European Quantum Industry Consortium (QuIC)

Industry quantum computing benchmarks

Dr. Thomas Strohm

Vice-President, QuIC

Teratec – 11 May 2023

QuIC

European Quantum
Industry Consortium

About QuIC

QuIC Organisation History

Non-for-profit **association** established in 2021 by several major business actors – large enterprises, SMEs, startups, investors – from across Europe.

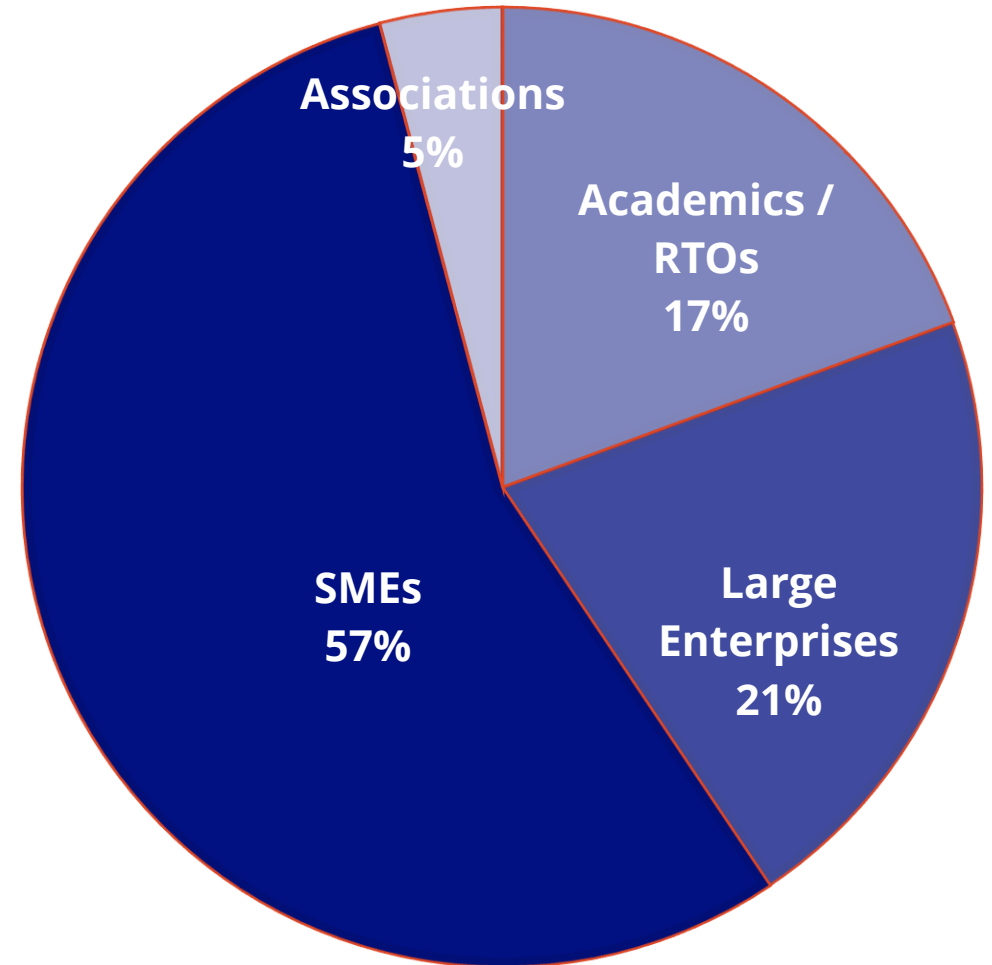**QuIC is THE voice of the European Quantum Technology (QT) industry**

Our mission is to strengthen the **pan-European industry competitiveness** in quantum technologies on the global scale.
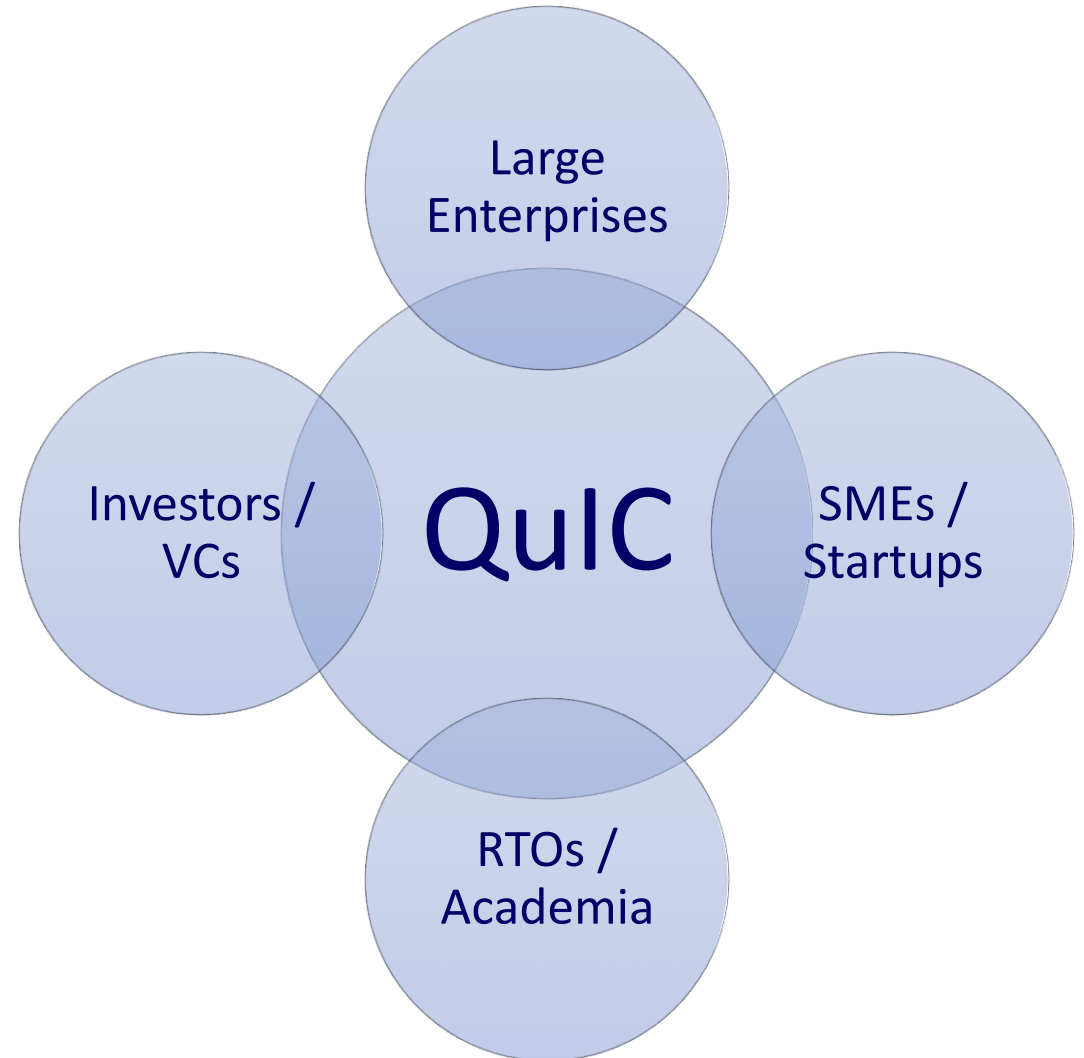
QuIC members

Member type	Full	Associate	Total
Large Enterprises	27	9	36
SMEs	69	25	94
Academics/ RTOs		33	33
Associations		7	7
Total	**96**	**74**	**170**

(Members as of 31 March 2023)

QuIC members

Country	Full	Associate	Total
AT	5	3	8
BE	0	1	1
CZ	1	0	1
DE	24	15	39
DK	1	2	3
ES	9	9	18
FI	4	2	6
FR	8	9	17
GR	1	0	1
IE	2	2	4
IT	4	4	8
LT	0	1	1
LU	1	0	1
NL	10	4	14
PL	3	2	5
PT	2	1	3
SE	0	1	1
SI	1	0	1

Country	Full	Associate	Total
CH	8	4	12
IL	1	1	2
NO	1	2	3
TR	0	1	1
UK	12	7	17

QuIC members

Members

39

19,5

0

Powered by Bing
© GeoNames, Microsoft, OpenStreetMap, TomTom
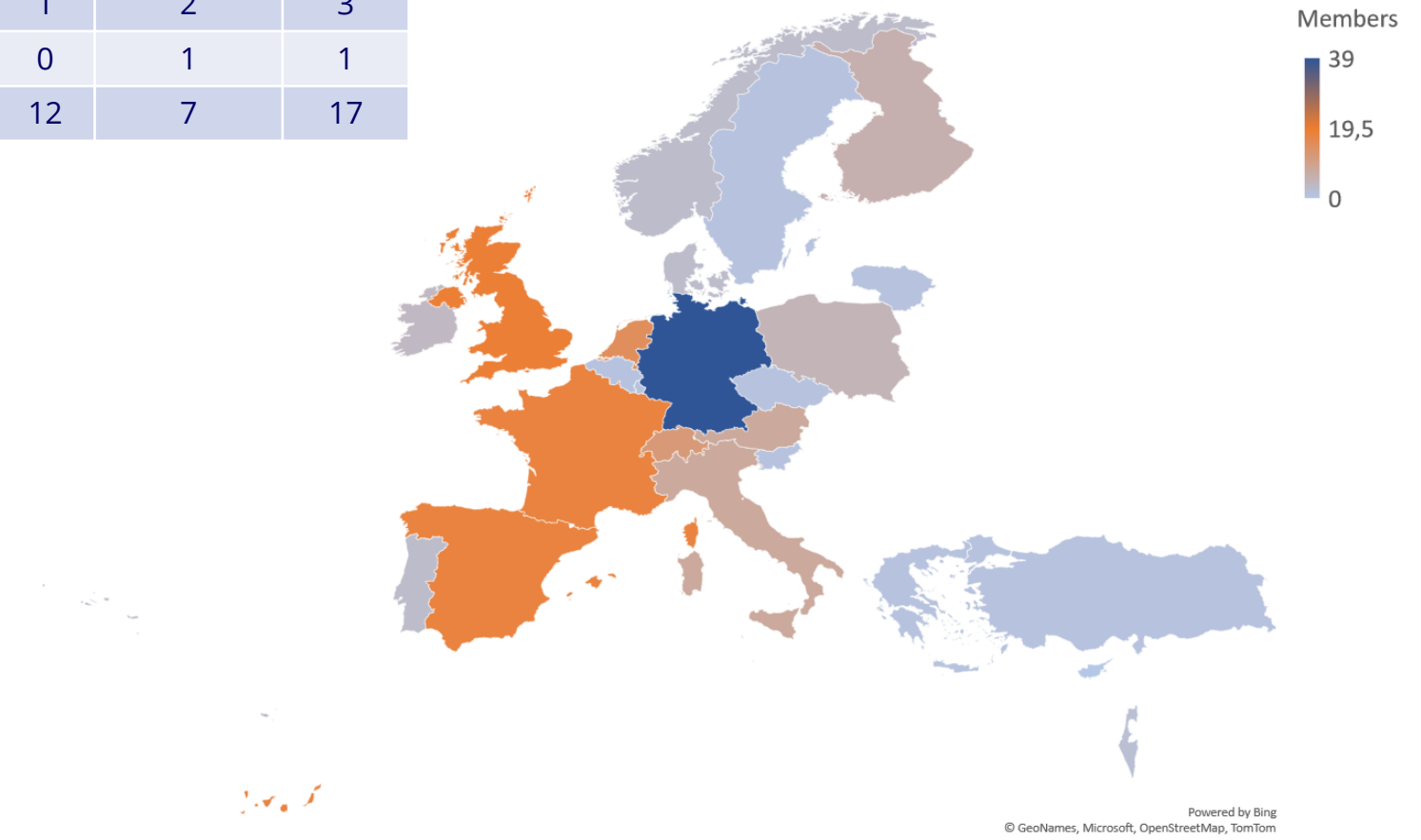
(Members as of 31 March 2023)

The 100 M€ question of industry and quantum benchmarking

100 M€ question of the industry

- **When** will industry make money by solving problems with QC?
- **What problems** will this be?

Footnotes
- I don't care about the QC hardware type
- Quantum advantage

Existing quantum benchmarks (selection)

Application-level

| QED-C benchmarks / Algorithmic qubits | Q-Score (Max-Cut) | QASM-bench, SupermarQ QPack scores, QUARK, ... |

System-level

| Cross entropy, HOG test | Quantum Volume | Volumetric Benchmarking |

Component-level

| Randomized benchmarking | Gate-set tomography | Init., 1-/2-qubit-gate, measurement fidelity |

What **we expect** from these q. benchmarks:
- HW-agnostic
- Scalable
- Useful
- Comprehensive

QuIC
European Quantum Industry Consortium

What is needed

Application-oriented benchmarks

Approach

- Collect problems that likely could benefit from QC

- Design a QC solution and provide an implementation

- Run it on existing QC HW

- Compare to implementation on conventional HW

Our offer

- industry-relevant use cases („technical dossiers")

- no implementions, however

Cooperations & contacts

- We are part of QUCATS

- We talk to different parties, notably: BACQ (LNE), FZ Jülich, Fraunhofer IKS, QPack Scores people, others

Challenges ahead

- Tracing 100 M€ question to system-level or component-level is almost impossible

- Comparison QC vs classical is difficult because of the very nature of quantum advantage (extrapolations or specific tricks needed)

- Specific benchmarks only give answers to specific problems

- Variety of HW platforms is very large: from large variations in gate-based QC to quantum annealers

- Different HW platforms develop at different pace

- Conventional computing is also a moving target (new algorithms, new computing paradigms)

The way forward

Let's cooperate to make European application-oriented benchmarks happen. They will boost our competitiveness. QuIC is able to provide relevant use cases.

Contact:

- thierry.botter@euroquic.org
- thomas.strohm@de.bosch.com