resistance

Source: Own Analysis

## Zusammenfassung und Thesen für die Panel Diskussion

**Eine schrittweise Implementierung, Digitalisierung und sinnvolle Kooperationen können Granularität ermöglichen. Es braucht regulatorische Unterstützung, klare Benchmarks und zielführende Vorgaben.**

### Schritt für Schritt

- **Stündlicher Matching-Score zur besseren Einschätzung des aktuellen Stands** statt öffentlichen Beanspruchens 100% stündlichen Matchings
- Interne Nutzung des Scores, um **Position strategisch zu verbessern**

### Digitalisierung

- **Übergang von manuellen zu stärker automatisierten Prozessen**, um einen exponentiellen Anstieg des Aufwands zu vermeiden
- **Überdenken der IT-Infrastruktur**, um eine stärker datengetriebene Arbeitsweise zu ermöglichen

### Kooperationen

- **Zusammenarbeit, wo internes Know-how und Fähigkeiten begrenzt** sind (insbesondere bei der erstmaligen Implementierung)
- **Nutzung der Nachfrage großer Kunden**, um interne Widerstände im Unternehmen zu überwinden

**Freiwilliges granulareres Matching wertschätzen**, welches funktionierende Schnittstelle zu aktuellem System besitzt (Keine Doppelzählung)

**Granulares Matching erleichtern** (z.B. Koppeln von stündlichen Erzeugungsprofile an monatliche GOs & regulatorische Unterstützung von Stromdatenaustausch)

**Klare Benchmark-Werte für granulareres Matching (z.B. stündlich/innerländisch) etablieren**, um gesellschaftliche Erwartungen zu steuern

**Vorgabe zu saisonalem Matching** zur besseren Nutzung bestehender Systeme und zur Förderung von Systemverbesserungen

**Einführung von stündlichem Matching für energieintensive Unternehmen** aufgrund ihres umfangreicheren Know-hows und Ressourcen im Energiesektor



## Ausblick

GET INVOLVED

## Erfahrungen mit granularerer Bilanzierung von Grünstrom in Europa (zeitlich und/oder lokal)?

### Nehmen Sie an unserer Studie teil!

**Wir bieten:**

- ✓ **Flexible Termingestaltung:** 60-minütiges Interview via Teams/Zoom zu einem Termin nach Ihren Wünschen im April/Mai 2025
- ✓ **Anonymität garantiert:** Ihre Erkenntnisse werden anonymisiert, um Ihre Identität zu schützen
- ✓ **Früher Zugang zu Ergebnissen:** Erhalten Sie exklusiven, frühen Zugang zu umfangreichen Ergebnissen vor deren Veröffentlichung



**Bei Interesse kontaktieren Sie uns gerne über die unten angegebenen Kontaktdaten!**

**Hanna Scholta**

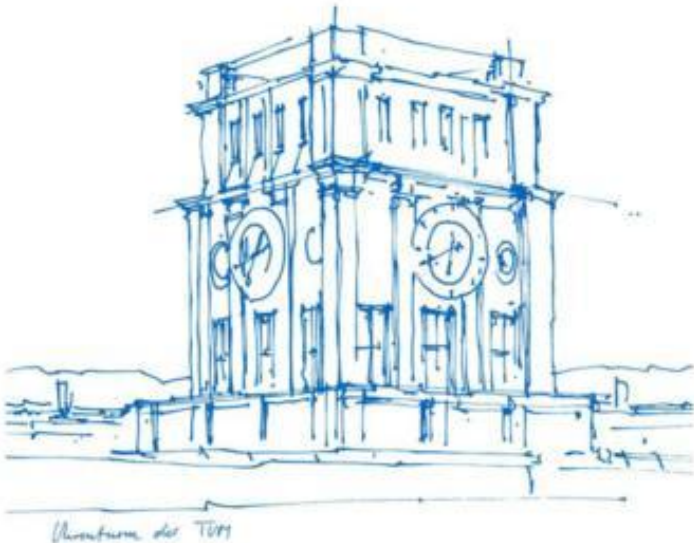
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