Deliverable 2.2: Report on financial and capacity scenarios

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Content

1. Purpose of the document

The purpose of the document is to analyse a range of likely financial and capacity scenarios that may arise for its operations during the ACTRIS Implementation phase. The scenario planning will be essential to map out the different probabilities and outcomes on the financial plan and operations of ACTRIS ERIC and to help making strategic decisions and identifying the main areas of risk for the long-term sustainability of ACTRIS.

2. Introduction

ACTRIS (Aerosols, Clouds and Trace Gases Research Infrastructure) is a distributed, pan-European Research Infrastructure (RI) aiming at understanding the spatial and temporal variability of short-lived atmospheric constituents and the complex processes driving their interactions, and quantifying their impacts on climate, air quality, human health, and ecosystems. The coordination and long-term operation of ACTRIS is ensured by its legal entity, ACTRIS ERIC (European Research Infrastructure Consortium). ACTRIS builds on:

- a considerable number (>100) of distributed **National Facilities (NF)** that include observational and exploratory platforms both within Europe and at selected global sites and which are responsible for the acquisition of reliable accurate, and high-quality ACTRIS data; and
- 8 European-level **Central Facilities (CF)** that are essential to ensure compliance of the NF instrumentation and measurements with the ACTRIS standard operating procedures and quality protocols. The CF consist of 6 Topical Centres (TC), covering the thematic areas of ACTRSI – aerosol in situ measurements, aerosol remote sensing, cloud in situ, cloud remote sensing, trace gases in situ, trace gases remote sensing – the Data Centre (DC) and the Head Office (HO). Each CF consists of several CF units which are operated by one or several research performing organisations (RPOs).

The operations of the NF are organised and financed nationally by the countries and their RPOs. The operations of the CF are partially financed by the hosting countries (70%), and partially by the contributions of member and observer countries to ACTRIS ERIC (30%). The ACTRIS HO operates directly under the ACTRIS ERIC, as does part of the ACTRIS DC. All TCs and part of the ACTRIS DC are operated outside the ACTRIS ERIC.

ACTRIS is in its implementation phase until 2025, the operational phase is planned to start in 2026. ACTRIS ERIC was officially established on April 27, 2023, and comprises today 17 member and observer countries[1]. The overall extent of ACTRIS, its components (CFs, NFs, RPOs), its timeline and the participating countries in the ACTRIS ERIC are illustrated in figure 2.1.

[1] Finland (FI, statutory seat), Austria (AT), Belgium (BE), Bulgaria (BG), Cyprus (CY), Czech Republic (CZ), Denkmark (DK), France (FR), Germany (DE), Italy (IT), Netherlands (NL), Norway (NO), Poland (PL), Romania (RO), Spain (ES, Sweden (SE), Switzerland (CH).

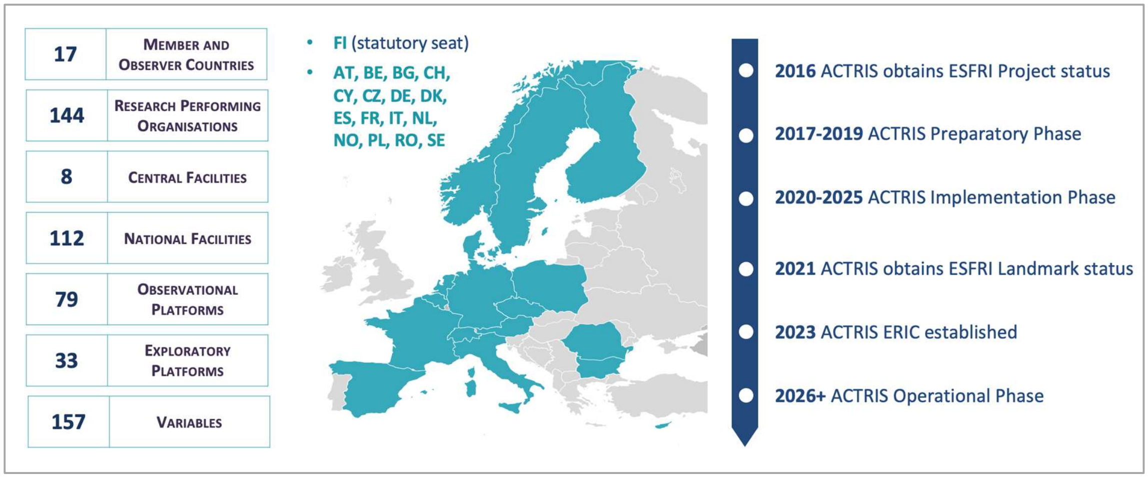


Figure 2.1: ACTRIS ERIC timeline, participating countries and components (status: June 2023).

ACTRIS ERIC oversees the strategic and financial development of ACTRIS and its long-term operation and sustainability. The ACTRIS ERIC financial model, comprising the revenues and expenditures for implementing and operating the CFs and the NFs, is based on contributions of the participating countries, and is detailed in the annex II of the statutes of ACTRIS ERIC.

The financial plan is a roadmap for ACTRIS ERIC to achieve its financial goals and support its strategy and is needed to forecast the revenues and expenditures while taking into account and assessing any pertinent financial risks. A risk assessment will depend on the different 'risk drivers'2 relevant for ACTRIS ERIC: i) the operating costs of the CF (HO, DC, TC), ii) the number of member and observer countries committed to ACTRIS ERIC, iii) the capacities of the CF to provide support to the NF, and iv) the number and type of NF to be supported by the CF.

The objectives of analysing the financial and capacity scenarios is to determine how different situations would affect the operational activity of ACTRIs ERIC until 2025 and to assess its associated risks.

3. Scenario description

The methodology for analysing the financial and capacity scenarios is described in the document MS10 Draft report on financial and capacity scenarios (see section 6). The analysis of different scenarios is made as a function of the different risk drivers, and their impact is briefly described/summarized below:

(1) Countries committed to ACTRIS ERIC

The number of ACTRIS ERIC member and observer countries is important, as is the type/size of the countries (in terms of their economy). Both number and type affect the available funding to cover the costs of the CF activities. The CF require sufficient resources to provide support to the NF in these participating countries. The CF costs were defined for the period of 2021-2025

[2] A Risk driver denotes an attribute, characteristic, variable or other concrete determinant the influences the risk provile of a system, entity, financial asset etc (*www.operiskmanual.org*).

(implementation phase)[3]. The revenues to cover the CF costs comprise different types: membership contributions, host contributions and host premium contributions[4], and any other revenues:

- Membership contributions: the membership contributions were fixed until 2025 in relation to the estimated CF costs within the ACTRIS 5-year financial plan. The calculation method of the membership contributions depends on:
    - The countries' Gross National Income (GNI): the revenues from the membership contribution of new countries to ACTRIS ERIC varies with a country's economic strength.
    - The number of NFs in the country: the CF expenditures depend on the operation support to be provided to each NF, which increase with an increasing number of NFs. Beyond the estimated CF costs, additional resources may be necessary to provide the required additional operation support.

  However, in case of different countries (compared to those initially planned) participating in the ACTRIS ERIC, the revenues are impacted. If new countries join the ACTRIS ERIC, additional revenues will become available. If fewer countries join the ACTRIS ERIC, fewer revenues will be available.

- Host contributions / host premium contributions: the operations of the CFs are financed by both the membership contributions (30%) and particularly by the contributions from the CF hosting countries (70%). In case of additional countries joining the ERIC, the additionally required resources (CF hosting contributions) for operation support to the new NFs from these additional countries, however, will have to be ensured.
- Other revenues: additional revenues may be important for consideration, due to their effect on the financial situation and capacity of ACTRIS. These are, however, not specifically considered as a risk driver although they may reduce the risks by providing additional funds allowing to co-finance the requird CF cost. Additional revenues may include, for example:
    1. Contributions from new countries joining the ERIC;
    2. Increased global amount of membership contributions due to new NF in the member/observer countries;
    3. Contributions from other organisations cooperating or linked to ACTRIS ERIC (e.g., JRC);
    4. Cash contributions from projects (European, national);

[3] The reference for the CF operation costs is based on the 5th edition of the CF Cost Book release in August 2020.

[4] *Membership contribution* means the amount of money the countries pay to join ACTRIS ERIC as members, permanent observers, or observers. *Host contribution* means support provided by members or permanent observers for the functioning of the Central Facilities that are not part of ACTRIS ERIC, hosted in their own country. *Host premium contribution* means the support provided by ACTRIS ERIC members and permanent observers for the functioning of the Central Facilities that are part of ACTRIS ERIC, hosted in their own country.

v. Cash or in-kind contributions from national funding agencies or national research performing organisations;

vi. Contributions via user fees from users of ACTRIS services (provided by CF and NF). Users of CF services comprise i) facilities that are not considered ACTRIS NFs, ii) facilities that are associated with international networks or partner programmes[5] (e.g., AERONET, EARLINET, NDACC, WMO-GAW, EMEP, E-PROFILE, PGN, LALINET, MPLNET, AD-NET, …), iii) facilities associated with national monitoring networks, or iv) any other national or international user including private companies. User fees, however, may not apply to all types of users depending on a future pricing scheme.

(2) NF inventory

The NF inventory represents the number of NF that require operation support from the relevant CF and CF units (TC and DC). The CF expenditures vary as a function of the NF that are brought to ACTRIS ERIC by the countries. An evolution of the NF inventory (i.e., increasing number and/or type of NFs) affects the CF activities and costs needed to provide the expected operation support to the NF. An overview of the (current) NF inventory is given in annex 1.

(3) CF capacity

The CF capacity, in particular the TC capacity, is important as the resources for operation support to the NF is not unlimited. I.e., each TC has a limited/maximum capacity which needs to be analysed with respect to a potential increase of participating countries and NF to be served. The number of countries engaged in ACTRIS is decisive for the CF activities and costs as each country brings a specific number of NFs. With an increasing number of participating countries, the CF activities for providing operation support to the NF will increase up to their maximum capacity, and the associated costs will increase accordingly. The CF capacity determined in 2020 has been based on their expected capacity and resoures (see table 3.1). The capacity is likely to have evolved with time since: available resources may have changed, other revenues may become available, emerging technologies may help optimizing the CF resources. In case of additional new NFs, the capacity of the TC needs to be explored to ensure that the required operation support to these NFs will be available.

[5] International and partner networks: AERONET (Aerosol Robotic NETwork): aeronet.gsfc.nasa.gov, EARLINET (European Aerosol Research Lidar Network): earlinet.org, NDACC (Network for the Detection of Atmospheric Composition Change): ndacc.larc.nasa.gov, WMO-GAW (World Meteorological Organisation-Global Atmospheric Watch): community.wmo.int/en/activity-areas/gaw, E-PROFILE (EUMETNET Profiling Programme): https://www.eumetnet.eu/activities/observations-programme/current-activities/e-profile/, PGN (Pandonia Global Network): pandonia-global-network.org, LALINET (Latin America Lidar Network): lalinet.org, MPLNET (NASA Micro-Pulse Lidar Network): mplnet.gsfc.nasa.gov, AD-Net (Asian dust and aerosol lidar observation Network): https://www-lidar.nies.go.jp/.

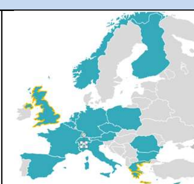
Table 3.1. Estimated TC capacity at the time of the establishment of CF costbook in 2020.

TC[6] / NF Components[7]	CAIS-ECAC	CIS	CIGAS	CARS	CCRES	CREGARS	Total
	AIS	CIS	TGIS	ARS	CRS	TGRS	
Max TC capacity	70-90	15	33	52	24	12	206-226

The scenario analysis analyses the financial situation and operational capacity of ACTRIS for different plausible scenarios of countries participating in ACTRIS ERIC. The analysis focuses mainly on the TC capacity in relation to the NF inventory as a function of the number of countries committed to ACTRIS ERIC. Not considered in the assessment is the impact of the actual revenues from membership contributions and host /host premium contribution for each of the scenarios (being subject of a separate study and involving comprehensive simulations). In this document, the scenario analysis is made for four different scenarios, summarised in table 3.2 and further described with respect to the expected number of NFs in the below subsections.

It must be emphasized that the scenario analysis focuses on the capacity of the entire TCs. Each of the six TCs is composed of between 4-8 TC units, with each focusing on specific and different types of variables /instruments /methodologies), totalling altogether 37 TC units. Although a TC may appear to have a sufficient capacity, some individual TC unit capacities within the same TC, if focused on, may not be sufficient, or vice versa. Considering the TC unit level capacity would require a futher, more detailed analysis which has not been the focus of this present document.

Table 3.2. Scenario overview.

Scenario		**Details**	
1	Initial	Initial scenario, basis of 5th edition of the CF Cost Book (2020) 17 Target countries: AT, BE, BG, CH, CY, CZ, DK, ES, FI, FR, **GR**, IT, NL, NO, PL, RO, **UK** +**JRC**	
2	Baseline	Current status quo (June 2023) 17 Target countries: AT, BE, BG, CH, CY, CZ, DE, **DK**, ES, FI, FR, IT, NL, NO, PL, RO, **SE** +**JRC**	

[6] The TCs include CAIS-ECAC (Centre for Aerosol In Situ Measurements-European Centre for Aerosol Calibration), CIS (Centre for Cloud In Situ Measurements), CIGAS (Calibration Center for Reactive Trace Gas In Situ Measurements), CARS (Centre for Aerosol Remote Sensing), CCRES (Centre for Cloud Remote Sensing), CREGARS (Centre for Reactive Trace Gases Remote Sensing).

[7] The TCs cover the following NF components (= thematic measurement areas) in ACTRIS: AIS (aerosol in situ), CIS (cloud in situ), TGIS (trace gases insitu), ARS (aerosol remote sensing), CRS (cloud remote sensing), TGRS (trace gases remote sensing).

Scenario		Details	
3	Full	Expected scenario (in the near term) 19 Target countries: AT, BE, BG, CH, CY, CZ, DE, **DK**, ES, FI, **GR**, FR, IT, NL, NO, PL, RO, **SE**, **UK** **+JRC**	
4	Complementary	Future potential scenarios (in a distant future) 19 Target countries: AT, BE, BG, CH, CY, CZ, DE, DK, ES, FI, GR, FR, IT, NL, NO, PL, RO, SE, UK +JRC 4a) +3 potential new countries: EE/ IE / PT 4b) +new NFs 4c) +additional other facilities (e.g., non ACTRIS NFs, network stations, other users)	

- Scenario 1 corresponds to the **initial scenario** which is based on the situation when the underlying costbook (n°5) was established, which considers an estimated maximum capacity for each CF with initially 17 countries and the JRC.
- Scenario 2 is considered as **baseline scenario**, as it corresponds to the (current) situation, after the establishment of ACTRIS ERIC, with those countries that have joined the ERIC as members or observer countries. Concerned are 17 countries, which are different from those in the initial scenario 1 (scenario 1 includes Greece and the United Kingdom (UK) which are not in scenario 2, instead included are the newly joined countries Denmark and Sweden).
- Scenario 3 (**full scenario**) considers 19 likely countries participating in the current ERIC (scenario 2), but furthermore Greece and the UK, as well as JRC.
- Scenario 4 considers different **complementary scenarios**, such as new countries in the ERIC with new NF or additional facilities which are, however, not included here as they may apply to all scenarios).

3.1 Scenario 1: Initial scenario

The initial scenario represents the situation corresponding to the establishment of the 5th edition of the CF Cost Book, in 2020. This scenario comprises 17 countries and the Joint Research Centre (JRC), as illustrated in figure 3.1. The JRC, being a European Commission's service, cannot joint the ERIC but is contributing to ACTRIS' activities, defined under a dedicated agreement. In this scenario, 115 NFs were considered, requiring operation support from the 6 TC covering the following NF components. Each of the 115 NFs covers at least one or several NF components. During the implementation phase, the number of NF components to be served is expected to evolve. The year considered for all scenario analyses is the expected NF status in 2025. The total number of NF components in scenario 1 is 224, with most of them being related to AIS (76 NF components), then ARS (50), TGIS (42), CRS (29), CIS (16) and TGRS (11), see table 3.3 for details listed by each participating country. The CF costs required to provide the operation support to the 115 NFs (224 NF components) were established by each CF, by considering their maximum capacity which itself is limited by the expected, available resources. A comparison with the TC capacity estimated in 2020 as shown in table 3.1 indicates that the initial maximum capacity appears insufficient for all TC, given the esimtated number of NF components to be served in scenario 1, e.g., CIS (missing 1 slot), CCRES (-5), CIGAS (-9).

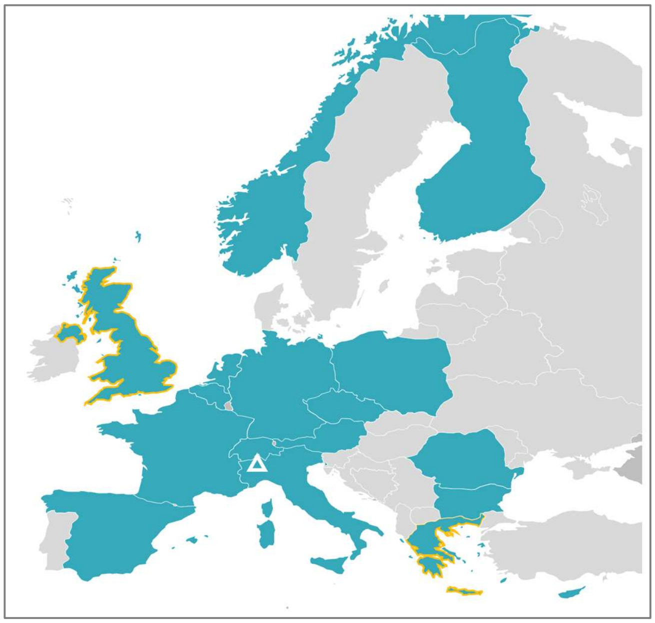


Figure 3.1 Participating 17 countries in ACTRIS ERIC (and including JRC, shown as white triangle) in the initial scenario, as expected at the time of the costbook establishment, in 2020.

Table 3.3 Planned NF inventory per country in 2025 for the initial scenario, extracted from the NF inventory in annex 1.

#	Country	# NF	AIS	CIS	TGIS	ARS	CRS	TGRS	# Components
		115	**76**	**16**	**42**	**50**	**29**	**11**	**224**
1	**Austria**	3	2	1	1	0	0	0	4
2	**Belgium**	5	2	0	2	0	0	2	6
3	**Bulgaria**	2	1	0	0	1	0	0	2
4	**Cyprus**	3	2	0	1	2	1	0	6
5	**Czechia**	4	3	1	1	1	0	0	6
6	**Finland**	14	11	4	6	2	4	0	27
7	**France**	8	7	0	5	5	2	1	20
8	**Germany**	24	13	5	9	9	7	5	48
9	**Greece**	9	6	1	2	4	1	1	15
10	**Italy**	10	6	1	4	8	4	1	24
11	**Netherlands**	1	1	0	1	1	1	1	5
12	**Norway**	3	2	1	2	0	1	0	6
13	**Poland**	7	3	0	0	7	2	0	12
14	**Romania**	6	3	1	1	4	3	0	12
15	**Spain**	8	8	0	1	3	1	0	13
16	**Switzerland**	3	3	1	3	1	1	0	9
17	**UK**	4	2	0	2	1	1	0	6
	JRC	1	1	0	1	1	0	0	3

3.2 Scenario 2: Baseline scenario

The baseline scenario indicates the current status quo of member and observer countries in the ACTRIS ERIC at the time of writing of this document. Scenario 2 comprises 17 countries also, and the JRC, see figure 3.2. The difference with the prevous initial scenario is the joining of the Denmark and Sweden as new members. Greece and the United Kingdom (UK) are not included as they have not yet joined the ACTRIS ERIC. The total number of countries has not changed, although the situation has evolved with respect to the number/type of NF to be served, see table 3.4. The total number of NF in the baseline scenario is reduced by 2 NF compared to the initial scenario, with overall 5 NF components less to be supported by the TCs compared to scenario 1. The initial TC maximum capacity (table 3.1) is not sufficient to provide support to all NFs in scenario 2, concerned are CIS (missing 1 slot), CCRES (-4), CIGAS (-9).

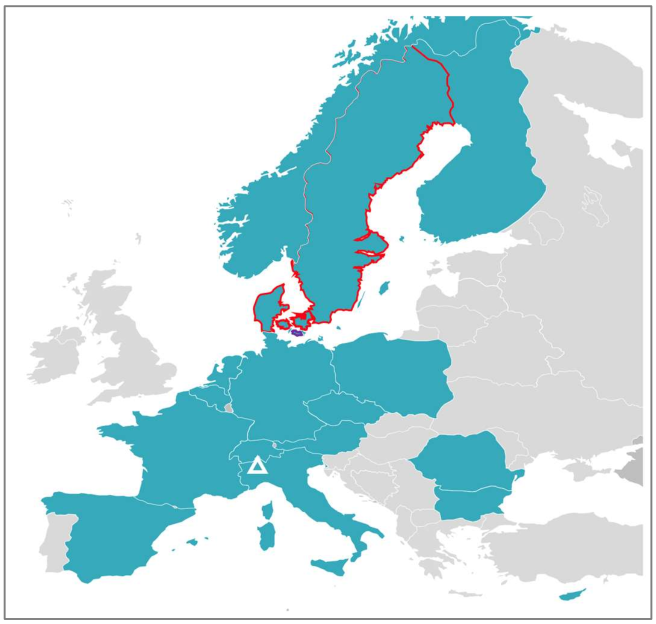


Figure 3.2 Participating 17 countries in ACTRIS ERIC in baseline scenario with the new countries Denkmark and Sweden and including JRC (shown as white triangle).

Table 3.4. Planned NF inventory per country in 2025 for the baseline scenario, extracted from the NF inventory in annex 1.

#	Country	# NF	AIS	CIS	TGIS	ARS	CRS	TGRS	# Components
		115	**78**	**16**	**42**	**45**	**28**	**10**	**219**
1	**Austria**	3	2	1	1	0	0	0	4
2	**Belgium**	5	2	0	2	0	0	2	6
3	**Bulgaria**	2	1	0	0	1	0	0	2
4	**Cyprus**	3	2	0	1	2	1	0	6
5	**Czechia**	4	3	1	1	1	0	0	6
6	**Denmark**	4	4	0	0	0	0	0	4
7	**Finland**	14	11	4	6	2	4	0	27
8	**France**	8	7	0	5	5	2	1	20
9	**Germany**	24	13	5	9	9	7	5	48

#	Country	# NF	AIS	CIS	TGIS	ARS	CRS	TGRS	# Components
10	**Italy**	10	6	1	4	8	4	1	24
11	**Netherlands**	1	1	0	1	1	1	1	5
12	**Norway**	3	2	1	2	0	1	0	6
13	**Poland**	7	3	0	0	7	2	0	12
14	**Romania**	6	3	1	1	4	3	0	12
15	**Spain**	8	8	0	1	3	1	0	13
16	**Sweden**	7	6	1	4	0	1	0	12
17	**Switzerland**	3	3	1	3	1	1	0	9

3.3 Scenario 3: Full Scenario

The full scenario considers a likely scenario in the near future. Scenario 3 builds on the actual status (baseline scenario) with the additional countries Greece and the UK, both having the willingness to contribute to ACTRIC ERIC but are awaiting the political country commitment to join. In this scenario, the total number of participating countries is 19, and includes the JRC (see figure 3.3). The total number of NFs included is 126, and the NF components to be supported by the TC is 240, an overview per participating country is given in table 3.5.

With respect to the baseline scenario, the total number of NFs and NF components is increased by 13 (12%) and 21 (10%), respectively. This increase is rather significant, given the fact that some of the TCs in the previous scenarios did already have an insufficient capacity to serve all NFs/NF components. This concerns the TCs CIS (missing 2 slots), CCRES (-6), CIGAS (-13).

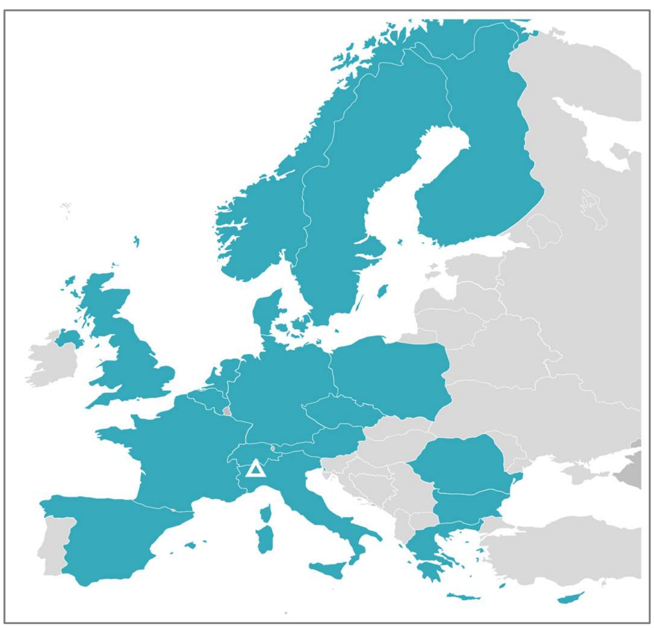


Figure 3.3 Full scenario considering 19 countries participating in ACTRIS ERIC and including JRC (shown as white triangle).

Table 3.5. Planned NF inventory per country in 2025 for the full scenario, extracted from the NF inventory in annex 1.

#	Country	# NF	AIS	CIS	TGIS	ARS	CRS	TGRS	# Components
		126	**86**	**17**	**46**	**50**	**30**	**11**	**240**
1	**Austria**	3	2	1	1	0	0	0	4
2	**Belgium**	5	2	0	2	0	0	2	6
3	**Bulgaria**	2	1	0	0	1	0	0	2
4	**Cyprus**	3	2	0	1	2	1	0	6
5	**Czechia**	4	3	1	1	1	0	0	6
6	**Denmark**	4	4	0	0	0	0	0	4
7	**Finland**	14	11	4	6	2	4	0	27
8	**France**	8	7	0	5	5	2	1	20
9	**Germany**	24	13	5	9	9	7	5	48
10	**Greece**	9	6	1	2	4	1	1	15
11	**Italy**	10	6	1	4	8	4	1	24
12	**Netherlands**	1	1	0	1	1	1	1	5
13	**Norway**	3	2	1	2	0	1	0	6
14	**Poland**	7	3	0	0	7	2	0	12
15	**Romania**	6	3	1	1	4	3	0	12
16	**Spain**	8	8	0	1	3	1	0	13
17	**Sweden**	7	6	1	4	0	1	0	12
18	**Switzerland**	3	3	1	3	1	1	0	9
19	**UK**	4	2	0	2	1	1	0	6
	JRC	1	1	0	1	1	0	0	3

3.4 Scenario 4: Complementary Scenarios

The complementary scenario considers several situations with additional countries that may joint the ACTRIS ERIC in a medium term. We can use, as an example, the following three countries Estonia, Ireland, and Portugal, as for these countries, actual information on NF and NF components are available and they are not unlikely to join the ACTRIS ERIC in a medium to longer term. However, other potential countries may be considered but are not further investigated in this document (e.g., Iceland, Lithuania, Slowakia, Turkey etc.). The process for expansion to these further countries is, at this stage, not sufficiently mature. An illustration with the complementary scenarios of the three countries is given in figure 3.4. These are already involved in various ACTRIS activities (e.g., some ongoing European INFRA[8] projects) and are currently building their national consortia, but are at different stages of maturity, also with respect to their political engagement for joining the ACTRIS ERIC. In these complementary scenarios, the total number of NFs to be served increases to between 127 and 130, depending on which country(ies) are considered, with a total number of NF components up to 246 (see

[8] INFRA projects are European projects financed under the Research Infrastructures Programmes in Horizon 2020 and Horizon Europe to support scientific excellence and innovation in Europe through world-class and accessible research infrastructures.

table 3.6). This scenario increases the total number of NFs and NF components, with respect to the current baseline scenario, by up to 17 (15%) and 27 (12%), respectively.

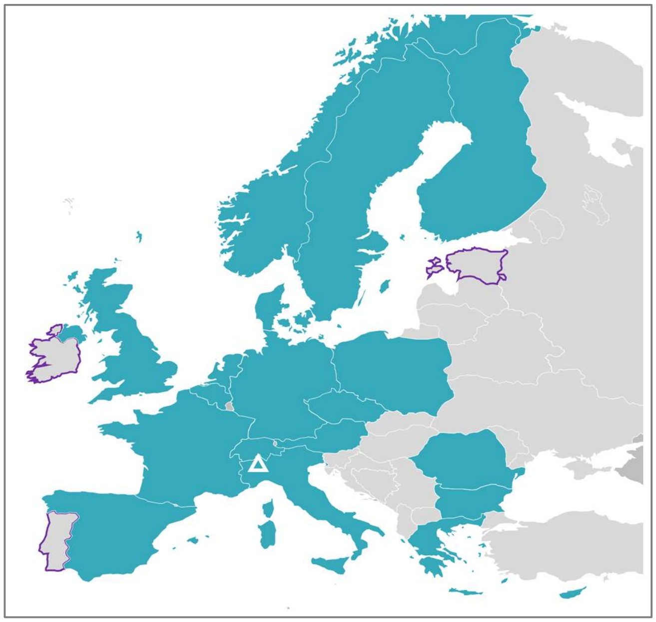


Figure 3.4 Complementary scenarios considering up to 22 countries participating in ACTRIS ERIC and including JRC (shown as white triangle). The potential new countries (Estonia, Ireland, Portugal) are outlined in purple.

Table 3.6. Planned NF inventory per country in 2025 for the complementary scenario, extracted from the NF inventory in annex 1.

#	Country	# NF	AIS	CIS	TGIS	ARS	CRS	TGRS	# Components
		130	**89**	**17**	**48**	**51**	**30**	**11**	**246**
1	**Austria**	3	2	1	1	0	0	0	4
2	**Belgium**	5	2	0	2	0	0	2	6
3	**Bulgaria**	2	1	0	0	1	0	0	2
4	**Cyprus**	3	2	0	1	2	1	0	6
5	**Czechia**	4	3	1	1	1	0	0	6
6	**Denmark**	4	4	0	0	0	0	0	4
7	**Finland**	14	11	4	6	2	4	0	27
8	**Estonia**	1	1	0	0	0	0	0	1
9	**France**	8	7	0	5	5	2	1	20
10	**Germany**	24	13	5	9	9	7	5	48
11	**Greece**	9	6	1	2	4	1	1	15
12	**Ireland**	2	2	0	2	0	0	0	4
13	**Italy**	10	6	1	4	8	4	1	24
14	**Netherlands**	1	1	0	1	1	1	1	5
15	**Norway**	3	2	1	2	0	1	0	6
16	**Poland**	7	3	0	0	7	2	0	12
17	**Portugal**	1	0	0	0	1	0	0	1

#	Country	# NF	AIS	CIS	TGIS	ARS	CRS	TGRS	# Compo nents
18	**Romania**	6	3	1	1	4	3	0	12
19	**Spain**	8	8	0	1	3	1	0	13
20	**Sweden**	7	6	1	4	0	1	0	12
21	**Switzerland**	3	3	1	3	1	1	0	9
22	**UK**	4	2	0	2	1	1	0	6
	JRC	1	1	0	1	1	0	0	3

3.5 Additional criteria

For the scenario analysis, assumptions on ACTRIS ERIC's financial strategy further need to consider risks related to additional criteria which can have a substantial impact on financial capacity and stability. These additional criteria can have a positive or negative impact. Main criteria to be taken into account are the following (the below list is not complete):

- **Emerging technologies**

New and emerging technologies are expected to have a positive impact on the financial capacity. For example, innovative technologies and progress may become more resource-efficient by facilitating and automizing the TCs's processes and steps, improving the quality by reducing errors, and reducing person-hours. An increased use of artificial intelligence and cloud technology furthermore can also offer new opportunities which may help the TCs to develop new methodologies which are more cost-efficient and more cost-effective.

- **Unpredictable price increases of goods and services**

Since 2020, several factors have led to a significant increase of costs for goods and services, with a strong impact on ACTRIS' financial capacity. Some of these factors are briefly explained below:

COVID-19 Pandemic

The pandemic in 2020 has caused general bottlenecks in the production and shipping of equipments and materials and most categories of consumer goods in the international supply chain. Manufacturers suffered from standstills and shortages during the pandemic, which in turn have affected inflation dynamics and prices for products. Purchasing, maintenance and repairs of instrumentation and other material required for ACTRIS activities were impacted by the consequences of the pandemic due to shortages, shipment delays, and particularly increasing costs for replacement and upgrading of equipment and other materials.

Inflation

Over the last decade, according to Eurostat[9], the average EU inflation rates were relatively low during 2014-2016 and slightly increased or remained more or leass steady in the 2017-2019 period (1.7%-1.9% 1.5%) and decreased in 2020 (0.7%) following the COVID-19 measures. However, in 2021 the inflation rate increased significantly to 2.9% and tripled to 9.2% in 2022. This has led to a strong increase of costs for investments and consumables at each of the CFs. (For the upcoming years, the European Central Bank[10] forecasts a declining inflation rate from 5.6% in 2023, 3.2% in 2024 and 2.1% in 2025.) A sustained increase of the costs of goods and services negatively affects the financial stability of the ACTRIS operations, as overall more resources are required to maintain the same level of activities and quality. At the same time, salaries have not increased accordingly, neither have the resources. Given the evolution of the inflation rate, ACTRIS ERIC's first 5-year financial plan, established in 2020, therefore, is longer very realistic as the high inflation has affected the overall cost planning of the CFs as well as of the NFs (e.g., related to needed investment and upgrading, maintenance, repaires, transport, etc. but also of the utilities and general overhead costs within the organisms operating the CFs and NFs).

Geopolitical situation
A changing geopolitical can potentially have important implications to the macro-financial stability of the ecosystem in which the research infrastructures are carrying out their activities. An increase of the geopolitical tensions between the world's large economical players (e.g., USA-China, Russia-Ukraine) potentially impacts the global economic and financial landscape as cross-border flow of goods and services, materials, capital, labor, and technologies, etc. are restricted in and from these countries. This, in turn, can lead to shortages, increased delivery times and lead to higher costs for products. It can also result in an increased financial fragmentation across countries and in an increase of economic costs, according to the International Monetary Fund[11]. The resulting general increase of costs for goods and services directly impacts the ACTRIS activities and affects the overall financial capacity of its CF and NFs. A much stronger price increase for instrumentation and repairs within ACTRIS has been observed with respect to the initial projections. A further aspect is the situation related to the Brexit, as it leads to increased costs (e.g., general costs, taxes, etc.) and is expected to impact both CF units and NFs in the United Kingdom[12].

Energy crisis
The pandemic, the rise of the inflation rate, and in particular the aggravating effect of the geopolitical situation have drastically led to an increase of energy prices since 2020, reaching peak levels in 2022. The increased costs for energy, as well as costs for fluids and gases needed for the measurements and equipment, have contributed to increased operational expenses at ACTRIS' CFs and NFs.

[9] Annual average inflation rates issued by Eurostat (https://ec.europa.eu/eurostat), the European Union's statistical office: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:HICP_all-items_%E2%80%94_annual_average_inflation_rates,_2013-2022(%25).png

[10] https://www.ecb.europa.eu/pub/projections

[11] Global Financial Stability Report of the International Money Fund (IMF), April 2023: https://www.imf.org/en/Publications/GFSR/Issues/2023/04/11/global-financial-stability-report-april-2023

[12] Only for scenarios 1, 3, and 4 (the baseline scenario 3 is not concerned, see figure 3.1).

- **Additional revenues**

Expected additional revenues or resources
The initial 5-year financial plan for ACTRIS ERIC has been established in 2020, a point in time after which the overall costs for operation of CFs and NFs have skyrocketed (for the various reasons explained above). Although the revenues did not follow the same evolution, new sources of income may have become available since 2020 that were not considered initially and may impact the financial situation positively, for example:

- Funding in countries hosting CFs/NFs and providing specific cash or in-kind support to research infrastructure operations, e.g., from national funding agencies or RPOs, to additionally funding of the CF operations.
- Participation of ACTRIS ERIC and/or its RPOs in European and national projects that aim at developing the facilities' operations, providing cash contributions for additional staff, investments, or consumables. This may include designated European calls within H2020 / Horizon Europe's (HE) Research Infrastructure programme (e.g., Green Deal calls (RI-URBANS, PAUL), H2020 ATMO-ACCESS, Horizon Europe (HE) IRISCC, HE CARGO-ACT, HE ENVRINNOV, HE EOSC Future, HE ENVRI-HUB NEXT, HE POLARIN), specific Earth Observations programmes (e.g. Copernicus projects CAMS21a, CAMS21b, CAMS2-27, CAMS2-82, dedicated ESA-funded projects) or specific national or regional funds to cover essential instrumentation and operations.
- Outside the NFs, a not insignificant number of users may requrie CF services of which some are expected to be fee-based, including non NFs, network stations, or any other user, including private companies.

Expected decreased revenues or resources
Inversely, in some cases the funding situation may also have worsed since the establishment of the initial 5-year financial plan (in 2020). Reasons may include, for example, the loss of personnel, unexpected breakdown of expensive instrumentation, a reduction of initially planned financial support from national funding agencies and/or RPOs considered secured, or any other economic reasons. Furthermore, the current number of ACTRIS member and observer countries is different than initially foreseen at the time of the establishement of the 5-year financial plan and impacts the financial flows to and availability of resources of certains TCs. Due to the general increase of costs, it is important to consider tha the resources have, on the other end, not increased and often have remaine the same.

- **Other criteria**

Among the RPOs hosting either the CF, NF or both are a large number of public research institutions. An important aspect to consider is the **difficulty of hiring qualified personnel** for the running of the operations with these RPOs, with salaries sometimes lower than in private institutions. RI staff requires a high degree of specialization, while the pool of potential candidates having the right skills and qualifications is rather limited. Permanent positions are furthermore not easily available in the RI landscape, making the jobs less attractive due to missing career growth opportunities. Job security and profession developments may be a critical aspect not only for hiring but also for **keeping the qualified staff.**

A not insignificant aspect affecting the TC capacity relates to **temporary unavailable resources**, e.g., in case of equipment failure. This can result in increased costs for repairs, operational downtime and/or delayed delivery of services.

Furthermore, the operations within ACTRIS ERIC require a minimum amount of management and inherent bureaucratic process (e.g., for planning, monitoring, reporting, meetings, etc.) to ensure a level of quality and efficiency. The management activities are required at each TC unit level and involves expert staff. Nevertheless, **excessive bureaucracy** must be avoided, as it may be resource intensive, inefficient and time consuming and, thus, significantly reduce the staff time required for other crucial operational activities witin the CF and imply delays. It can furthermore negatively impact staff well-being and morale.

Beyond the operational support provided by CFs to the NFs, ACTRIS ERIC has a significant global outreach, providing **expert CF services to users world-wide**. It contributes to several international networking programmes (e.g., AERONET, EARLINET, NDACC, WMO-GAW, EMEP, E-PROFILE, PGN) and collaborates with other international partner networks (e.g., LALINET, MPLNET, AD-NET), and provides services to international users in general. The capacity discussion must, therefore, also consider the capabilities and pertinence of the CF with respect to the global user needs for which capacity is reserved within certain TCs.

4. Analysis and discussion

An initial approach for analyzing the different scenarios is to consider the overall number of NFs components to be served with respect to the capacity of the TCs. Although the scenario 1 does no longer apply, as it corresponds to that before the creation of ACTRIS ERIC, it is considered important as it has the basis for the establishment of the financial plan with respect to the expected NF components to be served and the given TC capacity (indicated in this document as 'maximum capacity in 2020'). An overview of the initial maximum capacity for the different TCs is given in table 4.1. The numbers related to the NFs and NF components are extracted from above tables in section 3.

It is obvious that the maximum TC capacity in 2020 has been limited, allowing to serve all NF components only in the case of some TCs in scenario 1 (CAIS-ECAC, CARS, CREGAS). The number of NF components decreases in scenario 2 which has a small impact on the overall TC capacity, however, with CIS, CIGAS, and CCRES still limited to extend to all expected NFs.

Table 4.1. Overview of capacities at each TC with respect to the expected NFs to be served in scenarios 1-4. The numbers in red indicate an insufficiant capacity whereas the numbers in green indicate a sufficient capacity to serve all expected NFs.

TC / NF Components	CAIS-ECAC	CIS	CIGAS	CARS	CCRES	CREGARS	Total	# NF
	AIS	CIS	TGIS	ARS	CRS	TGRS		
TC Capacity								
Max TC capacity 2020	76	15	33	52	24	12	212	**115**

TC / NF Components	CAIS-ECAC	CIS	CIGAS	CARS	CCRES	CREGARS	Total	# NF
	AIS	CIS	TGIS	ARS	CRS	TGRS		
Evolved TC capacity 2023	90	20	50	52	24	12	248	
N° of components to be served								
Scenario 1: Initial scenario	76	16	42	50	29	11	224	**115**
Scenario 2: Baseline scenario	78	16	42	45	28	10	219	**113**
Scenario 3: Full scenario	86	17	46	50	30	11	240	**126**
Scenario 4: Complementary scenario	89	17	48	51	30	11	246	**130**
Deviation of N° of components to be served with respect to evolved TC capacity								
Scenario 1 - Initial scenario	16%	20%	16%	4%	-21%	8%	15%	
Scenario 2 - Baseline scenario	13%	20%	16%	13%	-17%	17%	17%	
Scenario 3 - Full scenario	4%	515%	8%	4%	-25%	8%	9%	
Scenario 4 – Complem scenario	1%	15%	4%	2%	-25%	8%	+6%	

However, in 2023 the situation has evolved with respect to the available resources for some TCs. This is indicated in the table as ‘updated maximum TC in 2023’. With the updated capacity, particularly for CAIS-ECAC, CIS, and CIGAS the situation changes. The available capacity of the TCs (with respect ot the updated max TC capacity in 2023) is shown in table 4.1 as a deviation (in %). The numbers in red indicate an unsufficiant capacity whereas the numbers in green indicate a sufficient capacity to serve all expected NFs. It appears that for most TCs the capacity is sufficient for the expected number of NF components in all scenarios, except for CCRES and for CAIS-ECAC (for CAIS-ECAC only if the lower capacity range is considered).

However, it is important to considered that each TC has different TC units which support different measurement variables / instruments. The numbers for the NF components in the table do not allow to differentiate between the type of variables / instruments. Therefore, the capacity may be sufficient for the overall TC, however with respect to certain variables / instruments this may not be the case. With a capacity that is at its limited as shown above, there is very little flexibility for additional facilities to be supported.

Indicated in table 4.1 is furthermore the total number of NFs which is 115 in the initial scenario, 113 in the current baseline scenario, increases to 126 and 130 in scenarios 3 and 4, respectively. Overall, the number of NF components in the current baseline scenario has remained stable or has slight decreased for most TCs (except CAIS-ECAC), on average by 1%. In the scenarios 3 and 4 the number of NF components increase, on average across all TC by 8% and 10% with respect to the initial scenario 1.

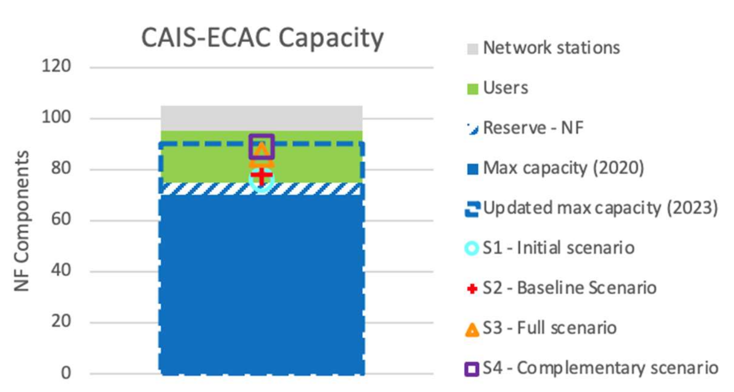
To better assess the situation at each of the TC, the capacity scenarios are analysed separately for each TC in the following subsections, based on a questionnaire completed by each TC in June 2023 (summarised in annex 2). The underlying questionnaire was intended to not only evaluate the expected capacity for the ACTRIS NFs and new NFs linked to the scenarios 3 and 4, but also to consider their potential capacity to expand and to serve other (= external) users, namely:

- non ACTRIS NFs,
- associated national and international network stations,
- other national and international users.

Although indicated separatedly in the subsection 4.1 to 4.6 for better visibility, the network stations are considered as users. In most cases the capacity to serve these is available, and services are provided with funding that is independent from the ACTRIS.

4.1 CAIS-ECAC Capacity

An overview of the CAIS-ECAC capacity is illustrated in figure 4.1. The figure shows the max TC capacity in 2020, the evolved TC capacity in 2023, and the capacity to serve additional facilities, i.e. new NFs and users such as non NFs, network stations (considered as user but indicated separately), and other national and international users). The numbers on which the graph is based is given in the table on the right-hand side. For CAIS-ECAC, the capacity (90) appears sufficient to support the NF in all scenarios, including some additional users. The CAIS-ECAC capacity is designed such that it furthermore allows to support additional network stations, e.g., stations represented by the German environmental agencies (Umweltbundesamt/UBA). Latter are served outside the ACTRIS activities and for which additional capacity is provided independently from ACTRIS. Similarly, a number of instrument manufacturers from the private sector are being supported by CAIS-ECAC outside ACTRIS, without impacting the TC capacity towards ACTRIS NFs. Nevertheless, these should in future be taken care of within the ACTRIS service provision system to users. For any other users, depending on their number and the scenario considered, the TC capacity may not be sufficient and may require additional resources, for example i) in the scope of dedicated funding for Transnational access under the EU INFRA project, or ii) in case of private sector users that pay for the services (e.g., instrument manufacturers such as TSI, Grimm, Airmodusm Palas, AVL etc.). CAIS-ECAC has sufficient human resources and TC space for the users but requires additional funding to cover all other expenses (equipment costs, consumables, utilities etc.).



CAIS-ECAC Capacity	
Max capacity	70
Updated capacity	90
Reserve - NF	5
Users	20
Network stations	10
S1	76
S2	78
S3	86
S4	89

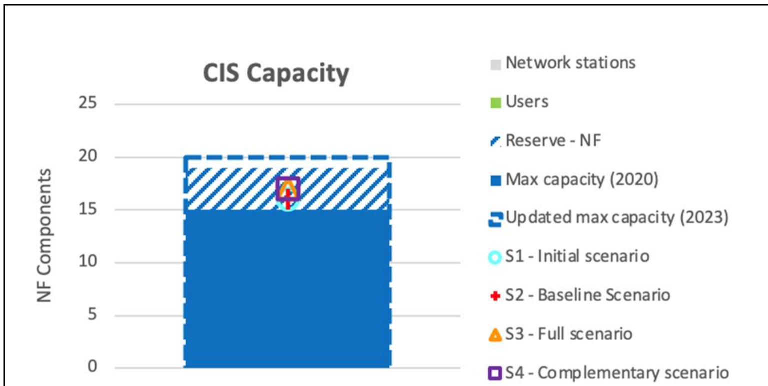
Fig. 4. 1. Capacity at CAIS-ECAC. Indicated is the maximum capacity in 2020 and updated capacity in 2023 (in blue and in blue dashed lines, respectively), as well as the reserve capacity for additional NFs (in blue diagonal lines, included in the updated capacity 2023). The capacity for other users is shown in green, the users relating to the associated network stations are separately shown in grey. The

expected number of NF components for each scenario S1-S4 is indicated by the colored markers. The corresponding numbers are listed on the right-hand side.

Despite technological developments and optimised processes to serve more facilities more efficiently, a projection for the 2025-2030 period anticipates a strong increase of TC costs, due to the general cost increase and due to inflation, estimated to be on the order of approximately 30%. This cost increase is very significant, and the situation can not be tackled unless additional funding (in cash) can be provided to cover all required expenses.

4.2 CIS Capacity

An overview of the CIS capacity is illustrated in figure 4.2. The initial capacity in 2020 (15 NF components) is not fully sufficient to serve all NFs planned in any of the scenarios, although the difference is little (1 NF component). CIS, composed of 4 CIS units, is currently short of one unit (CCPar), due to a hosting institution having withdrawn from the collaboration. Therefore, the support is only provided to a reduced set of variables / instruments. If CCPar were operational, 20 NF components could be supported. The capacity for full support and QA/QC (including data QA/QC and site audits) is only provided for new NFs (not to other users). Some support (e.g., participation in calibration activities, workshops, and trainings) may also be available to other users but depends on the free capacity for the individual activities and can, as such, not be quantified. Once all CIS units are operational, there will be sufficient capacity to support all NFs in all scenarios S1-S4. Additional other users, however, can only be supported through additional funding, e.g., via TNA.



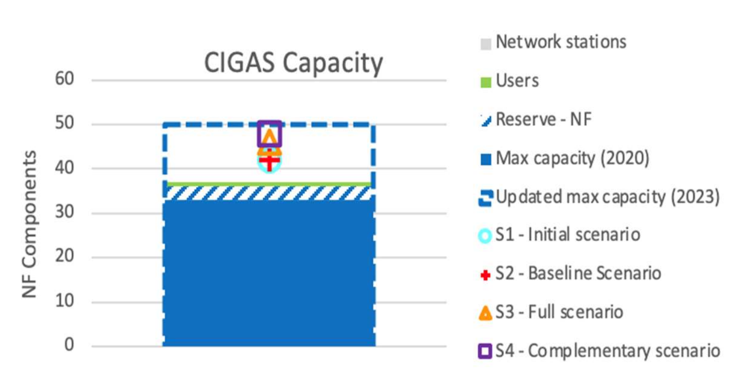
CIS Capacity	
Max capacity	15
Updated capacity	20
Reserve - NF	4
Users	
Network stations	
S1	16
S2	16
S3	17
S4	17

Fig. 4.2. Capacity at CIS. Indicated is the maximum capacity in 2020 and updated capacity in 2023 (in blue and in blue dashed lines, respectively), as well as the reserve capacity for additional NFs (in blue diagonal lines). The expected number of NF components for each scenario S1-S4 is indicated by the colored markers. The corresponding numbers are listed on the right-hand side.

A critical issue for CIS is the potential break-down and repair of critical equipment for which additional resources are needed and which are not foreseen in the current 5-year financial plan. Neither are specialised experts (e.g., IT staff) needed by the CIS. A potential risk is the loss of skilled staff and experts due to difficulties for offering long-term/permanent contracts. The required, relatively high level of bureaucracy and admiminstrative responsibilities leaves furthermore less time for the essential QA/QC and NF support. A CIS forecast for the 2025-2030 period expects a strong cost increase across all cost types (personnel, instruments, reparirs, energy costs, indirect costs). This is due to the general cost increase and inflation and is expected to impact the collaboration with the NFs in the UK due to the Brexit and associated tax issues.

4.3 CIGAS Capacity

An overview of the CIGAS capacity is illustrated in figure 4.3. Thanks to a positive trend of the CIGAS capacity, from initially 33 to 50 NF components to be served on an annual basis, the TC is now able to support all NFs in scenarios S1-S4. The capacity increase has been achieved by lowering the frequency of the provision of some services (e.g., from annual to biannual), but retaining minimum QA/QC standards. However, there is only little remaining capacity for other users, at maximum 1-2, and the TC is considered being at its limits. Additional capacities in the near future are difficult to quantify, however, some factors may have a positive impact, e.g., an increased efficiency of the services, new techological developments, or potential additional resources. Nevertheless, CIGAS also struggles with general cost increases and particularly the difficulty to hire and keep qualified and skilled personnel.

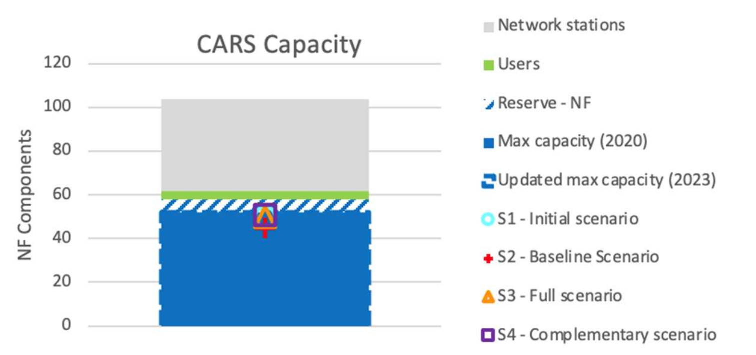


CIGAS Capacity	
Max capacity	33
Updated capacity	50
Reserve - NF	3
Users	1
Network stations	
S1	42
S2	42
S3	46
S4	48

Fig. 4.3. Capacity at CIGAS. Indicated is the maximum capacity in 2020 and updated capacity in 2023 (in blue and in blue dashed lines, respectively), as well as the reserve capacity for additional NFs (in blue diagonal lines) and other users (in green). The expected number of NF components for each scenario S1-S4 is indicated by the colored markers. The corresponding numbers are listed on the right-hand side.

4.4 CARS Capacity

An overview of the CARS capacity is illustrated in figure 4.4. Although the number of NF components (52) for which the capacity was initially designed in 2020 has not evolved and remained stable up until now, it is considered sufficient to support all NFs in all scenarios S1-S4. The TC furthermore has a large reserve capacity to serve in particular a large number (42) of associated network stations equipped with ARS instrumentation within, e.g., EARLINET (7 lidar stations) and AERONET (35 photometer stations). The network stations are indicated separately in figure 4.4. TC capacity is furthermore available for other users, including private companies, and the TC can furthermore also contribute to other CRS networks stations (e.g., 10 ceilometer stations, not included in the below figure.E-PROFILE).Therefore, there is no plan (and need within the European boundaries) to further develop the actual capacity as it is important to secure the support to the existing NF beneficiaries and users.



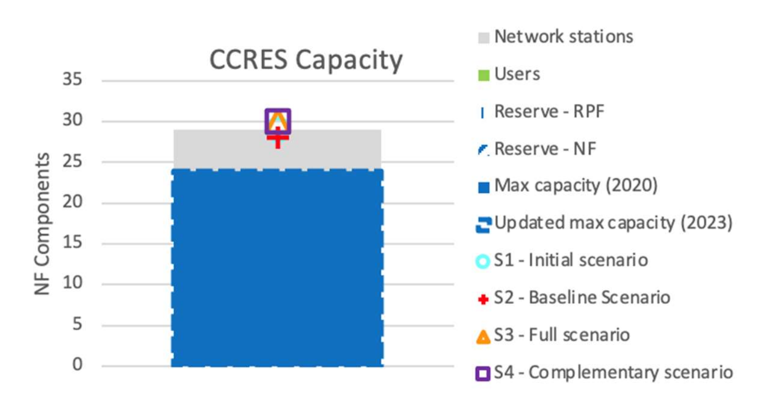
CARS Capacity	
Max capacity	52
Updated capacity	52
Reserve - NF	6
Users	4
Network stations	42
S1	50
S2	45
S3	50
S4	51

Fig. 4.4. Capacity at CIGAS. Indicated is the maximum capacity in 2020 and updated capacity in 2023 (in blue and in blue dashed lines, respectively), as well as the reserve capacity for additional NFs (in blue diagonal lines, included in the updated capacity 2023 although shown separately in the graph). The capacity reserved for the associated network stations is shown in grey, and for other external users in green. The expected number of NF components for each scenario S1-S4 is indicated by the colored markers. The corresponding numbers are listed on the right-hand side.

The coverage of ARS measurement facilities in Europe is considered sufficient. Therefore, it is not expected that the capacity requires further enlargement, unless there will be need to expand the capacity for provision of services world-wide. Some optimized processes and development of technologies for more automatic workflows are already planned and foreseen. Nevertheless, inflation and general cost increase is expected to impact the CARS capacity in the 2025-2030 period. This concerns the purchase, maintenance, and repair of instrumentation, but also the transport and travel for calibration and campaigns, utilities, etc. Salaries may not be sufficiently attractive to keep existing and hire specialised experts and personnel. The expected revenues will likely not follow the trend of increasing costs. Unless additional resources become available, the service provision may have to be adjusted by lowering the activity, i.e., by prioritizing the facilities (NFs vs other networking stations, users, etc.) or prioritizing the most essential and affordable activities (e.g., reducing expensive tasks of on-site audits, face-to-face workshops, etc.). Additional burdens are caused by instrument failures and needed replacements, but also by overload of repetitive and required bureaucratic tasks.

4.5 CCRES Capacity

An overview of the CCRES capacity is illustrated in figure 4.5. The number of NF components (24) for which the capacity was initially designed in 2020 has not evolved. However, it is considered too limited to provide support to all NFs in scenarios S1-S4, estimated to comprise between 28 to 30 NF components. The current, reduced capacity is mainly caused by a delayed commitment of human resources from the CCRES-NL unit. Furthermore, to date the CCRES-UK unit is not operational as the UK has not yet joined the ACTRIS ERIC. To remedy the situation, CCRES is developping and testing alternative, more efficient and less-labour intensive methods to overcome the capacity issue. Some shortcomings at CCRES are due to geopolitical issues and resulting availability of instruments components (e.g., for the Doppler cloud radar) coming from Ukraine and Russia. For the next 2025-2030 period, the TC is expected to be impacted by the increased costs due to inflation. CCRES collaborates with E-PROFILE (a large network of 400 automatic low-power lidars and 20-30 microwave radiometers (MWR)) to ensure coherency with ACTRIS data and provides some limited calibration services to 4-5 MWR. The network stations are indicated separately in figure 4.5.

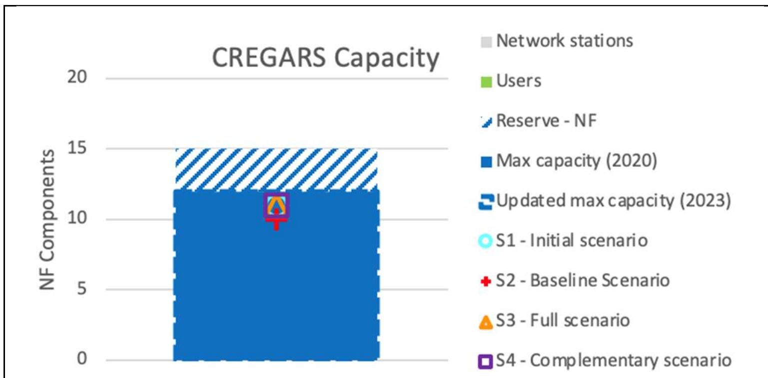


CCRES Capacity	
Max capacity	24
Updated capacity	24
Reserve - NF	n/a
Users	n/a
Network stations	4-5
S1	29
S2	28
S3	30
S4	30

Fig. 4.5. Capacity at CCRES. Indicated is the maximum capacity in 2020 and updated capacity in 2023 (in blue and in blue dashed lines, respectively)). The capacity reserved for the associated network stations is shown in grey. The expected number of NF components for each scenario S1-S4 is indicated by the colored markers. The corresponding numbers are listed on the right-hand side.

4.6 CREGARS Capacity

An overview of the CREGARS capacity is illustrated in figure 4.6. CREGARS has a limited number of NF components to be served, and the initial TC capacity (12) has not evolved but is considered sufficient for all scenarios S1-S4. CREGARS could potentially have a very large number of NDACC stations world-wide to be served as users that may a priori be interested in the CREGARS central processing system (these associated network stations are not shown in figure 4.6).



CREGARS Capacity	
Max capacity	12
Updated capacity	12
Reserve - NF	3
Users	
Network stations	
S1	11
S2	10
S3	11
S4	11

Fig. 4.6. Capacity at CREGARS. Indicated is the maximum capacity in 2020 and updated capacity in 2023 (in blue and in blue dashed lines, respectively), as well as the reserve capacity for additional NFs (in blue diagonal lines). The expected number of NF components for each scenario S1-S4 is indicated by the colored markers. The corresponding numbers are listed on the right-hand side.

The global NDACC stations outside Europe are expected to follow the NDACC protocol for instrument calibration, rather that the ACTRIS-compliant CREGARS protocol (data from those network stations are considered only partially ACTRIS-compliant). Within CREGARS, optimized processes due to a highly automated central processing systems would allow to easily expand the TC capacity to additional 10-15 facilities to be supported, although rather not seen necessary in the current situation. The strong increase in costs and revenue stagnation/decrease, however, may impact in the flexibility in the 2025-2023 period.

4.7 Overall assessment

An overview of the capacity situation at all TCs is given in figure 4.7 below. Considering the updated maximum TC capacities (in 2023), indicated in blue dashed lines, the capacity is sufficient for the expected global number of NF components for all TCs and all scenarios, but limited for one (CCRES).

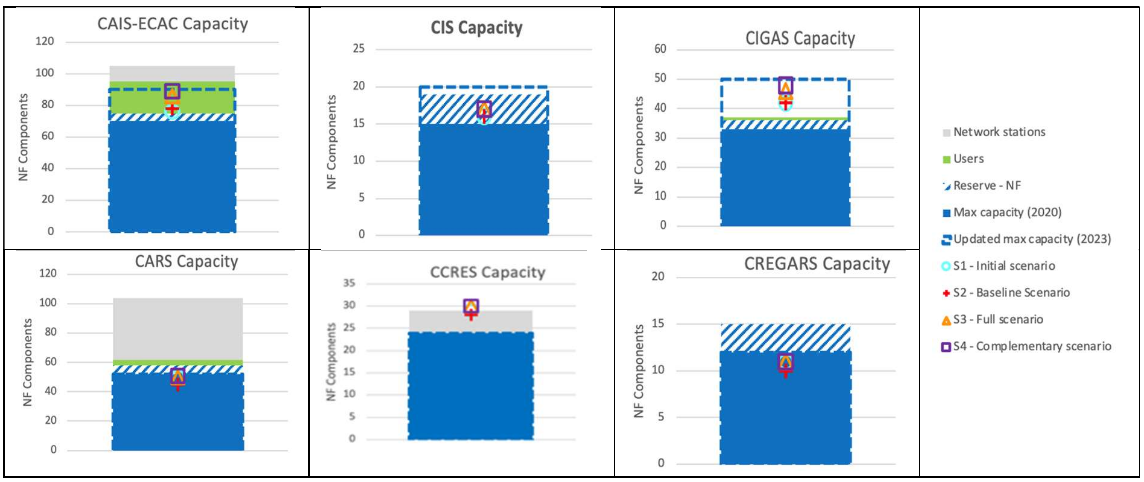


Fig. 4.7. Overview of capacities at all TCs.

This is visible in more detail in figure 4.8, indicated by the deviation of the updated maximum capacity from the total number of NF components for each TC and for each scenario S1-S4. The deviation is positive in four TCs (CAIS-ECAC, CIGAS, CARS, CREGARS), however, the additional available capacity for most of them is not very large, varying between 2 and 12 NF components in the current scenario (S2), and between 1and 4 NF components in a likely near-future scenario (S3). The deviation is negative for one TC (CCRES), being -4 in the current scenario (S2) and -6 in scenarios S3 and S4, and potentially negative for one further TC (CIS) by -1 (S2) and by -2 (in S3 and S4), as a function of the operational activity and capacity of currently one missing CIS unit.

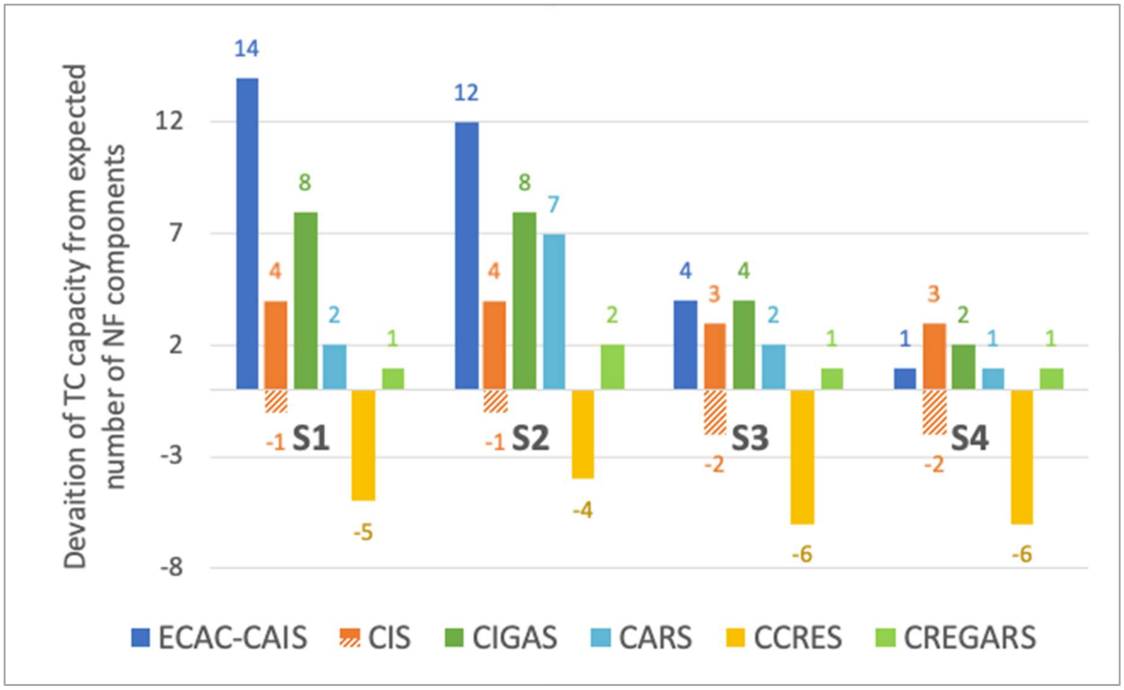


Fig. 4.8. Deviation of maximum TC capacities from expected number of NF components in each TC and for each of the 4 scenarios S1-S4. For CIS two situations are considered (the lower range is indicated in dashed column).

The capacities indicated in figure 4.8 concern the support to the NFs only. It is important to note that focusing only on the global number of NF components to be served per TC is critical, as the NF components cover different types of instruments / variables. This means that certain service support may still be critical, as the capacity depends on the individual capacities of each TC unit.

The capacity of the ACTRIS CFs to serve external user communities concern those facilities that are:

- facilities associated with international networks or partner programmes, and national monitoring networks,
- other users including non ACTRIS NFs and other national or international users form the scientific, public or private sector.

An overview is given in table 4. 2.

Table 4.2. Current TC capacity available for users including network stations.

TC Reserve capacity	CAIS-ECAC	CIS	CIGAS	CARS	CCRES	CREGARS
Associated network stations	10	n/a	n/a	42	4-5[13]	n/a[14]
Users	20	n/a	1	4	n/a	n/a

[13] CCRES collaborates with the E-PROFILE network which includes about 400 ALC (automatic low power lidars) and 20-30 MWR (microwave radiometers).
[14] CREGARS is linked to the NDACC network which comprises a very large number of stations world-wide (117).

Some very few slots are available for external users at CAIS-ECAC (20, although private sector users are not accounted for as indicated in section 4.1), at CIGAS (1), and CARS (4). Although the support of CARS to ARS facilities is saturated in Europe, not expecting further needs, this may not be the case of facilities related to CAIS-ECAC and CIGAS. Additional users can be served by CAIS-ECAC and CARS, however, requiring additional financial resources (e.g., coming from EU TNA programmes). As for the networking stations, the capacity is provided for by CAIS-ECAC and by CARS, but the activity does not overlap, as it is taken car of outside of ACTRIS. CCRES collaborates with E-PROFILE to develop coherent operation procedures and data products. Information on user facilities requiring support by CIS, CCRES and CREGARS is not available, but it is obvious from figure 4.7 that their capacities appear limited. CREGARS has furthermore many potential network stations to be served but which are here not considered.

The scenario analyses described above may face criticals risk due to the additional criteria that are described in section 3.5. Although the development of new innovative and automized technoclogies may have a positive and cost-effective impact on the TC capacities in the next 5-10 years, the expected increase of goods and services due to the pandemic, inflation, the geopolitical situation, and the energy crisis may be rather significant, and can strongly influency the TC's agility with respect to their service provision. New revenue sources may become available, but others may also be reduced. The most determinant factor appears to be related to human resources which are not fully secured beyond 2025. Some TCs may depend on staff under fixed-term contracts, and there is a challenge not only for hiring but also for keeping specialised and qualified personnel needed for the TC activities. Unexpected instrument failures and (needed) bureaucratic activities in the TCs may bring additional difficulties.

Contingencies plans should therefore include a reduction and/or optimisation of the TC activities, particularly of those activities that are very expensive (e.g, face-to-face audits and intercomparisons), a lowering of the frequqncy of the service provision, and a priorisation of services to NFs while reducing the services to networking stations and users. Additional resoures will be critical, some may be sought though European and national project funding, although latter will only allow to cover specific TC activities (e.g., for technological developments, training etc.) and not for the key operational activities.

5. Conclusions

This document investigates plausible capacity scenarios of countries participating in ACTRIS ERIC and the impact on ACTRIS operations during the implementation phase. Four scenarios are considered of expected NF inventories and available TC capacities to provide support and services including the current situation under ACTRIS ERIC and potential future scenarios. Additionally discussed is the capacity for serving other facilities /users other than the ACTRIS NFs, and how this potential reserved capacity is intended to be used. A particular attention has been given to an expected future evolution of the TC capacity in the 2025-2030 period. The planned capacity, due to a positive trend and evolution of the maximum capacity of some TC since the initial forcasts in 2020, is sufficient for the current scenario for fours TCs. The situation is critical for two TCs. For the four TCs, the maximum capacity also allows to serve the NFs / NF components under two future scenarios. However, the capacity of most TCs is very much at its limits and does not allow a large flexibility, and particularly not for service requests by external users. Only two of the TCs serve a significant number of network stations or other users which requires specific additional resources. A challenge faced by all TCs is the strong increase of general costs in the last 2-3 years due to the COVID-19 pandemic, the inflation, the geopolitical situation and energy crisis, while revenues and available resources have remained stable. Different contingency measures are being considered to be able to mitigate the risks of unsufficient resources in the 2025-2030 period provide adequate support and services to all NFs concerned.

6. References

ACTRIS Glossary: https://www.actris.eu/sites/default/files/inline-files/ACTRIS_glossary_April2022_0.pdf

ACTRIS 5-year Financial plan: https://intranet.actris.eu/index.php/s/NytzH7PBGgssqZG?dir=undefined&openfile=44779

ACTRIS Contingency plans for implementation (ACTRIS IMP D2.1). Confidential document (for information contact the ACTRIS HO).

ACTRIS Draft report on financial and capacity scenarios (ACTRIS IMP MS10): https://www.actris.eu/sites/default/files/Documents/ACTRIS%20IMP/Milestones/ACTRIS%20IMP_WP2_MS10_Draft%20report%20on%20financial%20and%20capacity%20scenarios.pdf

ACTRIS Finances / Membership contributions for Step 2 (ACTRIS_IAC_15_02c_Membership_Contributions_for_approval.pdf)

ACTRIS ERIC statutes: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023Y0503(01)

ACTRIS NF Labelling plan (ACTRIS IMP D5.1): https://www.actris.eu/sites/default/files/Documents/ACTRIS%20IMP/Deliverables/ACTRIS%20IMP_WP5_D5.1_ACTRIS%20NF%20Labelling%20Plan.pdf

ACTRIS Refined risk management plan (ACTRIS IMP MS2.6): https://www.actris.eu/sites/default/files/Documents/ACTRIS%20IMP/Milestones/ACTRIS%20IMP_WP2_MS11_Refined%20risk%20management%20plan.pdf

Annex 1. Planned NF Inventory

Table A1.1. Planned NF inventory per country as of June 2023. The table indicates the NF of the different components, their following components concerned: (aerosol in situ), CIS (cloud in situ), TGIS (trace gases insitu), ARS (aerosol remote sensing), CRS (cloud remote sensing), TGRS (trace gases remote sensing), as well as the readiness of the facility for labelling and/or status of the labelling process. The indicated facility types are observational platforms (OBS), atmospheric simulation chambers (ASC), mobile platforms (MOB) and laboratory platform (LAB).

Country	Facility name	Facility type	AIS	CIS	TGIS	ARS	CRS	TGRS
Austria	Sonnblick Observatory (SBO)	OBS	Planned for 2021	Planned for 2021				
Austria	University Innsbruck (UIBK)	OBS			Planned for 2022			
Austria	University Vienna (UNIVIE)	OBS	Planned for 2022					
Belgium	Observatoire de Physique de l'Atmosphère à La Réunion (OPAR), Franco-Belgian site	OBS						Submitted in January 2023
Belgium	PTR-MS	MOB			Planned for 2021			
Belgium	Scientific Station of the Jungfraujoch, Swiss-Belgian site	OBS						Planned for 2021
Belgium	Ukkel	OBS	Planned for 2023					
Belgium	Vielsalm	OBS	Planned for 2022		Planned for 2021			
Bulgaria	Basic Environmental Observatory Moussala - BEO Moussala	OBS	Planned for 2021					

Country	Facility name	Facility type	AIS	CIS	TGIS	ARS	CRS	TGRS
Bulgaria	Sofia (IE-BAS)	OBS				Planned for 2021		
Cyprus	Cyprus Atmospheric Observatory (CAO)	OBS	Planned for 2021		Planned for 2021	Planned for 2021		
Cyprus	Cyprus Atmospheric Remote Sensing Observatory CARO	OBS				Planned for 2021	Planned for 2021	
Cyprus	Unmanned Systems Research Laboratory (USRL)	MOB	Planned for 2021					
Czechia	Lom	OBS	Planned for 2022					
Czechia	Milešovka	OBS		Planned for 2024				
Czechia	National Atmospheric Observatory Kosetice	OBS	Initially accepted in December 2022		Planned for 2020	Planned for 2022		
Czechia	Suchdol	OBS	Planned for 2021					
Denmark	Aarhus University Research on Aerosols smog chamber facility (AURA)	ASC	Planned for 2025					
Denmark	Copenhagen University; Photochemical reactor	ASC	Planned for 2025					
Denmark	Risoe Research Station	OBS	Planned for 2025					
Denmark	Villum Research Station	OBS	Planned for 2025					
Finland	Aerosol, cluster and trace gas laboratory (Helsinki)	LAB	Planned for 2023		Planned for 2023			

Country	Facility name	Facility type	AIS	CIS	TGIS	ARS	CRS	TGRS
Finland	Doppler Cloud Radar	MOB					Planned for 2021	
Finland	Doppler Lidar	MOB					Planned for 2021	
Finland	Kuopio ASCs (KASCs)	ASC	Planned for 2023					
Finland	Marambio	OBS	Planned for 2022					
Finland	Mobile Aerosol Laboratory	MOB	Planned for 2022		Planned for 2023			
Finland	Multiwavelength Raman Lidar	MOB				Planned for 2021		
Finland	Pallas Atmosphere-Ecosystem Supersite	OBS	Initially accepted in December 2022	Planned for 2024	Submitted in September 2022		Planned for 2023	
Finland	SMEAR II (Hyytiälä)	OBS	Initially accepted in December 2022		Submitted in September 2022	Planned for 2025	Submitted in February 2023	
Finland	SMEAR III (Helsinki)	OBS	Planned for 2024		Planned for 2023			
Finland	SMEAR I (Värriö)	OBS	Planned for 2024	Planned for 2025	Planned for 2023			
Finland	SMEAR IV (Kuopio)	OBS	Planned for 2025	Planned for 2025				
Finland	Unmanned Aerial vehicle (UAV)	MOB	Planned for 2021	Planned for 2024				

Country	Facility name	Facility type	AIS	CIS	TGIS	ARS	CRS	TGRS
Finland	Utö Atmospheric and Marine Research Station	OBS	Planned for 2021					
France	Atmospheric Observatory of LiLle (ATOLL)	OBS	Planned for 2021			Planned for 2021		
France	Chambre de simulation atmosphérique à irradiation naturelle d’Orléans (HELIOS)	ASC	Planned for 2021		Planned for 2021			
France	Multiphase ASC (CESAM)	ASC	Planned for 2021		Planned for 2021			
France	Observatoire de Haute Provence (OHP-GEO)	OBS				Planned for 2023		
France	OPAR Observatoire de Physique de l'Atmosphère à La Réunion	OBS	Submitted in November 2022			Planned for 2022	Planned for 2025	Submitted in February 2023
France	Plateforme Pyrénéenne d'Observations Atmosphériques (P2OA)	OBS	Planned for 2021		Planned for 2023			
France	Site d’observation atmosphériques Puy de Dôme/ Opme/Cézeaux (COPDD)	OBS	Planned for 2021		Planned for 2021	Planned for 2021		
France	Site Instrumental de Recherche par Télédétection Atmosphérique (SIRTA)	OBS	Planned for 2021		Planned for 2021	Planned for 2021	Submitted in March 2023	
Germany	Aerosol from Ground to Cloud Mobile Experiment (ACME)	MOB	Planned for 2023	Planned for 2024				
Germany	Aerosol Interaction and Dynamics in the Atmosphere (AIDA and AIDA-dynamic)	ASC	Planned for 2022	Planned for 2022				
Germany	Atmosphere Simulation Chamber (SAPHIR)	ASC	Planned for 2022		Planned for 2023			
Germany	Atmospheric Chemistry Department Chamber (ACD-C)	ASC	Planned for 2022		Planned for 2022			

Country	Facility name	Facility type	AIS	CIS	TGIS	ARS	CRS	TGRS
Germany	Bremen	OBS						Initially accepted in February 2023
Germany	Cape Verde Atmospheric Observatory	OBS	Planned for 2023		Planned for 2023	Planned for 2022	Planned for 2023	
Germany	Dushanbe, Tajikistan	OBS				Planned for 2022		
Germany	Garmisch-Partenkirchen/Zugspitze/Schneefernerhaus	OBS	Planned for 2021			Planned for 2025		Planned for 2025
Germany	Jülich Observatory for Cloud Evolution (JOYCE)	OBS					Submitted in September 2022	
Germany	Karlsruhe Low-Cloud Exploratory (KLOCX)	MOB		Planned for 2025			Planned for 2025	
Germany	Leipzig Aerosol and Cloud Remote Observations System (LACROS)	MOB				Planned for 2021	Planned for 2021	
Germany	Melpitz Research Station	OBS	Planned for 2022		Planned for 2024	Planned for 2025	Planned for 2025	
Germany	Meteorological Observatory Hohenpeißenberg (DWD)	OBS	Planned for 2022		Planned for 2021	Planned for 2021		
Germany	Meteorological Observatory Lindenberg	OBS					Initially accepted in May 2023	
Germany	Mobile FTIR spectrometer	MOB						Planned for 2024
Germany	München	OBS				Planned for 2024	Planned for 2024	

Country	Facility name	Facility type	AIS	CIS	TGIS	ARS	CRS	TGRS
Germany	Ny-Ålesund, Spitsbergen	OBS				Planned for 2023		Planned for 2022
Germany	OCEANET mobile shipborne remote sensing facility	MOB				Planned for 2021		
Germany	Paramaribo, Surinam	OBS						Planned for 2025
Germany	Quartz Glass Reactor (QUAREC)	ASC	Planned for 2022		Planned for 2022			
Germany	Schmücke	OBS	Planned for 2024	Planned for 2024	Planned for 2021			
Germany	Taunus Observatory	OBS	Planned for 2024		Planned for 2025			
Germany	Turbulent Leipzig Aerosol Cloud Interaction Simulator (LACIS-T)	ASC	Planned for 2022	Planned for 2022				
Germany	Waldhof	OBS	Planned for 2021		Planned for 2021			
Greece	Athens Supersite Demokritos	OBS	Planned for 2020					
Greece	Athens Supersite NOA	OBS	Planned for 2020		Planned for 2022			
Greece	Athens Supersite NTUA	OBS				Planned for 2020		
Greece	Finokalia	OBS	Planned for 2020					
Greece	FORTH-ASC	ASC	Planned for 2020					
Greece	HELMOS Mt	OBS	Planned for 2020	Planned for 2024				

Country	Facility name	Facility type	AIS	CIS	TGIS	ARS	CRS	TGRS
Greece	PANGEA	OBS	Planned for 2023		Planned for 2023	Planned for 2020	Planned for 2022	Planned for 2022
Greece	PANGEA mobile platform	MOB				Planned for 2022		
Greece	Thessaloniki	OBS				Planned for 2021		
Italy	Atmospheric RomE joint Supersite	OBS				Planned for 2022		
Italy	ChAMBRe	ASC	Planned for 2025		Planned for 2025			
Italy	CIAO	OBS	Planned for 2022			Initially accepted in March 2023	Planned for 2021	Planned for 2023
Italy	CIAO Mobile Facility	MOB				Planned for 2022	Planned for 2022	
Italy	CMN-PV	OBS	Planned for 2022	Planned for 2022	Planned for 2022	Planned for 2022		
Italy	Lampedusa	OBS				Planned for 2022	Planned for 2022	
Italy	Lecce (ECO CNR + UNISALENTO)	OBS	Planned for 2022		Planned for 2022	Planned for 2022		
Italy	Lecce Mobile facility	MOB	Planned for 2022		Planned for 2022			
Italy	Naples Fixed National Facility	OBS	Planned for 2023			Planned for 2023		
Italy	UNIAQ/CETEMPS	OBS				Planned for 2021	Planned for 2022	

Country	Facility name	Facility type	AIS	CIS	TGIS	ARS	CRS	TGRS
Netherlands	Ruisdael Observatory: CABAUW	OBS	Planned for 2022		Planned for 2022	Planned for 2022	Planned for 2022	Planned for 2022
Norway	Birkenes	OBS	Initially accepted in January 2023					
Norway	Trollhaugen	OBS	Planned for 2020		Planned for 2020			
Norway	Zeppelin	OBS	Submitted in November 2022		Submitted in September 2023			
Poland	ACTRIS ICOS collocated station	OBS				Planned for 2026		
Poland	ACTRIS-Poland Mobile LAB	MOB				Planned for 2026		
Poland	Belsk	OBS	Planned for 2023			Planned for 2023		
Poland	Racibórz	OBS	Planned for 2024			Planned for 2024		
Poland	Rzecin	OBS				Planned for 2025	Planned for 2025	
Poland	Warsaw	OBS				Initially accepted in March 2023	Planned for 2022	
Poland	Wrocław	OBS	Planned for 2026			Planned for 2026		

Country	Facility name	Facility type	AIS	CIS	TGIS	ARS	CRS	TGRS
Romania	ATMOSLAB	MOB	Planned for 2023	Planned for 2023		Planned for 2023		
Romania	CERNESIM	ASC	Planned for 2020		Planned for 2020			
Romania	RADO-Bucharest	OBS	Initially accepted in December 2022			Initially accepted in March 2023	Submitted in September 2022	
Romania	RADO-Cluj	OBS				Planned for 2020	Planned for 2023	
Romania	RADO-Galati	OBS					Planned for 2023	
Romania	RADO-Iasi	OBS				Planned for 2023		
Spain	Barcelona	OBS	Initially accepted in December 2022			Initially accepted in March 2023		
Spain	El Arenosillo – ESAt	OBS	Planned for 2020					
Spain	EUPHORE	ASC	Planned for 2020		Planned for 2020			
Spain	Granada	OBS	Planned for 2020			Planned for 2020	Planned for 2020	
Spain	Izaña Atmospheric Observatory	OBS	Planned for 2020					
Spain	Madrid	OBS	Planned for 2020			Planned for 2020		

Country	Facility name	Facility type	AIS	CIS	TGIS	ARS	CRS	TGRS
Spain	Montsec	OBS	Planned for 2020					
Spain	Montseny	OBS	Planned for 2020					
Sweden	Exploratory platform SMHI	MOB					Planned for 2023	
Sweden	Exploratory platform UG	MOB	Planned for 2023		Planned for 2023			
Sweden	Hyltemossa	OBS	Planned for 2021		Planned for 2023			
Sweden	Norunda	OBS	Planned for 2021		Planned for 2023			
Sweden	Östergarnsholm	OBS	Planned for 2023					
Sweden	Svartberget	OBS	Planned for 2023		Planned for 2023			
Sweden	Zeppelin	OBS	Planned for 2021	Planned for 2021				
Switzerland	Jungfraujoch	OBS	Submitted in October 2022	Planned for 2024	Submitted in October 2022			
Switzerland	PACS-C2	ASC	Planned for 2022		Planned for 2022			
Switzerland	Swiss Midland: Payerne(PAY) Beromuenster(BRM)	OBS	Planned for 2025		Planned for 2025	Planned for 2025	Planned for 2025	
United Kingdom	Auchencorth Moss	OBS	Planned for 2022		Planned for 2021			
United Kingdom	Chilbolton Observatory	OBS				Planned for 2024	Planned for 2021	

Country	Facility name	Facility type	AIS	CIS	TGIS	ARS	CRS	TGRS
United Kingdom	Manchester Aerosol Chamber	ASC	Planned for 2021					
United Kingdom	Roland von Glasow Air-Sea-Ice Chamber	ASC			Planned for 2021			
EC-JRC	European Commission Atmospheric Observatory	MOB	Planned for 2020		Planned for 2020	Planned for 2020		

Annex 2. Questionnaires on capacity at ACTRIS TC

The questionnaires have been completed by the representatives of each ACTRIS TC, during June/July 2022. The assessment of the capacity scenarios has been based on the updated information gathered from these.

Annex 2.1 CAIS-ECAC

CAIS-ECAC	
(1) Number of components/facilities to be served with respect to the initial scenario	**76**
(2) Number of components/facilities of the TC for which the capacity was initially designed (baseline: costbook n°5 in 2020)?	70-90
(3) Available/ reserved capacity to support other facilities, considering the 5-year financial plan and current number of NFs (baseline: costbook n°5 in 2020)?	
NFs in Greece, UK	yes
Associated network stations	yes
Potential new NFs in ACTRIS ERIC member/observer countries	yes
Other users	yes
Comments	CAIS-ECAC already provides services for national observatories and manufacturers via contracts outside of ACTRIS. The capacity (lab time and HR) for these are available independently from ACTRIS. These observatories and manufacturers must pay for the services. New NFs can be supported if the total number of NFs remains within the initially planned capacity. However, if the no. of new NFs will exceed 80 facilities, then additional funding will become necessary. Lab time and HR are available. Other users can be served e.g., via TNA.
(4) Intended use of reserved capacity (if any)	
N° of new NFs	5
N° of RPFs	5
N° of associated network stations	15
N° of other users	10
Comments	The associated network stations comprise those part of the UBA/national agencies (German states offices). Other users also include private companies (instrument manufacturers), including TSI, Grimm, Airmodus, Palas, AVL, … Users outside of ACTRIS are handled within the WCCAP activities. There is no overlap with the ACTRIS dedicated services.
(5) Evolvement to date of the maximum TC capacity, as considered in the initial 2021-2025 financial plan	No, we expect 80 NFs at the moment so there will be some more space for 10 additional NFs (by then we will reach the maximum based on the 5-year-plan)

(6) Possibility for additional capacity that would allow to take up/support/serve new facilities in the 2025-2030 period	
Potential additional capactiy min/max	Yes, 5-15 additional facilities
Optimized process to allow more efficiently to serve more facilities	x
New development /emerging technologies	x
Additional resources	x
Other	Additional facilities can be supported with additional funding
Comments	
(7) Indicate any other issues that may impact your TC capacity in the 2025-2030 period	
Inflation	Yes, approximately +30%
Increasing general costs	Yes, approximately +30%
Geopolitical issues	
Expected additional revenues or resources	Yes, for hiring additional staff
Expected decreased revenues or resources	
Other	

Annex 2.2 CIS

CIS	
(1) Number of components/facilities to be served with respect to the initial scenario	**16**
(2) Number of components/facilities of the TC for which the capacity was initially designed (baseline: costbook n°5 in 2020)?	**15** (plus 5 reserved capacity)
(3) Available/ reserved capacity to support other facilities, considering the 5-year financial plan and current number of NFs (baseline: costbook n°5 in 2020)?	
NFs in Greece, UK	yes
Associated network stations	no
Potential new NFs in ACTRIS ERIC member/observer countries	yes
Other users	no
Comments	Capacity for full support and QA/QC (including data QA/QC and site audits) is only reserved for new NFs. Some support like participation in calibration activities, workshops and trainings can also be given to others, but this depends on the free capacity for the individual activities and can not be planned in numbers. Without the CIS unit CCPar, CIS can only serve a reduced set of variables / instruments (15). When CCPar is implemented, 20 can be supported (including reserved capacity). Also, reduced personel for site audits is available at the moment due to open CCPar positions. As soon as replacement for CCPar is identified and implemented, CIS will be at full planned capacity.
(4) Intended use of reserved capacity (if any)	
N° of new NFs	4
N° of RPFs	
N° of associated network stations	
N° of other users	
Comments	The capacity for new NFs (4) also includes 1 NF in Greece.
(5) Evolvement to date of the maximum TC capacity, as considered in the initial 2021-2025 financial plan	no
(6) Possibility for additional capacity that would allow to take up/support/serve new facilities in the 2025-2030 period	
Potential additional capactiy min/max	no
Optimized process to allow more efficiently to serve more facilities	
New development /emerging technologies	
Additional resources	
Other	
Comments	

(7) Indicate any other issues that may impact your TC capacity in the 2025-2030 period	
Inflation	Yes, we all face increased costs for personnel, energy, instruments, and repairs. To maintain or increase the TC capacity, this has to be considered for the next period.
Increasing general costs	In addition to inflation we might also have to consider increased overhead costs in the RPOs.
Geopolitical issues	Brexit and tax issues with UK
Expected additional revenues or resources	The amount of services for associated networks or other users will strongly depend on additional revenues / resources. Travel costs for NFs might influence level of participation at on-site activities (calibration workshops), TNA is needed.
Expected decreased revenues or resources	
Other	Break-down and repair of critical equipment, lack of trained and specialized personnel: difficulties to offer long-term contracts due to 5y planning periods, which might cause expert drain; we also see the need for IT experts, which was not allocated in the cost books of most CFs. High level of bureaucracy and admiminstrative responsibilities leaves less time for QA/QC and NF support

Annex 2.3 CIGAS

CIGAS	
(1) Number of components/facilities to be served with respect to the initial scenario	**42**
(2) Number of components/facilities of the TC for which the capacity was initially designed (baseline: costbook n°5 in 2020)?	**33**
(3) Available/ reserved capacity to support other facilities, considering the 5-year financial plan and current number of NFs (baseline: costbook n°5 in 2020)?	
NFs in Greece, UK	yes
Associated network stations	no
Potential new NFs in ACTRIS ERIC member/observer countries	yes
Other users	no
Comments	Given the evolution, currently up to 50 can be served.
(4) Intended use of reserved capacity (if any)	
N° of new NFs	3
N° of RPFs	1
N° of associated network stations	
N° of other users	
Comments	A potential RPF could be, e.g., Mace Head (IE)
(5) Evolvement to date of the maximum TC capacity, as considered in the initial 2021-2025 financial plan	Yes. In 2020 the TC capacity has been designed to support 33 NF on an annual basis for all services provided. An increased capacity can be achieved by lowering the frequency of the provision of some services to biannual, which would be the max. reasonable time frame for such a compromise.
(6) Possibility for additional capacity that would allow to take up/support/serve new facilities in the 2025-2030 period	
Potential additional capactiy min/max	no
Optimized process to allow more efficiently to serve more facilities	
New development /emerging technologies	
Additional resources	
Other	
Comments	It's much too early to estimate additional capacities based on increased efficiency, new developments or potential additional resources. The flexibility of the CiGas capacity is expected to be at its limits during the 1st financial period as pointed out in the comment of question 4.
(7) Indicate any other issues that may impact your TC capacity in the 2025-2030 period	
Inflation	To be considered in the next financial period
Increasing general costs	Increased salaries as a consequence of inflation
Geopolitical issues	
Expected additional revenues or resources	

Expected decreased revenues or resources	
Other	The difficulty to hire or keep qualified personnel

Annex 2.4 CARS

CARS	
(1) Number of components/facilities to be served with respect to the initial scenario	**50**
(2) Number of components/facilities of the TC for which the capacity was initially designed (baseline: costbook n°5 in 2020)?	**52**
(3) Available/ reserved capacity to support other facilities, considering the 5-year financial plan and current number of NFs (baseline: costbook n°5 in 2020)?	
NFs in Greece, UK	yes
Associated network stations	yes
Potential new NFs in ACTRIS ERIC member/observer countries	yes
Other users	yes
Comments	CARS can support 52 ARS NFs (lidar + photometer) and contributes to 30 CRS (ceilometer) Reserved capacity for users of all kind (EARLINET, AERONET, E-PROFILE, companies)
(4) Intended use of reserved capacity (if any)	
N° of new NFs	6
N° of RPFs	1
N° of associated network stations	42
N° of other users	3
Comments	The capacity for new NFs (6) also includes JRC (1), Greece (4), UK (1) A potential RPF could be, e.g., EVASO (PT) The associated network stations comprise 7 EARLINET lidar stations: Belgrade (RS), Alomar (NO), Kuopio (FI), Catania (IT), Nicolosi (IT), Finokalia (GR), Burjassot (ES) and numerous AERONET stations (35 photometers, too many to be listed here)
(5) Evolvement to date of the maximum TC capacity, as considered in the initial 2021-2025 financial plan	No, the plan was already ambitious, our focus is now to implement what was already planned.
(6) Possibility for additional capacity that would allow to take up/support/serve new facilities in the 2025-2030 period	
Potential additional capactiy min/max	no
Optimized process to allow more efficiently to serve more facilities	
New development /emerging technologies	
Additional resources	
Other	
Comments	CARS has planned from the beginning to support as much as possible both the NFs and the users. This plan includes already optimized processed and development of technologies for more automatic workflows. The max. capacity can only be reached by implementing the measures as initially planned. Also, we do not foresee the need to extend this capacity in the near future, unless CARS becomes a global

	provider. In Europe, we don't foresee the setup of many other ARS stations, and we do not think that the private sector in this field will evolve significantly by 2030; Europe has already a good coverage due to ACTRIS.
(7) Indicate any other issues that may impact your TC capacity in the 2025-2030 period	
Inflation	Salaries may not be sufficiently high to motivate CARS existing and new personnel, considering life costs.
Increasing general costs	Maintenence and repairements of the instruments may be overwhelming due to increasing costs; especially lidar components are very expensive, but also transport to and from calibration & campaigns, utilities, etc. Alltogether means that the costs initially estimated are now in reality much higher, while the resources remain the same.
Geopolitical issues	As long as the war does not extend, no critical issues.
Expected additional revenues or resources	Unfortunately CARS has to find additional revenues or resources in order to balance the costs. These resources may come as in-kind from the institutions but the amounts are limited. Based on our experience in ATMO-ACCESS, soft money (projects) cannot be used, although it is not logic to consider that eveything a TC does is paid by ACTRIS (because is not!). Especially for training and development of technologies we should be able to use project money. Otherwise, we have to reduce the activity according to the available resources.
Expected decreased revenues or resources	In case an additional decrease of revenues or resources occurs, CARS will have to reduce its activity by: a) giving up to services offered to users and associated network stations, or b) giving up to expensive tasks (e.g. direct comparisons, on site audits, face-to-face workshops, etc.)
Other	Lack of (interested) specialized personnel. Dead times when a crucial equipment breaks. Too much bureaucracy (plans, reports, statistics, meetings).

Annex 2.5 CCRES

CCRES	
(1) Number of components/facilities to be served with respect to the initial scenario	**29**
(2) Number of components/facilities of the TC for which the capacity was initially designed (baseline: costbook n°5 in 2020)?	**24**
(3) Available/ reserved capacity to support other facilities, considering the 5-year financial plan and current number of NFs (baseline: costbook n°5 in 2020)?	
NFs in Greece, UK	yes
Associated network stations	no
Potential new NFs in ACTRIS ERIC member/observer countries	no
Other users	no
Comments	
(4) Intended use of reserved capacity (if any)	
N° of new NFs	n/a
N° of RPFs	n/a
N° of associated network stations	Difficult to quantify. CCRES collaborates with E-PROFILE to ensure that ACTRIS and E-PROFILE data are coherent. There are 400 automatic low-power lidars (ALC) and 20-30 microwave radiometer (MWR) in E-PROFILE. CCRES supports about 4-5 MWR stations for calibration services
N° of other users	n/a
Comments	
(5) Evolvement to date of the maximum TC capacity, as considered in the initial 2021-2025 financial plan	no
(6) Possibility for additional capacity that would allow to take up/support/serve new facilities in the 2025-2030 period	
Potential additional capactiy min/max	no
Optimized process to allow more efficiently to serve more facilities	
New development /emerging technologies	
Additional resources	
Other	
Comments	Problem of HR commitment
(7) Indicate any other issues that may impact your TC capacity in the 2025-2030 period	
Inflation	Inflation has an impact on cost
Increasing general costs	
Geopolitical issues	Several microwave components for cloud radars come from Ukraine/Russia
Expected additional revenues or resources	
Expected decreased revenues or resources	So far we have no garantee of commitment from CCRES-NL

Other	

Annex 2.6 CREGARS

CREGARS	
(1) Number of components/facilities to be served with respect to the initial scenario	**11**
(2) Number of components/facilities of the TC for which the capacity was initially designed (baseline: costbook n°5 in 2020)?	**2**
(3) Available/ reserved capacity to support other facilities, considering the 5-year financial plan and current number of NFs (baseline: costbook n°5 in 2020)?	
NFs in Greece, UK	yes
Associated network stations	yes
Potential new NFs in ACTRIS ERIC member/observer countries	yes
Other users	no
Comments	
(4) Intended use of reserved capacity (if any)	
N° of new NFs	3
N° of RPFs	
N° of associated network stations	Unknown. It is not unlikely that several NDACC stations would like to use our Cental Processing system. They would probably still rely on NDACC for their instrument calibration however, therefor making the data only partially ACTRIS compliant. The central processing system is highly automated and therefore its max capacity is higher than the stated 12 NFs.
N° of other users	
Comments	The Harestua, Paris and Sodankyla PIs have expressed interest to pursue NF status. At the same time several stations on the current NF list may struggle to achieve NF status under the current requirements (see comment further below) and might postpone their application. It is not unlikely that several NDACC stations would like to use our Cental Processing system. They would probably still rely on NDACC for their instrument calibration however, therefore making the data only partially ACTRIS compliant. The central processing system is highly automated and therefore its max capacity is higher than the stated 12 NFs.
(5) Evolvement to date of the maximum TC capacity, as considered in the initial 2021-2025 financial plan	With the current requirements we do not foresee large changes in total number of NFs

(6) Possibility for additional capacity that would allow to take up/support/serve new facilities in the 2025-2030 period	
Potential additional capactiy min/max	Yes, 10-15 additional facilities. The capacity will be more or less determined by how many sites we can annually hook up to the CP system (2 to 3 per year), given the budget constraints. If budgets severely decrease, this will of course impact our assessment
Optimized process to allow more efficiently to serve more facilities	x
New development /emerging technologies	see comment on new compact FTIRs
Additional resources	
Other	
Comments	
(7) Indicate any other issues that may impact your TC capacity in the 2025-2030 period	
Inflation	When the initial costbook was drafted, no rampant inflation was envisioned. Extending the current financial framework to 2026 and 2027 means that the membership fees diverge further and further from the set out 30% cost target. This puts a larger burdon the RPOs and Nations supporting the NFs
Increasing general costs	Tied to the topic above, costs have significantly risen recent years.
Geopolitical issues	
Expected additional revenues or resources	
Expected decreased revenues or resources	
Other	The current National funding framework does not extend beyond 2026