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State of Cover gas Use and Implementation of Alternatives :

"SF6 Gas Reduction, Alternatives and Process Improvement in the Japan Mg Industry"

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Plan and way to SF6 gas reduction (1)

EU : Regulation

Mg Die-casting	Entry into force: 4 July, 2006
Mg die-casting if SF6 gas use > 850 kg * per year	Date of SF6 use Ban: January/1 2008

* its volume might be revised

USA : Voluntary partnership

Voluntary partnership between US-EPA and Mg Industry 14 companies (Mg melting and casting)	Support by IMA
Partnership's Goal	Eliminate of SF6 emission : December/31 2010

Japan : Voluntary restriction goal announced in June 2007

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Plan and way to SF6 gas reduction (2)

Japan : **Voluntary restriction goal** announcement

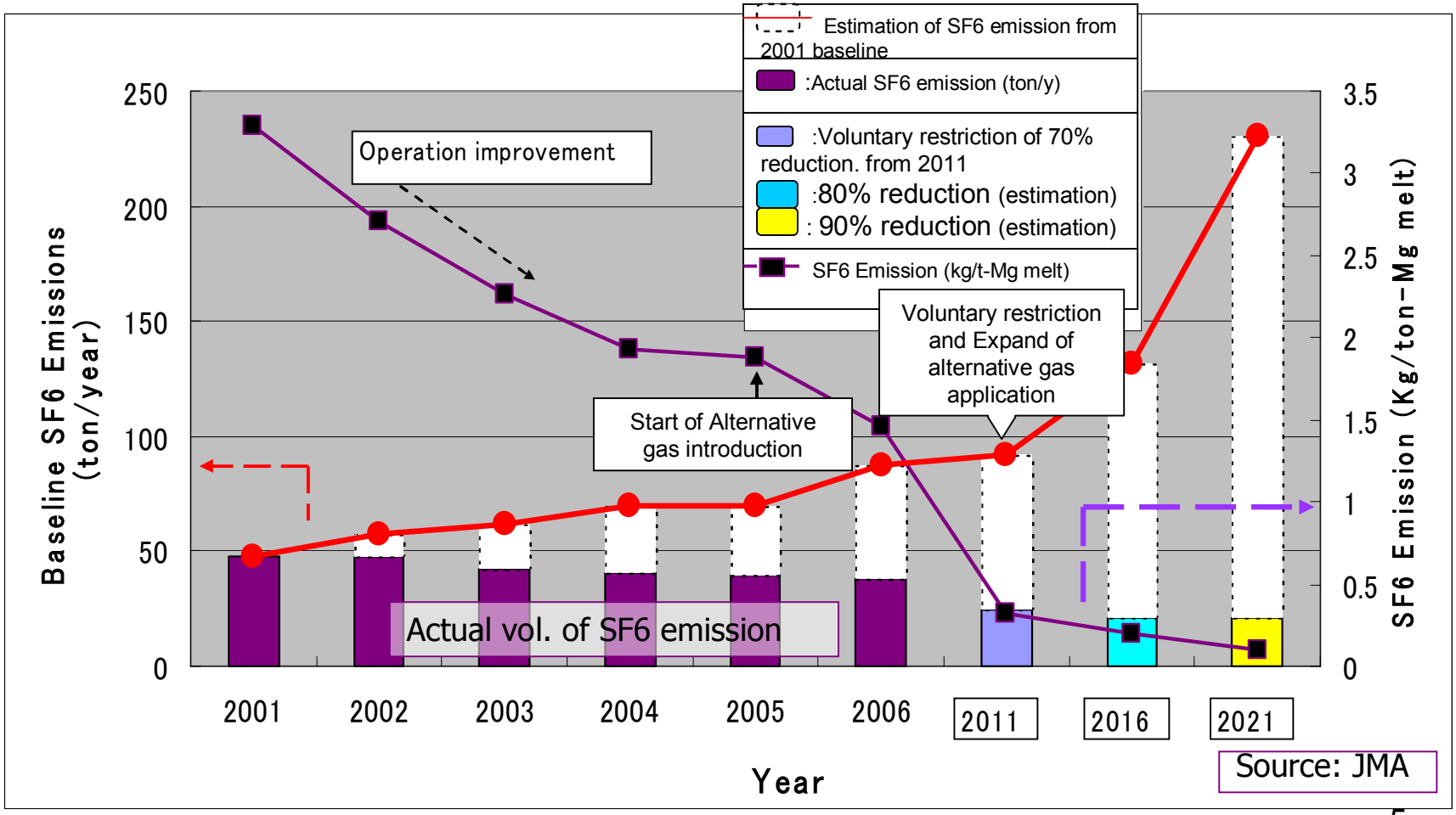
Voluntary restriction goal	JMA announcement (June 8,2007)
Mg Industry if SF6 use in plant above 500 kg/ year	Eliminate of SF6 emission : December/31 2010
JMA member(133, relating with magnesium industry)	44 casting company such as die-cast, cast (sand etc.) and recycle/alloy job
No signature of this voluntary action plan between JMA or METI and each company	JMA: in charge of Promotion for action plan in Environment/Climate protection in Mg industry with active cooperation to Government
METI/NEDO :R & D Project (Development of Technology to Synthesize Energy-saving CFC Substitutes)	Alternative gas project in Mg (Nagaoka University of Tech. , Chiba Institute of Tech., Central Glass Co., Ltd, Toso F-Tech Inc, Ahlesty Corporation, Tosei Ltd , JMA/JAA)
METI/NEDO : Promotion program (Financial support for Introduction and Practical Adoption of Emission Control Equipment and Facilities, or Technology etc)	Continuing Financial Support of Equipment introduction on the F.Y. 2008, max.2/3 -1/3 depend on GHG reduction effect,. (Total amount 3.1 bill. JY for 3 furon gas redn.)

Stream of SF6 emission from year 2001~ 2006~ 2021 in Japan

➢Estimation of CO2 reduction: about 2 million ton/Year 2021 on baseline 2001

Countermeasure for GWG Emission Reduction

✓Continuous improvement of operation process and equipment etc.
✓Voluntary restriction activity
✓Introduction of alternative gas



Trial and Study of Alternative Gas in Japan

Cover gas	Chemical formula	Life (years)	GWP_{100}	Remarks	
Normal cover gas used in Japan					
SF_6	—	3200	22200	B.P(sub.pt.) -64℃, M.P -51℃, M.Wt.(146) : Best protect. perform.	
SO_2	—	2-3 day	≒0	Poisonous for men(<2ppm)	
1st stage trial or Introduction of New protective cover gas in Japan					
HFC-134a (AM cover gas)	CH_2FCF_3	14	1300	B.P -10℃; MP -27℃,M.wt.(102) Refrigerant: Kyoto Protocol reduction obligatio	AMT (Fuji Shokai)
NOVEC612 (MG-Shield gas, FK)	$C_3F_7C(O)C_2F_5$	0.014 (5 day)	≒1	B.P 49 ℃(Liquid at room temp)	Taiyo Nissan Corp.
New trial target : protective cover gas in Japan				NEDO's proj. gas	
1234ze (Trans-1,3,3,3 tetra-fluoropropene)	$CF_3CH=CHF$	0.055 (20 day)	9	B.P -19℃; Mol. Wt. (114) AMES test: (-)	Central Glass Co.
CF_3I (Tri-fluoro Iodide methan)	CF_3I	0.005 (2 day)	1.2	B .P -22℃; Mol. Wt. (196) AMES test: (+ ?)	Toso F-Tech Inc

Progress of Introduction of FK gas system at Tokai Rika

• Oct/2005 ; Start "MG-Shield" gas system Introduction in one model line

•FY 2007 ; All D.C. machine (hot 13 & cold 2) be introduced and equipped

Overseas Plant : start on 2008

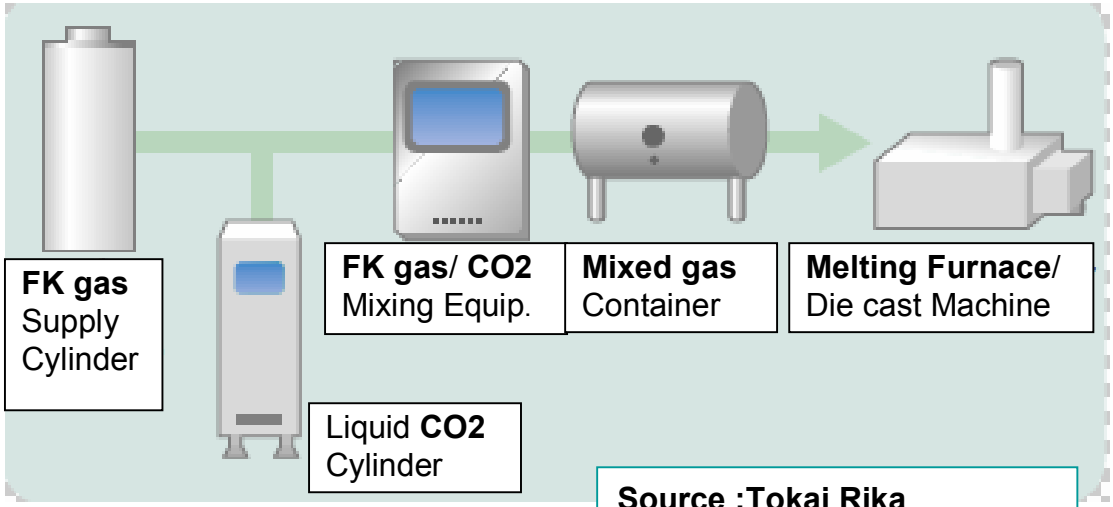
✓ Expectation of GHG Reduction at Otowa plant is 51,800t-CO2 on Fiscal year 2007

✧ NEDO's Financial Support Program in 2005

FK gas and CO2 gas mixing system

Property of Cover Gas for Mg melt

Property	SF6	FK gas (MG-Shield gas)
GWP	23,900	1
Gas life (year)	3,200	0.014 (3-5 days)
Gas consumption (t/year)	2.25 (actual in year 2004)	0.3 (prospect in year 2007)
CO2 equivalent (t/year)	52,000	200



FK gas supplying system

Source :Tokai Rika Environment and Social report 2006 ,2007

Organization for SF_6 Alternative Gas Program

JMA (Japan Magnesium Association)
151 Members : including 44 members of Die cast, Casting (sand etc.) and Recycle/Smelting

METI (Ministry of Economy, Trading and Industry)

NEDO (New Energy and Industrial Technology Development Organization)

Environment Committee

NEDO's project: Research and development of new alternative cover gas for Mg melt(2005 – 2006)

- Trend survey of SF6 gas reduction and alternative gas study in Mg industry at domestic & overseas
- Follow-up the gas study **(JMA)**

- Thermodynamic study of Mg/cover gas reaction etc.
- Effect of environment condition (humidity etc.) on the melt ignition property (**Chiba Inst. Tech**)

- Study of the new four cover gases on the Mg alloy melt protn. performance , exhaust gas etc.,
- Effect of carrier gas on the melt ignition property (**Nagaoka University of Tech)**

- Practical application test of new alternative gases at C.C. and H.C. Mg die casting shop: (**•Ahlesty Corporation**
- **•Tosei Co., Ltd**)

- New Cover Gas Supplier and Developer**:**

(• **Central Glass Co.,Ltd.**

• **TOSO F-Tech Inc.**)

New cover gas development in Japan

NEDO's PRESS RELEASE March 26, 2007

:As a part of NEDO's Project (Development of Technology to Synthesize Energy-saving CFC Substitutes)

- **New Energy and Industrial Technology Development Organization (NEDO) :**
  - **Developed Two New cover gases for magnesium melt and**
  - **Practical application at die cast is in sight.**

- **Near equal fire-proof gas as SF6 and GWP of less than 1/1000 that of SF6:**
  - **1234ze(*1) (Trans-1,3,3,3-tetrafluoropropene): GWP=9 *2)**
  - **CF3I (Tri-fluoro iodide methane): GWP 1.2**

- **Collaborating organizations in this project:**
  - Central Glass Co., Ltd
  - TOSO F-Tech Inc.
  - Nagaoka Univ. of Technology
  - The Japan Magnesium Association

(*1): Revised by Company
*2) Data from Central Glass Co.Ltd.,

http://www.nedo.go.jp/english/190326/190326.html

Introduction of alternative gas system
=General consideration or judging points=

☑ Chemical and physical property

1. Low GWP
* Total GHG reduction of Cover gas plus Carrier gas

2. Protective performance (compared to SF6 gas)
* Satisfactory level with SF6 gas
* Applicability at higher temperature casting alloys

3. Safety: Hazard to Health of original gas/ Emission gas/ decomposed gas etc.,
* Chemical stability at casting temperature

4. Corrosion : gas cylinder, transfer tube, pot, and equipment etc.,

☑ Economical and Procurement:

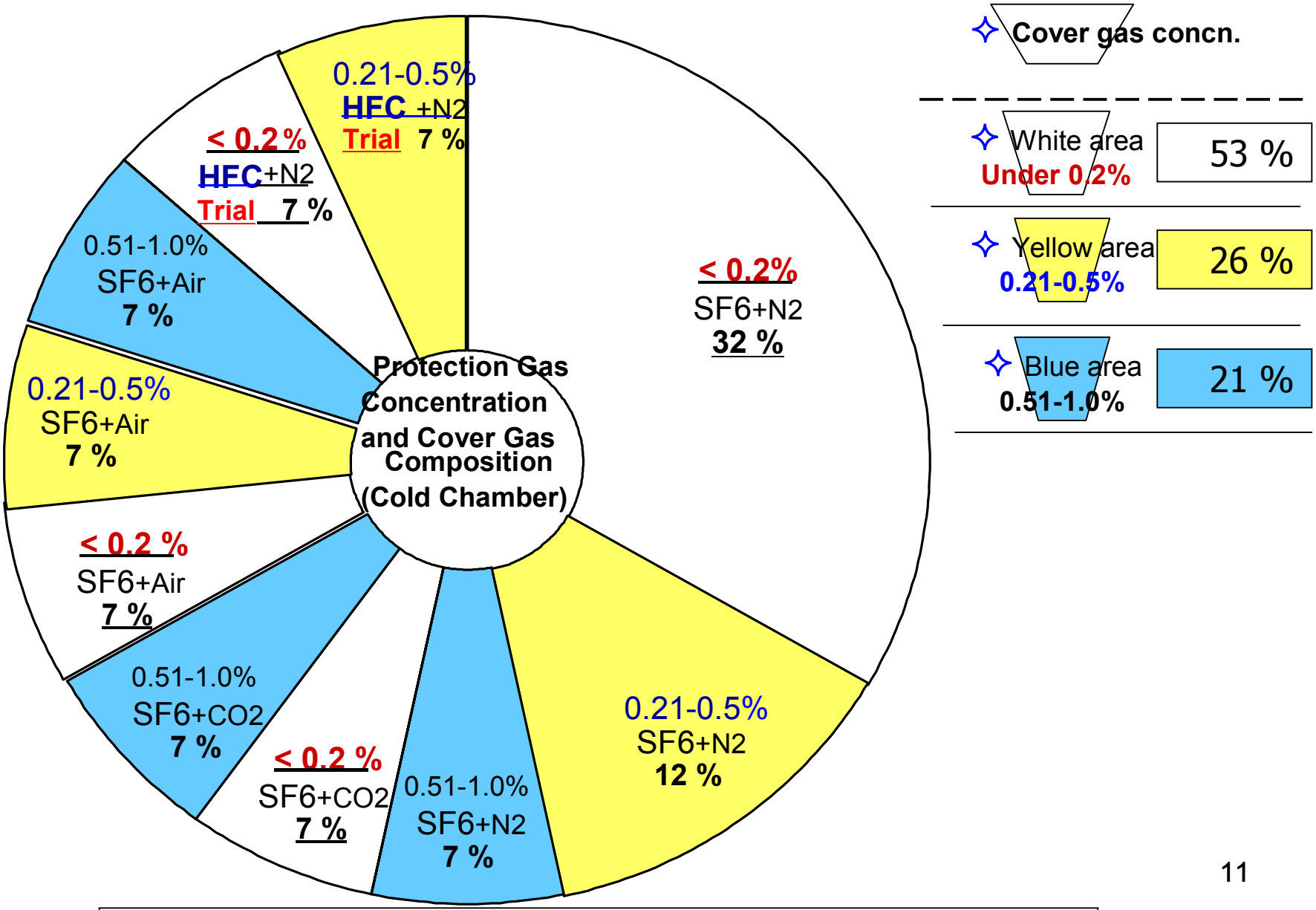
5. Cost: Cover gas and carrier gas
* Running cost up ?
* Possibility of total cost reduction ?

6. Necessity of additional equipments such as gas heating/vaporization control
* Condensation trouble (necessity of temperature control of alternative gas)
* Vaporizing stability of gas (Necessity or not of temperature control on gas supply system)

7. Easy and stable gas supply in the world widely?
* Technology transfer to overseas plant

Source: NEDO's Research program of the synthesis of F-gas (2005),JAA/JMA

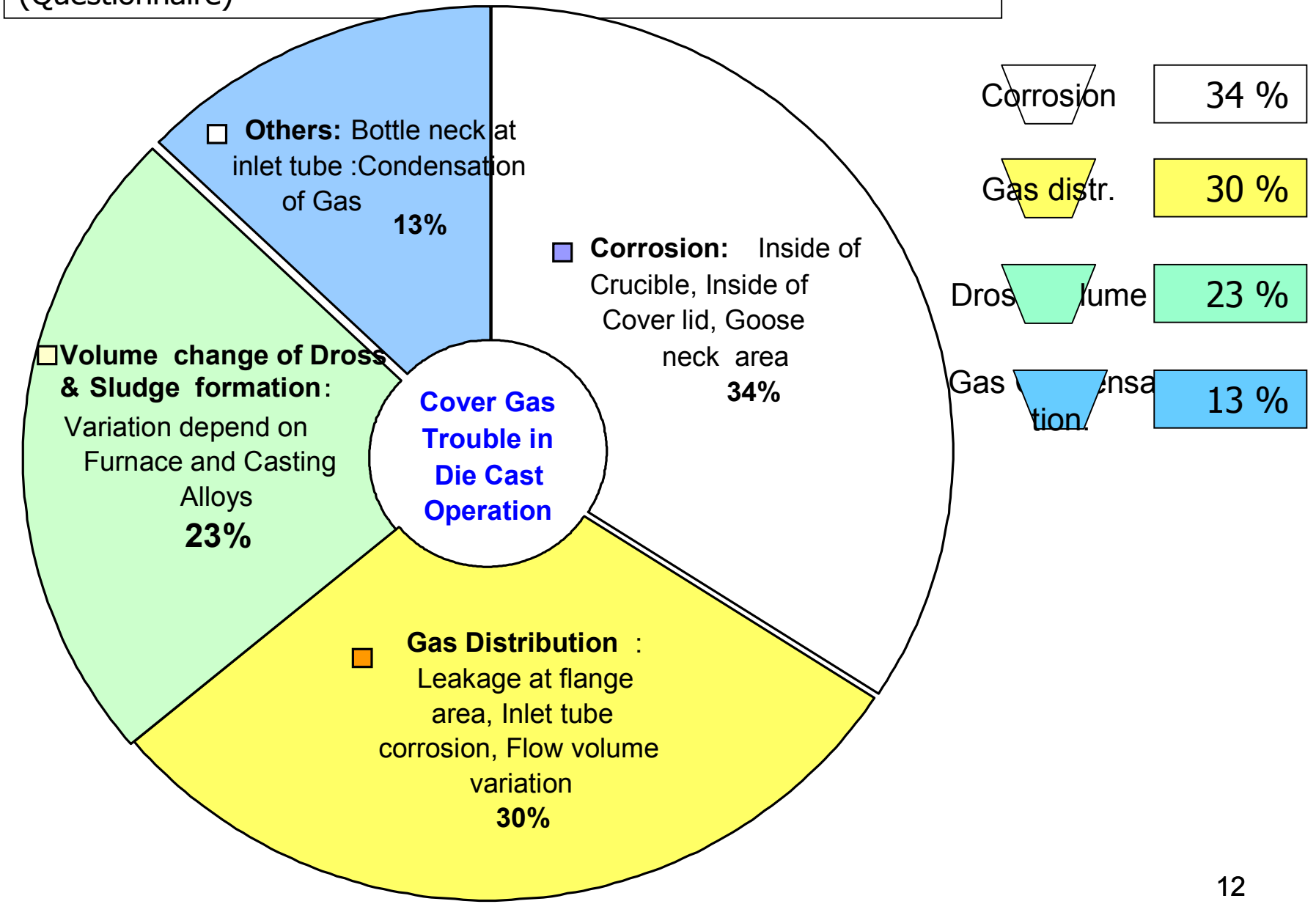
Cover Gas and its Concentration at C.C. Diecasters (15)
(Questionnaire)



Source: NEDO's Research program on the synthesis of alternative F-gas (2005),JAA/JMA

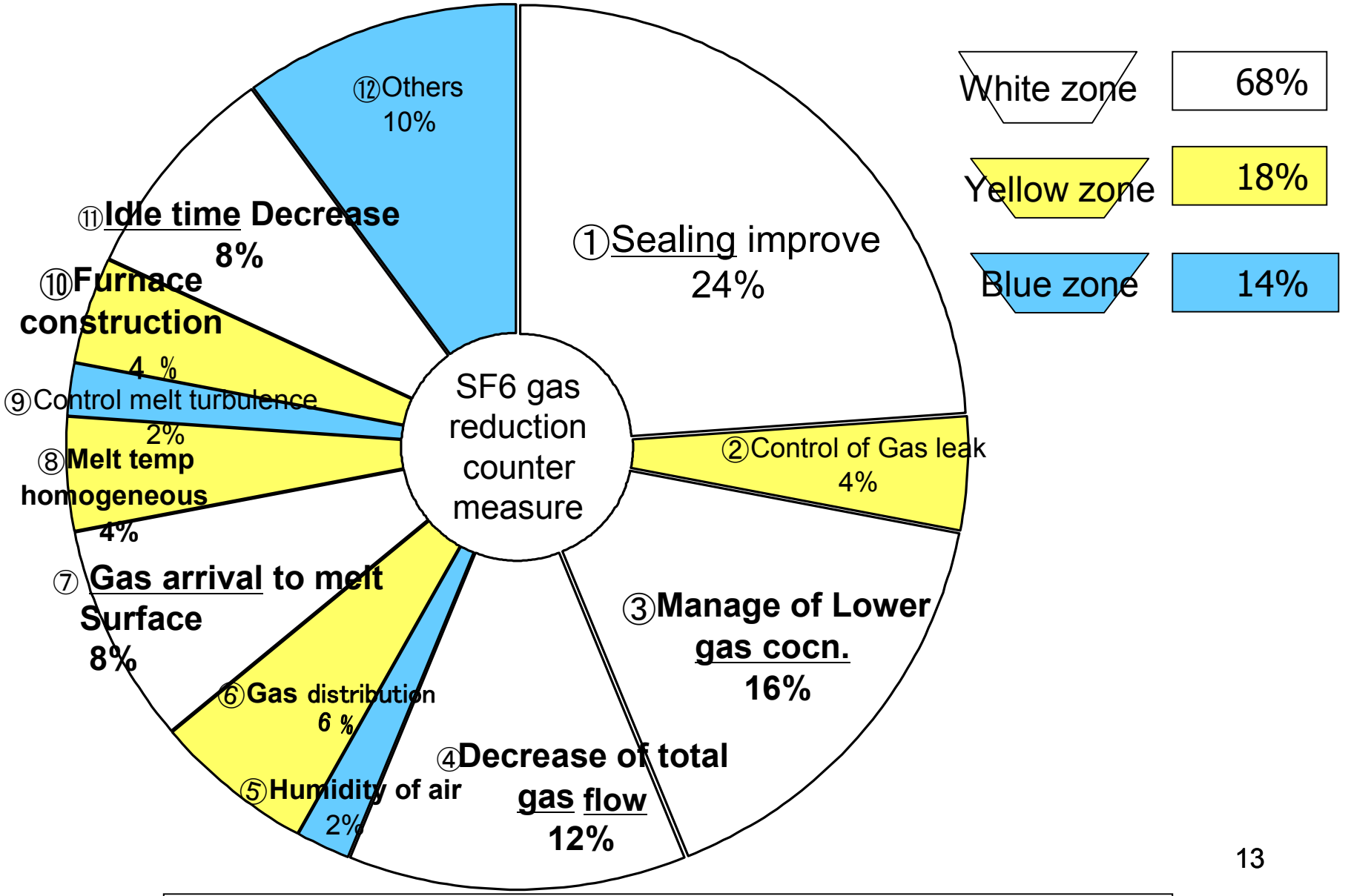
Cover gas Troubles in Die Cast Operation

(Questionnaire)



Source: NEDO's Research program on the synthesis of alternative F-gas (2005),JAA/JMA

Countermeasure for SF6 Gas Reduction in Die Cast Process (Questionnaire)



Source: NEDO's Research program on the synthesis of alternative F-gas (2005 ,JAA/ JMA

Thank you for attention