

# Quantum Economic Development Consortium (QED-C)

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**QED·C**

The logo for QED-C features the text "QED·C" in a bold, white, sans-serif font. The dot between "QED" and "C" is a small circle. The text is set against a background of a dark, swirling pattern of light blue and white lines, resembling a quantum field or a complex network, with numerous small, bright white dots scattered throughout.

# National Strategy: Key QIS Policy Provisions



## NATIONAL STRATEGIC OVERVIEW FOR QUANTUM INFORMATION SCIENCE

*Prepared by the*  
SUBCOMMITTEE ON QUANTUM INFORMATION SCIENCE  
*under the*  
COMMITTEE ON SCIENCE  
*of the*  
NATIONAL SCIENCE & TECHNOLOGY COUNCIL  
AUGUST 2018

1. Choosing a science-first approach to QIS
2. Creating a quantum-smart workforce for tomorrow
3. Deepening engagement with quantum industry
4. Providing critical infrastructure
5. Maintaining national security and economic growth
6. Advancing international cooperation

*Six important Policy Principles*

# The Quantum Consortium, and the NQI (HR 6227)

## SEC. 201. Quantum Consortium:

Not later than 1 year after the date of enactment of this Act, the Director of the NIST shall convene a consortium of stakeholders to identify the future measurement, standards, cybersecurity, and other appropriate needs for supporting the development of a robust quantum information science and technology industry in the United States.

*The NQI Act Established the QED-C*



## GOALS:

- to assess the current research on the needs identified (per SEC 201)
- to identify any gaps in the research necessary to meet the needs (per SEC 201)
- to provide recommendations on how the NIST and the Program can address the gaps (per SEC 201)

## REPORT TO CONGRESS:

Not later than 2 years after the date of enactment of this Act, NIST shall submit Congress a report summarizing the findings of the consortium.

# Objectives of the QED-C

- Identify gaps and provide R&D funding to fill gaps in enabling technology and infrastructure;
- Foster sharing of intellectual property, efficient supply chains, and enabling technology;
- Determine workforce needs essential to the development of quantum technologies;
- Provide efficient public-private sector coordination;
- Support standards development of the emerging quantum industry, and
- Highlight best use cases to accelerate development efforts

# QED-C LOI Signatories

## Corporate

- Advanced Research Systems
- Aliro Technologies
- Amazon
- AO Sense
- ARM Research
- AT&T
- Atom Computing
- BAE Systems
- Boeing
- Boston Consulting Group
- BP
- Bra-Ket
- CEC Security
- Citi
- ColdQuanta
- Corning
- Cryomech
- D-Wave
- Entanglement Institute
- EZ Form Cable
- Fieldline
- FLIR
- GE Global Research
- General Dynamics Mission Systems
- Google
- Holzworth Instrumentation
- Honeywell
- HPD
- Hyperion Research
- IBM
- Inside Quantum Technology
- Intel
- IonQ
- Janis Research
- Keysight
- KMLabs
- L3 Harris
- Lake Shore Cryotronics
- Lockheed Martin
- Marki Microwave
- Microchip/Microsemi
- Microsoft
- Montana Instruments
- NuCrypt
- Photodigm
- Photon Spot
- Physical Science Inc.
- Psi Quantum
- PQ Secure Technologies
- QC Ware
- QPRI
- Qrypt
- Quantum 1 Group
- Quantum Circuits
- Quantum Computing
- Quantum Computing Report
- Quantum Design
- Quantum Microwave
- Quantum Opus
- Quantum Semiconductor
- Quantum Thought
- Quantum Xchange
- Qubitekk
- Qulab
- Qunnect
- Raytheon-BBN
- Rigetti
- Riverside Research
- Rydberg Technologies
- Sivananthan Laboratories
- SkyWater Technology Foundry
- Spectral Quantum Technologies
- SRI International
- Stable Laser Systems
- Strangeworks
- Takeda
- Toptica
- TRIAD National Security
- Twinleaf
- United Technologies Research Center
- US Advanced Computing Infrastructure
- Vescent Photonics
- Young Basile Hanlon & MacFarlane, PC
- Zapata Computing
- Zyvex Labs

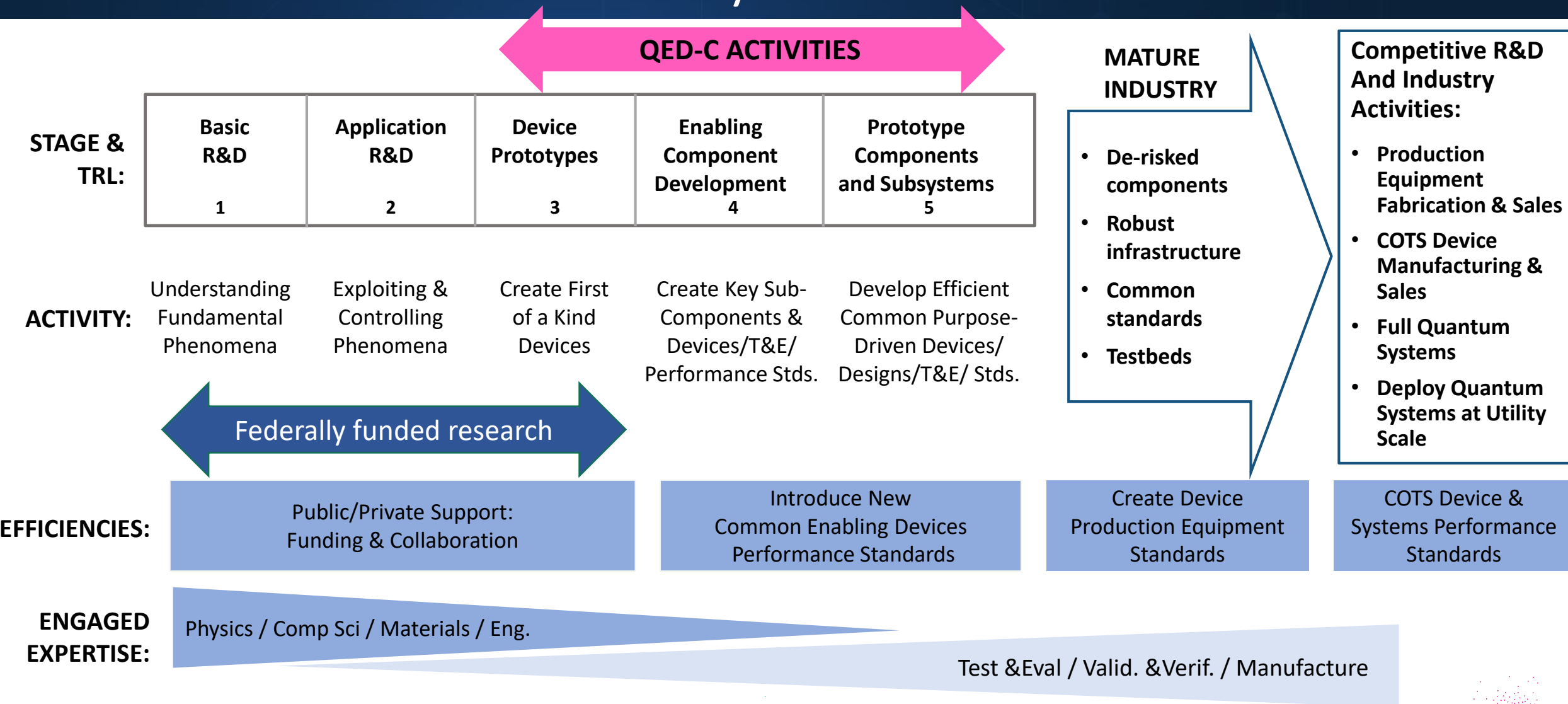
## Academic

- Caltech/INQNET
- Colorado School of Mines
- George Mason University
- Georgia Institute of Technology
- Pittsburgh Quantum Institute (PQI)
- Purdue University
- Rochester Institute of Technology
- Southern Methodist University (SMU)
- Stanford
- SUNY Polytechnic Institute
- University of Arizona
- University of Buffalo
- University of Chicago
- University of Colorado
- University of Maryland
- University of Oklahoma
- University of Wisconsin

## Other

- American Physical Society
- Federal Reserve Bank of Philadelphia
- Los Alamos National Laboratory
- OSA
- SEMI
- SPIE
- Universities Space Research Association

# All segments of R&D continuum require support: Role of Government vs. Industry



# Breakdown of QED-C Membership

- 100+ Entities Total:
  - 80+ Corporations
  - 17 Academic Institutions
  - 6 Professional Societies/ NGO's
- Five Basic Stakeholder Groups:
  - "Quantum Companies"/ Hardware Developers
  - Suppliers
  - Quantum End Users
  - Standards Developers
  - Researchers and Academics

QED-C Members represent the full cross-section of Quantum:

- Computation,
- Simulation,
- Communication,
- Metrology, and
- Sensing

# QED-C Governing Board- Industry Led

(Elected October 29, 2018 to a 2-Year term)

- Jay Lowell, Boeing
- Dana Anderson, Cold Quanta
- Bill Vanderlinde, DOE
- Eric Ostby, Google
- Mark Ritter, IBM
- Carl Williams, NIST
- Matt Johnson, QCWare
- Open Seat
- Christopher Savoie, Zapata Computing

Joe Broz, QED-C Chairman and Executive Director

Celia Merzbacher, Associate Director

Ratified

## Initial Board Composition (3-4-2)

- Large Industrial members at highest dues levels (3)
- Representatives of medium and small-size companies (4)
- Federal Partners (2) + USG Observers
- (Possibly) non-voting state or regional economic development representatives
- Others as approved by GB



# Consortium Development 3-Year Timeline

## 2019:

- **Complete formation documents** (IP, Membership, Dues, etc.); All LOI's converted to formal Participation Agreements; Grow membership to 50+ entities
- Initial TAC deliverables on Workforce and Infrastructure Gaps; Identify major Enabling Technology Gaps, Primary Use Cases, and Survey the Quantum Standards Landscape

## 2020:

- **Establish Consortium R&D strategy** (by USG and Industry) for closing identified gaps
- Complete initial Enabling Technologies, Workforce, Use Case, and Standards landscape
- Set-up system for Enabling Technology R&D funding and evaluation; Prepare and issue initial R&D RFP's

## 2021:

- **First Proposal Award(s) and First Technology Transition and Consortium IP License(s) issued**
- SDO Implementation of Initial Quantum Performance and Quantum Manufacturing Equipment (QME) Industry Standards
- Expand Enabling Technology Funding and TAC Scope; Add new TAC's

# Consortium and IP Owner Rights

- **USG License**: Grant to the USG a non-exclusive, nontransferable, paid-up, worldwide perpetual license to use the Consortium IP for any Government purpose
- **Evaluation License**: Grant to each QED-C Member a non-exclusive, royalty-free, non-transferable license for the duration of Member's membership to use the Consortium IP (without the right to sublicense) for the limited purposes of further evaluation and R&D
- **Commercial License**: On request, grant to any QED-C Member a non-exclusive, transferable worldwide license (with the right to sublicense) on commercially reasonable, nondiscriminatory ("RAND") terms
- **Third-Party Licenses**: On terms negotiated by the Development Partner

# QED-C Technical Advisory Committees

- **Enabling Technologies** – Leader: Thomas Ohki, Raytheon BBN. Identify gaps, Categorize, Prioritize, Identify needed R&D, Supply Chain, Assess Required Resources
- **Quantum Use Cases** – Leader: Jim Gable, Bra-Ket Sciences. Define the “Killer Quantum Apps”, Markets, Timeline, Roadblocks, CONOPS, CSWaP, R&D Required
- **Workforce** – Leader: Steven Lambert, APS. Quantum workforce shortfall, data, solutions, USG R&D impact, Assess Resources Required
- **Standards and Performance Metrics** – Leader: Tom Lubinski, Quantum Circuits, Inc. Types of Standards and KPI’s, Organization(s) and Structures

# QED-C: Participating in a Global QIS Ecosystem

## The Four Pillars of Productive Economic Trade:

- Free & Fair Trade
- Open Markets
- Growth of Global Supply Chain
- Respect for IP / National Security

### The 4 Open T's:

- Taxes – Level Playing Field
- Technology – Investments by private sector and Governments in R&D
- Trade – Fair trade
- Talent – Highly skilled talent & immigration policies

*Kelvin Droegemeier, OSTP, August 30<sup>th</sup>, 2019 memo—*

*“Strike a balance between the openness of our research ecosystem and the protection of our ideas and research outcomes.”*

# Conclusions

- The QED-C is off to a fast-start, more than 100 members (large and small)
- Membership includes majority of the U.S. Quantum Industry and significant Manufacturing Supply Chain companies; Membership tiers defined for foreign company and academic engagement
- QED-C focuses on identifying and resolving major enabling technology barriers and gaps, technical standards, use cases, and workforce issues
- Industry Technical Advisory Committees in key areas of: Workforce, Enabling Technologies, Use Cases, and Standards & Performance Metrics
- The QED-C has established a formal structure for Standards Development, Consortium IP Development and Licensing

# THANK YOU

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