****

**APT REPORT ON**

**EFFORTS TO GREEN DATA CENTRES IN THE ICT/TELECOMMUNICATIONS SECTOR IN THE APT MEMBER COUNTRIES**

**Edition: June 2019**

**The 31st APT Standardization Program Forum (ASTAP-31)**

**11 – 15 June 2019**

**Tokyo, Japan**

***(Source: ASTAP-31/OUT-31)***

**No. APT/ASTAP/REPT-43**

 Table of Contents

[1 Scope 2](#_Toc12253793)

[2 Terms and Definitions 2](#_Toc12253794)

[2.1 A Data Center 2](#_Toc12253795)

[2.2 A Green data centre 2](#_Toc12253796)

[2.3 Power density 2](#_Toc12253797)

[2.4 Space efficiency 2](#_Toc12253798)

[2.5 Power Usage Effectiveness (PUE) 2](#_Toc12253799)

[2.6 Carbon Usage Effectiveness (CUE) 2](#_Toc12253800)

[3 Overview of Related International Standardization Activities on Green Data Centre 2](#_Toc12253801)

[3.1 ITU-T 2](#_Toc12253802)

[3.2 ISO/IEC JTC1 3](#_Toc12253803)

[3.3 ETSI 3](#_Toc12253804)

[3.4 ANSI/TIA 3](#_Toc12253805)

[3.5 LEED 4](#_Toc12253806)

[3.6 The Green Grid 4](#_Toc12253807)

[3.7 Uptime Institute 5](#_Toc12253808)

[4 National Policies, Laws, Regulations and Management Systems of Member Countries and Example Initiative 5](#_Toc12253809)

[4.1 Malaysia 5](#_Toc12253810)

[4.1.1 Study of the carbon footprint of sample Data Centres in Malaysian Government Offices 5](#_Toc12253811)

[4.1.2 Technical Code for the Specification for Green Data Centres 8](#_Toc12253812)

[4.2 Indonesia 8](#_Toc12253813)

[4.2.1 Formulating Technical Regulations: Standardisation of DC Infrastructures 8](#_Toc12253814)

[4.3 Japan 8](#_Toc12253815)

[5 Analysis of Further Study 9](#_Toc12253816)

[6 References 9](#_Toc12253817)

Appendix…Questionnaire on Green Data Centre in APT Countries …………………………12

# ****Scope****

The scope of this report covers efforts in Asia Pacific region such as policies and activities on the Green Data Centre (GDC) in the ICT/Telecommunication sector.

# ****Terms and** Definitions**

## A Data Center

A repository for the storage, management and disseminations of data.

## A Green data centre

A repository for the storage, management, and dissemination of data in which the mechanical, lighting, electrical and computer systems are designed for maximum energy efficiency and minimum environmental impact.

##  Power density

The energy consumption of ICT equipment per rack cabinet of floor area of a server room.

## Space efficiency

The ratio of floor area employed for ICT equipment in relation to the total floor area of the building.

## Power Usage Effectiveness (PUE)

The ratio of total amount of energy used by a computer data center facility to the energy delivered to computing equipment.

## Carbon Usage Effectiveness (CUE)

A measure of data center sustainability in terms of data center specific carbon emissions. CUE is calculated by dividing the “total CO2 emissions caused by total data center energy” by the “energy consumption of the IT computing equipment”.

# ****Overview of Related International Standardization Activities on Green Data Centre****

## ITU-T

Recommendation ITU-T L.1300 describes best practices aimed at reducing the negative impact of data centers on the climate. The application of the best practices defined in this document can help owners and managers to build future data centers, or improve existing ones, to operate in an environmentally responsible manner.

This Recommendation describes best practices for energy-efficient construction, operation and management of green data centres that contain a number of essential components, including ICT equipment and services, cooling, power equipment, data centre building, etc.

Best practices have been identified and divided into different clauses to cover the following different components of a data centre:

* planning, utilization and management;
* ICT equipment and services;
* cooling;
* data centre power equipment;
* other data centre equipment;
* data centre building;
* monitoring;
* design of network;
* cloud data centre;
* optimization of energy management of the whole data centre.

## ISO/IEC JTC1

ISO/IEC JTC 1 is a joint technical committee of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). Its purpose is to develop, maintain and promote standards in the fields of information technology (IT) and Information and Communications Technology (ICT).

ISO/IEC JTC1 has published three parts of data centers energy efficiency KPI series as ISO/IEC 30134 series and ISO/IEC TS 22237-1:2018:

* ISO/IEC 30134-1:2016 Part 1 of the series which is overview of the entire ISO/IEC 30134 series
* ISO/IEC 30134-2:2016 Part 2, Power Usage Effectiveness (“PUE”)
* ISO/IEC 30134-3:2016 Part 3, Renewable Energy Factor (“REF”)
* ISO/IEC TS 22237-1:2018 Information Technology – Data Center Facilities and Infrastructures – General Concepts

## ETSI

ETSI, the European Telecommunications Standards Institute, produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast and internet technologies.

ETSI is a not-for-profit organization with more than 700 ETSI member organizations drawn from 62 countries across 5 continents world-wide.

ETSI, a major actor in Information and Communication Technology standardization (ICT), has recently published the DCEM (Data Centre Energy Management) indicator standard, to measure energy efficiency and compare energy management efficiency in data centres.

This indicator, the DCEM Global KPI, has been developed by ETSI’s OEU (Operational Energy efficiency for Users) Industry Specification Group and is defined in ETSI GS OEU 001. This group comprises ICT companies from various sectors including banking, telecommunications, the automotive and the aeronautical industry.

The DCEM Global KPI specifies the coefficient or ‘Global KPI’ of the eco-efficiency and energy management of data centres. It combines two indicators: one taking into account different sizes of data centre (S, M, L or XL) and a second incorporating 9 different levels of performance, similar to the energy classification model used for home appliances. The DCEM Global KPI meets a twofold objective: to assess the level of eco-efficiency in data centres, and to allow benchmarking of data centres or ITC locations in a wide range of industrial sectors.

The DCEM Global KPI is based on a formula with 4 different component KPIs defined in the new ETSI Standard ES 205 200-2-1:

* Energy consumption, KPIEC
* Task efficiency, KPITE
* Energy reused, KPIREUSE
* Renewable energy, KPIRE

## ANSI/TIA

The American National Standards Institute is a private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. In 2005, The Telecommunication Industry Association announced ANSI/TIA-942, the telecommunication infrastructure standards for data centre.

The ANSI/TIA-942 standard is recognized by the American National Standards Institute (ANSI) and specifies detailed guidelines for planning and building telecommunications infrastructure such as multi-tenant data centres. The standard is regularly updated through the work of a designated sub-committee, and is designed through a consensus-based approach. The latest version is TIA-942-B, and was published in June 2017.

The ANSI/TIA-942-A specification references private and public domain data center requirements for applications and procedures such as:

* + Network architecture
	+ Electrical design
	+ File storage, backup and archiving
	+ System redundancy
	+ Network access control and security
	+ Database management
	+ Web hosting
	+ Application hosting
	+ Content distribution
	+ Environmental control
	+ Protection against physical hazards (fire, flood, windstorm)
	+ Power management

## LEED

LEED or Leadership in Energy and Environmental Design, is the most widely used green building rating system in the world. Available for virtually all building, community and home project types, LEED provides a framework to create healthy, highly efficient and cost-saving green buildings. LEED certification is a globally recognized symbol of sustainability achievement. LEED is a globally recognized symbol of excellence in green building. LEED certification ensures electricity cost savings, lower carbon emissions and a healthier environment.

## The Green Grid

The Green Grid is an affiliate membership level of the [Information Technology Industry Council (ITI)](https://www.itic.org/), a premier trade association that works to advance public policies for the tech sector. ITI’s Green Grid works to improve IT and data center energy efficiency and eco-design around the world. It is an open industry consortium of information and communications technology (ICT) industry end-users, policymakers, technology providers, facility architects, and utility companies.

The Green Grid, the data center industry group known best for creating the industry’s most popular data center efficiency metric, Power Usage Effectiveness (PUE), has developed a new metric for data center operators, called Performance Indicator (PI).

The Green Grid published PUE in 2007. Since then, the metric has become widely used in the data center industry. Unlike PUE, which focuses on both cooling and electrical infrastructure, PI is focused on cooling. The Green Grid’s aim in creating it was to address the fact that efficiency isn’t the only thing data center operators are concerned with. Efficiency is important to them, but so are performance of their cooling systems and their resiliency.

Expanding its focus on sustainability, The Green Grid in 2010 announced the creation of two new metrics to measure carbon and water use in data centers. The new metrics, Carbon Usage Effectiveness (CUE) and the Water Usage Effectiveness (WUE), are designed to build upon the momentum of The Green Grid’s widely-used Power Usage Effectiveness (PUE) metric.

With the new metrics, The Green Grid is broadening its efforts to take a more holistic view of data center sustainability. CUE will help data center managers determine the amount of greenhouse gas emissions generated in delivering work from the IT gear in a data center facility. Similarly, WUE will help managers determine the amount of water used by the facility, and the amount used to deliver work from IT operations.

## Uptime Institute

Uptime Institute is an American professional services organization best known for its "Tier Standard” and the associated certification of data center compliance with the standard.

The data center Tier standards are a standardized methodology used to determine availability in a facility. It offers companies a way to measure [return on investment](https://en.wikipedia.org/wiki/Return_on_investment) (ROI) and define desired levels of delivered performance. As of 2017, more than 1000 data centers worldwide have formally certified their data centers using the Tier standard.

There are two parts of the Tier certification process:

* Tier Certification of Design Documents - typically the first step in the Tier process and used to align the design and construction of a new facility with an organization's business needs.
* Tier Certification of Constructed Facility - the final part of the process which assures that the actual constructed data centers delivers the results specified in the Tier Standard: Topology specification.

The Tier certifications are awarded in four levels:

* Tier IV - Fault tolerant site infrastructure
* Tier III - Concurrently maintainable site infrastructure
* Tier II - Redundant capacity components site infrastructure (redundant)
* Tier I - Basic site infrastructure (non-redundant)

# National Policies, Laws, Regulations and Management Systems of Member Countries and Example Initiative

During the ASTAP27 meeting, the EG of GICT&EMF received three input documents (from Malaysia and Japan) and one informative document (from Indonesia) for this work item.

## Malaysia

### Study of the carbon footprint of sample Data Centres in Malaysian Government Offices

In 2015, the Malaysia Technical Standards Forum Bhd (MTSFB) and its Green ICT Working Group, in collaboration with the Sustainable Energy Development Authority (SEDA Malaysia) and Malaysia Communications and Multimedia Commission (MCMC) conducted a study of the carbon footprint of sample Data Centres in Malaysian Government Offices.

The objective of the study was to analyze the energy used to operate data centres (DC). The study involved placing data measuring equipment on the electrical distribution board (DB) for recording the energy consumption of the ICT equipment and energy used for lighting, cooling and powering up the data centre; while at the same time, logging the temperature and humidity levels within the data centre environment.

The baseline findings and best practice recommendations report of the study are as below:

**i) Baseline findings**

The findings of the study are as shown in charts and tables below.

**Figure 1.1 Energy consumption based on percentage**

 **Figure 1.2 Estimated Annual Consumption (kWh)**

Table 1.1 is prepared by the Uptime Institute as part of the certification process of the data centres in industry.

**Table1.1 Uptime Institute Levels of Efficiency Ratings charts**

|  |
| --- |
| Current PUE & DcIE |
| PUE | **DcIE** | **Level of Efficiency** |
| 3.0 | 33.3% | Very In-efficient |
| 2.5 | 40% | In-efficient |
| 2.0 | 50% | Average |
| 1.5 | 67.6% | Efficient |
| 1.2 | 83% | Very Efficient |

The Power Usage Effectiveness (PUE) is a ratio of the total energy used by the Data Centre (DC) to the energy used by the IT equipment.

$$PUE = \frac{Total Energy Consumption by Data Centre (kWh)}{Total Energy Consumption by IT Devices (kWh)}$$

The PUE for the data centres is as below.

**Figure 1.3 Power Usage Effectiveness**

**ii) Best Practice Recommendations**

Recommendations on potential energy saving measures are list in the table below.

**Table 1.2 Potential Energy Saving Measures**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Site Name | Improve air flow and Increase AC Setpoint | Server Power Mgmt S/W | Inverter for ACSU | Portable Dehumidifier | Increase AC Setpoint in UPS Room | Insulate Window Area | Partition DC and Realign Cabinets | Partition under floor air plenum | Replace Glass/Plastic Doors with Grill | Relocate In Row AC |
| 1 | X | X  | X  | X | X  |  | X |  |  |  |
| 2 | X | X  | X  | X | X |  | X |  |  |  |
| 3 | X | X  |  | X |  |  |  |  |  | X |
| 4 | X | X  |  | X |  |  |  |  |  |  |
| 5 | X | X  |  | X | X |  |  |  |  |  |
| 6 | X | X  |  | X | X | X | X | X  | X |  |
| 7 | X | X |  | X |  |  | X |  | X |  |
| 8 | X | X |  | X |  | X | X | X | X |  |
| 9 |  |  |  |  |  |  |  |  |  | X  |
| 10 | X  | X | X | X  | X  |  | X  | X  | X  |  |

### Technical Code for the Specification for Green Data Centres

The technical code for the Specification for Green Data Centres (‘Technical Code’) was developed in pursuant to section 185 of the Act 588 by the Malaysian Technical Standards Forum Berhad (MTSFB) via its Technical Experts Group (TEG) on Green Data Centres under the supervision of Green ICT Working Group.

The Technical Code was developed to provide the minimum requirements for green data centres for the purpose of establishing policies, systems and processes to improve the energy efficiency of data centres and at the same time reducing the carbon footprint of the industry.

## Indonesia

### Formulating Technical Regulations: Standardisation of DC Infrastructures

The objective for the standardization activity if to come up with a guideline for designing, implementing and operating Data Centres.

Green Building Council Indonesia is established for green building certification.

The proposed best practices of GDC are listed as follows;

* Maintain the green factor of PUE < 1.5
* Free cooling
* Dynamic rotary UPS to provide greener power solution without using any lead (Pb) based battery
* Chiller engine for cooling tower (economizer)
* Green building material
* Controlled lighting

In 2019, a new Indonesian National Standard (SNI) on Data Center is being formulated and consists of technical requirements, governance, implementation and certification aspects of data center. The proposed standard also considers the importance of energy efficiency of data centre.

## Japan

Japan performed comparative analysis between a data centre with some energy saving technology and a data centre with conventional technology by hybrid LCA method and these results were consented to be published as a Supplement to L.1410, named “Case study : a hybrid approach based comparative analysis of the environmental impact of a baseline datacenter and an energy-efficient datacenter“

The Recommendation ITU-T L.1410 deals with environmental life cycle assessments (LCAs) of information and communication technology (ICT) goods, networks and services.

# Analysis of Further Study

The ICT and in particular data centres energy consumption is increasing globally due to more internet and broadband communication.

The rapidly expanding data centre industry in the Asia Pacific will continue driving growth in demand for energy resources. Energy use in data centers throughout this region is rising to match skyrocketing demand. Approximately 26.5% of the total energy used by the data centers around the world is consumed by the Asia Pacific region and there is no sign of slowing demand. Furthermore, data center operational costs have also been heavily impacted by the rising costs of energy.

Against this trend, it is important to adopt policy actions to improve the energy efficiency of data centres and limits the energy consumption growth.

Data centers and IT equipment are just starting to become increasingly energy-efficient, and there are a variety of metrics, standards and certifications that have emerged such as: PUE, CUE, WUE, LEED, Energy Star. Standards and metrics are important to enable the accurate measurement and comparison of data centers and IT equipment and, along with certification programs, can maintain the integrity of tech companies’ claims for energy efficiency.

# References

[1] Uptime Institute tier certifications, Web 20 May 2019, <<https://en.wikipedia.org/wiki/451_Group>>

[2] ISO/IEC TS 22237:2018, Web 20 May 2019

<<https://www.iso.org/standard/72925.html>>

[3] ISO/IEC 30134:2016, Web 27 May 2019

<https://www.iso.org/standard/63451.html>

[4] ETSI ES 205 200-1: Access, Terminals, Transmission and Multiplexing (ATTM);

Energy management; Global KPIs; Operational infrastructures; Part 2: Specific requirements;

Sub-part 1: Data centres https://www.etsi.org/deliver/etsi\_es/205200\_205299/2052000201/01.02.01\_60/es\_2052000201v010201p.pdf

[5] ETSI releases the first global KPI on energy-efficiency in ICT, Web 26 May 2019 <https://www.etsi.org/newsroom/news/798-2014-06-press-etsi-releases-the-first-global-kpi-on-energy-efficiency-in-ict>

[6] Performance Indicator, Green Grid’s New Data Center Metric, Explained, Web 26 May 2019, <https://www.datacenterknowledge.com/archives/2016/07/18/performance-indicator-green-grids-new-data-center-metric-explained>

[7] Green Grid Creates Metrics for Carbon Water, Web 21 May 2019, <https://www.datacenterknowledge.com/archives/2010/12/02/green-grid-creates-metrics-for-carbon-water>

[8] Recommendation ITU-T L.1300: Best Practices on Green Data Centre, Web April 2019 https://www.itu.int/rec/T-REC-L.1300-201406-I/en

**Appendix**

* Questionnaire on Green Data Centre in APT Countries

**Appendix**

|  |  |
| --- | --- |
| APTlogogreen3 | **ASIA-PACIFIC TELECOMMUNITY** |
| **The 23rd APT Standardization Program Forum** **(ASTAP-23)** | **Document****ASTAP-23/OUT-16** |
| 03 – 07 March 2014, Pattaya, Thailand | **07 March 2014** |

Working Group on ICT and Climate Change

**Questionnaire on Green data Centre in APT countries**

**Introduction**

This questionnaire intends to invite APT member countries, affiliates, and sector members to provide their valuable inputs on Green Data Centre, Green Data Centre management, policies and standards practices among different stakeholders in APT member countries. The response will be used to construct a macro overview of the current Green Data Centre landscape in the region. All the information collected from the members will be reflected in the aggregated survey results analysis. The due date for your response is 30 April 2014. Please send your response to the ICT&CC WG Chairman, Dr. Chung, Sam Young (sychung@kcc.go.kr), Green Data Centre Rapporteur Lead, Mr Alex Kuik (tskuek@digi.com.my), and the APT secretariat, aptastap@apt.int.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Draft Questionnaire on Green Data Centre Best practices and measurements in APT countries**

**Objective:**

 This Questionnaire aims to collect information on best practices and measurements related to Green Data Centre in APT member countries in order to establish a macro overview of the current regional Green Data Centre landscape and to identify best practices in the area. Such a mapping of Green Data Centre best practices within the region would serve as a base document, upon which APT member countries could use for further research and development work in the Green Data Centre arena.

**Scope**

 This Questionnaire focuses on environmentally sound management of Green Data Centre, including metrics and measurements associated with it.

 Although there are various definitions of Green Data Centre used by a number of institutions and organizations, the Rapporteurs of this Questionnaire use the following definition of Green Data Centre.

 Green Data Centre:

A Data Centre is a repository for the storage, management and disseminations of data.

 A Green Data Centre has mechanical, lighting, electrical and computer systems designed for maximum energy efficiency and minimum environmental impact.

 The expected benefits of Green Data Centre include:

* Reduction in power and cooling
* Increased server/storage utilization
* Improvement in Data Centre space

 For the sake of simplicity taking into account the scope of work being done in ASTAP, the scope of this Questionnaire would focus only on **Green Data Centre metrics and measurements used in APT Member countries**. It is acknowledged that different countries will have different acceptable metrics, due to local and seasonal weather variations. The data that is requested is based on experience and surveys that respondents have with regards to the Green Data Centre in their home country.

 Respondents to this Questionnaire should be aware of the following categories of Data Centres that are used in this questionnaire:

1. Captive data centre

Client-owned-and-operated data centre, typically providing service resources directly to their organization. The personnel in a captive facility are legal employees of the organization, not the vendor

1. Non-captive data centre

Commercialised third party data centre which provide out-sourced services to clients

**Structure**

 The Questionnaire is divided into 4 parts with 14 questions. The details are as follows:

**Questionnaire on green data centre best practices and measurements in APT countries**

|  |
| --- |
| **Part 1: General** |
| **No.** | **Questions** | **Responses** **(examples are given below only for better understanding)** |
| 1 | Name of organization who responds to the Questionnaire and details of contact person(s).  | Name: .Country: .Organization: . Address: .Tel. : . Fax: .e-mail: .  |
| 2 | Role and responsibility of respondent in Data Centre management. Note: May check more than one item  | Government – policy maker ( )Captive data centre operator ( )Non-captive data centre operator ( )Client of non-captive data centre ( )Equipment Manufacturer ( )NGO / Activist / Environmentalist ( )R&D institution ( )Others ( ) please specify : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 3 | Involvement of your organization in ICT and climate change activities Note: When you have more two activities, please add more lines | 1. Local Organization (from mm/yy) (from mm/yy)2. International Organization (from mm/yy) (from mm/yy) |
| 4 | Project or work plan relating to Data Centre / Data Centre management.Please provide details of data centre under your organization’s direct management; if any. Note: Input the data centre information including other relevant information  | 1. When was this data centre built?Which year ( \_\_\_\_ )2. Total size of the data centre floor space\_\_\_\_\_\_\_ sqft (please specify separately if more than one location.)3. Climate in which the location of the data centre is situated – latitudinal regions. ( Tropical / Sub-topical / Warm temperate / Cool temperate / Boreal / Subpolar / Polar ) |

|  |
| --- |
| **Part 2: Green Data Centre and Green Data Centre management** |
| 5 | Please give an indication on current status of Green Data Centre management policy in your country.Note: May check more than one item and can provide details in attachment. | 1. Dominant management group (who are the parties spearheading activities and enforcements)Government ( ) Industry ( )R&D Institute ( ) University ( ) Others ( ) None ( )2. Management scheme : Policy/ Strategy ( ) Education ( ) R&D ( ) Others ( ) 3. Priority at national level Very high ( ) High ( ) Normal ( )Low ( ) Very Low ( ) None ( ) |

|  |
| --- |
| **Part 3: Policy and standard practice** |
| 6 | Are there any localized standards or guidelines for Green Data Centre in your country? If so, please provide reference.(add lines if more than one standards or guidelines are used. )  | Local standards and guidelines existence:No ( )Yes ( )  Title of Standards / Guidelines : 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

If non-existent, is there any international standard that is used in your country? Title of Standards / Guidelines:1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
 |
| 7 | Status of Green Data Centre implementation in your country.How many data centres in your country that has been certified Green? | 1. Number of Green Data Centres currently ( \_\_\_ )

2. Are there any future data centres that are targeted to be converted or retro-fitted to achieve the Green Status? ( Y / N )1. Is there a target for the number or percentage of data centres that will be green in your country? ( number: \_\_\_\_ / \_\_\_ % targeted by year \_\_\_\_\_\_ )
 |

|  |
| --- |
| **Part 4: Recommendations/Suggestions** |
| 8 | Measurements used in defining whether a data centre can be classified as Green**Terms :*** PUE = Power Usage Effectiveness (Rating of 3 levels which is; Minimum, Good and Excellent is used for classifying the efficiency level)
* SAT = Supply Air Temperature

 * RHR = Relative Humidity Range @ 1.5m above the floor at rack level
* USE = UPS System Efficiency
 |

|  |  |  |
| --- | --- | --- |
| Metrics | Malaysia’s Proposal | APT Member’s proposal |
| PUE – Minimum | 1.9 |  |
| PUE – Good | <1.9 and > 1.6 |  |
| PUE – Excellent | > 1.6 |  |
| SAT | > 23°C |  |
| RHR | 30% to 60% |  |
| USE |  >90% |  |

Comments from APT members :\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 9 | Area or issues of interest that needs to have collaborative work in this region | Please specify : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

THANK YOU

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_