

Batteriforskning; nuläge, trender och internationella samarbeten

Tentativa resultat

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Presentation outline

1. About Future Mobility
2. Battery research study
 - Purpose
 - Methods
 - Trends
 - Leading research groups
 - Collaborations
3. Conclusions



About Future Mobility

Purpose: Strengthened research and innovation networks between Sweden and the United States within sustainable mobility

Management: Lindholmen Science Park

Funding: Vinnova, the Swedish Innovation Agency

Time period: 2022 – 2025

FUTURE
MOBILITY

A long-exposure photograph of a road at night, showing vibrant light trails in shades of cyan, magenta, and white. The road surface is dark, and a white line runs down the center, leading towards a bright light source in the distance.

What we offer

- Vetted networks
- Precise matchmaking
- Opportunity scouting
- Practical inspiration
- Funding assistance

Battery research study – purpose and data

Gain knowledge about battery research in the world. Specifically:

- Which research environments are leading?
- How do Swedish actors collaborate?

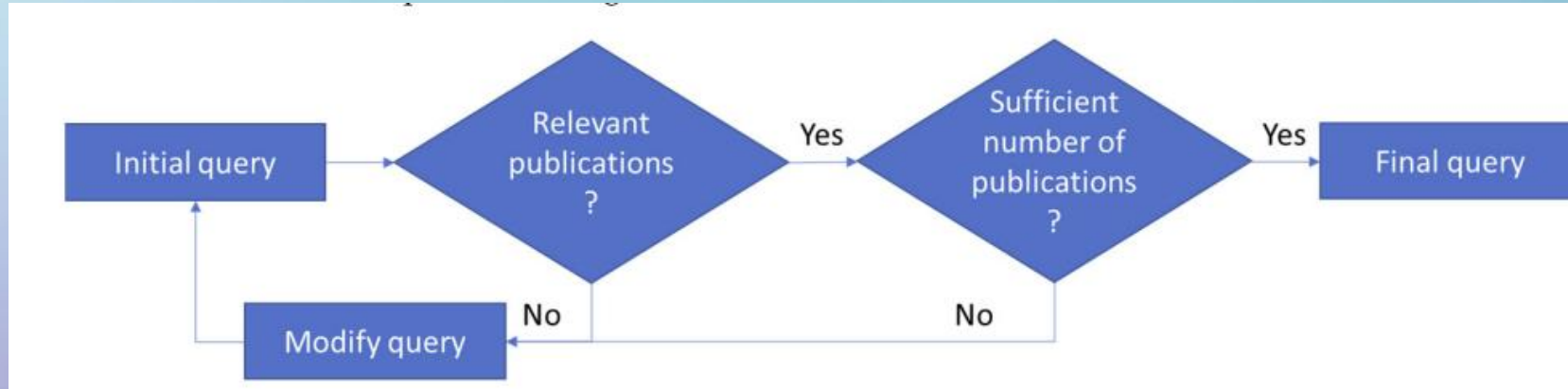
Data comes from:

- Scientific publications (Scopus)
- Interviews with battery researchers, editors of battery journals and people in the automotive industry.

Many thanks to the Swedish Energy Agency for the funding!

Method - overview

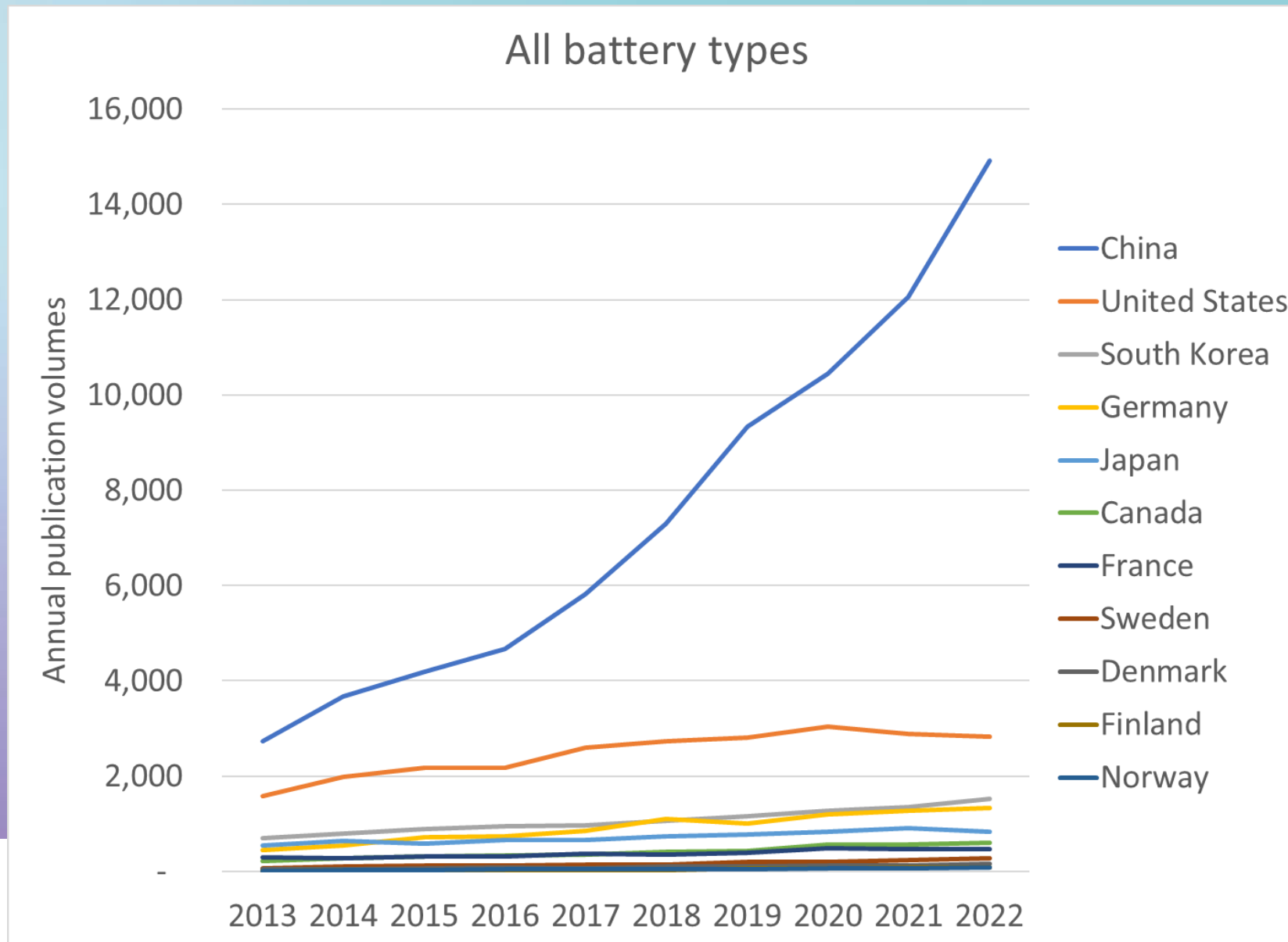
Search for Scopus publications using search terms to be matched in the title or abstract of each publication. Within the broad query for "battery publications" using ~170 search terms, specific battery chemistries and other focus areas were also studied.



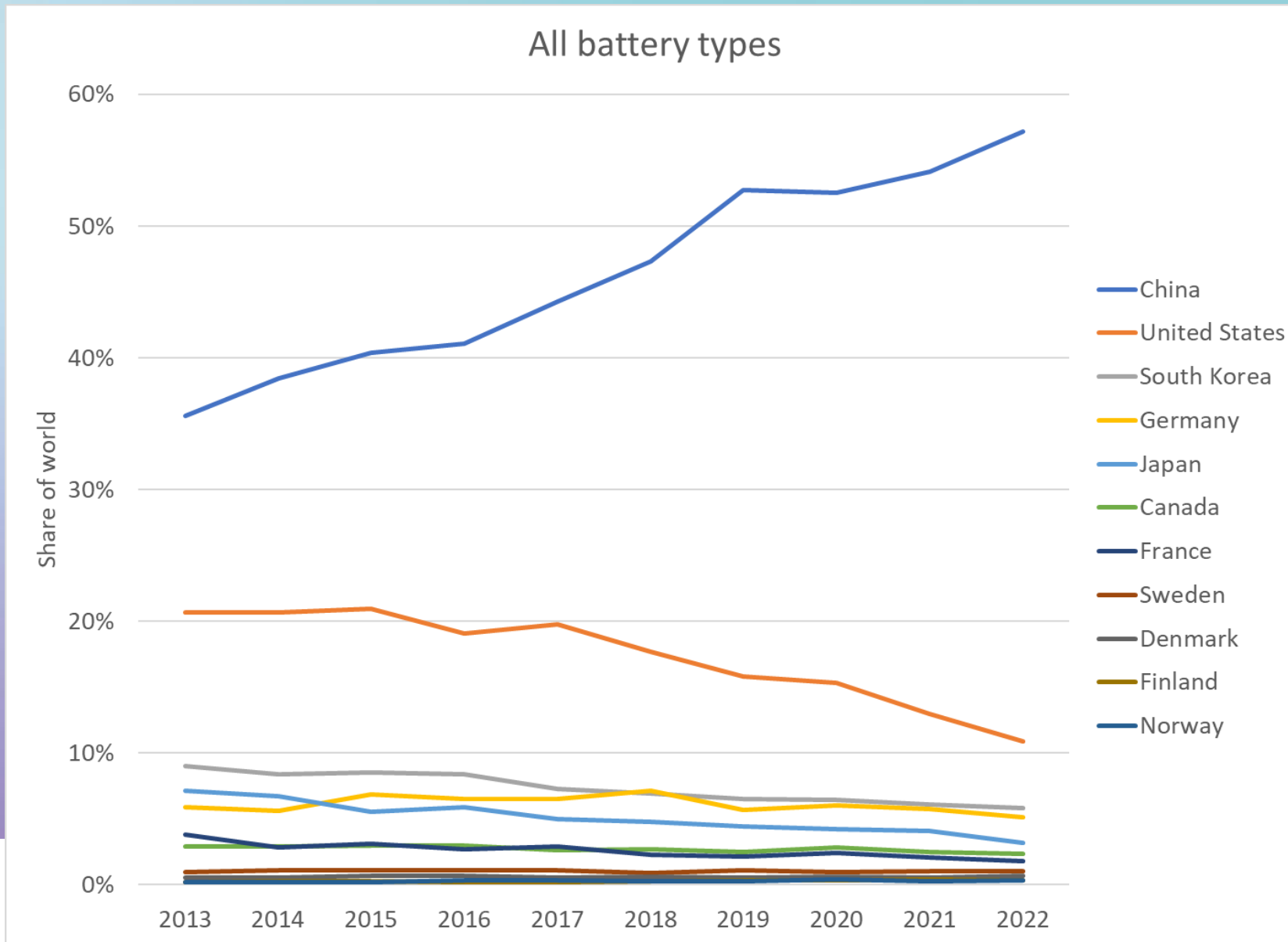
Semi-structured interviews (Teams) with notes made available to the respondents for check.

Figure from: Pohl, H.; Karlström, M. Academic and Corporate Vehicle Electrification Research. *World Electr. Veh. J.* 2023, 14, 71. <https://doi.org/10.3390/wevj14030071>

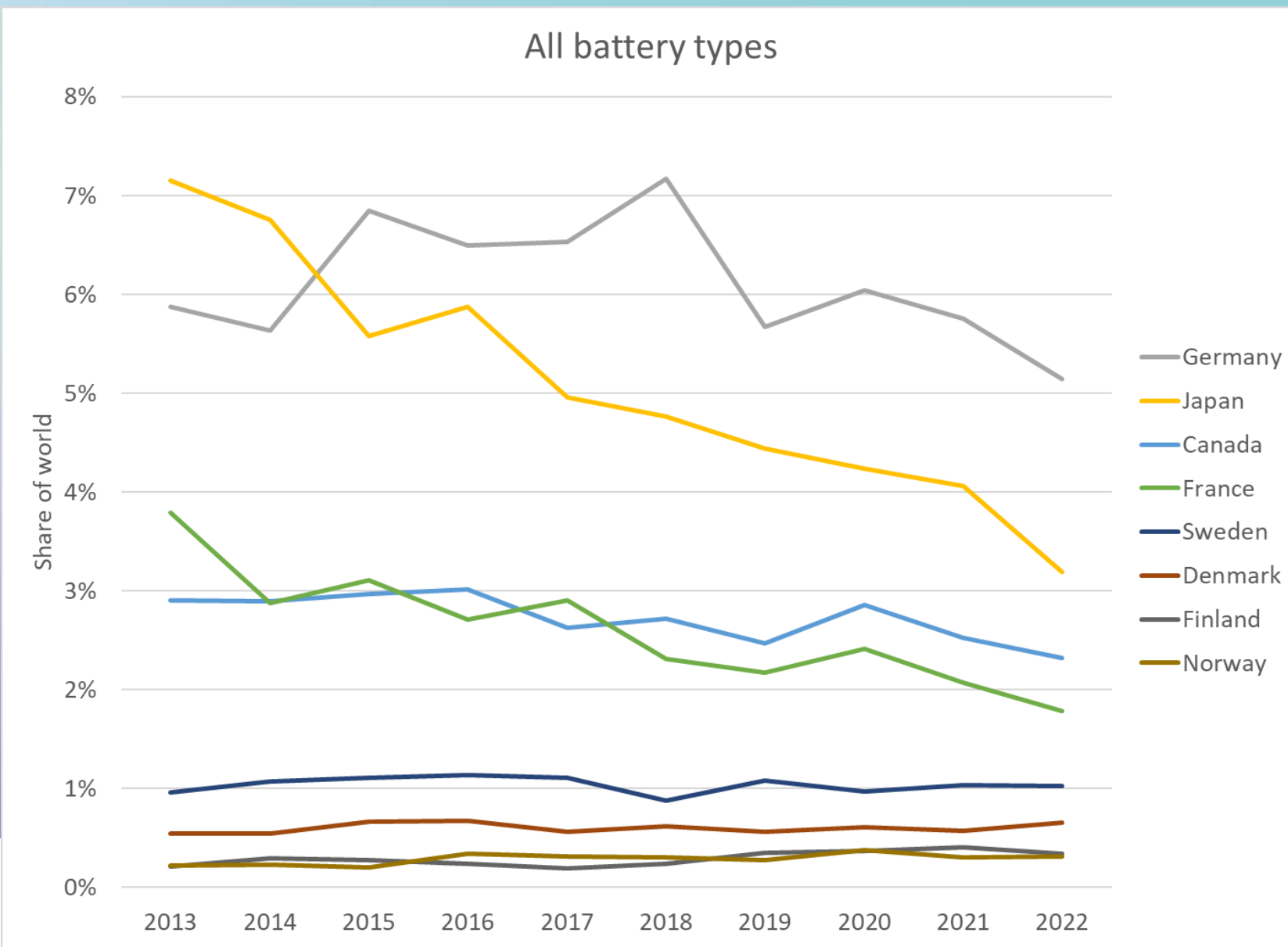
Overall volume development



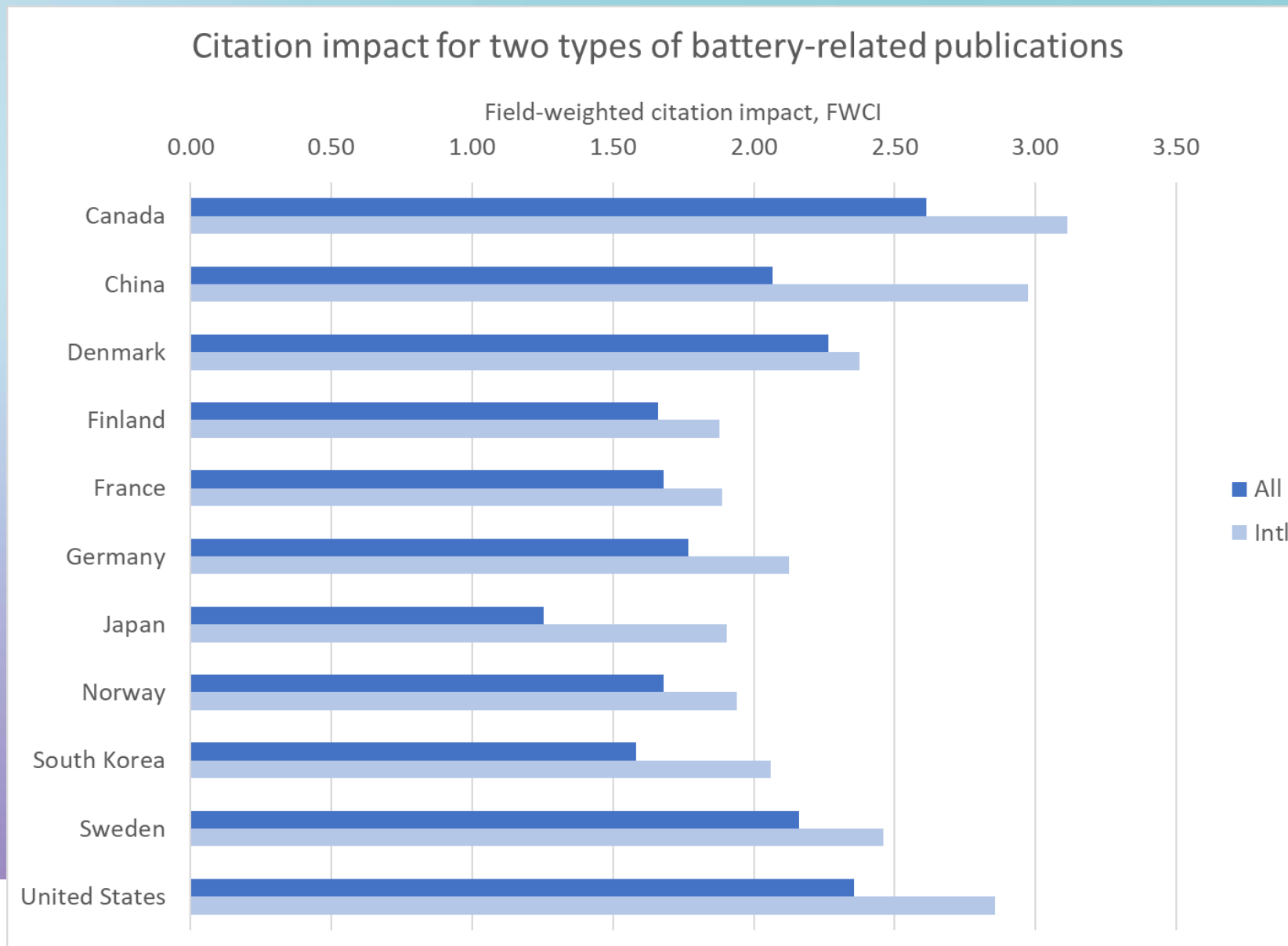
Relative volume development



Relative development – smaller countries

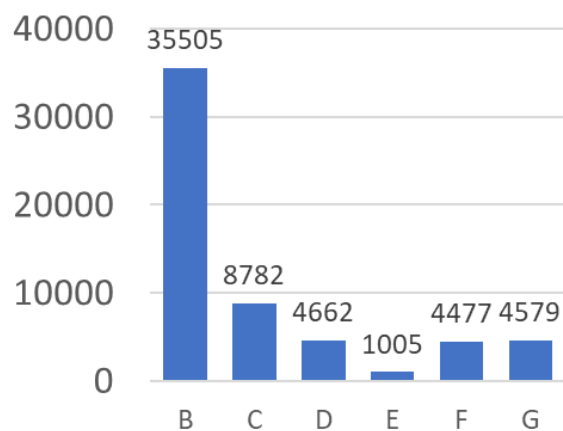


International battery-related publications are more cited

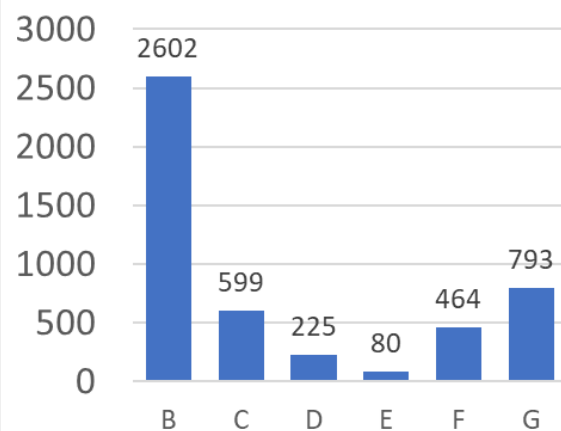


Publication volumes per chemistry

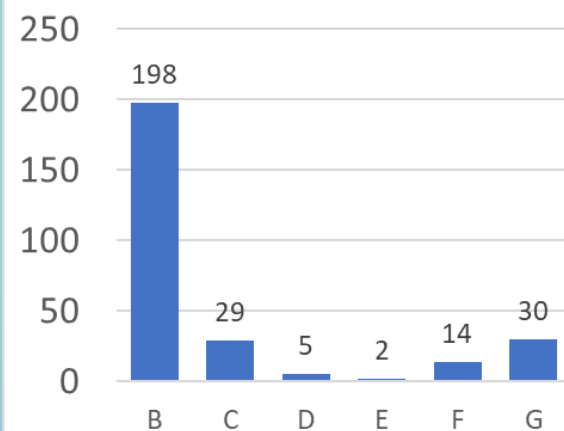
China



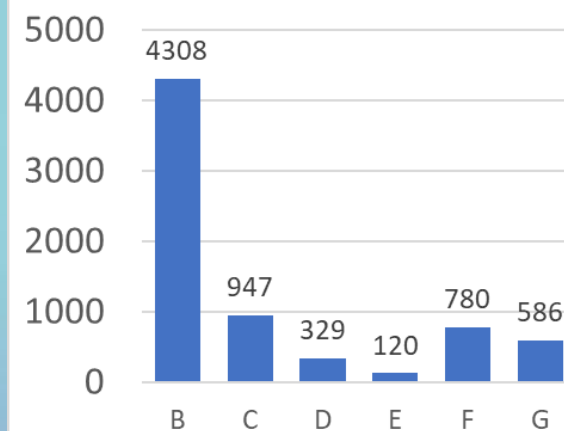
Japan



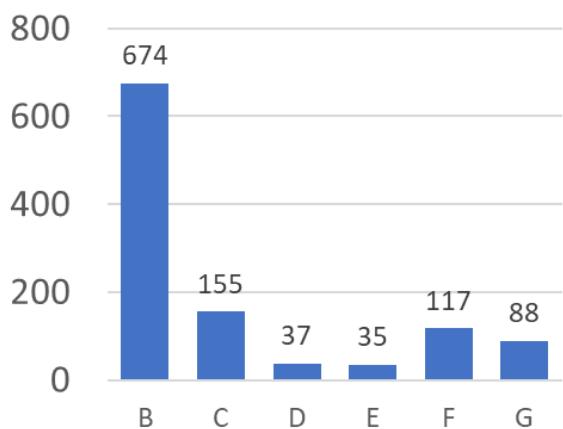
Norway



South Korea

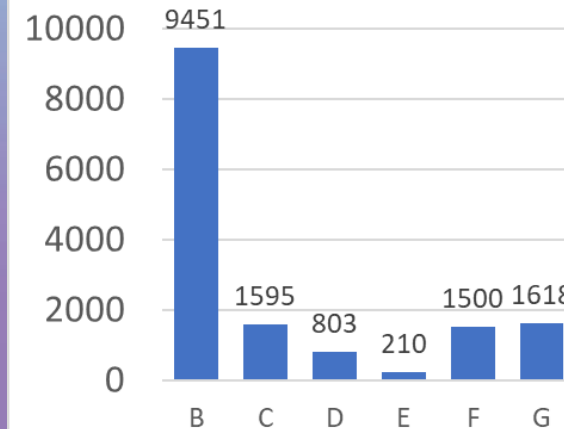


Sweden

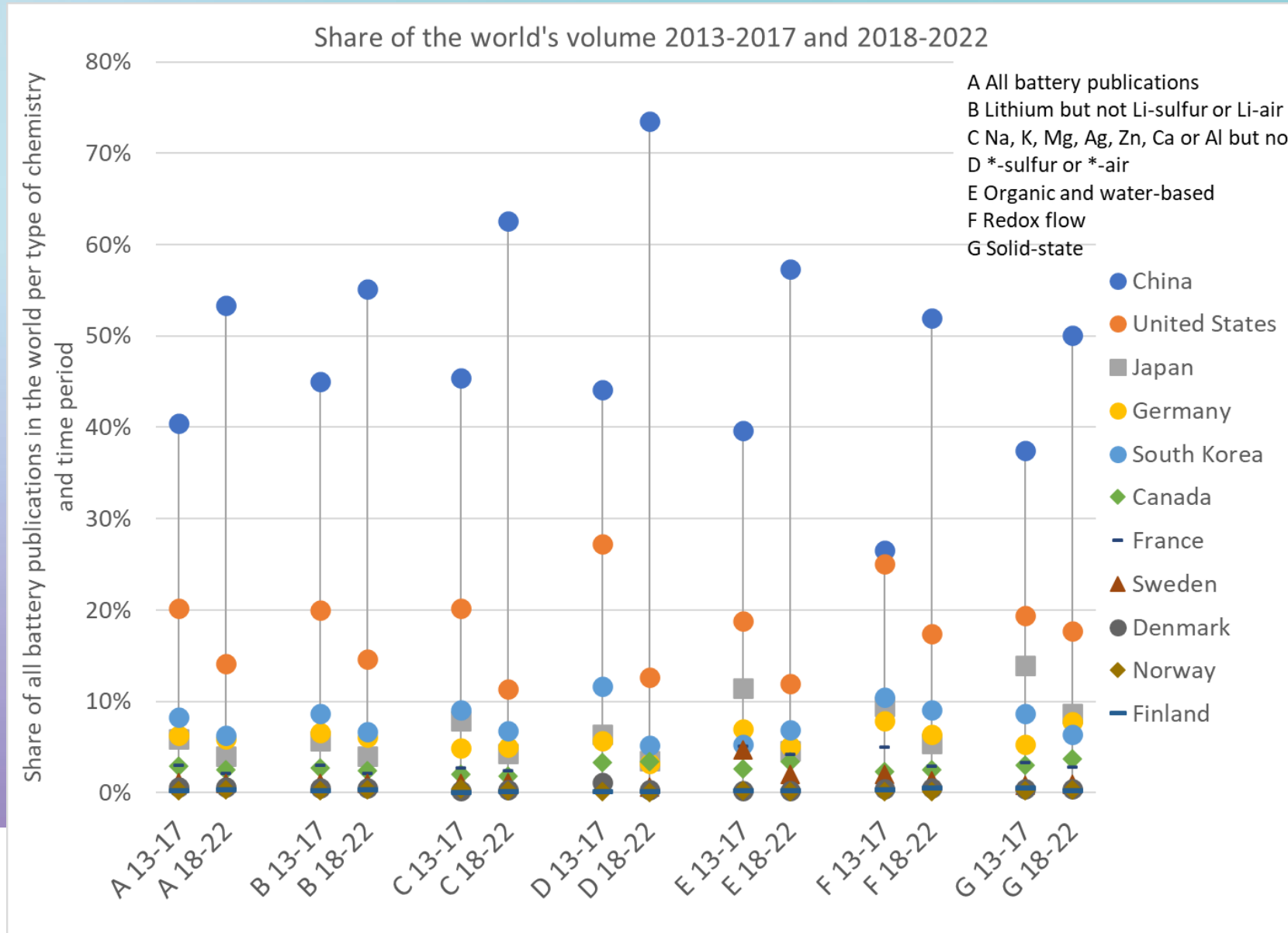


B	Lithium but not Li-sulfur or Li-air		
C	Na, K, Mg, Ag, Zn, Ca or Al but not *-sulfur or *-air		
D	*-sulfur or *-air		
E	Organic and water-based		
F	Redox flow		
G	Solid-state		

United States



"Market share" overall and per chemistry



Note: Small publication volumes in field E

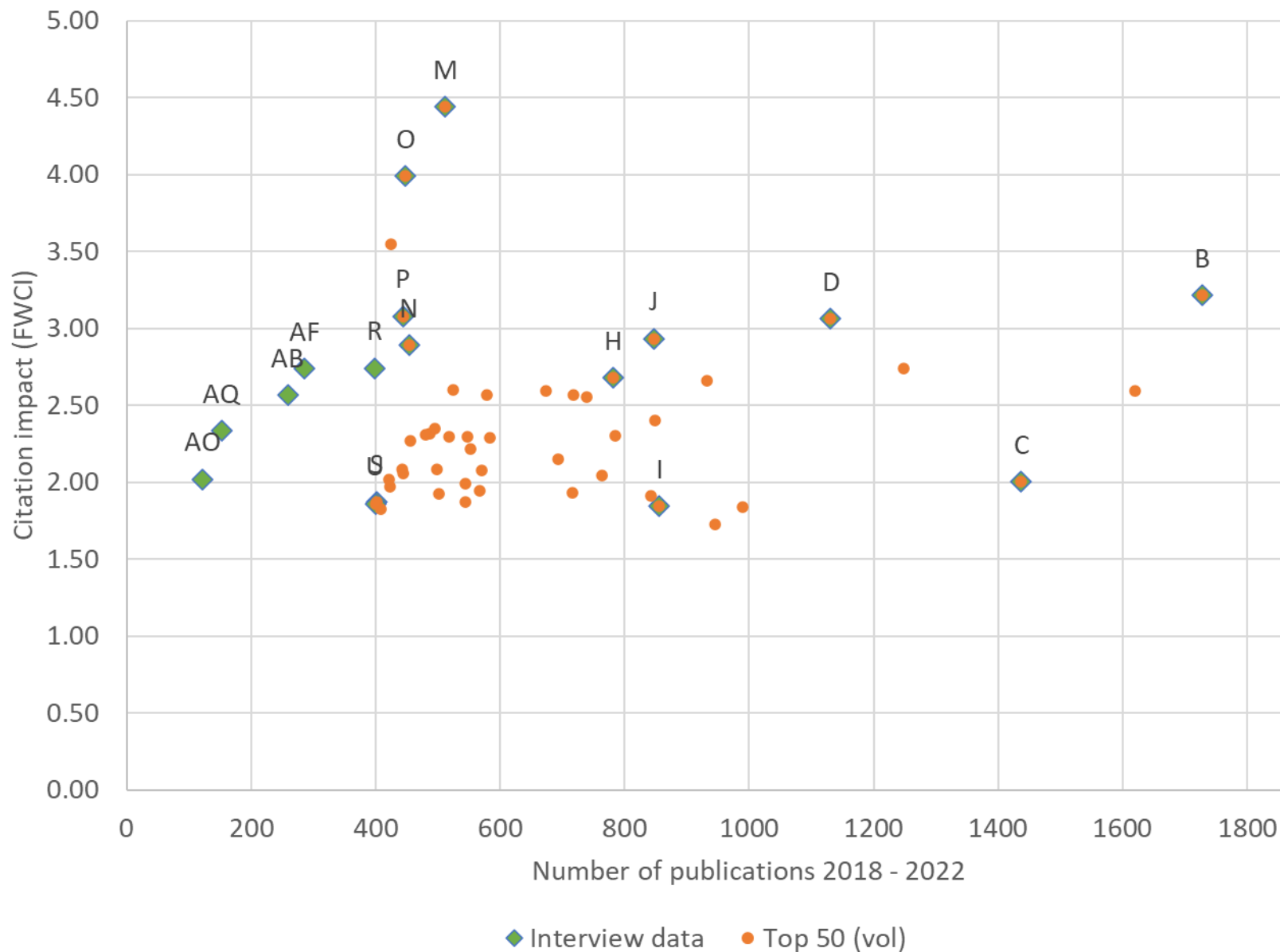
Leading research environments

Two approaches:

- Interviews
- Scientometrics

Open for respondents to define "leading".

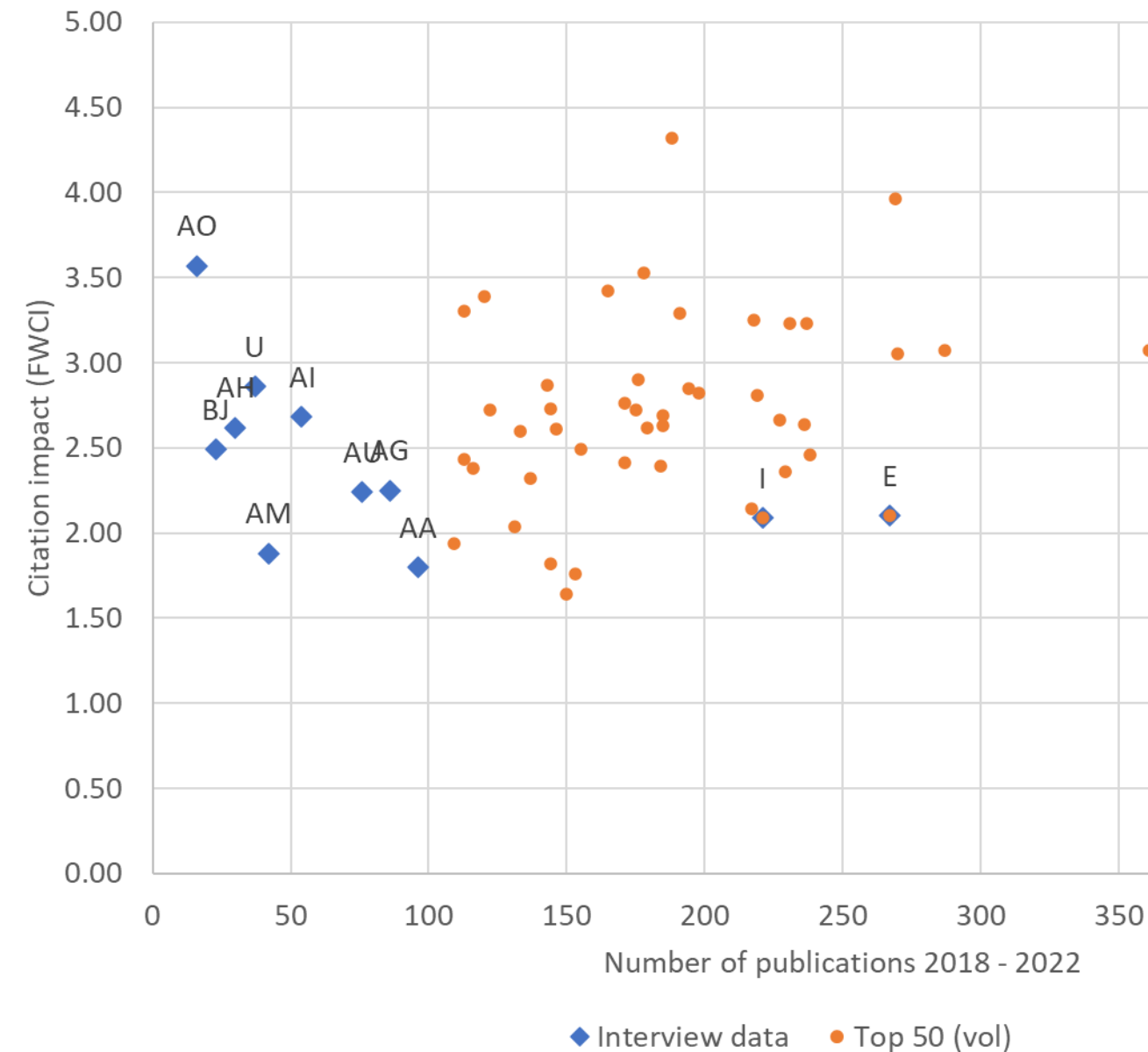
Top institutions - Lithium but not Li-S or Li-air



Institution	Vol	FWCI
A Chinese Academy of Sciences	4009	2.52
B Tsinghua University	1728	3.22
C Central South University	1437	2.01
D Beijing Institute of Technology	1131	3.06
H Peking University	781	2.68
I Karlsruhe Institute of Technology	856	1.84
J Argonne National Laboratory	847	2.93
M Stanford University	512	4.44
N Lawrence Berkeley National Labor	454	2.89
O University of Texas at Austin	448	3.99
P University of California at Berkeley	444	3.08
R Oak Ridge National Laboratory	398	2.74
S Seoul National University	402	1.88
U University of Münster	400	1.86
AB Ulsan National Institute of Science	259	2.57
AF The Faraday Institution	285	2.74
AO Université de Picardie Jules Verne	122	2.02
AQ Dalhousie University	153	2.34

◆ Interview data ● Top 50 (vol)

Top institutions - Na, K, Mg, Ag, Zn, Ca or Al but not *-S or *-air

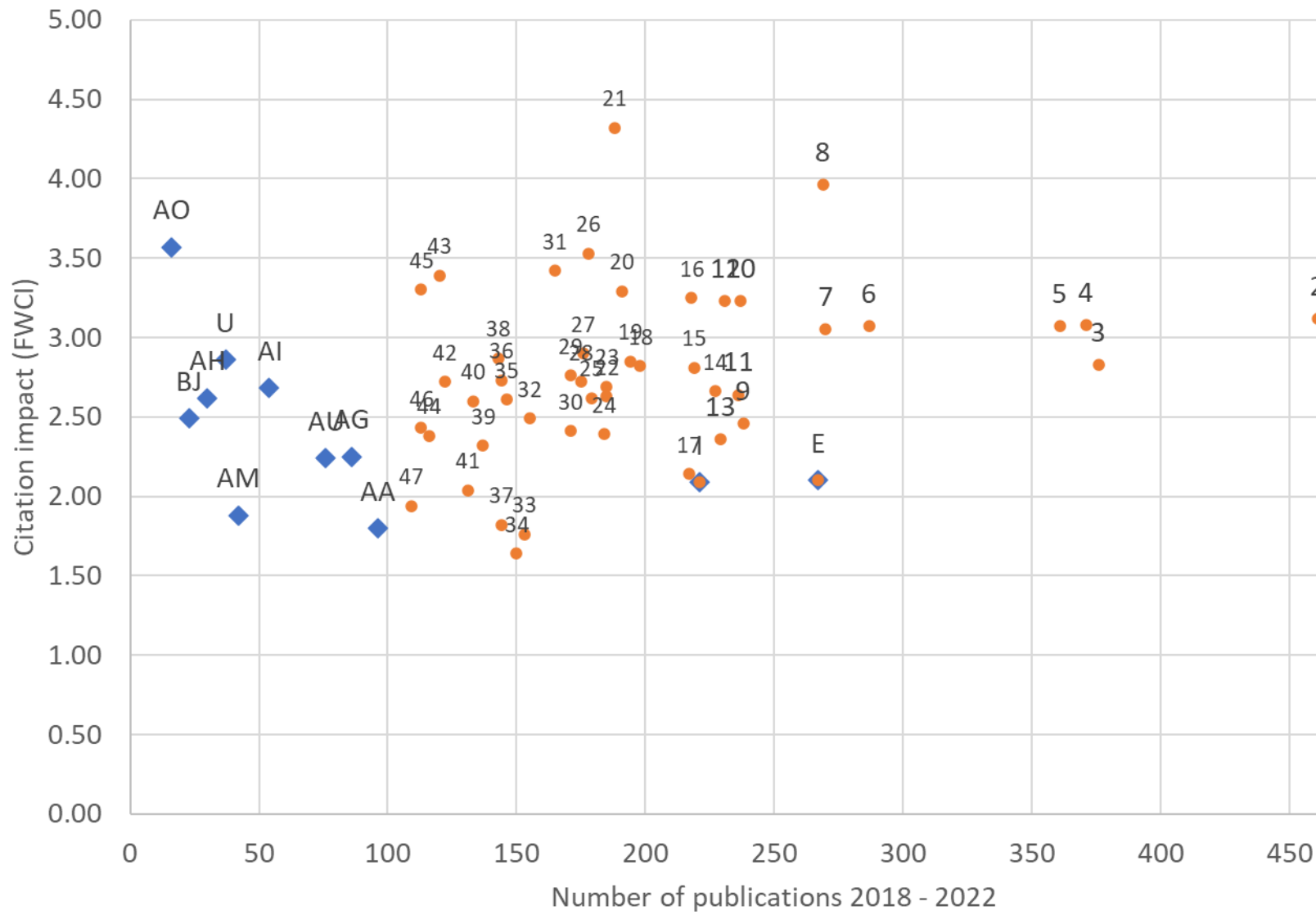


◆ Interview data ● Top 50 (vol)

Institution	Vol	FWCI
A Chinese Academy of Sciences	1112	2.89
E CNRS	267	2.10
I Karlsruhe Institute of Technology	221	2.09
AA Uppsala University	96	1.80
AG CIC energigune	86	2.25
AU Tokyo University of Science	76	2.24
AI Deakin University	54	2.68
AM The University of Tokyo	42	1.88
U University of Münster	37	2.86
AH Chalmers University of Technology	30	2.62
BJ CSIC - Institute of Materials Science of Barcelona	23	2.49
AO Justus Liebig University Giessen	16	3.57



Top institutions - Na, K, Mg, Ag, Zn, Ca or Al but not *-S or *-air



◆ Interview data ● Top 50 (vol)

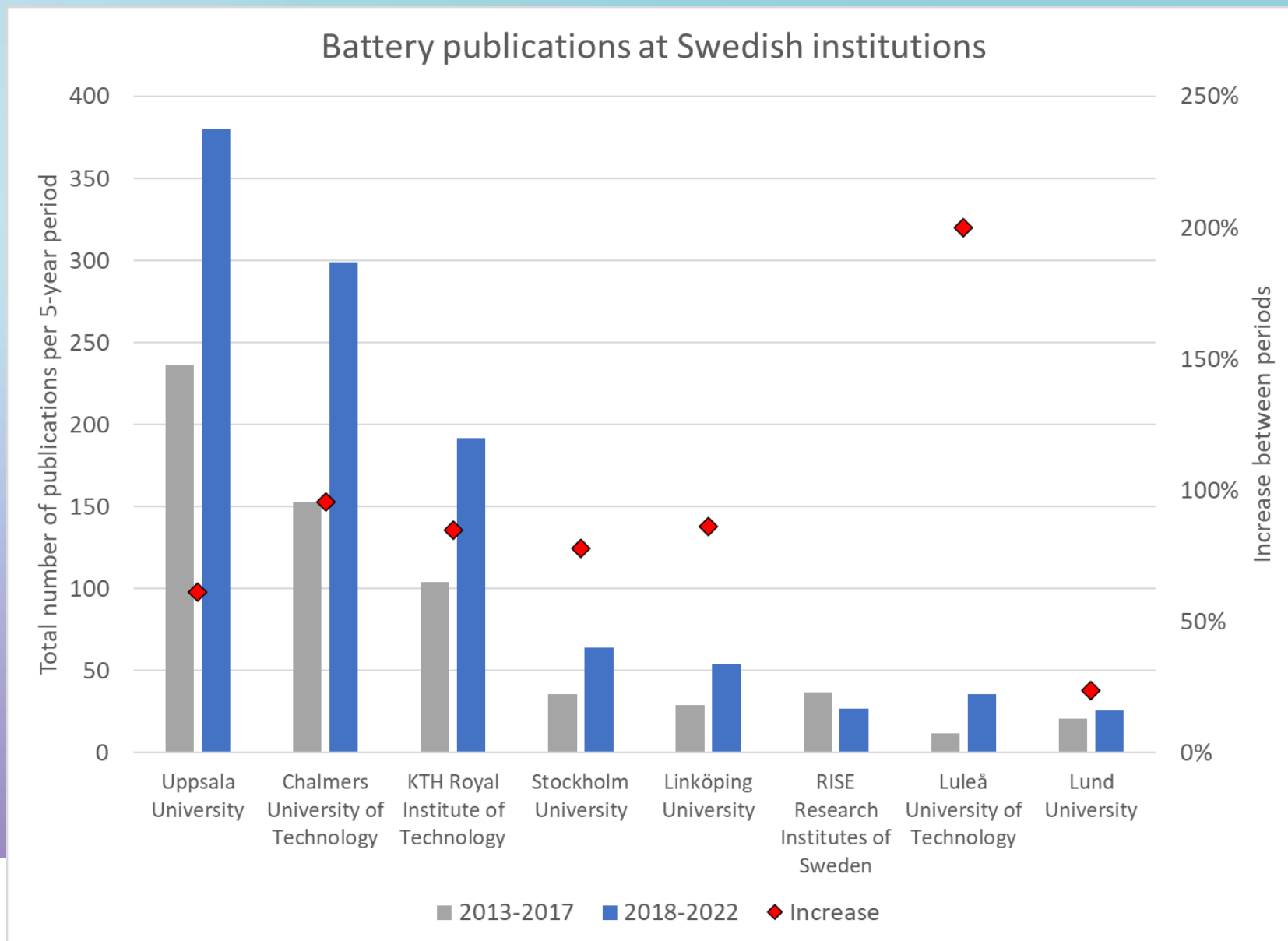
Institution	Vol	FWCI
A Chinese Academy of Sciences	1112	2.89
1 United States Department of Energy	471	2.73
2 Central South University	461	3.12
3 University of Chinese Academy of Sciences	376	2.83
4 University of Science and Technology of China	371	3.08
5 Zhengzhou University	361	3.07
6 Nankai University	287	3.07
7 Peking University	270	3.05
8 University of Wollongong	269	3.96
E CNRS	267	2.10
9 Shanghai University	238	2.46
10 Tsinghua University	237	3.23
11 Huazhong University of Science and Technolog	236	2.64
12 Tianjin University	231	3.23
13 Harbin Institute of Technology	229	2.36
14 Beijing Institute of Technology	227	2.66
I Karlsruhe Institute of Technology	221	2.09
15 Zhejiang University	219	2.81
16 Shandong University	218	3.25
17 Shanghai Jiao Tong University	217	2.14
18 Guangdong University of Technology	198	2.82
19 Xiamen University	194	2.85
20 Hunan University	191	3.29
21 CAS - Institute of Physics	188	4.32
22 Fudan University	185	2.63
23 South China University of Technology	185	2.69
24 National University of Singapore	184	2.39
25 Soochow University	179	2.62
26 City University of Hong Kong	178	3.53
27 Wuhan University of Technology	176	2.90
28 Argonne National Laboratory	175	2.72
29 Beijing University of Chemical Technology	171	2.76
30 Xi'an Jiaotong University	171	2.41
31 Nanyang Technological University	165	3.42
32 University of Science and Technology Beijing	155	2.49
33 Kvoto I University	153	1.78

● Lindnornen
● Science Park
●●●

Focus Sweden

- Lindholmen
- Science Park
- ● ●

Publication volumes 2013-2017 and 2018-2022



Co-publication network Uppsala University

Uppsala University		Volume 2018 - 2022	
Institution	Country	All	Max 10 co-authors
KTH Royal Institute of Technology	Sweden	63	61
Chalmers University of Technology	Sweden	39	32
Stockholm University	Sweden	35	33
CNRS	France	29	20
Scania AB	Sweden	28	28
Shanghai University	China	22	22
Karlsruhe Institute of Technology	Germany	20	14
Paul Scherrer Institute	Switzerland	19	14
Technical University of Denmark	Denmark	17	11
Cadi Ayyad University	Morocco	16	15
United States Department of Energy	United States	16	6
Helmholtz Centre Berlin for Materials	Germany	15	15
The Faraday Institution	United Kingdom	12	6
Indian Institute of Technology Ropar	India	11	11
University of Oxford	United Kingdom	10	3

Partners with at least 10 co-publications during 2018 – 2022

Co-publication network Chalmers U. of T.

Chalmers University of Technology		Volume 2018 - 2022	
Institution	Country	All	Max 10 co-authors
Uppsala University	Sweden	39	32
CNRS	France	28	19
KTH Royal Institute of Technology	Sweden	25	19
Beijing Institute of Technology	China	21	21
CSIC	Spain	21	17
RISE Research Institutes of Sweden	Sweden	21	21
Gyeongsang National University	South Korea	20	20
Warsaw University of Technology	Poland	20	16
Université de Picardie Jules Verne	France	19	15
CSIC - Institute of Materials Science of I	Spain	16	14
Volvo Car Corporation	Sweden	16	16
Technical University of Denmark	Denmark	14	10
Xi'an Jiaotong University	China	14	12
University of Gothenburg	Sweden	13	13
University of Rome La Sapienza	Italy	13	12
National Research Council of Italy	Italy	11	9
Volvo Group	Sweden	11	11
Universität der Bundeswehr München	Germany	10	9
University of Cambridge	United Kingdom	10	7

Co-publication network KTH

KTH Royal Institute of Technology		Volume 2018 - 2022	
Institution	Country	All	Max 10 co-authors
Uppsala University	Sweden	63	61
RISE Research Institutes of Sweden	Sweden	26	24
Chalmers University of Technology	Sweden	25	19
Scania AB	Sweden	17	17
Stockholm University	Sweden	11	10
Mälardalen University	Sweden	10	10

Partners with at least 10 co-publications during 2018 – 2022

Tentative conclusions

- Interesting to compare results from interviews with publication study
- China has many institutions with high volumes and good citation impact in all battery types
- Several strong research environments in the United States
- No strategic battery collaboration Sweden – United States

Interested in US-Sweden collaborations?



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Innovation collaboration between Sweden and the United States