

# Circular economy and standardization in Korea



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## Scope explanation

### Back ground

- Competition of securing rare metals becomes severe due to **paradigm shifting of supply chain** for the demanding industry
- **Environmental & renewable energy, green gas issues** are coming out resulting in international regulation

### Needs

- **Enhancing recycling** of rare metals in Korea to make **securing raw materials**

### Objective

- Development of international standard for rare metals related issues in ICT goods including recycling **to promote usage of recycled raw materials (Economical & Environmental benefits)**

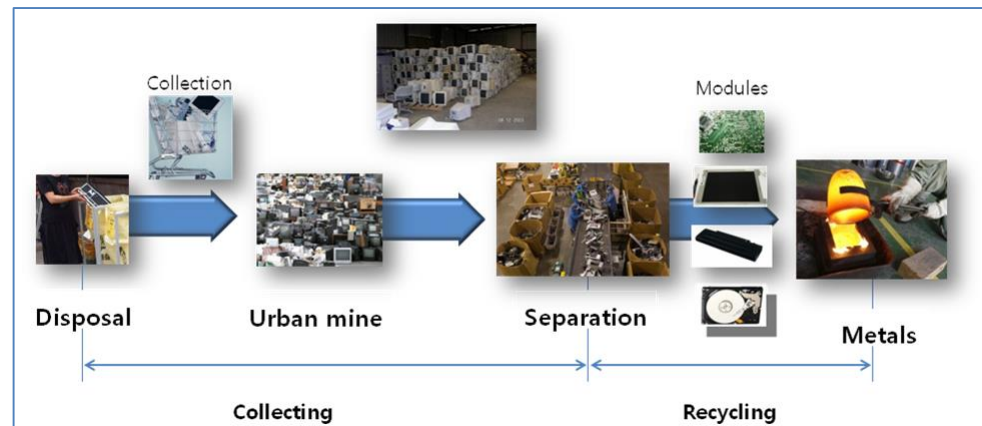
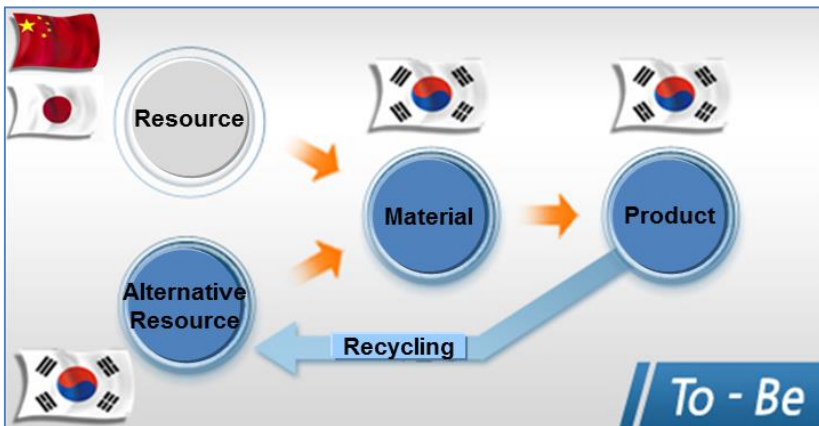
## Strategies: circulation for alternative resources

### Goal

- Increasing national efficiency of materials utilization

### Target

- Recycling of scraps during manufacturing
- Reuse & recycling of end-of-life products (e-waste)



## Activating circulation of rare metals

### Regulating Recycling System

- **Electronic product** : expand species (2010~)
- **Automobile** : expand recycling component (2013~)
- **Byproduct** : classifying as specific product (2011~)

### Increasing Collect Efficiency

- Ordinary collecting system of scraps
- Appliances : duty of manufacturer for separation & discharging

### Introducing Content Indication System

- "Rare Metal Indication System" for the 6 CREs of IT product:  
Cell phone, Digital camera, PMP, MP3, Pocket game, Navigation
- **How manage import & export products? International Standard**

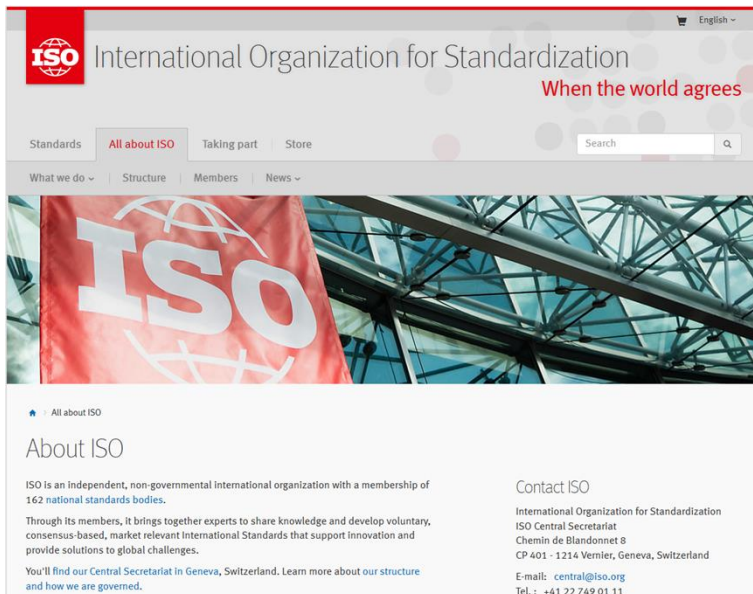
## International Standardization Activity of Korea in Rare Metals



Organization		Study Group (SG)/ Technical Committees (TC)	Scope	Korean Agency
ITU	ITU-T	SG5: Environment and climate change	Methodologies for evaluating ICT effects on climate change and publishing guidelines for using ICTs in an eco-friendly way	Ministry of Science, ICT (National Radio Research Agency)
	ITU-D	SG2: ICT, Climate Change Adaptation and e-Waste	The impact of human activities on the environment	
ISO		TC 298 Rare earth	Standardization in the field of rare earth ores, concentrates, metals, alloys, compounds, materials, including the reuse and recycling of waste rare earth products.	Ministry of Trade, Industry and Energy (Korean Agency for Technology and Standards)
IEC		TC 111: Environmental standardization for electrical and electronic products and systems	To prepare the necessary guidelines, basic and horizontal standards, including technical reports, in the environmental area, in close cooperation with product committees of IEC, which remain autonomous in dealing with the environmental aspects relevant to their products	

## ISO(International Organization for Standardization)

- ISO creates documents that provide requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose. They give world-class specifications for products, services and systems, to ensure quality, safety and efficiency. **They are instrumental in facilitating international trade.**
- ISO has published 22347 International Standards and related documents, covering almost every industry, from technology, to food safety, to agriculture and healthcare. ISO International Standards impact everyone, everywhere.

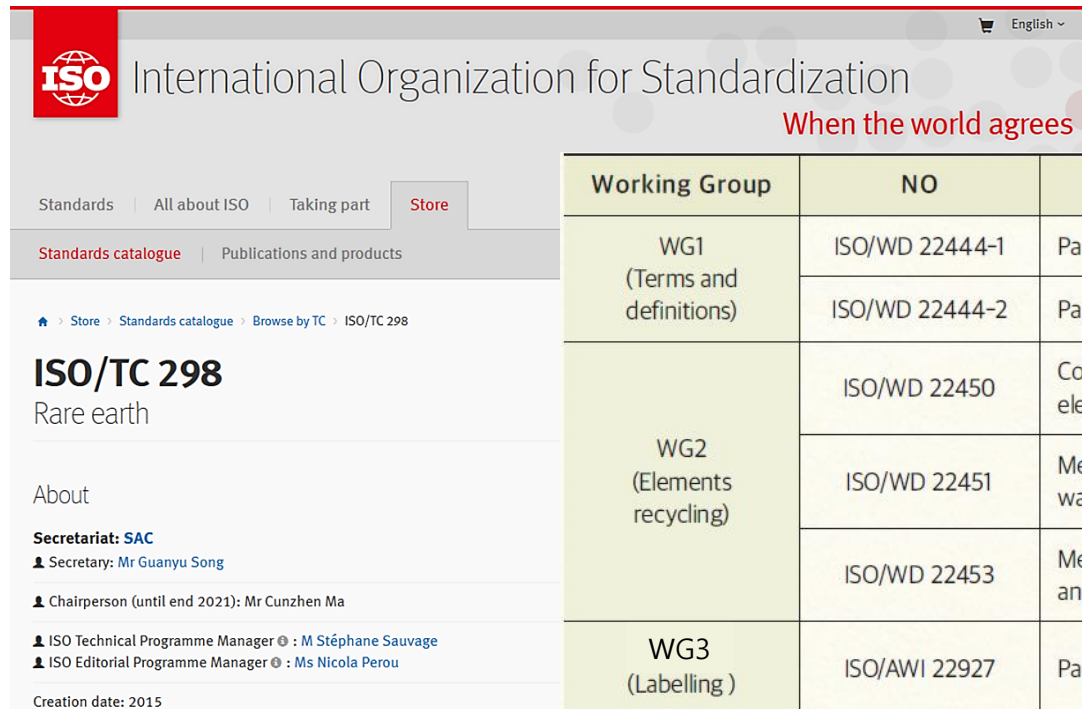


### ISO

- ISO is an independent, non-governmental international organization, central secretariat located in Geneva, Switzerland.
- Founded 1946~
- Member: 162 countries, 784 technical committees

## ISO TC 298 Rare earth

- Scope: standardization in the field of rare earth mining, concentration, extraction, separation and conversion to useful **rare earth compounds/materials** which are key inputs to **manufacturing** and further production process in a safe and environmentally sustainable manner.
- Working group: WG1, WG2, WG3



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### ISO/TC 298

Rare earth

About

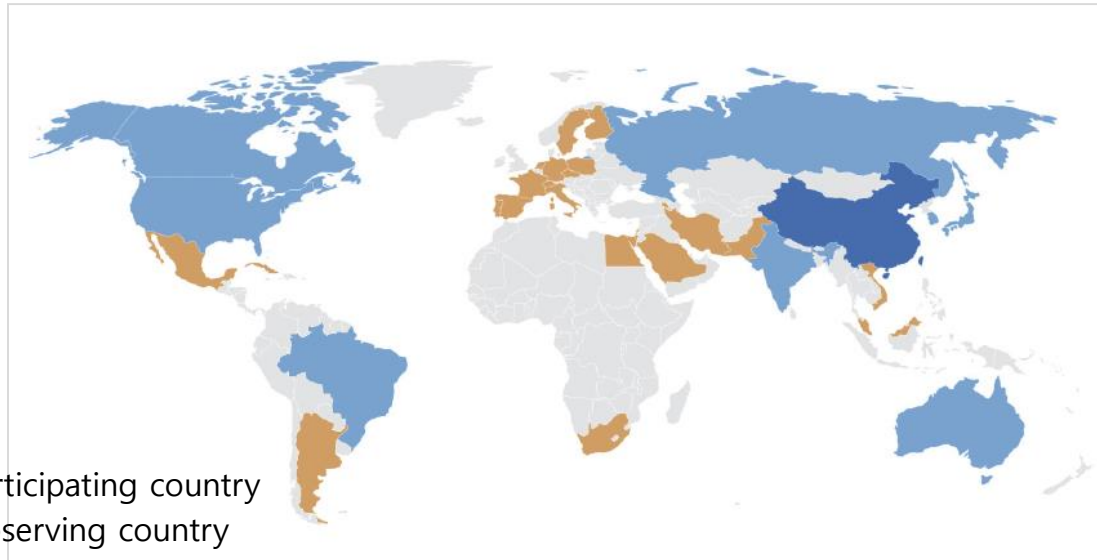
**Secretariat: SAC**  
 Secretary: [Mr Guanyu Song](#)  
 Chairperson (until end 2021): Mr Cunzhen Ma  
 ISO Technical Programme Manager: [M Stéphane Sauvage](#)  
 ISO Editorial Programme Manager: [Ms Nicola Perou](#)

Creation date: 2015

Working Group	NO	Title
WG1 (Terms and definitions)	ISO/WD 22444-1	Part 1: Minerals, oxides and other compounds
	ISO/WD 22444-2	Part 2: Rare earth metals and their alloys
WG2 (Elements recycling)	ISO/WD 22450	Communication formats for providing recycling information on rare earth elements in by-products and industrial wastes
	ISO/WD 22451	Measurement method of rare earth elements in by-products and industrial wastes
	ISO/WD 22453	Method for the exchange of information of rare earth elements in by-products and industrial wastes
WG3 (Labelling)	ISO/AWI 22927	Packaging and Labelling

## ISO TC 298

- Members
  - 9 Participating countries: US, India, Japan, Korea, Australia, China, Canada, Brazil ( ` 17), Russia ( ` 17)
  - 22 Observing countries: EU (France, Germany, etc.), Mexico, Egypt etc.




- JTAB (Joint Technical Advisory Board)
- JCG (Joint Coordination Group)
- JPC (Joint Project Committee)
- JTC (Joint Technical Committee)
- JWG (joint working group)
- TC (technical committee)
- SC (Subcommittee)
- PC (project committee)
- WG (working group)
- PWI (preliminary work item)
- NP (new work item proposal)
- WD (working draft)
- CD (committee draft)
- DIS [draft International Standard (ISO)]
- CDV [committee draft for vote (IEC)]
- FDIS (final draft International Standard)
- PAS (Publicly Available Specification)
- TS (Technical Specification)
- TR (Technical Report)



## ISO TC207 SC5

- Scope: standardization in the field of **life cycle assessment and related environmental management tools for products and organizations**. It includes life cycle based resource efficiency and eco-efficiency assessment, and encompass consideration of a life cycle perspective in the assessment of impacts from **the extraction of raw materials to the final disposal of waste.**



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### ISO/TC 207/SC 5

Life cycle assessment

#### About

##### Secretariat: AFNOR

Secretary: M Jean-Charles Michaud

Chairperson (until end 2022): Mr Dr Peter Saling

Vice chairperson: Mrs Nydia Suppen Reynaga

ISO Technical Programme Manager: Mr José Alcorta

ISO Editorial Programme Manager: Ms Nicola Perou

Creation date: 1993

#### Quick links

[Work programme](#)  
Drafts and new work items

[Working area](#)  
on ISOTC and Public inform

[ISO Electronic application](#)  
IT Tools that help support the development process

Structure | Liaisons

#### Liaison Committees to ISO/TC 298

The committees below can access the documents of ISO/TC 298:

Reference	Title	ISO/IEC
ISO/TC 82	Mining	ISO

#### Liaison Committees from ISO/TC 298

ISO/TC 298 can access the documents of the committees below:

Reference	Title	ISO/IEC
IEC/TC 68	Magnetic alloys and steels	IEC
IEC/TC 111	Environmental standardization for electrical and electronic products and systems	IEC
ISO/TC 37	Language and terminology	ISO
ISO/TC 79	Light metals and their alloys	ISO
ISO/TC 82	Mining	ISO
ISO/TC 132	Ferroalloys	ISO
ISO/TC 207	Environmental management	ISO
ISO/TC 207/SC 5	Life cycle assessment	ISO

## ISO TC 298 NP

- Measurement method for magnet scraps containing rare earth elements (PWI 22928)



- The standard assessment (ex. analysis method) for investigate the concentration of rare earths (Nd, Dy, Tb) in the disposed NdFeB magnets

**Form 4: New Work Item Proposal**

<b>Circulation date:</b> Click here to enter text.	<b>Reference number:</b> Click here to enter text. (to be given by Central Secretariat)
<b>Closing date for voting:</b> Click here to enter text.	<b>ISO/TC 298/SC</b> Click here to enter text. <input type="checkbox"/> Proposal for a new PC
<b>Proposer (e.g. ISO member body or A liaison organization):</b> KATS	<b>N</b> Click here to enter text.
<b>Secretariat:</b> China (SAC)	

A proposal for a new work item within the scope of an existing committee shall be submitted to the secretariat of that committee with a copy to the Central Secretariat and, in the case of a subcommittee, a copy to the secretariat of the parent technical committee. Proposals not within the scope of an existing committee shall be submitted to the secretariat of the ISO Technical Management Board.

The proposer of a new work item may be a member body of ISO, the secretariat itself, another technical committee or subcommittee, an organization in liaison, the Technical Management Board or one of the advisory groups, or the Secretary-General.

IMPORTANT NOTE: Proposals without adequate justification risk rejection or referral to originator.

Guidelines for proposing and justifying a new work item are contained in Annex C of the ISO/IEC Directives Part 1.

(1) The proposer has considered the guidance given in the Annex C during the preparation of the NWP.

**Proposal (to be completed by the proposer)**

**English title:**  
Measurement method for magnet scraps containing rare earth elements

**French title (if available):**  
Click here to enter text.

(In the case of an amendment, revision or a new part of an existing document, show the reference number and current title)

**Scope of the proposed deliverable**

This document provides information and the method to measure the concentration of rare earth elements (REEs) in magnet scraps. This recommendation contains an overall classification of magnet scraps and measurement methods according to their REE content.

**Purpose and justification of the proposal\***

See: "ISO-TC298\_20020\_Resolution\_of\_the\_2nd\_Plenary\_Meeting\_Toronto Resolution 12 (Session 2017) - Preliminary working item (PWI)

Proposal: "Measurement method for magnet scraps containing rare earth elements"

ISO/TC 298 decided to adopt preliminary working item (PWI) proposal and request Korea to submit its final version of Form 4 and draft for discussion in future ISO system.

Unanimously accepted.

The purpose of this NWP is to provide detailed information about the nature of REEs found in magnet scraps, classification of these magnet scraps with REE concentration and their specific measurement methods depending on the concentration. For example Nd-Fe-B magnets have relatively higher concentration of Nd (REE) as compared to other magnets like Sm-Co and can be classified into one category and so on. This NWP will provide categorical classification of magnet scraps and several standardized methods will be introduced for measuring the REE content accurately with categorical classification.

Consider the following: Is there a verified market need for the proposal? What problem does this standard solve? What value will the document bring to end-users? See Annex C of the ISO/IEC Directives part 1 for more information. See the following guidance on justification statements on ISO Connect: <http://connect.iso.org/pastevents/wgac/2016/201607200101>

## PWI (~17.06)

Resolution 12 (Toronto, 2017) - Preliminary working item (PWI)

Proposal "Measurement method for magnet scraps containing rare earth elements":

ISO/TC 298 decided to adopt preliminary working item (PWI) proposal

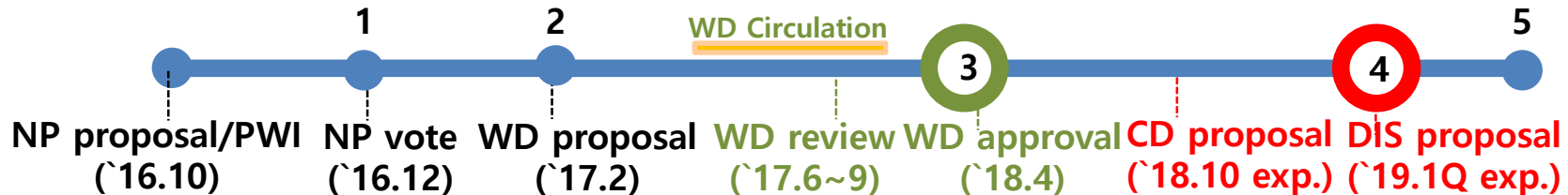
"Measurement method for magnet scraps containing rare earth elements"

and request Korea to submit its final version of Form 4 and draft for electronic NP ballot in ISO system.

Unanimously accepted.

## ISO TC 298 WD

- Elements Recycling – Communication formats for providing recycling information on rare earth elements in industrial waste and end of life cycled products (WD22450)



- The standard format to supply rare earth containing information of scraps or byproducts of manufacturing & industrial e-waste for recycling

### Ex.) Information

Manufacturer, Original place, Shape, Date, Weight, REs compositions etc.

ISO TC 298/TC298/WG.02  
Secretariat: SAC

Elements Recycling – Communication formats for providing recycling information on rare earth elements in industrial waste and end of life cycled products

**CD Stage**

Warning for WDs and CDs  
This document is not an ISO International Standard. It is distributed for review and comment. It is subject to change without notice and may not be referred to as an International Standard.  
Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

To help you, this guide on writing standards was produced by the ISO/TC298 and is available at <http://www.iso.org/iso/iso-standards>  
A model manuscript of a high International Standard (known as "The Blue Model") is available at <http://www.iso.org/iso/standards>

REE Application	Expected REE stocks by 2020 (tons)	Recycling Process Efficiency	Recycled REE in 2020 (tons)
Magnets	300,000	55%	2,333
Lamp phosphors	25,000	80%	6,000
NiMH Batteries	50,000	50%	1,750

Table 1. Expected REE waste stocks in year 2020 (Suzumasa et al.)

There is a big difference in amount of waste REE generated and its recycling due to lack in maturity of recycling technologies and communication formats between manufacturers or producers and recyclers in REE recycling process. The first and foremost important step in identification of products containing REEs. A typical recycling process is depicted in Fig 2.

Fig 2. Typical recycling process. Black arrows represent forward steps, red arrows represent additional steps that are proposed in this standard. N1, N2 and N3 represent the proposed standard documents which are necessary for ensuring smooth demand supply balance for REEs.

This standard (N1) defines REE-related substances that are discarded at the product stage as waste, end of life cycled products and suggests ways to facilitate their recycling. N1 relates to measurement methods of REE in industrial waste and end of life cycled products whereas N2 focuses on management of database obtained from communication with producer, recycler and a management agency for effective recycling. Simultaneous application of N1, N2 and N3 is necessary to assure complete and efficient recycling of these "vitamins of industry". Combination of N1, N2 and N3 into one document is not possible due to different scope of each document. Therefore each of these three concepts will be judged as an individual standard.

The purpose of this standard (N1, first among three documents) is to specify communication formats to provide the information on rare earth elements contained in industrial waste and end of life cycled products from producers or manufacturers to recyclers. The table format which includes the types of rare earth elements and their concentrations in the industrial waste and end of life cycled products will be defined in this standard.

## ITU(International Telecommunication Union) Standardization Program

- The Study Groups of ITU's Telecommunication Standardization Sector (ITU-T) assemble experts from around the world to develop international standards known as ITU-T Recommendations which act as **defining elements in the global infrastructure of information and communication technologies (ICTs)**.



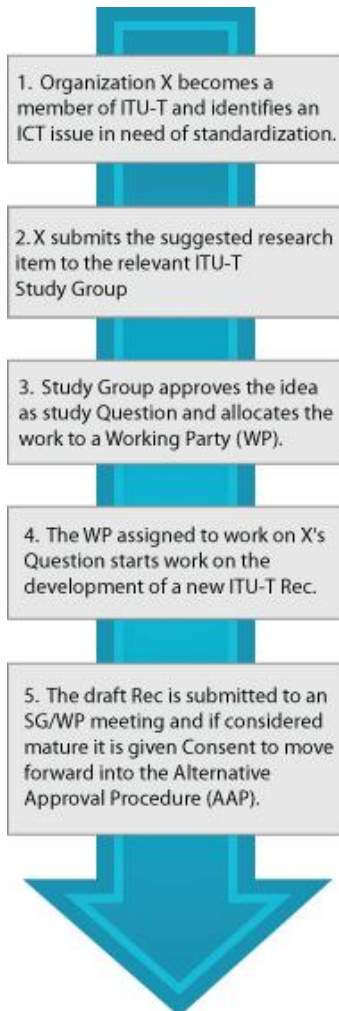
The screenshot shows the ITU website's Standardization Sector page. The header includes the ITU logo, the slogan "Committed to connecting the world", and a search bar. A navigation menu lists various ITU departments, with "Standardization" highlighted. The main content area features a "Study Group 17" announcement for a meeting on cybersecurity in Geneva, a "security" graphic, and a "News" section with articles on audio device standards, app security, and an international forum on transport systems. There are also sections for "ARTIFICIAL INTELLIGENCE" and "INTELLIGENT TRANSPORT" with corresponding images.

### ITU

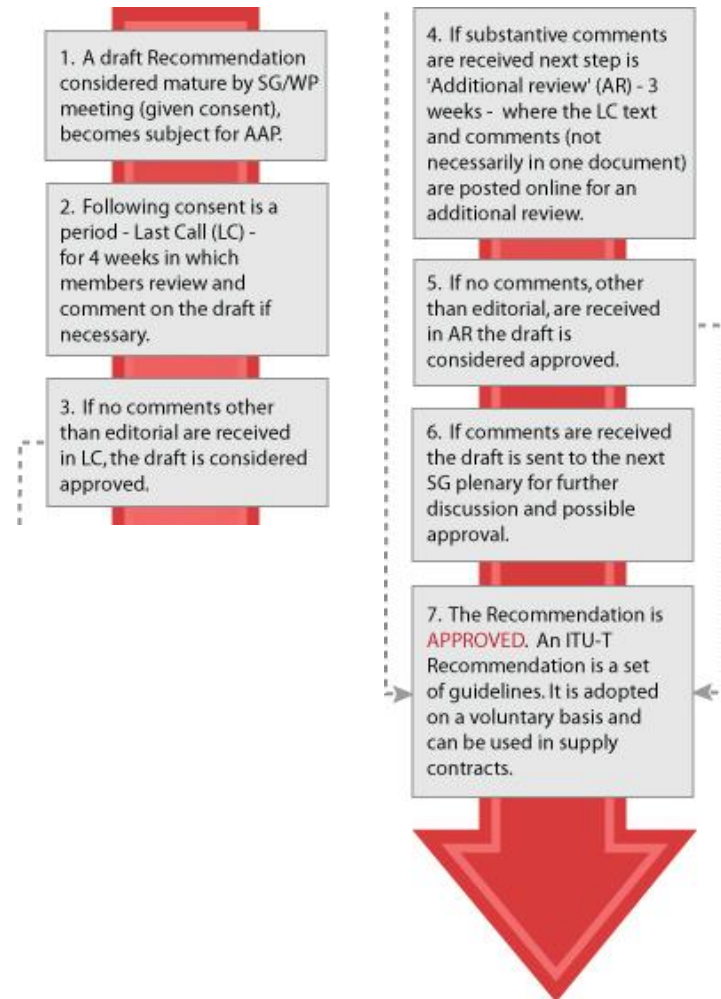
- ITU is the United Nations specialized agency for information and communication technologies – ICTs.
- Founded 1865~
- Member: 193 countries, 800 organizations

## ITU Standardization Procedure

### Standard Development Procedure



### Standard Approval Procedure



## ITU-T L-Series

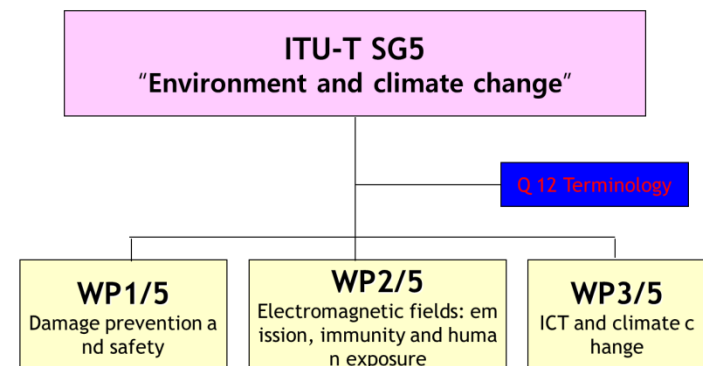
- Scope: Study **the safety and environmental performance associated with ICTs**, including the avoidance of hazardous materials and final disposal. Ensure that the ICTs cause minimum environmental and health impact. Minimize and mitigate the effect of e-waste
- Main Tasks: Motivate ITU members to share experiences and spread knowledge related to environmental sustainability aspects. Determine processes to **minimize the environmental impact**. Study solutions to mitigate e-waste. UCS/CPS, rare metals, battery, conflict material.....

ITU-T L-Series Recommendations: Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant

<b>L.100-L.199</b>	<b>Optical fibre cables</b>
L.100-L.124	Cable structure and characteristics
L.125-L.149	Cable evaluation
L.150-L.199	Guidance and installation technique
<b>L.200-L.299</b>	<b>Optical infrastructures</b>
L.200-L.249	Infrastructure including node elements (except cables)
L.250-L.299	General aspects and network design
<b>L.300-L.399</b>	<b>Maintenance and operation</b>
L.300-L.329	Optical fibre cable maintenance
L.330-L.349	Infrastructure maintenance
L.350-L.379	Operation support and infrastructure management
L.380-L.399	Disaster management
<b>L.400-L.429</b>	<b>Passive optical devices</b>
<b>L.430-L.449</b>	<b>Marinized terrestrial cables</b>
<b>L supplements</b>	<b>Supplements to ITU-T L-series Recommendations</b>

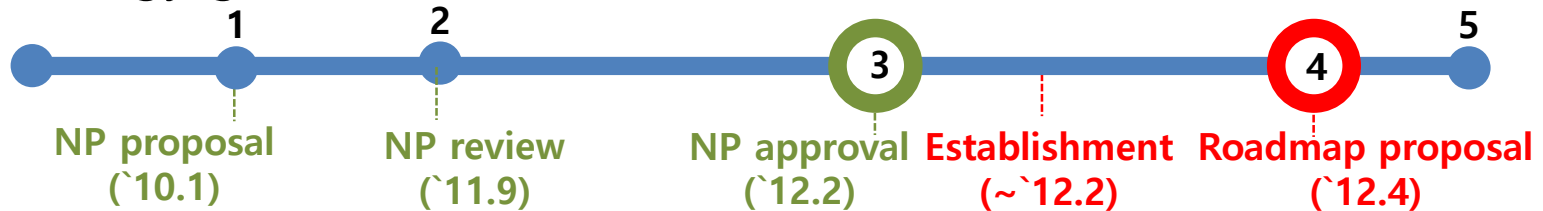
## 'SG5: Environment, climate change and circular economy' Environmental impact reduction including e-waste

Structure of ITU-T Study Group 5

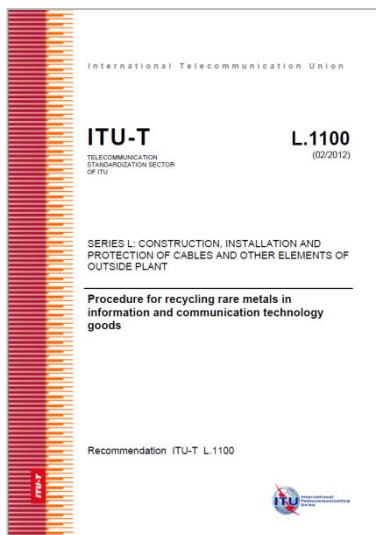


## ITU-T L.1100 Recommendations

- Procedure for recycling rare metals in information and communication technology goods(02/2012)



- “A method to provide recycling information of rare metals in ICT goods”
- Outlines key considerations in all phases of the recycling process, and provides guidelines as to how organizations may fairly and transparently report on rare metal recycling.



**Figure 2 – Typical rare metal application for ICT goods**

Each country has different industrial structures and security situations, and the definition of rare metals is not the same in each one. Some examples are listed in Appendix I. In order to have standardized information, ICT goods organizations should classify the common rare metals as shown in Table 1. Appendix II provides examples of communication formats for providing recycling information on the selected rare metals.

Group	Elements
Alkaline earth metal	Li, Ce, Be, Sr, Ba
Metals	Ge, Bi, Sn, Te
VII group	Co
Iron group	B, Ga, In, Tl, Cd
High fusion point metal	Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Re
Rare earth	La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Sc, Y
Platinum group	Ru, Rh, Pd, Os, Ir, Pt

As well as being rare, rare metals such as indium, yttrium, gallium and arsenic are widely used in ICT goods such as mobile phones, PCs, and display, touch-screen and LED lighting. For instance, a mobile phone includes more than 20 rare metals such as neodymium, titanium, barium, zirconium, niobium, gallium, indium and tantalum. Figures 3 and 4 show the rare metals commonly used in a cellular phone and an LCD.

Rec-ITU-T L.1100 (02/2012) 3

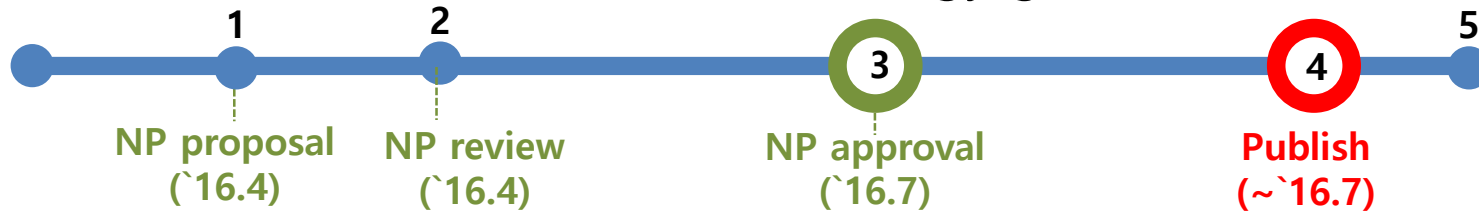
Recommendation ITU-T L.1100 provides information on the recycling procedures of rare metals in information and communication technology (ICT) goods. It also defines a communication format for providing recycling information of rare metals contained in ICT goods.



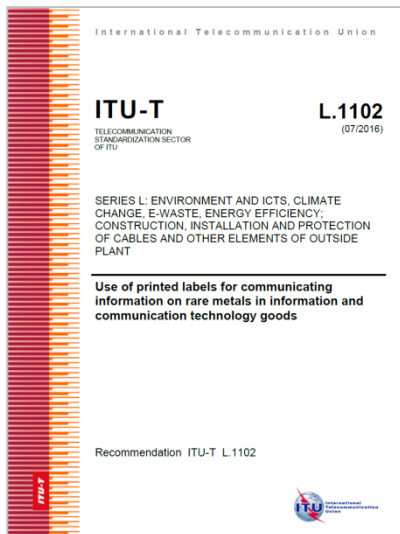


## ITU-T L.1102 Recommendations

- Use of printed labels for communicating information on rare metals in information and communication technology goods(07/2016)



- Recommendation ITU-T L.1102 describes printed label methods to provide information on rare metals contained in information and communication technology (ICT) goods, and includes requirements specified in Recommendations ITU-T L.1100 and ITU-T L.1101 on the disclosure of rare metals information to consumers and recyclers.



When the measured device includes 80 ppm of Li and 200 ppm of Be, the elements are required to be encoded as "Li:80 Be:200" which can be decoded as shown in Table 3.

Element	Quantity	Unit
Li	80	ppm
Be	200	ppb

Figure 1 provides an example QR code label which contains rare metals information.

Figure 1 – An example QR code containing information on rare metals

Figure 1 provides the following rare metals information after decoding the code image:

Manufacturer: ABC K2antennae  
 Model Name: Laptop 10  
 Model Number: DEF-123-00  
 Composition of Elements:

1. Alkali Earth: Ba:1.5w
2. Metalloid: Se:250w
3. Iron Group: None
4. Boron Group: None
5. High Fusion Point Metal: Ti:0.3w Cr:1.075w Mo:17.0w
6. Rare Earth: None
7. Platinum Group: Rh:1.0w Pd:1.5w

8. Others: Be:25.5w Cd:1.0w In:1.3w Ni:5w Pb:1w Sn:4.15w Zn:1.6w Al:7.4w Pt:7.0w Bi:1.5w Rb:1.4w Ag:1.05w Au:70w Cu:23.0w Hf:1.04w

This rare metals information can be interpreted as in Table 4 with reference to Table II.7 in Appendix II of [ITU-T L.1100].

Rev. ITU-T L.1102 (07/2016)

Table 4 – Composition of rare metals by interpretation and reference to Appendix II of [ITU-T L.1100]

Element	Composition (ppm)
Be	29 500
Cl	1 490
Ge	< 290 000
K	< 90 000
Pb	10 000
Sb	4 150
Zn	14 160
Al	47 400
Ba	6 140
Cr	1 075
Fe	76 800
Mn	17 800
Na	1 580
Si	91 400
Ti	< 10 300
Ag	1 053
Au	70
Cu	29 800
Ni	2 040
Pd	< 1 500
Rh	< 1 600
Sr	16 300

7.2 Communication process for printed labels providing information on rare metals in ICT goods

The ICT goods manufacturing industries may choose to follow the process of communication of printed labels providing information on rare metals in ICT goods, as shown in Figure 2. In this case, the recycling industry could obtain more reliable and specific information on the rare metals to be recycled. This information is very useful selecting appropriate recycling methods.

## ASTAP: APT(Asia Pacific Telecommunity) Standardization Program

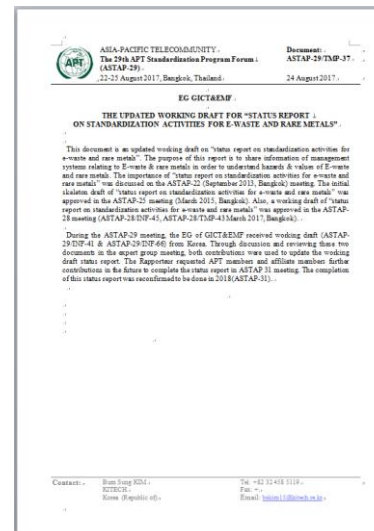
- Status report on standardization activities for e-waste and rare metals (ASTAP Status Report)



- Supplying the standard information (ex. materials flow) & roadmap of rare earth to prevent environmental harmfulness and securing resources.

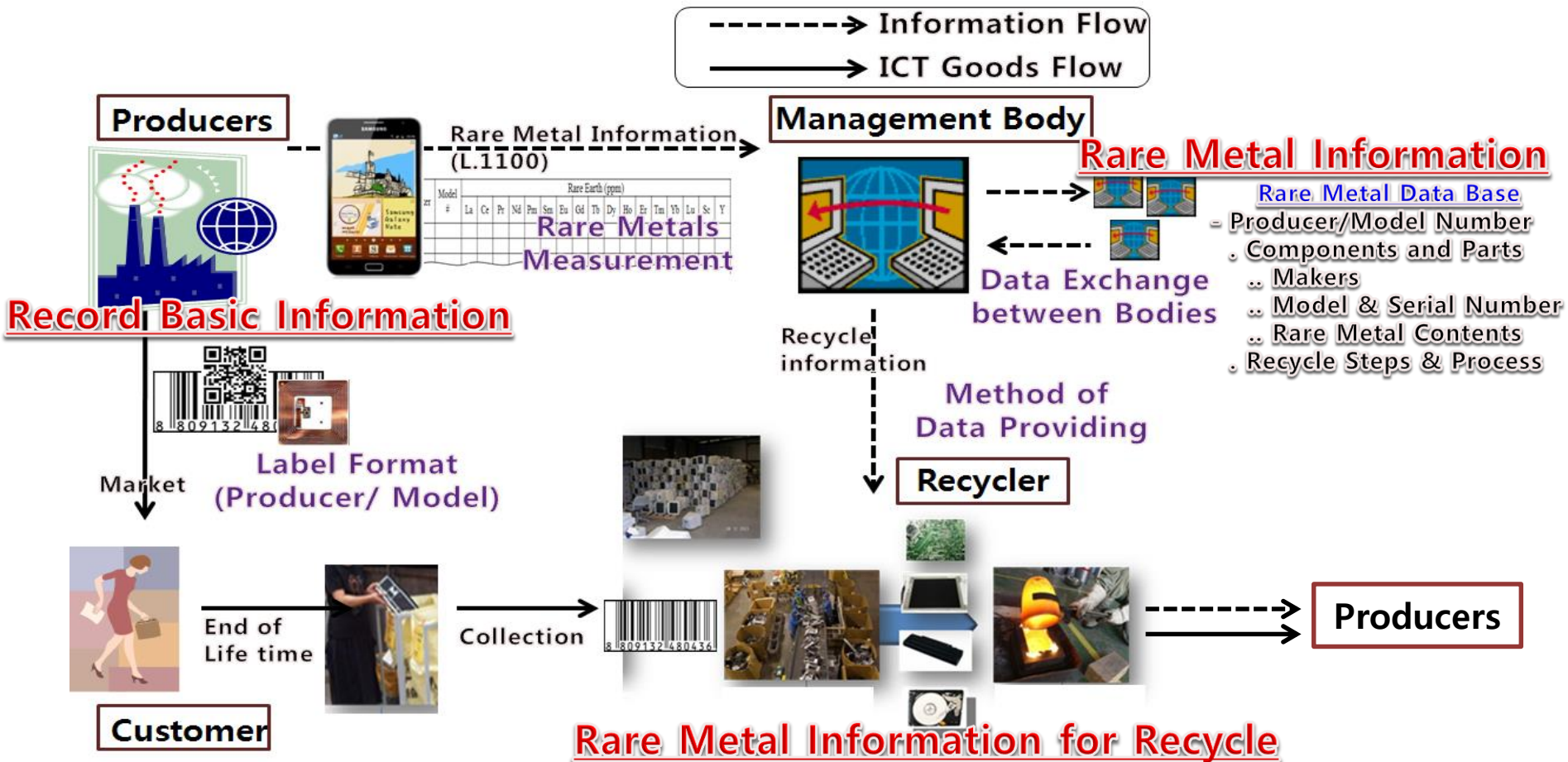
### AST

- Founded 1979~
- Member: 42 countries, 130 organizations



## Example of circular economy through standardization

- Supply **accurate & proper information** of EoL products for the alternative resources & efficient, safe and environmental friendly recycling



## Standardization $\neq$ Regulation

- Cost and efficiency for materialization of recycled rare metals to the alternative resources.
- Value or purity of alternative resource comparing to virgin materials.
- Quality control of product or limitation of content by using alternative resources.
- Incentive to company or organization who followed standardization of rare metals for the recycling.

Selection of optimized assessments (process, procedure etc.) as the kinds and amounts of rare metals in the EoL products by A. I. (Artificial Intelligence)

⇒ Need unifiedly formatted D. B. (or big data) through standardization.

Thank you for your  
kind attention

Special thanks to Dr. Bum-Sung Kim and Dr.  
Taek-Soo Kim at KITECH.