

# Outcomes of the broad and regular horizon scanning, monitoring and assessment of the most recent technological developments in synthetic biology

Kishma Primus-Ormond + Florian Rabitz

Co-chairs of the multidisciplinary Ad Hoc Technical Expert Group on synthetic biology

# Overview of the presentation

- I. Introduction and background
- II. Methodology and outcomes (Annex I)
- III. Capacity-building, technology transfer and knowledge-sharing (Annex II)
- IV. Review process (Annex III)
- V. Recommendations (Annex V)

**Important: Kindly refer to the original document for full detail!**

# I. Introduction and background

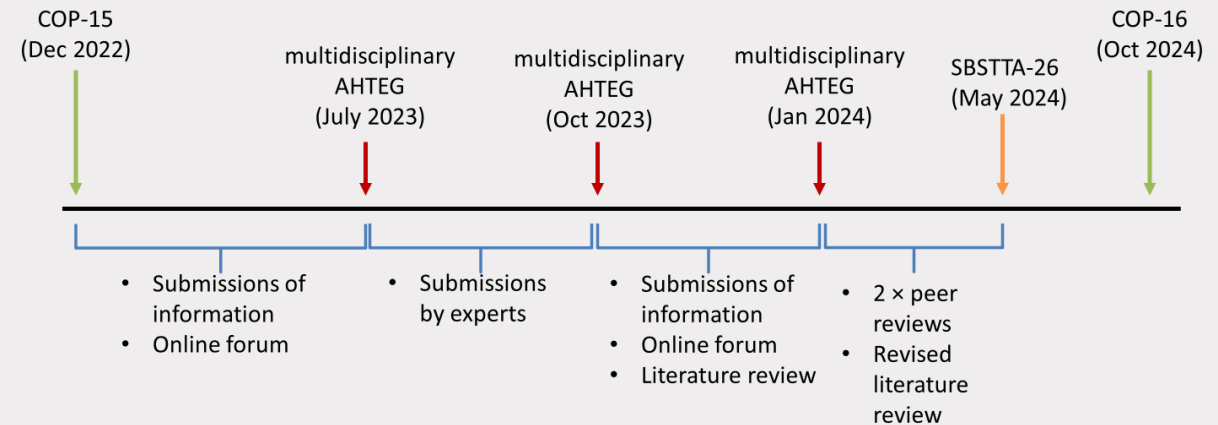
- Synthetic biology: umbrella term covering diverse developments in the life sciences
- More than a decade of discussion on potential positive and negative implications for the CBD
  - Decision XI/11
  - Decision XII/24
  - Decision XIII/17
  - Decision 14/19
  - Decision 15/31
  - 3 previous AHTEGs (2015-2016; 2017-2018; 2019-2020)
- Parallel processes on aspects of synbio under IUCN and WHO
- AHTEG addressing risk assessment for gene drives under Cartagena Protocol

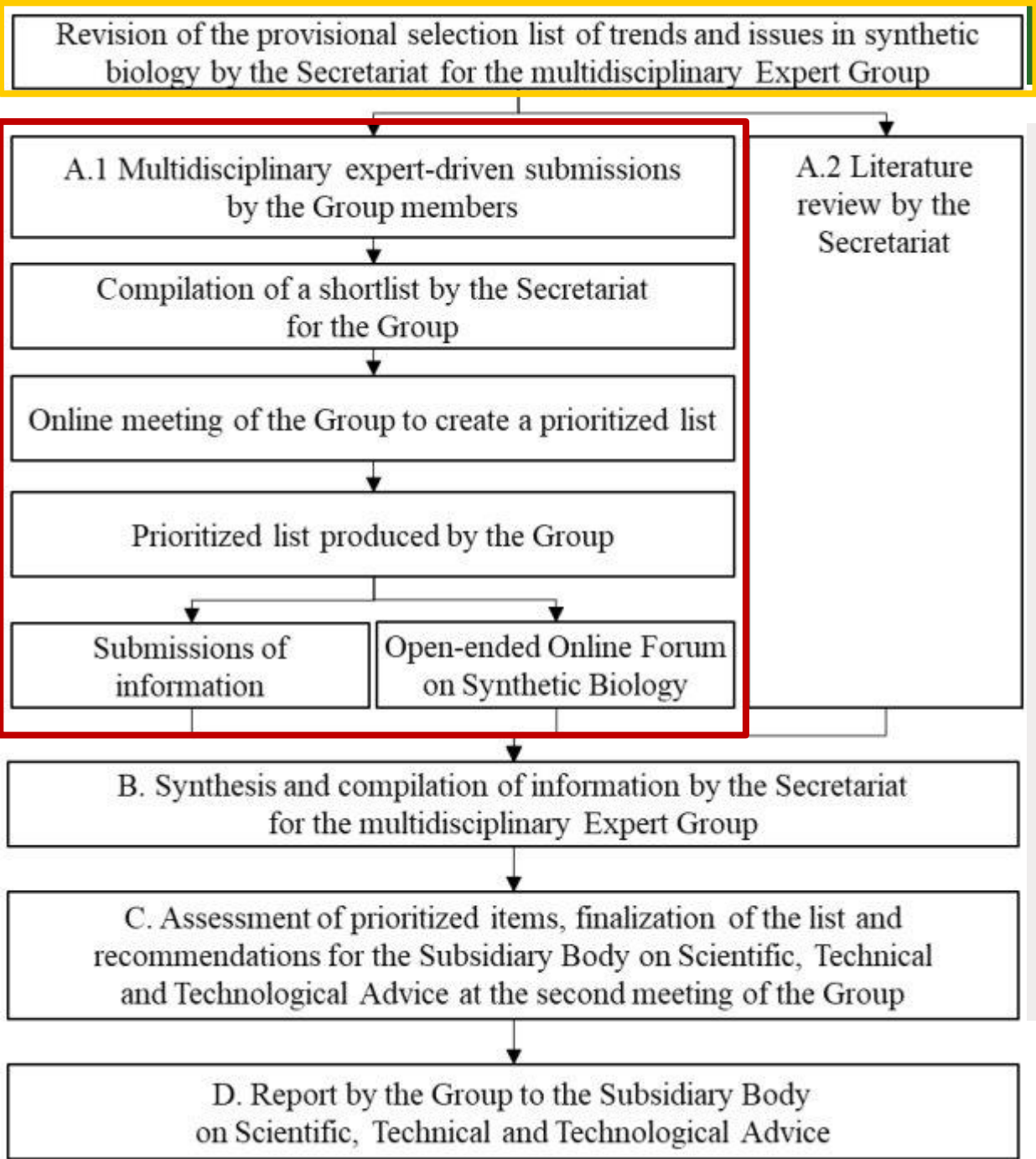
# I. Introduction and background

- Operational definition: “synthetic biology is a further development and new dimension of modern biotechnology that combines science, technology and engineering to facilitate and accelerate the understanding, design, redesign, manufacture and/or modification of genetic materials, living organisms and biological systems” (Decision XIII/17)
- Synbio applications vary in technological readiness and some are largely speculative
- Potential positive and negative implications for all objectives of the Convention

# I. Introduction and background

- Decision 15/31 established “a process for broad and regular horizon scanning, monitoring and assessment of the most recent technological developments in synthetic biology”
- This process consists of: a) information gathering; b) compilation, organization and synthesis of information; c) assessment; d) reporting
- Multidisciplinary AHTEG to “[i]dentify and prioritize trends and issues” relevant for the three objectives of the Convention; and to “[i]dentify capacity-building, technology transfer and knowledge-sharing needs”
- mAHTEG to develop recommendations “on specific issues that may require further consideration” by COP, NP COP-MOP and / or CP COP-MOP





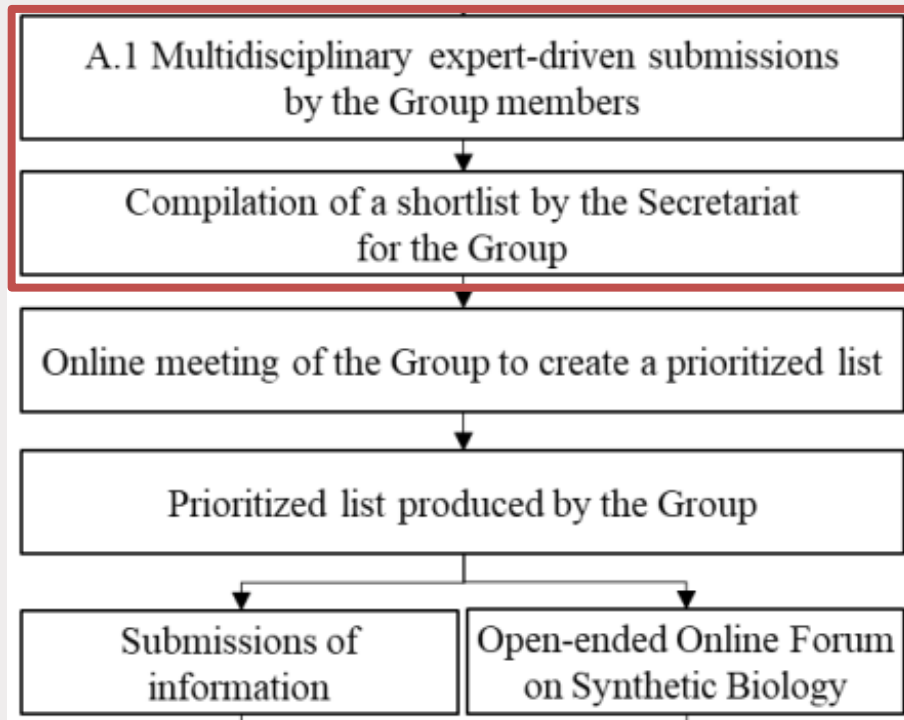
Multidisciplinary expert-driven process

August 2023 – January 2024

29 January – 2 February

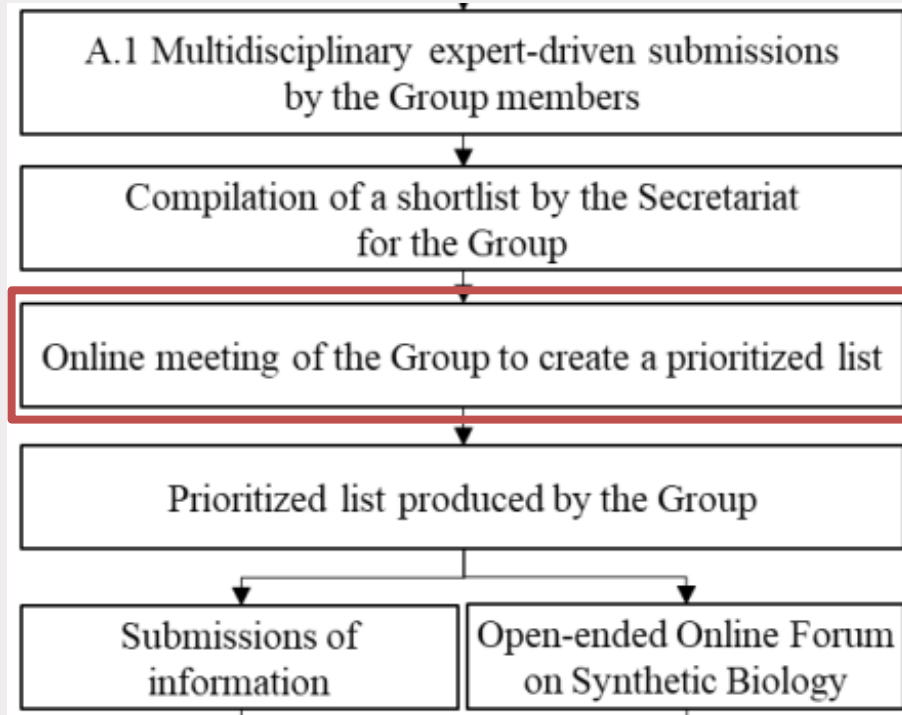
May 2024

## II. Methodology for the 2023–2024 intersessional period



- A virtual submission process (31 August to 18 September 2023):
  - Select an item from the provisional selection list or suggest a new item
  - Provide information on the potential impacts on the three objectives of the Convention
  - Share additional relevant considerations
  - Provide an estimated timeframe to release or impact
  - Share relevant publications related to the selection
- A maximum of five selections could be submitted
- 33 items from provisional selection list received submissions + 4 new items suggested

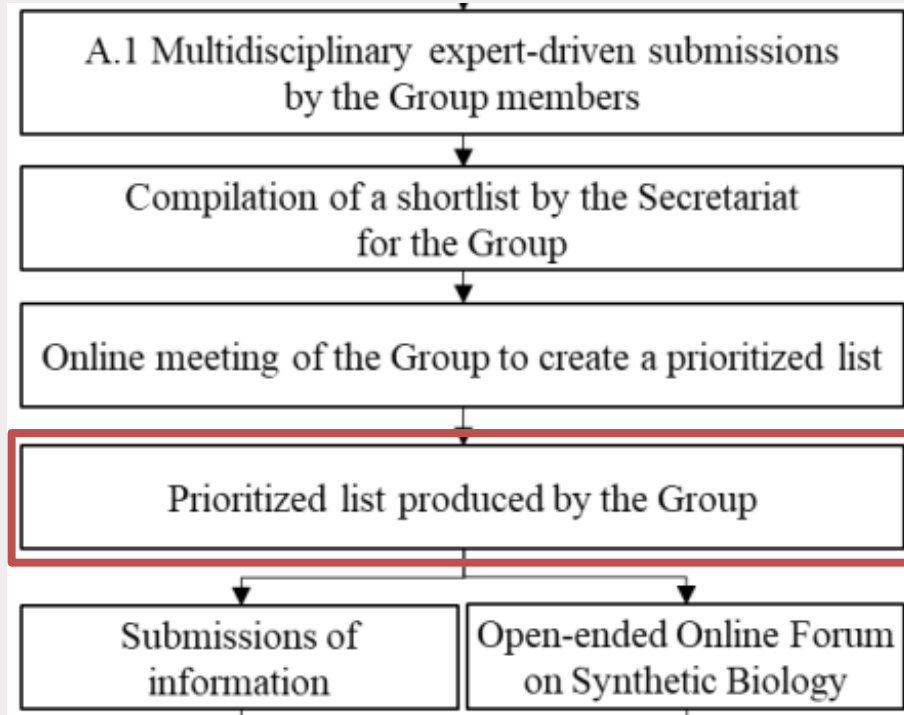
## II. Methodology for the 2023–2024 intersessional period



- Virtual meeting 10-12 October 2023
- Proceed with 37 items
- Indicative preferencing
  - Assignment of score from 1 – 1000 based on:
    - Potential impacts on objective of Convention
    - Relevance to Parties
    - Urgency
  - Z-scores were calculated and results distributed
  - 17 items received positive Z-scores
- 17 items would make up the prioritized list

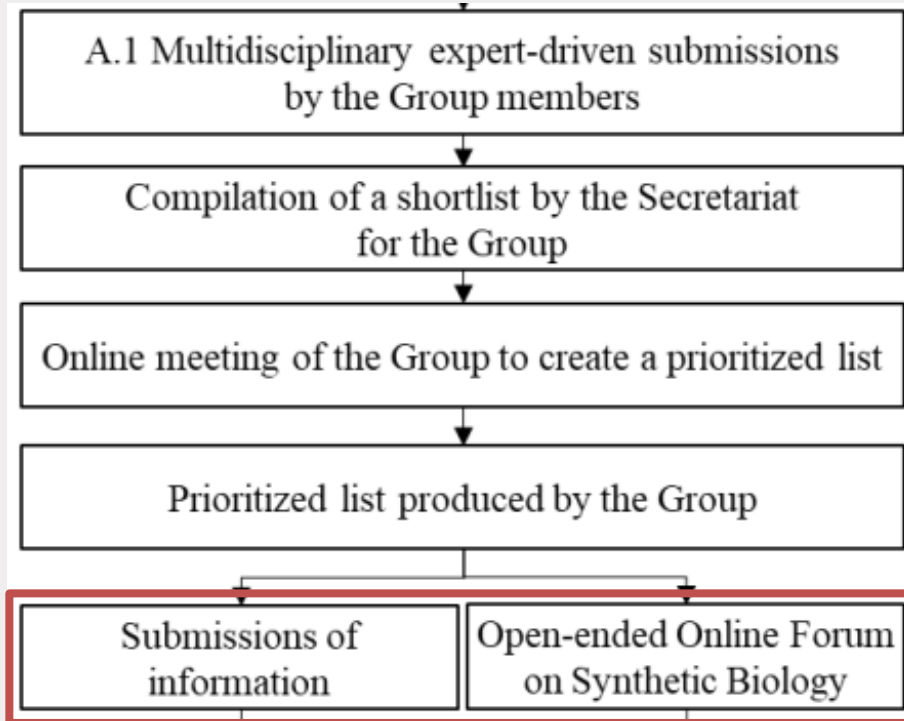


## II. Methodology for the 2023–2024 intersessional period



- Prioritized list was divided into 5 items for a detailed assessment and 12 items for less detailed assessment (further deliberations and preferencing)
- 5 items for detailed assessment:
  - i. Self-spreading vaccines for wildlife
  - ii. Self-limiting insect systems
  - iii. Development of engineered gene drives to control vector-borne diseases and invasive species
  - iv. Integration of artificial intelligence and machine learning
  - v. Inequity in the participation of developing countries in the context of synthetic biology

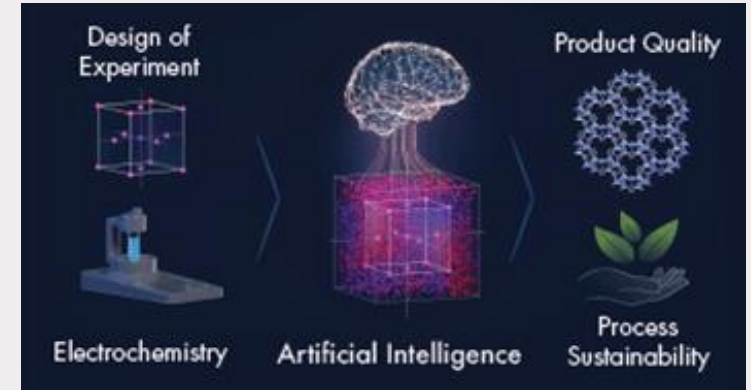
## II. Methodology for the 2023–2024 intersessional period



- Submissions of information (Nov 2023)
  - Further information gathering on 12 trends and issues for less detailed assessment
- Open-ended online forum (Nov 2023)
  - Further information gathering on 5 trends and issues for more detailed assessment
- Information was compiled, organized and synthesized by the Secretariat (INF doc for the meeting of the multidisciplinary Expert Group)

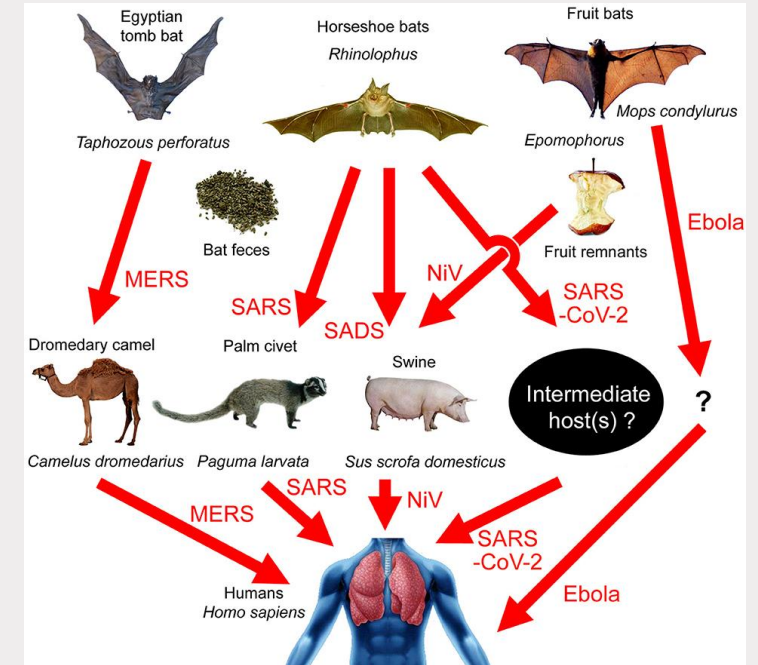
## II. Prioritized for detailed assessment: AI and machine learning

- Rapid advances in AI and ML enable novel uses of synbio
- Developments include LLMs for risk assessment, biodesign tools for protein engineering, and cyberphysical systems with interaction between AI and synbio components
- Rapid technological progress and commercialization
- Potential to enhance conservation efforts and improve efficiency of resource use
- Potential harm from deliberate or accidental releases of novel LMOs; complex questions regarding utilization of Digital Sequence Information



## II. Prioritized for detailed assessment: Self-spreading vaccines for wildlife

- Aimed at addressing challenges in wildlife conservation, animal disease management and preventing zoonotic disease spillover
- Research in early stages - applications against Lassa fever, Ebola and Rabies are currently being explored
- Could be used to for control of invasive species, management of pesticide resistance and improved disease management and resilience in wildlife
- Risk of unintended negative impacts, including spillover into non-target species
- Potential for transboundary movement



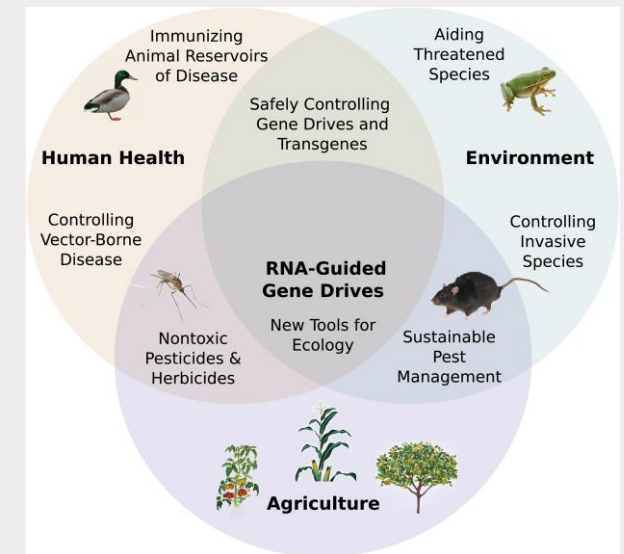
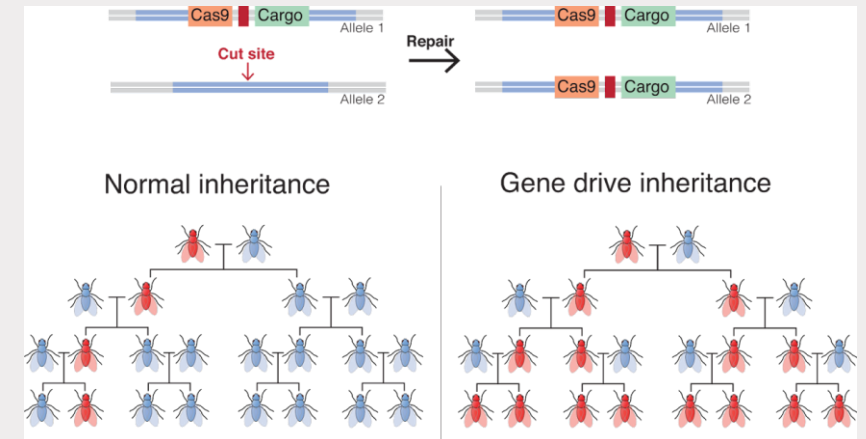
## II. Prioritized for detailed assessment: Self-limiting insect systems

- Self-limiting insect systems use genetic engineering for suppression of insect populations, akin to Sterile Insect Technique
- Technology in early stages of commercialization
- Potential tool for managing pests (as well as disease vectors)
- Potential for transboundary movement



## II. Prioritized for detailed assessment: Engineered gene drives

- Engineered gene drives are genetic systems that are transmitted to progeny at super-Mendelian (> 50 per cent) frequencies
- Could allow effective biological control of pests (and disease vectors) via population suppression or population replacement
- Broad R&D activity, exploration of potential field trials
- Potential for transboundary movement
- Risk assessment for gene drives currently unclear



## II. Prioritized for detailed assessment: Inequity in the participation of developing countries

- Developed countries lead in synbio R&D
- Need for capacity-building in developing countries (research, development, assessment, monitoring and management of synbio)
- Need to ensure access to potential benefits
- Need for appropriate regulatory capacities for monitoring and managing biosafety aspects of synbio



## II. Prioritized trends and issues in synthetic biology

### Prioritized for a more detailed assessment

Self-spreading vaccines for wildlife

Self-limiting insect systems

Development of engineered gene drives to control vector-borne diseases and invasive species

Integration of artificial intelligence and machine learning

Inequity in the participation of developing countries in the context of synthetic biology

### Additional trends and issues prioritized for assessment

Engineered bacteria for nitrogen-fixation and fertilizers

Transient modification of agricultural plants, pests and pathogens using RNA interference or nanomaterials

Genome-edited plants

Microbiome engineering for non-medical purposes

Use of synthetic biology in wild organisms in the context of resilience in threatened species

Synthetic biology applications for bioremediation, biodegradation or biomining

Technical refinement of novel delivery systems and chemistries to modify organisms in the field or in nature

Ability to recreate viruses by chemical DNA synthesis

Interaction of synthetic biology organisms in the environment and potential for cumulative effects

Dual-use nature and biosecurity implications of synthetic biology

Transboundary movements and relation to detection and identification of synthetic biology organisms, parts and products

Increased field-testing of synthetic biology applications, including in areas outside the national jurisdiction of the developer or funder





# III. Capacity-building, technology transfer and knowledge-sharing (Annex II)

- Options were developed independently from other processes
  - 11 options for capacity-building
  - 11 options for technology transfer
  - 13 options for knowledge-sharing
- Supporting the development of bioeconomies in developing countries could contribute to the objectives of the Convention
- Need to balance against need for monitoring and managing adverse socioeconomic and environmental impacts

Table of options in Annex II

## IV. Review of process (Annex III)

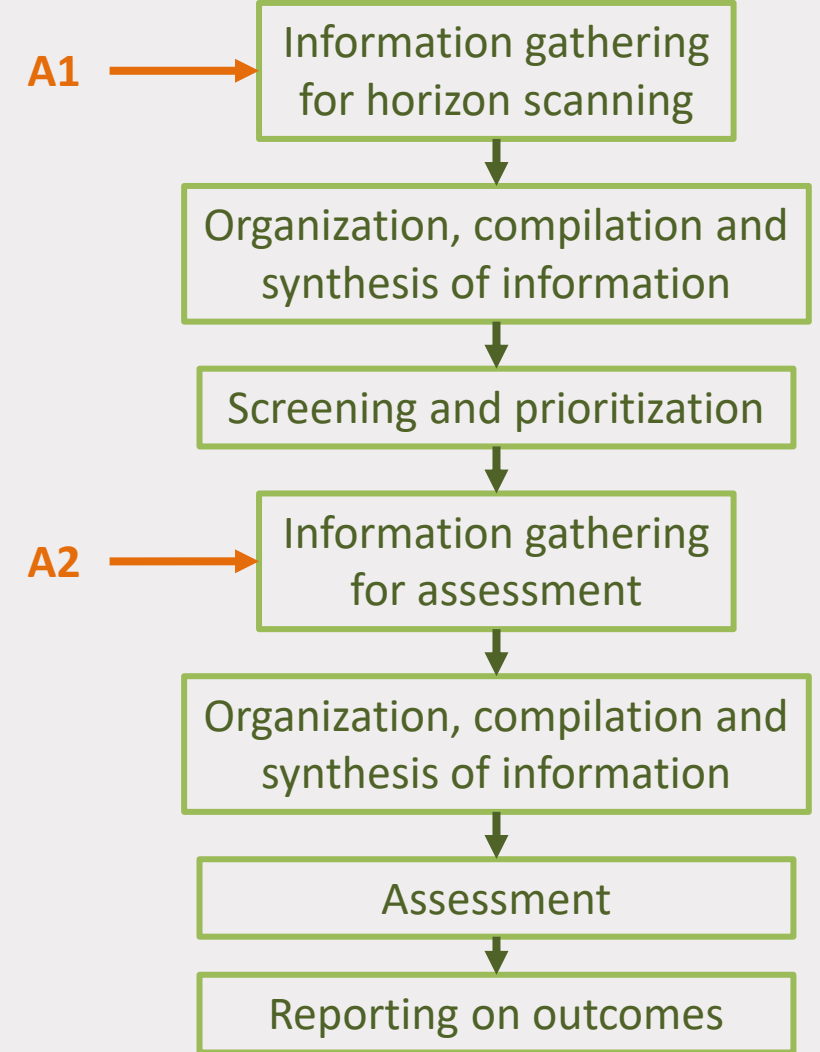
- General reflections from group members:
  - Addressed all four steps from decision 15/31
  - Task completed in 6 months
  - Sound multidisciplinary process under the Convention was developed and provided a unique experience
  - Additional resources were required by the Secretariat
  - Challenges related to visas and resourcing

# IV. Review of process (Annex III)

- Elements for improving the process

## A) Information gathering

- **Two parts: (A1) horizon scanning and (A2) to inform the assessment step**
- Submissions of information, online forums, literature review
- Engagement with diverse stakeholders (e.g., IPLCs, women, youth, scientists, practitioners), including in other languages
- Integrating national research priorities
- Call upon additional specific expertise
- Start literature review earlier to be taken into account
- Search terms could have collaborative input from multidisciplinary Expert Group
- BCH could be a valuable resource
- Review of prioritized topics



# IV. Review of process (Annex III)

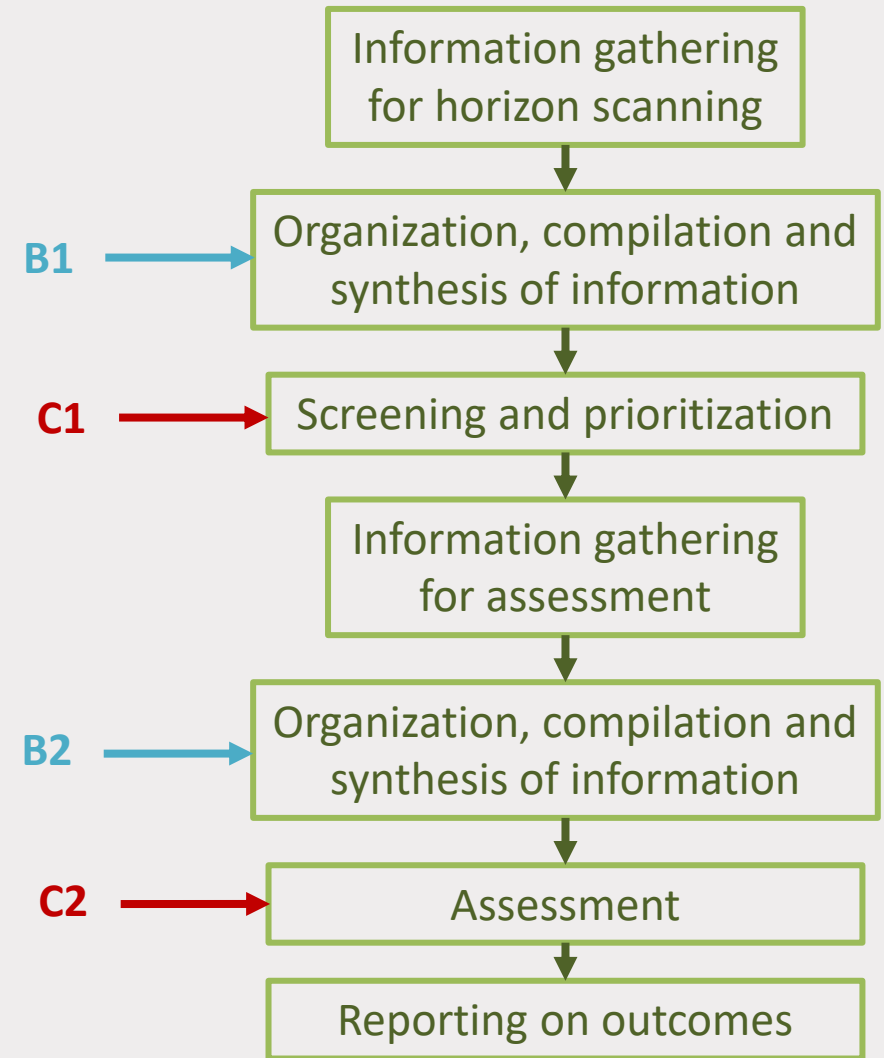
- Elements for improving the process

## B) Compilation, organization and synthesis of information

- **Two phases (B1 + B2)**
- Peer review is important for literature review
- Timely and effective compilation
- Synthesizing information should be aligned with overall methodology to provide basis for assessment

## C) Assessment

- **Two phases: (1) screening and (2) assessment of prioritized items**
- Screening order: exchange among experts; initial z-scoring; discussions and exchange among experts; and final z-scoring (with flexibility)
- Inclusive participation of experts from different disciplines (IPLCs, academics, specialized experts)
- Incorporation of other knowledge systems, forums and appropriate information-gathering methods
- Benefit from information provided through monitoring



## V. Recommendations from multidisciplinary Expert Group (Annex V)

- Noting that SBSTTA will perform a review, mAHTEG provided options for consideration depending on how this review takes shape
- 26 potential recommendations on:
  - General considerations
  - Artificial intelligence and machine learning
  - Self-spreading vaccines for wildlife
  - Engineered gene drives
  - Inequitable participation of developing countries
  - Self-limiting insect systems

# Final considerations

- First horizon scan under the Convention
- Important lessons were learned during this first cycle
- An inclusive, multidisciplinary process is key, especially for assessments
- 5 key areas of synthetic biology were assessed
- 12 additional areas were also prioritized
- 35 different options for capacity-building, technology transfer and knowledge-sharing were highlighted
- Several different options for recommendations are available to support SBSTTA in their review of the process

# Thank you!

## Secretariat of the Convention on Biological Diversity

413 St. Jacques Street, Suite 800  
Montreal, Quebec, Canada H2Y 1N9  
Tel. +1 514 288 2220



[secretariat@cbd.int](mailto:secretariat@cbd.int)  
[bch@cbd.int](mailto:bch@cbd.int)



[cbd.int](http://cbd.int)  
[bch.cbd.int](http://bch.cbd.int)  
[bch.cbd.int/protocol](http://bch.cbd.int/protocol)



[facebook.com/UNBiodiversity](https://facebook.com/UNBiodiversity)  
[facebook.com/UN.Biosafety](https://facebook.com/UN.Biosafety)



[twitter.com/UNBiodiversity](https://twitter.com/UNBiodiversity)  
[twitter.com/BCHCPB](https://twitter.com/BCHCPB)



[instagram.com/UNBiodiversity](https://instagram.com/UNBiodiversity)



[linkedin.com/company/UNBiodiversity](https://linkedin.com/company/UNBiodiversity)