

# Workshop A1

## Accelerating applications for humanity

OQI Operational Launch  
5 March 2024 | CERN, Geneva



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An initiative hosted by CERN, born at GESDA, supported by UBS

- 1. Key Objectives**
  - Generate new use case topics and form full teams of volunteers to continue outline the use cases
  - Clarify ways of engagement with OQI for the development of use cases
  
- 2. Acceleration of use cases through OQI**
  - What have we achieved so far
  - Objectives of the pilot phase
  - Methodology for use case development and evaluation
  
- 3. Brainstorming Sessions**
  - Health, Food, Climate, Water, Other topics
  
- 4. Conclusions & Next Steps**



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**Acceleration of use cases  
through OQI – what have we  
achieved so far**

**OQI Mission:** Inclusively unleash the powers of quantum computing to ensure that the whole world contributes to and benefits from quantum computing.

## *A1 Pillar: Accelerating Applications for Humanity*

- **Position OQI as a centre for expertise** on the applications of quantum computing for the SDG (and their future succeeding framework): Use cases vetted from a scientific and impact point of views.
- **Shift the cursor:** Rebalance the focus of quantum computing applications (with limited resources and experts) towards impact. Counteract hype effects.

**OQI Mission:** Inclusively unleash the powers of quantum computing to ensure that the whole world contributes to and benefits from quantum computing.

## Overarching values and principles of CERN

CERN's core values: Integrity, commitment, professionalism, creativity and diversity

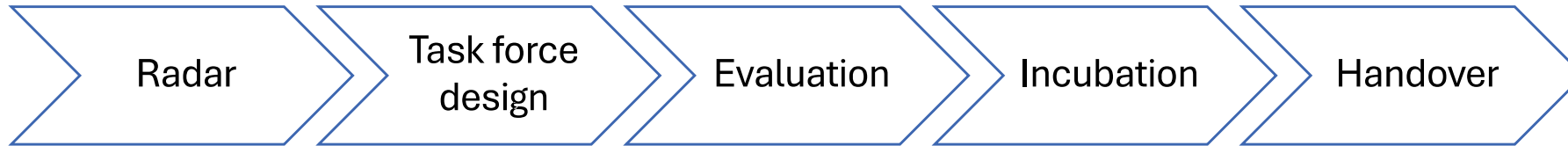
CERN is committed to the advancement of science and the wide dissemination of knowledge by embracing and promoting practices making scientific research more open, collaborative, and responsive to societal changes

CERN's goals include:

- To be a politically neutral voice for science, advocating investment in fundamental research and evidence-based policy
- To train a new generation of scientists and engineers
- To inspire and nurture scientific awareness in all citizens

# What we have achieved so far

## From science to a science diplomacy instrument: OQI timeline



### Incubation of the OQI in 2023:

- ✓ Proof of concept and realizability of the OQI activities, as envisaged by the task force who conceive it
- ✓ Strong traction and engagement of a growing OQI community
- ✓ Securing of the governance structure and funding for the 3 years pilot (incl. donations of resources and capacity by spearheading partners)

### Specifically for ACCELERATING APPLICATIONS FOR HUMANITY (A1):

- ✓ Built teams of experts (quantum computing, domain, impact)
- ✓ 4 outlines of quantum computing use cases for SDGs (AMR, Carbon Reduction, Food Systems) --> white paper
- ✓ Impact X feasibility assessment: defined the use case development phases & evaluation methodology

# Objectives for the pilot phase of OQI (2024-2026)



## A1 Objectives

- OQI to be established as a reference place to develop applications of quantum computing for the SDGs and other societal challenges.
- Effective exploration of at least 20 projects targeting SDG-related use cases and other societal challenges to be supported by the OQI
- Effective completion of at least 4-6 projects
- Provision of an online repository of project documentation

## Key Milestones for 2024

Call for submission and evaluation of new projects submissions by scientific and impact experts

Expert workshops and match-making of new expert teams to explore new projects --> including R&Ders from underserved geographies

Development of the proof of concept of 2-4 use cases and first implementation on simulators and quantum computers

Compilation of an initial on-line repository (incl. OQI and vetted external projects)

## Objectives of today's A1 workshop

- Leverage the brainstorming session to
  - generate new ideas for SDG use cases
  - form new teams of volunteers to continue the development of new use cases
  
- Clarify the methodology for use case development & evaluation process
  
- Clarify the mechanisms for engagement with OQI



## Potential benefits of quantum computing:

- Address complex problems; in some cases, may reach higher accuracy or even speedup computation

### Carbon Reduction

- SDG: 13
- Team: ETHZ, EPFL, UNFCCC
- Method: Quantum Chemistry
- Quantum Computing simulation to reduce carbon dioxide (CO<sub>2</sub>) in the atmosphere by improving catalysis process responsible for the fixation of carbon on the surface of materials

### Antimicrobial Resistance

- SDG: 3
- Team: Copenhagen, Alphanosos, GARDP
- Method: Quantum Machine Learning
- Addressing global public health challenges, by developing a quantum computing solution to improve current AI models, predict more quickly and accurately patterns of resistance and identifying new chemical compounds with low resistance on more targeted bacteria

### Food Production & Security

- SDG: 2
- Team 1: EPFL, NITheCS, GAIN  
Team 2: ForQast, Oxforc, EY
- Method: Quantum Optimization
- Improving sustainability of global food systems by making them more resilient to climate change through a quantum optimization solution to produce more nutritious food locally in less land & that would reduce food transport costs and emissions.



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# Brainstorming Sessions

Constructive feedback

# Brainstorming Outline

March 5, 20024



Topic

SDGs

Team

Full Name(s) & Expertise

Expertise needed (*domain specific, impact, quantum*)

Context

Societal challenges

Impact & benefits of a new quantum computing solution (*accuracy, speedup, ...*)

Scientific Problem Scoping

Technical challenges & quantitative/mathematical conceptualization of the problem

Existing (classical) computational approach  
(*constraints, size of the problem, Datasets, bottlenecks*)

Quantum Computing Solution

Type of algorithm/method  
Resource assessment for a proof of concept  
(*Type of devices, number of qubits, time frame (NISQ, FTQC), ...*)

Key steps to achieve the proposed project



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# Brainstorming Session

1. Health (SDG 3)



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# Brainstorming Session

2. Climate (SDG 13)



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# Brainstorming Session

3. Food (SDG 2)



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# Brainstorming Session

4. Open Topics



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# Conclusions & Next Steps



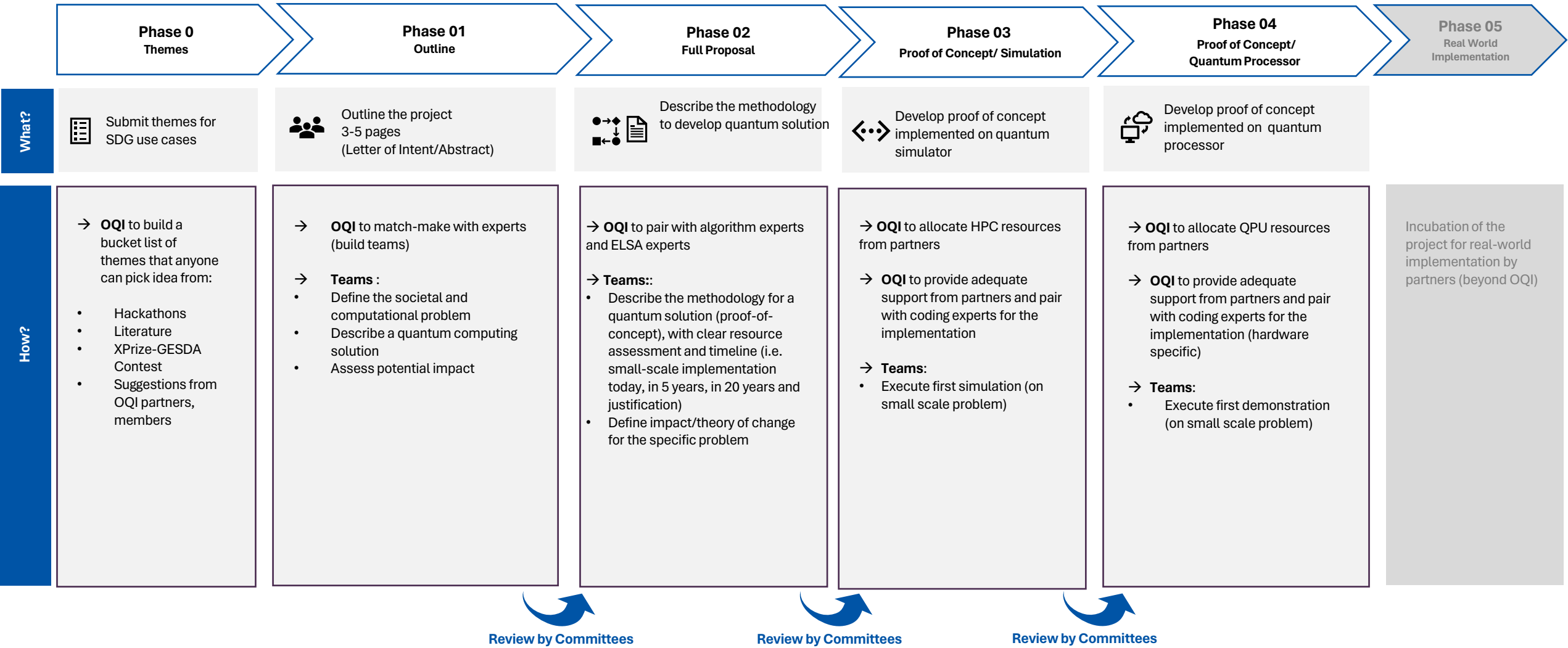
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  - form new teams of volunteers to continue the development of new use cases
- Clarify the methodology for use case development & evaluation process
- Clarify the mechanisms for engagement with OQI, either in the
  - development of new OQI use cases
  - valorisation of external use cases to feed the use case repository

## Next Steps

- Call for Submission (announcement April 2024)  
OQI as the match-maker --> supporting underserved geographies and demographics in OQI teams
- Evaluation process (scientific/impact criteria) to advance in the development phases and prepare for an implementation of a proof of concept on quantum devices --> pool of experts (scientific/impact)
- Vetting of external use cases to build a repository and encourage participation

# Methodology to build SDG use cases



# Engagement Mechanisms

For new candidate partners/ members, submit your manifestation of interest on [www.oqi.cern.global](http://www.oqi.cern.global)

Tier	Objective	Eligibility Criteria
<b>PARTNER</b>	<b>Co-shape and co-create OQI's unique value proposition</b>	<p><b>OQI partners are institutions that benefit from peer recognition for their scientific or in the impact expertise.</b></p> <p>Partners ...</p> <ul style="list-style-type: none"> <li>• either have served as OQIs spearheading partners during its incubation phase or have consistently engaged resources to OQI's work as OQI members for at least a year</li> <li>• commit to co-shape the OQI's unique value propositions for the three years of the pilot throughout the 4A's</li> <li>• are vetted by the OQI Advisory Committee</li> <li>• abide to OQIs values and openness principles</li> </ul>
<b>MEMBER</b>	<b>Contribute continuously to at least one of OQI's 4 A's</b>	<p><b>OQI members are institutions that benefit from peer recognition for their scientific or in the impact expertise.</b></p> <p>Members ...</p> <ul style="list-style-type: none"> <li>• have disclosed their governance structure</li> <li>• commit to actively contribute on at least one of the 4A's assiduously for at least one year</li> <li>• have appointed at least one expert from their institution as focal point of contact for OQI and contributor to its working groups</li> <li>• abide to OQIs values</li> <li>• have submitted a complete membership form with supporting documentation and are vetted by the OQI Management Team</li> <li>• qualify for partner level after having demonstrated their commitment for at least one year</li> </ul>
<b>FRIEND</b>	<b>Stay informed and be potentially solicited for consultations</b>	<p><b>OQI Friends are individuals</b> (such as experts from the private or public sector, countries, citizens) who are committed to open science, inclusivity and CERN's values and associate themselves with the OQI.</p> <p>Friends socialize the OQI in their communities.</p>



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