Japan's Reporting on Carbon Capture and Storage

28 June 2023
20th Workshop on GHG Inventories in Asia (WGIA20)

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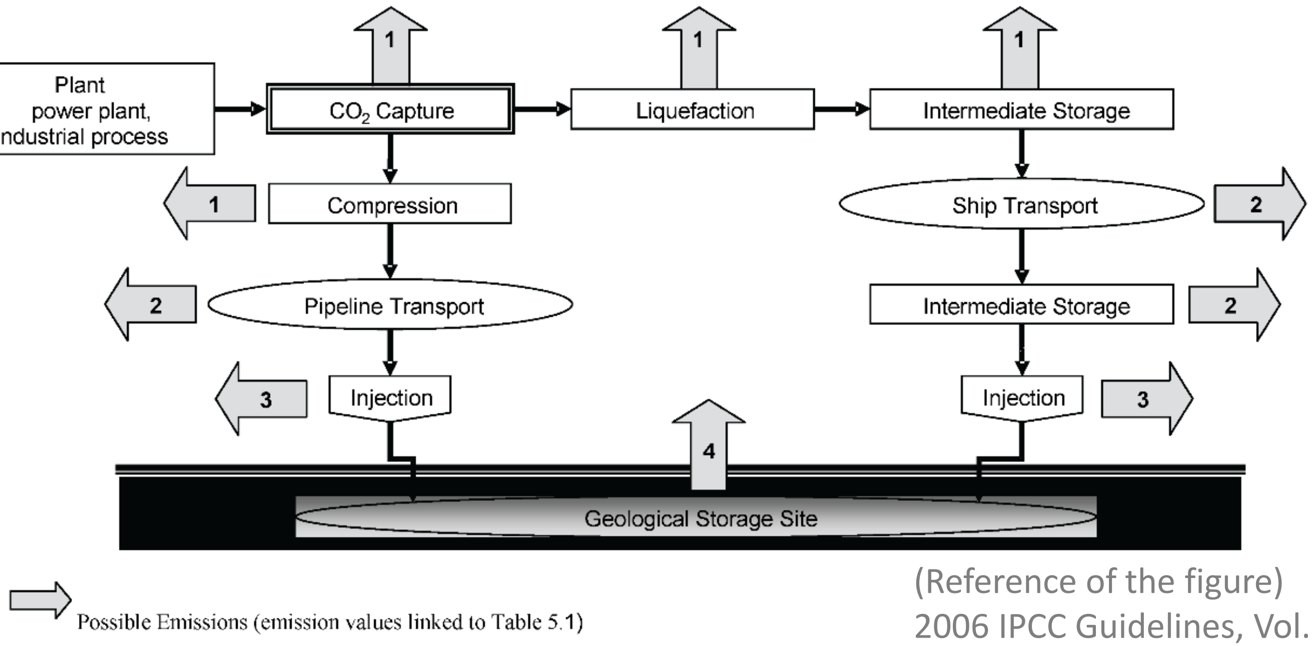
PART 1 INTRODUCTION

Overview of CCS

Figure 5.1 **Schematic representation of the carbon capture and storage process with numbering linked to systems discussion above.**



(Reference of the figure)
2006 IPCC Guidelines, Vol.2

	System	Reporting category	Data needed to report
1	Capture and compression system	Category where capture takes place	Captured amount & fugitive emissions
2	Transport system	1.C.1. Transport of CO_2	Fugitive emissions
3	Injection system	1.C.2.a. Injection	Fugitive emissions
4	Storage system	1.C.2.b. Storage	Fugitive emissions

Information needed to report CCS in the GHG inventory

- Under which category does carbon capture take place?
- How much is the amount captured?
- From which category do fugitive emissions occur?
  - CO_2 transport (pipelines, ships, etc.), injection and storage.
- How much is the amount of fugitive emissions?

Global reporting status of CCS

- It is found that currently 4 countries* report CO_2 injected at storage sites in their national GHG inventory.
  - Australia
  - Canada
  - Japan
  - Norway
- CCS is an emerging technology, and it seems that not much experience is gained globally regarding reporting CCS in the GHG inventory.

* Reference: GHG Data Interface (GHG-DI; https://di.unfccc.int)

(Note)

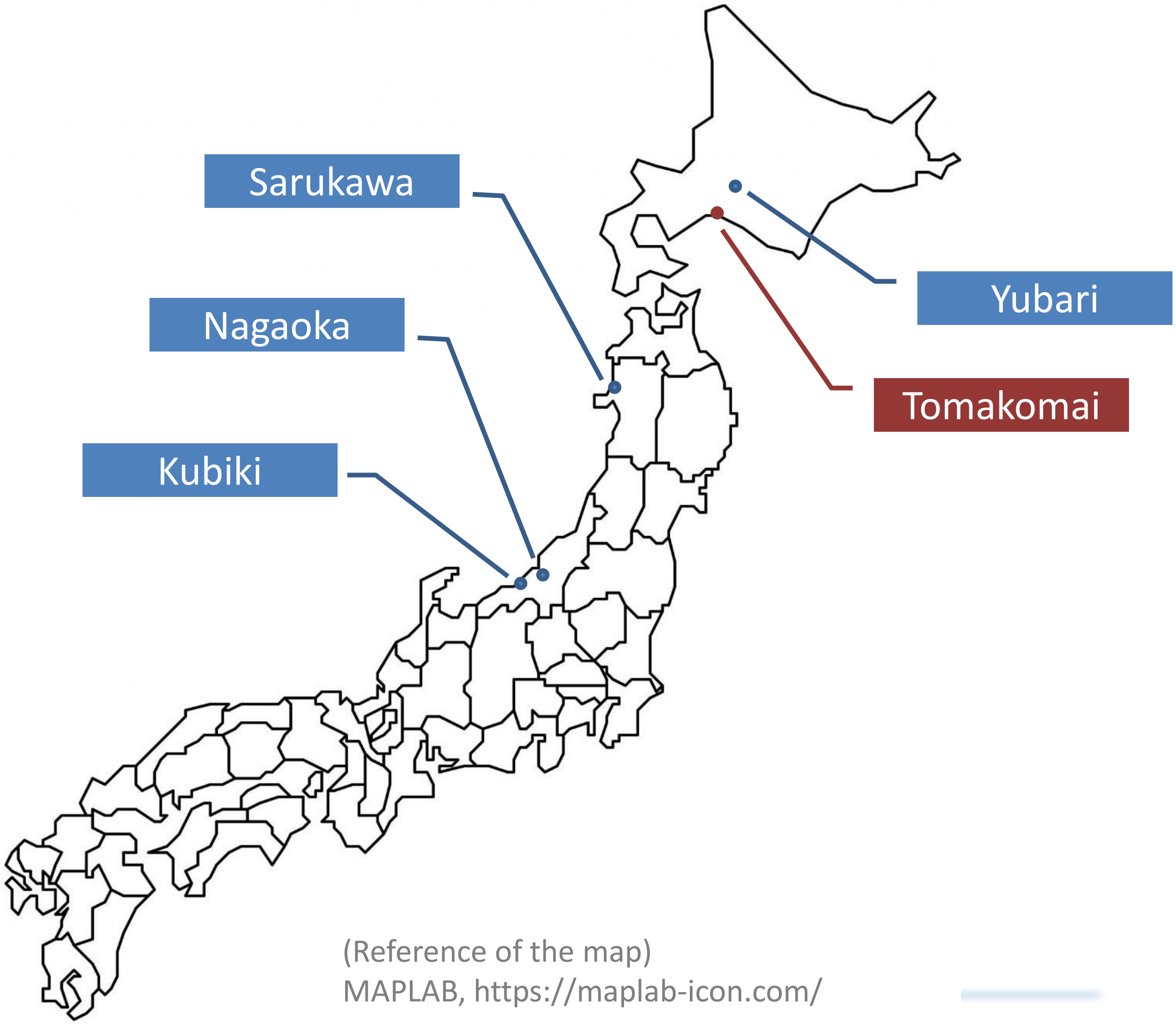
- Finland reports CCU (precipitated calcium carbonate made from CO_2 from fuel combustion).
- The reporting status of CCS from non-Annex I Parties is not known because such data are not obtained from GHG-DI, which summarizes data using tables in Decision 17/CP.8.

PART 2 JAPAN'S CURRENT REPORTING STATUS ON CCS

Japan's past CCS projects

Injection site	Period of injection	Purpose
Kubiki, Niigata	Mar 1991 – Jun 1993	Enhanced oil recovery
Sarukawa, Akita	Sep 1997 – Sep 1999	Enhanced oil recovery
Nagaoka, Niigata	Jul 2003 – Jan 2005	Demonstration of geological storage of CO_2
Yubari, Hokkaido	Nov 2004 – Oct 2007	Enhanced coal bed methane recovery
Tomakomai, Hokkaido	Apr 2016 – Nov 2019	Demonstration of geological storage of CO_2

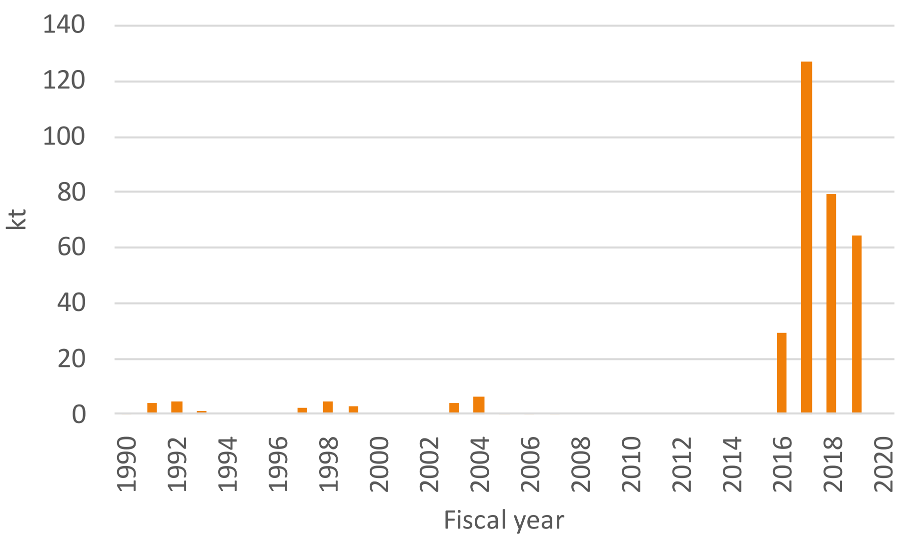
5 CCS projects in Japan



(Reference of the map)
MAPLAB, https://maplab-icon.com/

Reporting status of CCS in Japan's GHG inventory: subtractions

- CO_2 injected amount is subtracted from Petroleum Refining (1.A.1.b) or Ammonia Production (2.B.1).
- Captured amount is assumed to be the same as injected amount.



Total amount of CO_2 injected at storage sites

Reporting status of CCS in Japan's GHG inventory: subtractions

The case where the origin of CO_2 is the Energy sector.

TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY
Fuel combustion activities - sectoral approach
(Sheet 1 of 4)

Inventory 2019
Submission 2023 v4
JAPAN

GREENHOUSE GAS SOURCE A	AGGREGATE ACTIVITY DATA		IMPLIED EMISSION FACTORS			EMISSIONS			
	Consumption		CO_2[1]	CH_4	N_2O	CO_2[2]	CH_4	N_2O	CO_2 Amount captured
	(TJ)	NCV/GCV[3]	(t/TJ)	(kg/TJ)		(kt)			
1.A. Fuel combustion	15721381.29	GCV				1047370.79	49.73	19.21	64.51
Liquid fuels	5635900.76	GCV	67.59	2.16	1.37	380867.68	12.17	7.72	64.51
Solid fuels	4723339.19	GCV	90.13	3.07	1.68	425704.07	14.51	7.94	NO
Gaseous fuels	4341035.93	GCV	51.01	3.36	0.47	221418.50	14.60	2.06	NO
Other fossil fuels[4]	509602.81	GCV	38.03	0.91	2.10	19380.55	0.47	1.07	NO
Peat[5]	NO,IE	GCV	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO
Biomass[6]	511502.60	GCV	128.88	15.61	0.81		7.98	0.42	NO

Captured amount is reported here.

Reporting status of CCS in Japan's GHG inventory: subtractions

The case where the origin of CO_2 is the IPPU sector.

TABLE 2(I).A-H SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES AND PRODUCT USE Inventory 2004

Emissions of CO_2, CH_4 and N_2O Submission 2023 v4

(Sheet 1 of 2) JAPAN

GREENHOUSE GAS SOURCE SINK CATEGORIES	ACTIVITY DATA		IMPLIED EMISSION FACTORS[2]			EMISSIONS					
	Production/Consumption quantity		CO_2	CH_4	N_2O	CO_2		CH_4		N_2O	
						Emissions[3]	Recovery[4]	Emissions[3]	Recovery[4]	Emissions[3]	Recovery[4]
	Description[1]	(kt)	(t/t)			(kt)					
A. Mineral industry						39745.12	NE				
1. Cement production	Production of clinker	61202.00	0.51			31276.19	NE				
2. Lime production	Consumption of limestone	14950.20	0.43			6398.69	NE				
3. Glass production	olomite, and soda ash, etc	601988.29	0.00			259.84	NE				
4. Other process uses of car						1810.41	NE				
a. Ceramics	of limestone and dolomite	1508.12	0.46			700.02	NE				
b. Other uses of so	Use of soda ash	195.82	0.41			81.07	NE				
c. Non-metallurgic		NE	IE,NE			IE	NE				
d. Other	of limestone and dolomite	2336.66	0.44			1029.32	NE				
B. Chemical industry						5820.75	92.72	1.34	0.02	10.27	NA,NE
1. Ammonia production[5]	Production of ammonia	1352.47	0.24	NE	NA	314.13	6.43	NE	NE	NA	NA

Captured amount is reported here.

Reporting status of CCS in Japan's GHG inventory: emissions

- CO_2 Transport and Storage (1.C.) category includes the CO_2 emissions associated with the CCS.
- Japan reports the emissions as the notation keys (NO, NE or NA).

Definition of the notation keys

- “NO” (not occurring) for categories or processes, including recovery, under a particular source or sink category that **do not occur** within an Annex I Party;
- “NE” (not estimated) for AD and/or **emissions** by sources and removals by sinks of GHGs **which have not been estimated but for which a corresponding activity may occur** within a Party. ...
  Furthermore, a Party may consider that a **disproportionate amount of effort would be required to collect data** for a gas from a specific category that would be **insignificant** in terms of the overall level and trend in national emissions and in such cases **use** the notation key “**NE**”. ... An emission should only be considered insignificant if the likely level of emissions is **below 0.05 per cent of the national total GHG emissions**, and does not exceed 500 kt CO_2 eq. ... Parties should use approximated AD and default IPCC EFs to derive a likely level of emissions for the respective category. ...;
- “NA” (not applicable) for **activities** under a given source/sink category that **do occur** within the Party **but do not result in emissions or removals** of a specific gas. ...

(Reference) Decision 24/CP.19, Annex I, paragraph 37

(Note) 0.05% of the national total is about 0.6 Mt-CO_2 eq. for Japan.

Reporting status of CCS in Japan’s GHG inventory: emissions

- Transport of CO_2 (1.C.1.)
  - Pipelines (1.C.1.a.)
    - “NA” for Tomakomai site where the airtightness is assured.
    - Insignificant “NE” for the other sites, because the likely level of emissions are less than 3 kt-CO_2
  - Ships (1.C.1.b.)
    - “NO” because ships were not used.
  - Other (1.C.1.c.)
    - “NO” for Tomakomai site, because there were no related activities.
    - Insignificant “NE” for the other sites, because the emissions from liquefied CO_2 transport do not occur basically or the amount is quite small even if the emissions occur.

(Note) 3 kt is a criterion to include the emissions in the national totals established by the Committee for the Greenhouse Gases Emissions Estimation Methods in FY2012.

Reporting status of CCS in Japan's GHG inventory: emissions

- Injection and Storage (1.C.2.)
  - Injection (1.C.2.a.)
    - "NA" for Tomakomai site where the airtightness is assured.
    - Insignificant "NE" for the other sites, because the likely level of emissions are less than 3 kt-CO_2
  - Storage (1.C.2.b.)
    - Insignificant "NE" for all reporting years, because the likely level of emissions are less than 3 kt-CO_2
- Other (1.C.3.)
    - "NO" for all reporting years.

Reporting status of CCS in Japan's GHG inventory: emissions

TABLE 1.C SECTORAL BACKGROUND DATA FOR ENERGY — Inventory 2019

CO_2 Transport and storage — Submission 2023 v4

(Sheet 1 of 1) — JAPAN

Notation keys are reported for fugitive emissions.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA	IMPLIED EMISSION FACTORS	EMISSIONS
	CO_2 transported or injected(1)	CO_2	CO_2(2)
	(kt)	(kg/kt)	(kt)
1. Transport of CO_2	64.51	NO,NA	NO,NA
a. Pipelines	64.51	NA	NA
b. Ships	NO	NO	NO
c. Other	NO	NO	NO
2. Injection and storage(3)	129.02	NE,NA	NE,NA
a. Injection	64.51	NA	NA
b. Storage	64.51	NE	NE
3. Other	NO	NO	NO
Information item(4, 5)			
Total amount captured for storage			64.51
Total amount of imports for storage			NO
Total A			64.51
Total amount of exports for storage			NO
Total amount of CO_2 injected at storage sites			64.51
Total leakage from transport, injection and storage			NE
Total B			64.51
Difference (A-B) (6)			0.00

Injection amount is reported here for reference (information item).

Data source

- There are no official statistics.
- Literature survey and interview to the entities of the projects are used.

PART 3 POSSIBLE ISSUES

Impact on the comparison between RA and SA due to CCS

- CCS makes the comparison between the Reference Approach (RA) and the Sectoral Approach (SA) complicated.
- There are two methodologies to estimate the CO_2 emissions from Fuel Combustion category (1.A.):
  - RA: Top-down approach, using a country’s energy **supply** data
  - SA: Bottom-up approach, using a country’s energy **consumption** data for each category

Impact on the comparison between RA and SA due to CCS: RA

RA calculation formula is as follows:
(2006 IPCC Guidelines, Vol.2, Ch.6)

EQUATION 6.1
CO_2 EMISSIONS FROM FUEL COMBUSTION USING THE REFERENCE APPROACH

$$CO_2\ Emissions = \sum_{all\ fuels}\left[\begin{array}{l}((Apparent\ Consumption_{fuel} \bullet Conv\ Factor_{fuel} \bullet CC_{fuel}) \bullet 10^{-3} \\ - Excluded\ Carbon_{fuel}) \bullet COF_{fuel} \bullet 44/12\end{array}\right]$$

Where:

CO_2 Emissions	= CO_2 emissions (Gg CO_2)
Apparent Consumption	= production + imports – exports – international bunkers - stock change
Conv Factor (conversion factor)	= conversion factor for the fuel to energy units (TJ) on a net calorific value basis
CC	= carbon content (tonne C/TJ) Note that tonne C/TJ is identical to kg C/GJ
Excluded Carbon	=carbon in feedstocks and non-energy use excluded from fuel combustion emissions (Gg C)

"Excluded Carbon" does not include captured amounts.
It means captured amount is not subtracted under RA calculation.

Impact on the comparison between RA and SA due to CCS: SA

SA calculation formula is as follows:
(2006 IPCC Guidelines, Vol.2, Ch.2)

EQUATION 2.7
TREATMENT OF CO_2 CAPTURE

$$Emissions_s = \mathrm{Pr}oduction_s \boxed{- Capture_s}$$

Where:

s = source category or subcategory where capture takes place

Captures = Amount captured.

Productions = Estimated emissions, using these guidelines assuming no capture

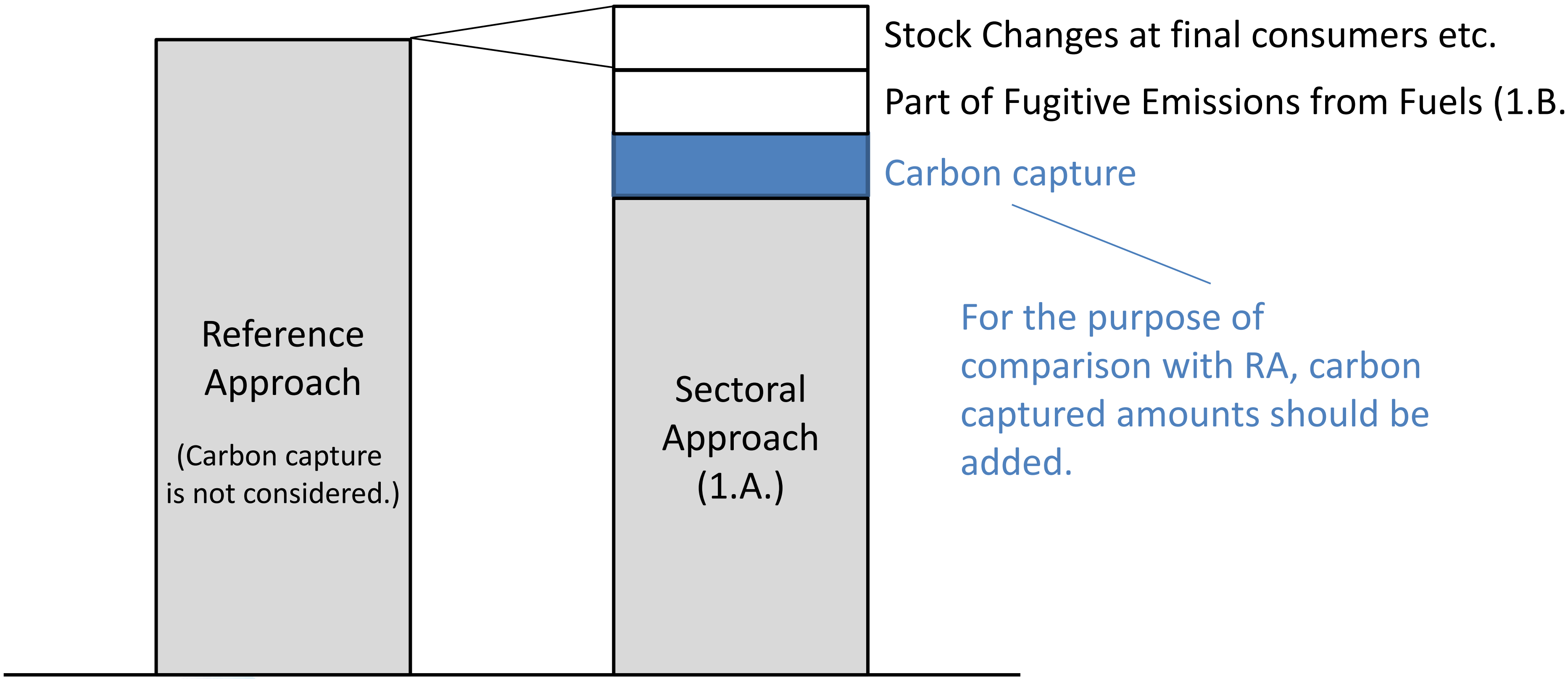
$Emissions_s$ = Reported emission for the source category or sub-category

Captured amount is subtracted under SA calculation.

Impact on the comparison between RA and SA due to CCS

- Intuitively, SA becomes lower than RA due to the introduction of CCS.
- However, according to the 2006 IPCC Guidelines (Vol. 2, page 6.11), RA results should be compared with SA emissions before carbon captured amounts are subtracted out.

Impact on the comparison between RA and SA due to CCS



This figure is drawn by the presenter based on the 2006 IPCC Guidelines, Vol.2, Figure 6.1.

Impact on the comparison between RA and SA due to CCS : CRTs

TABLE 1.A(c) COMPARISON OF CO_2 EMISSIONS FROM FUEL COMBUSTION Year
Comparison of CO_2 emissions from fuel combustion Submission
(Sheet 1 of 1) Country

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FUEL TYPES	REFERENCE APPROACH			SECTORAL APPROACH [1]		DIFFERENCE [2]	
	Apparent energy consumption [3] (PJ)	Apparent energy consumption (excluding non-energy use, reductants and feedstocks) [4] (PJ)	CO_2 emissions (kt)	Energy consumption (PJ)	CO_2 emissions [5] (kt)	Energy consumption (%)	CO_2 emissions [6] (%)
Liquid fuels (excluding international bunkers)							
Solid fuels (excluding international bunkers)							
Gaseous fuels							
Other fossil fuels							
Peat							
Total							

(1) "Sectoral approach" is used to indicate the approach (if different from the reference approach) used by the Party to estimate CO_2 emissions from fuel combustion, as reported in tables 1.A(a)s1-1.A(a)s4.
(2) The difference in CO_2 emissions estimated using the reference approach and those estimated using the sectoral approach (difference = 100 per cent x ((RA-SA)/SA)). For calculating the difference in energy consumption between the two approaches, data as reported in the column "Apparent energy consumption (excluding non-energy use, reductants and feedstocks)" are used for the reference approach.
(3) Apparent energy consumption data shown in this column are as in table 1.A(b).
(4) For the purposes of comparing apparent energy consumption in the reference approach with energy consumption in the sectoral approach, data in this column come from table 1.A(d).

(5) For the sectoral approach, gross emissions (without accounting for CO_2 captured) are included in the comparison.

The Common Reporting Tables (CRTs), Table 1.A(c), Footnote 5 is based on the description in the 2006 IPCC Guidelines explained in the previous slides.

Reporting issue of CO_2 capture in the CRF Reporter

- In FY2004, 6.46 kt CO_2 is captured in Japan (0.04 kt in the Energy sector and 6.43 kt in the IPPU sector).
- 'CO_2 captured' in table 10, summary 1.A and summary 2 of the current CRF don't always represent all of the capture that occurred in Japan, because the above tables generated by the CRF Reporter don't consider CO_2 capture from the IPPU sector.
- It is unknown how the CRT reporting tool will work.

CRF Table	**Item**	**Value (FY2004)**	**Remarks**
Table 1	CO_2 captured	0.04	Independent variable
Table 1.A(a)	1.A. Fuel combustion; CO_2 amount captured	0.04	Independent variable
Table 10, Summary 1.A, Summary 2	CO_2 captured	0.04 (not 6.46)	Automatically filled from Table 1.A(a)
Table 2(I).A-H	2.B.1. Ammonia production; CO_2 recovery	6.43	Independent variable
Table 1.C	Total amount captured for storage	6.46	Independent variable

Other issues of reporting

- If the source of captured CO_2 is unknown, it is difficult to subtract the captured amount.
  - According to the 2006 IPCC Guidelines (Vol.2, Equation 2.7), the amount captured should be subtracted from the category where the capture takes place.
  - However, if carbonated gas is purchased and stored underground, it may be difficult to identify the origin of the carbonated gas.
- In case of small-scale experiments, use of less reliable data tends to be unavoidable.

Summary

- 5 CCS projects are reflected in the Japan's National GHG Inventory (JNGI).
  - The captured amount is subtracted from the CO_2 origin: Fuel Combustion (1.A.) and Chemical Industry (2.B.) categories.
  - The fugitive emissions from CCS are reported using the notation keys (NO, NE, NA).
- There may be some issues to note when reporting CCS in the GHG inventory.
  - RA results should be compared with SA emissions before carbon captured amounts are subtracted out.
  - Some tables generated by the CRF Reporter do not reflect CO_2 captured in the IPPU sector. (It is unknown how the CRT reporting tool will work.)
  - In case that the source of CO_2 is unknown, it is difficult to identify which category the amount should be subtracted from.