

# FY2011

## Progress of Business Strategy

May 2012



**SUMITOMO METAL MINING Co., Ltd.**

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# I . Trend in Business Performance and Asset Components



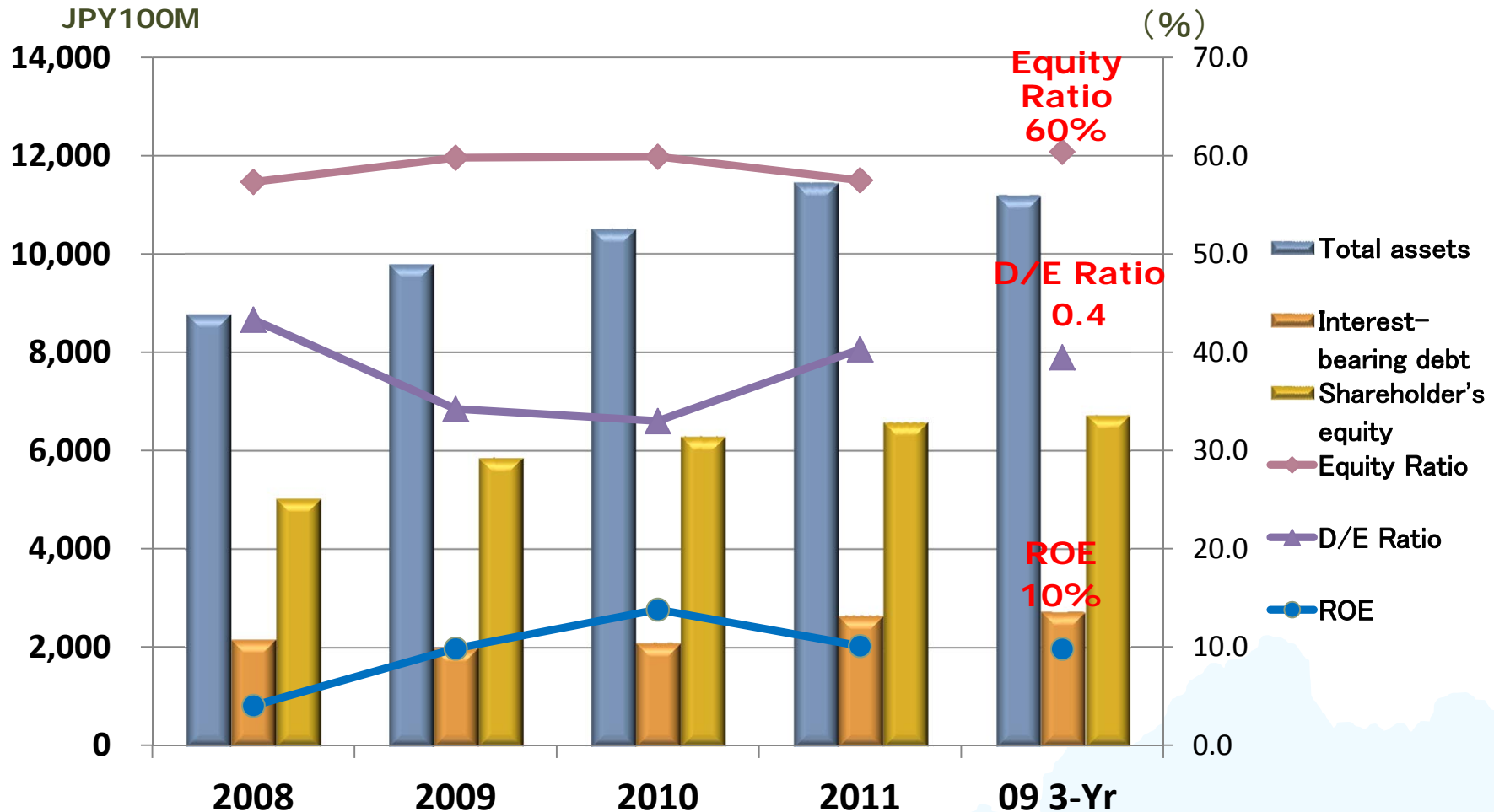
**Sierra Gorda Project    Pre-stripping**

# 1) Consolidated Results



	2009	2010	2011	2012 Forecast	09 3-yr 2012
Consolidated recurring profit (JPY100M)	878	1,237	1,088	920	1,100
Overseas asset contribution to cons. RP (JPY100M)	461	763	749	620	550
Cu (\$/T)	6,101	8,140	8,485	8,500	6,000
Ni (\$/lb)	7.7	10.7	9.6	8.0	8.0
Au (\$/Toz)	1,023	1,294	1,646	1,650	1,000
Exchange (¥/\$)	92.9	85.7	79.1	80.0	90.0

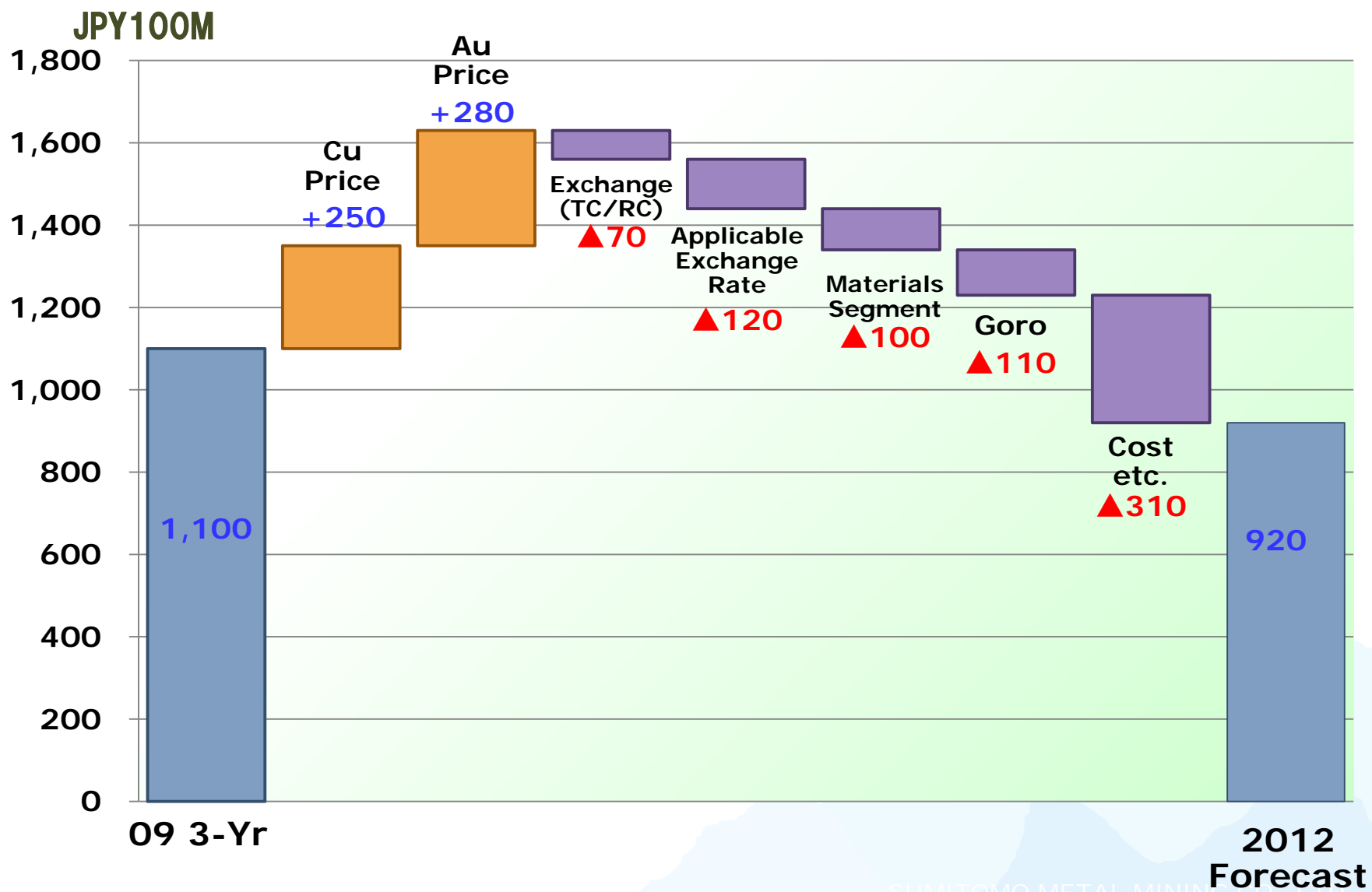
## 2) Maintenance and utilization of sound finances



**SMM issued bonds in the second quarter of FY2011 and continuously maintained a stable equity ratio**

### 3) Recurring profit Analysis

(FY2012 Forecast vs 09 3-Yr 2012)





## Ⅱ. Progress of 09 3-Yr Business Plan



**Sierra Gorda Dump truck**

SUMITOMO METAL MINING CO., LTD.

# 1) Mineral Resources

## ① Three Methods to Procure Resources Overseas

### 1) Exploration by SMM

The majority of resources will be procurable by SMM.  
It takes considerable time to start mining operation.



Stone Boy Project

### 2) Participate in a mine development project

Relatively short-term operation is possible.  
Obtaining majority share is difficult.  
There are risks of competition with other companies and an increase in expenses.



Sierra Gorda Project

### 3) Increase production at existing mines

We can use partners' capabilities.  
There are not many large-scale projects in which we can increase production.  
It is difficult to increase the SMM equity interest ratio.



Cerro Verde Mine



# 1) Mineral Resources

## ② Progress of SMM Exploration—Stone Boy

### Stone Boy Project

#### Ratio of Interests

SMM 95%  
Sumitomo Corp. 5%

#### Target Minerals

Au, Sb, etc.

#### Current Status

The boring surveys began in 1991.  
(The Pogo mine was discovered during this project.)

**Naosi section in the Monte Cristo area**  
**2008–2010: Conducted the boring surveys.**

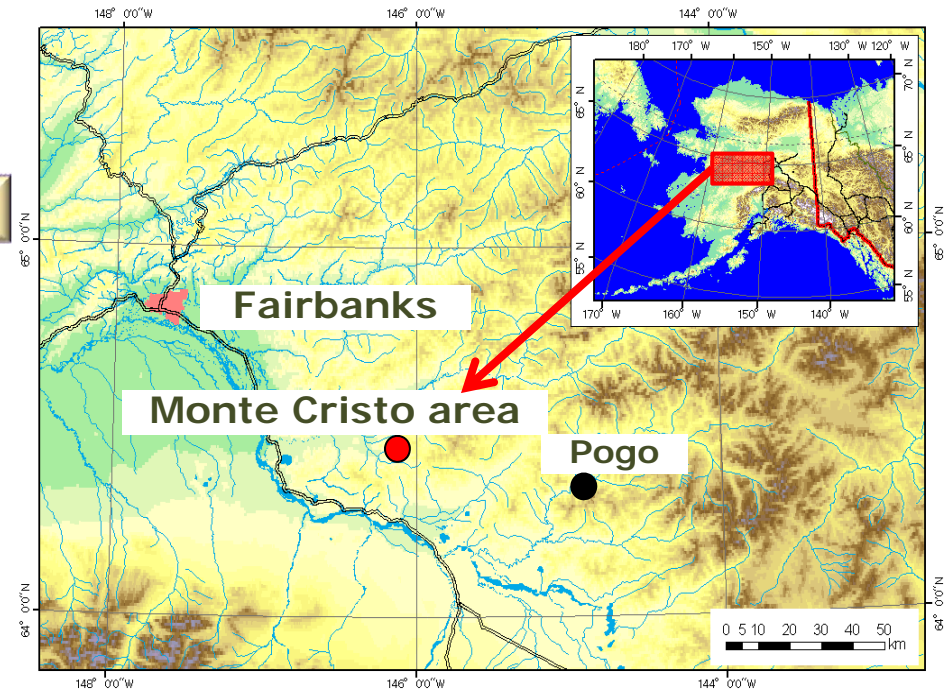
The existence of promising mineralization zones for Au, Ag and Sb was confirmed within 27 of the 29 pits.

**2011: 12 pits were explored.**

A concentration experiment for the Naosi ore body is under execution.

**A more extensive survey will be conducted to obtain more accurate volume of minable reserves.**

**Mineralization zones outside of the Naosi section will also be investigated.**



# 1) Mineral Resources

## ②Progress of SMM Exploration—Solomon Project

### Solomon Project

#### Target

Nickel oxide ores

#### Mining Zones

**Choiseul Island:**

1 mining zone, approx. **200 km<sup>2</sup>**

**Santa Isabel Island:**

3 mining zones, approx. **150 km<sup>2</sup>**

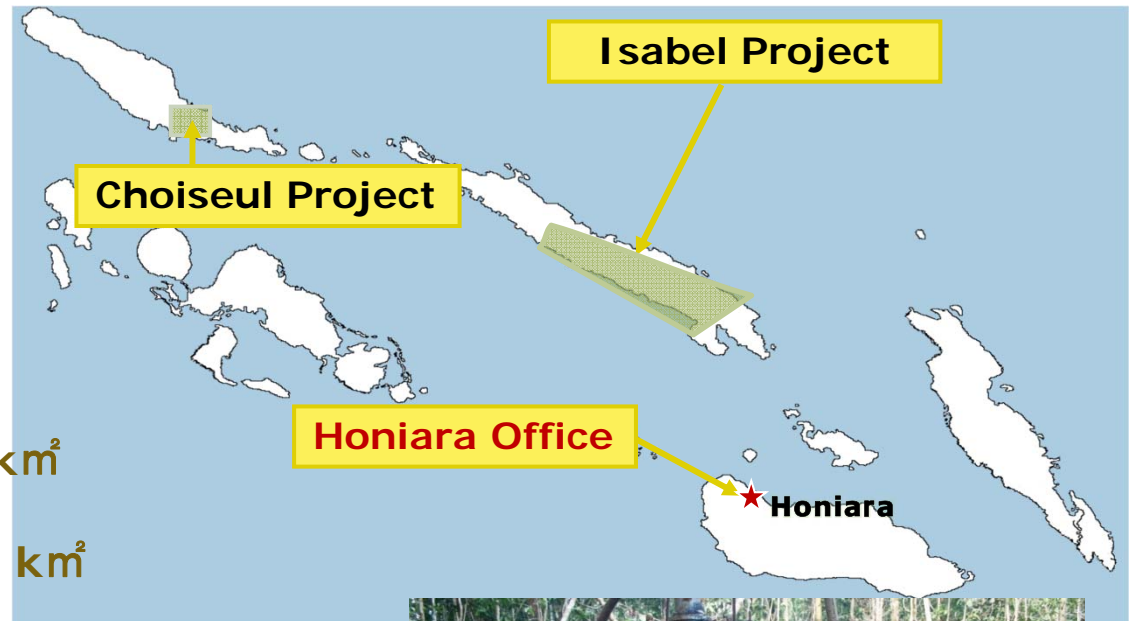
#### F / S

A pre-FS (feasibility study) and an environmental impact study (EIS) have been completed.



In parallel with the exploration in the above mining zones, applications for permits and approvals have been filed to move toward the operating stage for the mining of minerals.

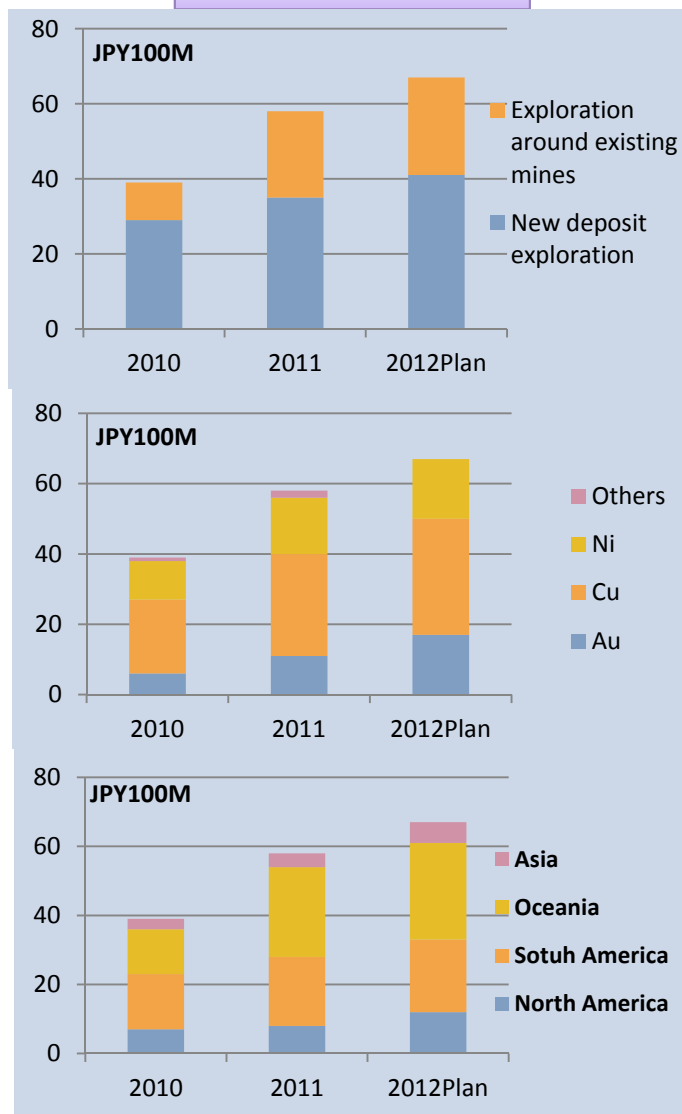
The Solomon Project Dept. was established on 4/1.



# 1) Mineral Resources

## ② Progress of SMM exploration – Worldwide Exploration

Exploration Costs



Engaged in approx. 20 exploration projects



# 1) Mineral Resources

## ③ Participation in a Mine Development Project—Sierra Gorda

Signed the contract for participation in the Sierra Gorda copper mine development project on May 15, 2011

### Location

Region 2, Republic of Chile  
140 km northeast of Antofagasta  
Altitude: Approx. 1,700 m



### Equity Interest Ratio

KGHM International\* 55%  
SMM 31.5%  
Sumitomo Corp. 13.5%  
Off-take right in copper concentrates:  
SMM & SC 50%

### Minalable Volume

Approx. 1.3 billion tons, Mining life: 20 years

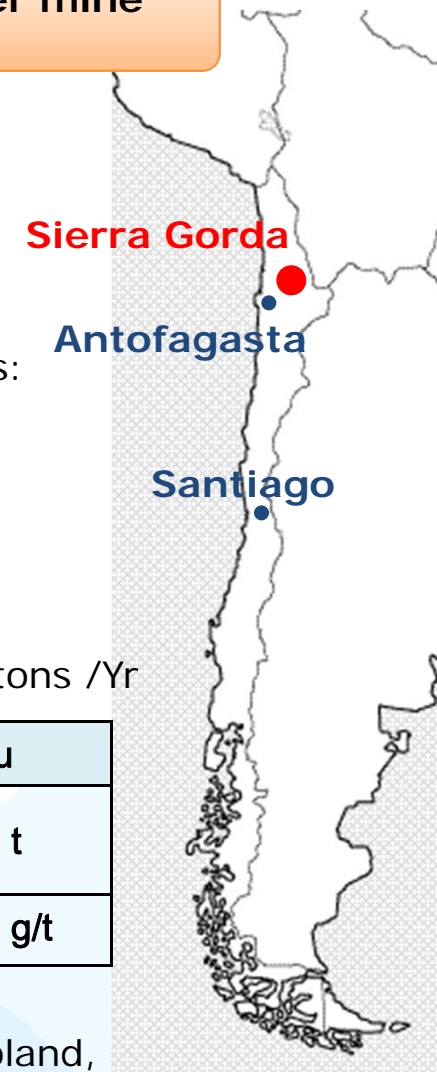
### Off-take Right

Copper volume: 110,000 tons /Yr

	Cu	Mo	Au
Contained metal volume	5,000 kt	300 kt	80 t
Grade	0.4%	0.025%	0.06 g/t

**Start of Operation**

**Scheduled for 2014**



\*Quadra FNX was purchased by KGHM, a nonferrous metal producer in Poland, in March 2012, and became KGHM International.



# 1) Mineral Resources

## ③Participation in a Mine Development Project—Sierra Gorda

### Sierra Gorda Project

#### Development Schedule

	2011	2012	2013	2014	2015	2016	2017
Acquisition of required permits and approvals	→						
Construction	→						
Operations (110 kt)				→			
Expansion of operations to 190 kt					→		
Operations (190 kt)							→

- Obtained an environmental permit in June 2011 and started construction in July 2011.
- August 2011: Dispatched staff from SMM (4 staffs).
- Progress of construction work
  - Construction of accommodations, offices and related support facilities is under way.
- Started pre-stripping work in March 2012.
- Development fund (approx. \$3.0 billion in total):  
Concluded a \$1.0 billion loan contract with financial institutions.



SUMITOMO METAL MINING CO., LTD.

# 1) Mineral Resources

## ③Participation in a Mine Development Project—Projects under Consideration

Country	Target Metals
Canada	Cu, Au
United States	Cu
Chile	Cu
Peru	Cu
Argentina	Cu
Indonesia	Au, Ag

- Reinforce and promote new project extraction work.
- Collaborate with overseas partners and external organizations.
- Aggressively assess projects prior to FS, taking into account the intensifying competition in project participation.



# 1) Mineral Resources

## ④ Expansion of Existing Mines—Morenci

### Morenci Mine (North America) Expansion Project

#### Reinforcement Plan

	Current
Mining output	635 kt/day
Concentration capability	50 kt/day
Production volume of copper	280 kt/year



2014
816 kt/day
115 kt/day
380 kt/year



#### Schedule

- Complete FS in 1Q of 2012.
- Scheduled to start initial construction work during FY 2012.
- Complete construction by the end of 2014 and launch full-scale operation.
- Cost for the launch of operation: Up to \$1.6 billion

#### Equity Interest Ratio

FCX 85%  
SMM 12%  
Sumitomo Corp. 3%

# 1) Mineral Resources

## ④ Expansion of Existing Mines—Cerro Verde

### Cerro Verde Mine (Peru) Expansion Project

#### Reinforcement Plan

	Current		2016
Mining output	320 kt/day	➔	850 kt/day
Concentration capability	120 kt/day		360 kt/day
Production volume of copper	300 kt/year		500 kt/year



#### Schedule

- Start procedures for the assessment of environmental impacts in 4Q 2011.
- Complete the procedures for required permits and approvals by the end of 2012.
- Start construction in 2013 with full production by the end of 2015.
- Aim to operate for 30 years.
- Cost for the launch of operation: \$4.0 billion

#### Equity Interest Ratio

FCX 53.56%  
SMM 16.80%  
Sumitomo Corp. 4.20%  
Other 25.44%

# 1) Mineral Resources

## ④ Expansion of Existing Mines—Northparkes

### Northparkes Mine (Australia) Expansion Project

#### Reinforcement Plan

	Current		2016
Concentration capability	5.8 Mt/year	➔	Production of 30 Mt/year is under consideration
Production volume of copper	38 kt/year		Production of 150 kt/year is under consideration



#### Background

##### STEP CHANGE PROJECT

August 2010

- Announced a shift to the pre-FS stage to explore the possibility of expansion.
- Planned the expansion of production scale by developing the bottom of three existing ore bodies and a new ore body.

#### Schedule

- Complete the pre-FS by the end of 4Q 2012 and the FS by the end of 3Q 2013.
- Aim for full-scale production from 2016.

#### Equity Interest Ratio

Rio Tinto 80.0%  
SMM 13.3%  
Sumitomo Corp. 6.7%

# 1) Mineral Resources

## ⑤ Maintaining Gold Resources at Two Mines

### Pogo Mine

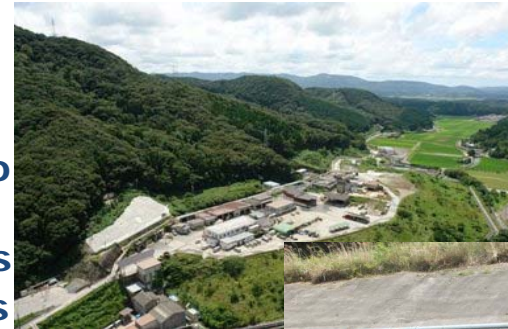
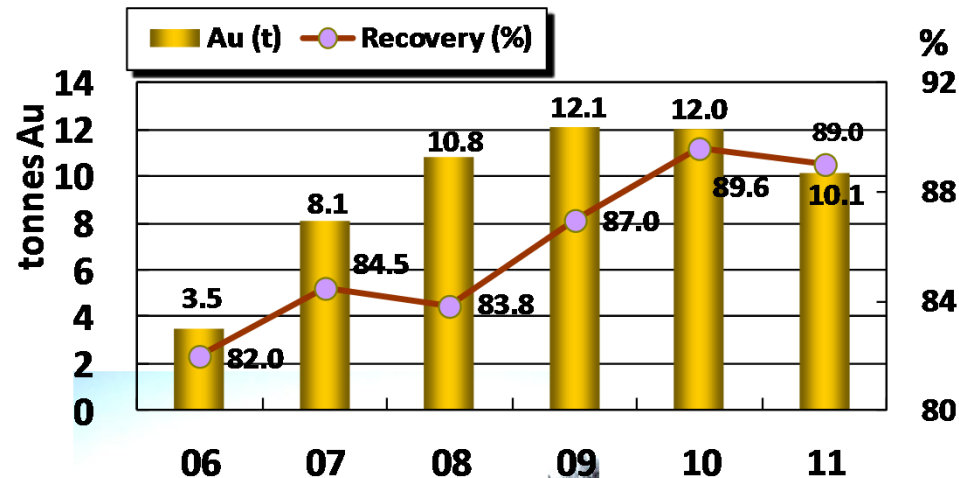
Production output for 2011: 10.1 tons

→ Production output of Au decreased due to the mining of low-grade ore.

Reserves as of December 31, 2011: 155 tons

New Au volume identified in 2011: 44.6 tons

Implement exploration to acquire more ore.



### Hishikari Mine

Sales volume in FY2011 (Result):  
7.5 tons

Reserves (as of December 31, 2011)  
:150 tons

New Au volume identified in 2011  
: 9.6 tons

Maintaining reserves by carrying on  
the policy of “Explore the same  
amount as we mine.”



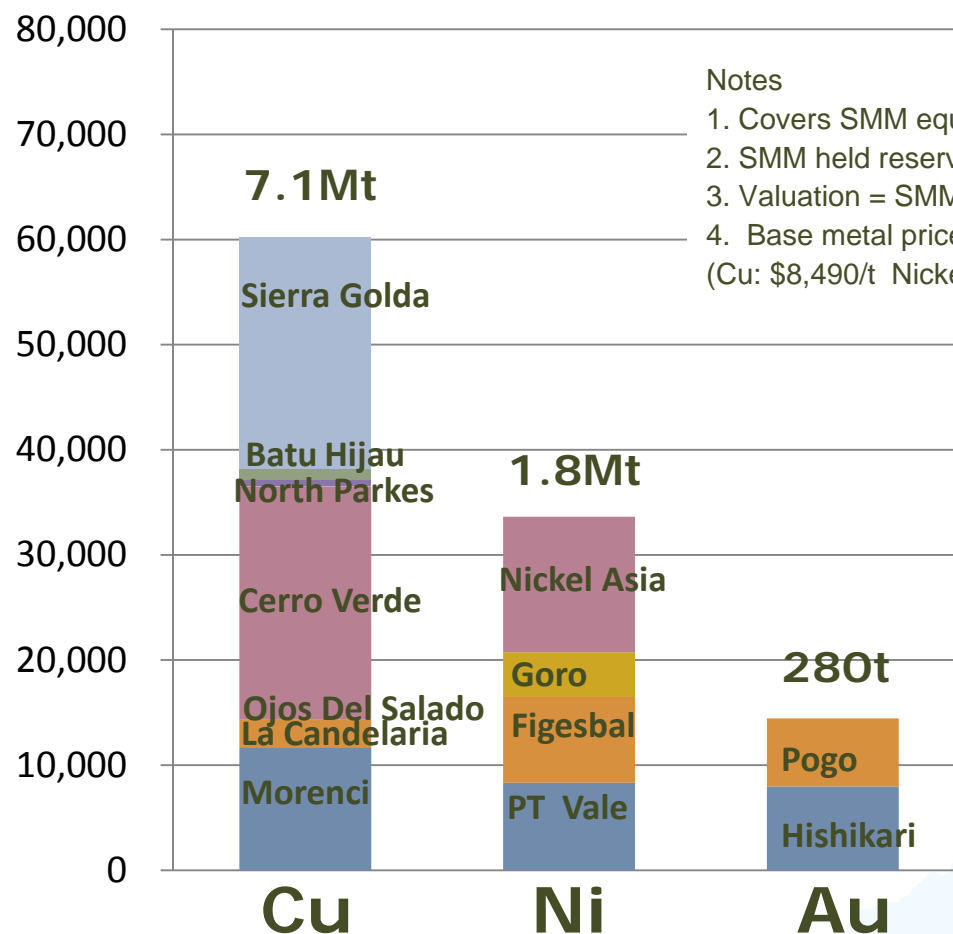
# 1) Mineral Resources

## ⑥ Mining Interest - Reserves

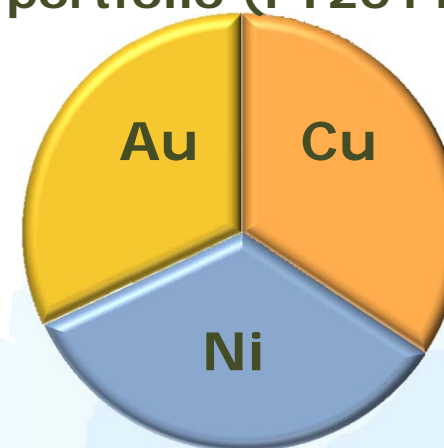
Valuation  
(\$USD million)

**Total: 110B\$**

(Calculation based on estimated reserves)

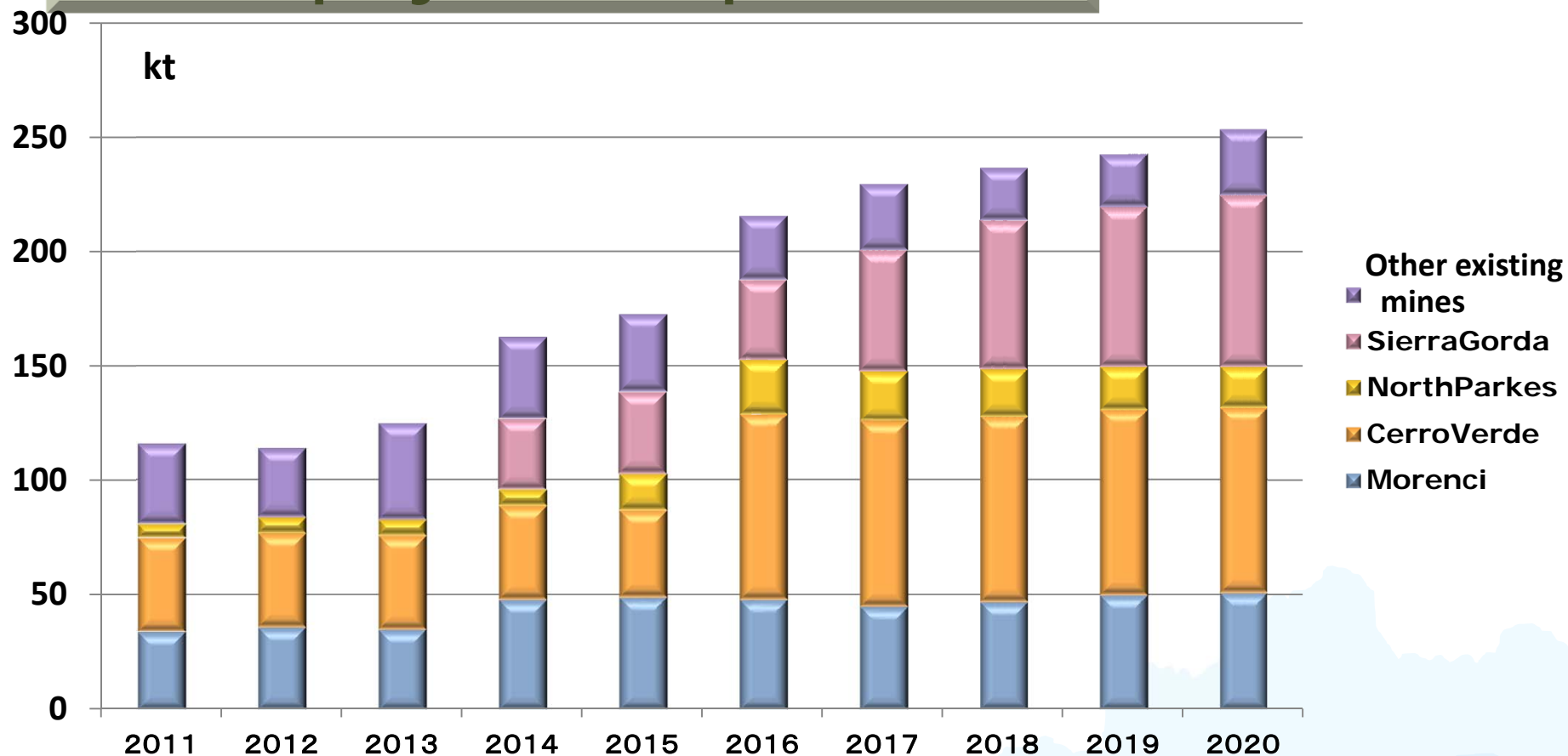


**SMM equity interest  
production amount by metal  
portfolio (FY2011)**



# 1) Mineral Resources ⑦ Increase Cu Interest

## SMM Equity interest production



Going forward to Long term vision,  
Cu Interest production 300kt/year



## 2) Smelting & Refining

### ① Progress of the Taganito Project

**Steady progress of the 2nd construction of world's most advanced HPAL plant based on CBNC results**

- ◆ Production capacity: Ni 30 Kt/year, Co 2.6 Kt/year
- ◆ Investment amount: US\$1.3 billion
- ◆ Investment ratio: SMM 62.5%, NAC 22.5%, MITSUI & CO., LTD. 15%
- ◆ Scheduled period for operation: 30 years

**Construction to resume in December 2011.  
Approx. 40% completed.**

#### **Schedule**

**March 2010** Started construction work.

**October 2011** An assault incident occurred.

**December 2011** Safety measures were taken and construction was resumed.

**2012** Full-scale construction work  
Reinforce our structure toward the launch of operation.  
Promote measures to reinforce our security system.

**2013** Complete the construction work.  
Start commercial production.



## 2) Smelting & Refining

### ② Promotion of 65-kt Electrolytic Nickel Production Operation

Reinforce Electrolytic Ni Production Capacity at Niihama Nickel Refinery

- ◆ Capacity: 41 kt/year → 65 kt/year
- ◆ Investment amount: ¥14.0 billion
- ◆ Schedule

Scheduled to be completed in 1Q 2013

Complete the launch of operation prior to the launch of HPAL operation at Taganito

Facility Reinforcement

Process Development/Improvement

Operation in Conjunction with Taganito



#### Status of progress

- Completed the construction work to install new CM process equipment.
- Construction is under way to expand the buildings for the electrolyzing operation.



Steady progress toward 100 kt/year Ni production structure

## 2) Smelting & Refining

### ③Cu Operation Plan at SMM's Toyo Smelter

Flash furnace will undergo complete brickwork renovation during its mandatory shutdown maintenance period.

Completed almost as scheduled, resulting in improved capability to address high-load operations.

Develop and improve an advanced concentrate burner

Improve productivity through high oxygen efficiency, by reducing copper slag loss and the dust generation ratio.

Promote further cost reduction measures

Improve productivity and reduce expenses such as depreciation, labor costs and maintenance/repair costs.

Improve operational environment



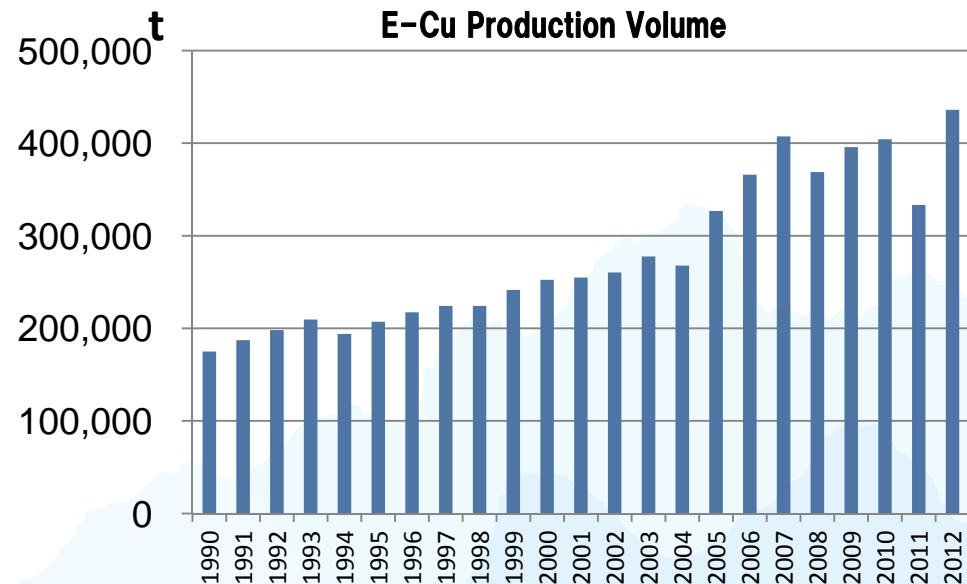
**Further enhance competitiveness**

**FY2012 Production Plan**

Electrolytic copper: **436 kt/year**

Stable high-load operation at our new flash furnace

Processing increased volume of recycled raw materials



## 2) Smelting and Refining

### ④ Status of the Goro Project

**June 2011** Dispatched one executive level person, two process engineers and one facility engineer from SMM.

- Support for fundamental solution on the issue of solvent extraction facilities.
- Improved the damaged facilities.

**November 2011** ~Started pilot operation of the entire process.

HPAL → SX (solvent extraction) → FBR (fluidized bed reactor)

- Toward the establishment of the finished product (nickel oxide) production system



**2011** Nickel hydroxide shipment volume: Approx. 7,000 tons



**2012** Scheduled to begin full-scale production of nickel oxide (approx. 20 kt)

## 2) Smelting & Refining

### ⑤ Establishment of a Smelting and Refining R&D Structure

#### Establish a Smelting & Refining development center

##### Purpose

- Continually and quickly develop processing and facility/equipment technologies that are the world's most advanced in the smelting and refining field.
- Nurture human resources through development.
- Develop and pass on smelting and refining processes, facility/equipment and other related technologies.

##### Concept

- Gather engineers in our research centers, plants and engineering works departments.
- Combine devices and equipment according to the project and conduct testing efficiently.
- Upgrade engineers' skills through development
- Position "Meister" with long experience and ample knowledge, to pass on our technologies and knowledge.

##### Schedule

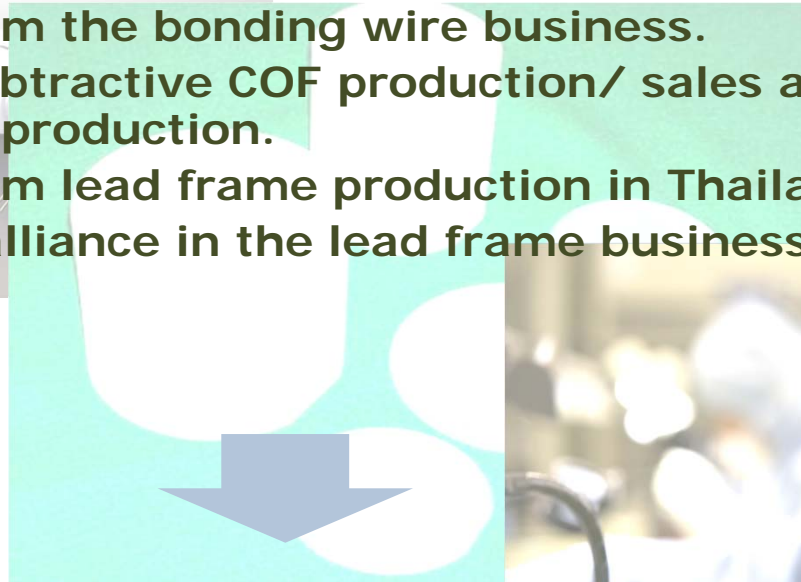
- Start design and installation preparation of buildings and basic facilities/equipment in FY2012.
- Start the Smelting/Refining Development Center in 2013.

### 3) Materials

#### ①Acceleration of Selection and Concentration

##### Implementation of various measures toward the shift of our business structure

- Withdraw from the bonding wire business.
- Terminate subtractive COF production/ sales and shift to semi-additive COF production.
- Withdraw from lead frame production in Thailand.
- Promote an alliance in the lead frame business.



- ◆ Concentrate management resources for materials used in the environmental and energy fields.
- ◆ Restructure the materials business segment.



### 3) Materials

#### ② Integration of Lead Frame Business

Started planning toward the integration of the lead frame business with Hitachi Cable, Ltd.



Achieve synergies by combining the management resources of both companies and optimizing the strengths of each company.

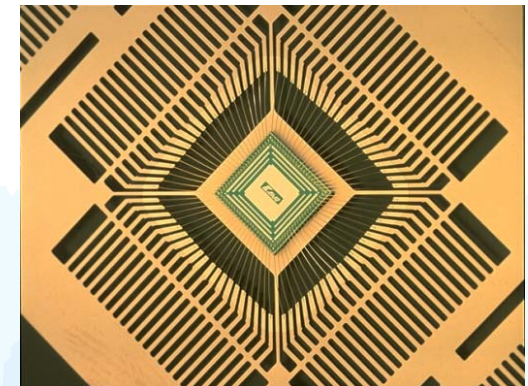
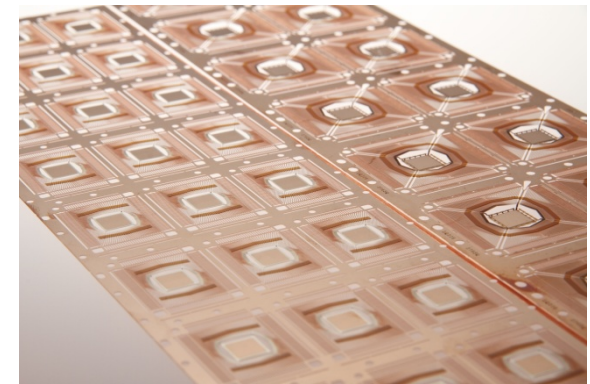


We plan to reach a formal contract by the end of the first half of 2012.

- Horizontal integration → Make production and sales more efficient
- Vertical integration → Develop advantage in the materials procurement capability



We plan the timely disclosure of specific content relative to the integration via future negotiations.



### 3) Materials

## ③ Integration of Materials Business



Thorough shift of the business structure to make our materials business an independent core business

**Further concentration in growth fields**

**Efficient allocation of management resources**

**Acceleration of development speed of new products**

**Establish a specific structure quickly and start operation.**

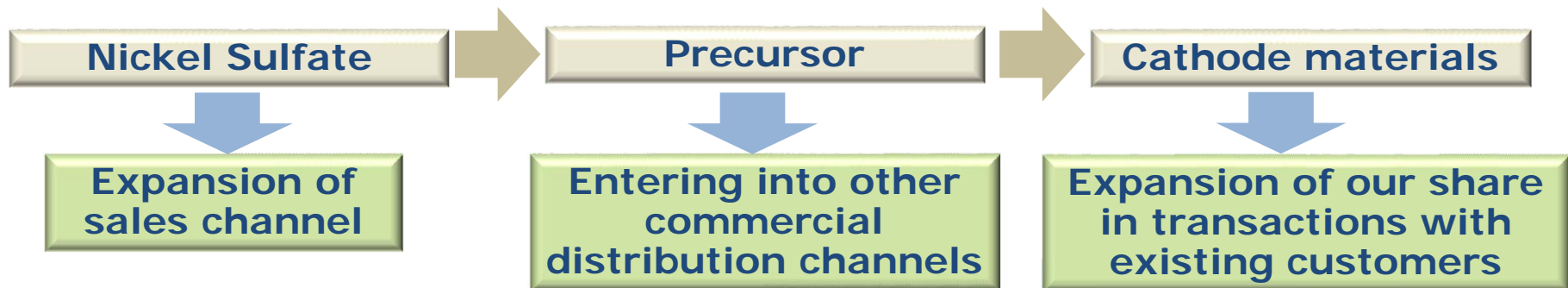
### 3) Materials

#### ④ Growth Strategy: Battery Materials

##### Basic Strategy

① Maintain for the first vendor position of cathode materials for TOYOTA vehicles (such as the PRIUS)

② Enter into the existing supply chain



Increase the capacity of nickel sulfate

Current capacity  
25,000 tons/year

February 2014  
45,000 tons/year

Increase the precursor capacity

Current capacity  
700 tons/month

September 2012  
1,500 tons/month



### 3) Materials

## ④ Growth Strategy: Battery Materials

### Basic Strategy

③ Establish a new recycling business model between resources and cathode materials

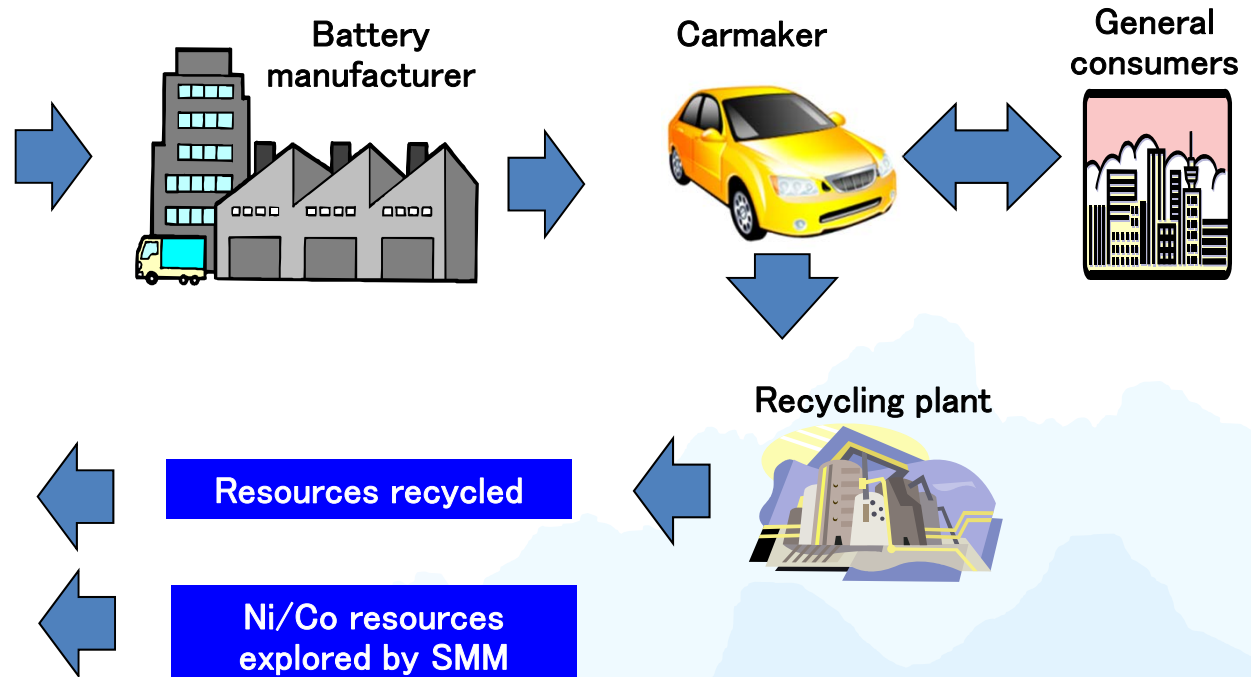
Develop a process that can collect all Ni/Co contained in used nickel hydroxide batteries.

Processing capacity: The volume of cathode materials for approx. 50,000 general HEV cars

Development and manufacturing of battery materials



Manufacturing of nickel chemical products

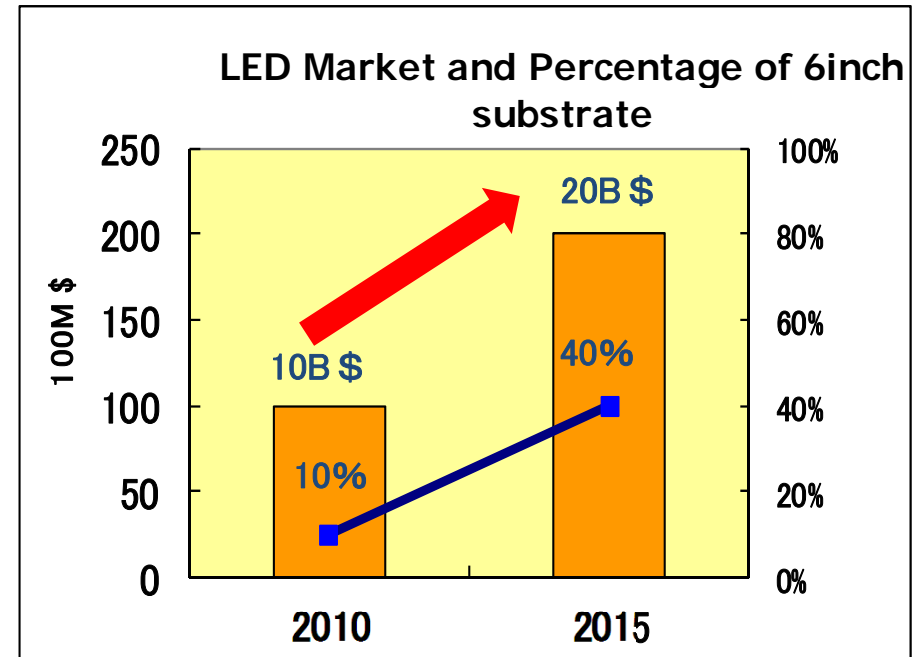


### 3) Materials

## ⑤Growth Strategy: Sapphire Substrates

In line with the expanding demand for lighting LEDs, there are strong inquiries for large-scale substrates.

- ◆ The mass-production technology of large crystalline sapphire substrates has been established.
  - Cost reduction has been achieved by allowing two 6-inch diameter substrate bars to be pulled from a single ingot.
  - The mass manufacturing process of sapphire substrates is already under way at Ohkuchi Electronics Co., Ltd., toward launching the business.
- ◆ The 6-inch diameter substrate production increase plan
  - Capital investment: ¥1.2 billion (including the investment already made)
  - Completion: Scheduled for October 2012





### 3) Materials

## ⑥Sales Integration (China)

**Establish SMM's distribution company in China**

**Sumitomo Metal Mining Management (Shanghai) Co., Ltd**

**Start of operation: July 2012**

**Location: Shanghai**

**Content of business:**

- **Function of a trading company such as sales of materials products and refined metals**
- **Support for administrative services provided by SMM's subsidiaries and affiliates in China**
- **Accumulation of knowledge about business in China**
- **Provision of information to SMM**
- **Nurturing of human resources by a trainee system**

#### **Target**

- ◆ **Expand sales in an emerging market.**
- ◆ **Collect and analyze information on our own and formulate our strategies for the Chinese market.**
- ◆ **Make an example that becomes a reference to use when we further expand business to other emerging markets.**





## 4)Enhancing the Strengths of Ongoing Projects

Projects primarily in the Mineral Resources and Smelting & Refining segments, will each start contributing to business performance from FY2012.

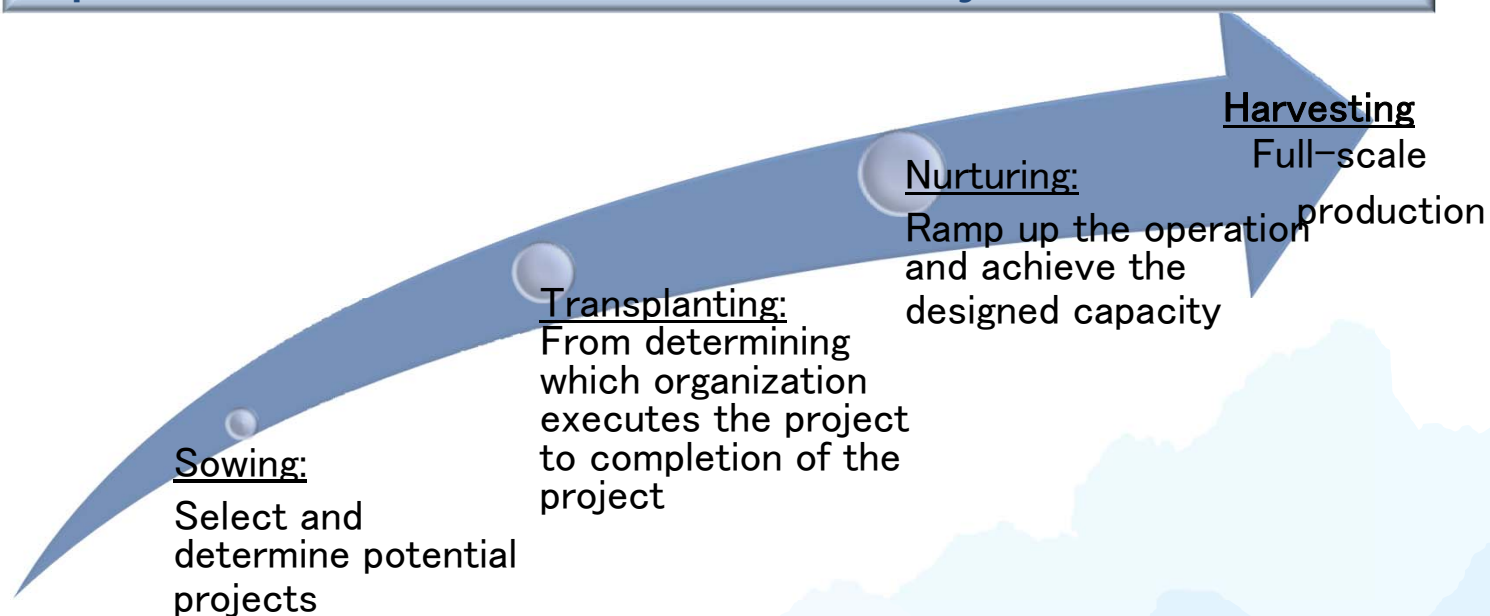
		09 3-Yr	12 3-Yr Plan				15 3-Yr Plan		
		2012	2013	2014	2015	2016	2017	2018	
Mineral Resources	Sierra Gorda Project			1 <sup>st</sup> Stage			2 <sup>nd</sup> Stage		
	CerroVerde Expansion					○			
	Morenci Expansion			○					
	NorthParkes Expansion					○			
Smelting & Refining	Taganito		○						
	ENi 65kt		○						
	Goro Project	○							
Cu Equity interest production (Cu-kt/Yr)		120	130	160	170	220	230	240	
Ni Production Capacity(Ni-kt/Yr)		70	100	100	100	100	100	150?	

## 5) Enterprise Value Committee

- ◆ Prepare and oversee large-scale projects with a long-term vision.
- ◆ Screen appropriate “sowing” projects from among the new large-scale candidate projects.
- ◆ Continually monitor the progress by project from “Transplanting” to harvesting.”

Mineral Resources / Smelting & Refining business  
: Investment amount of more than ¥20.0 billion,  
Expected income of more than ¥5.0 billion a year

Materials business: Investment amount of more than ¥5.0 billion,  
Expected income of more than ¥1.0 billion a year

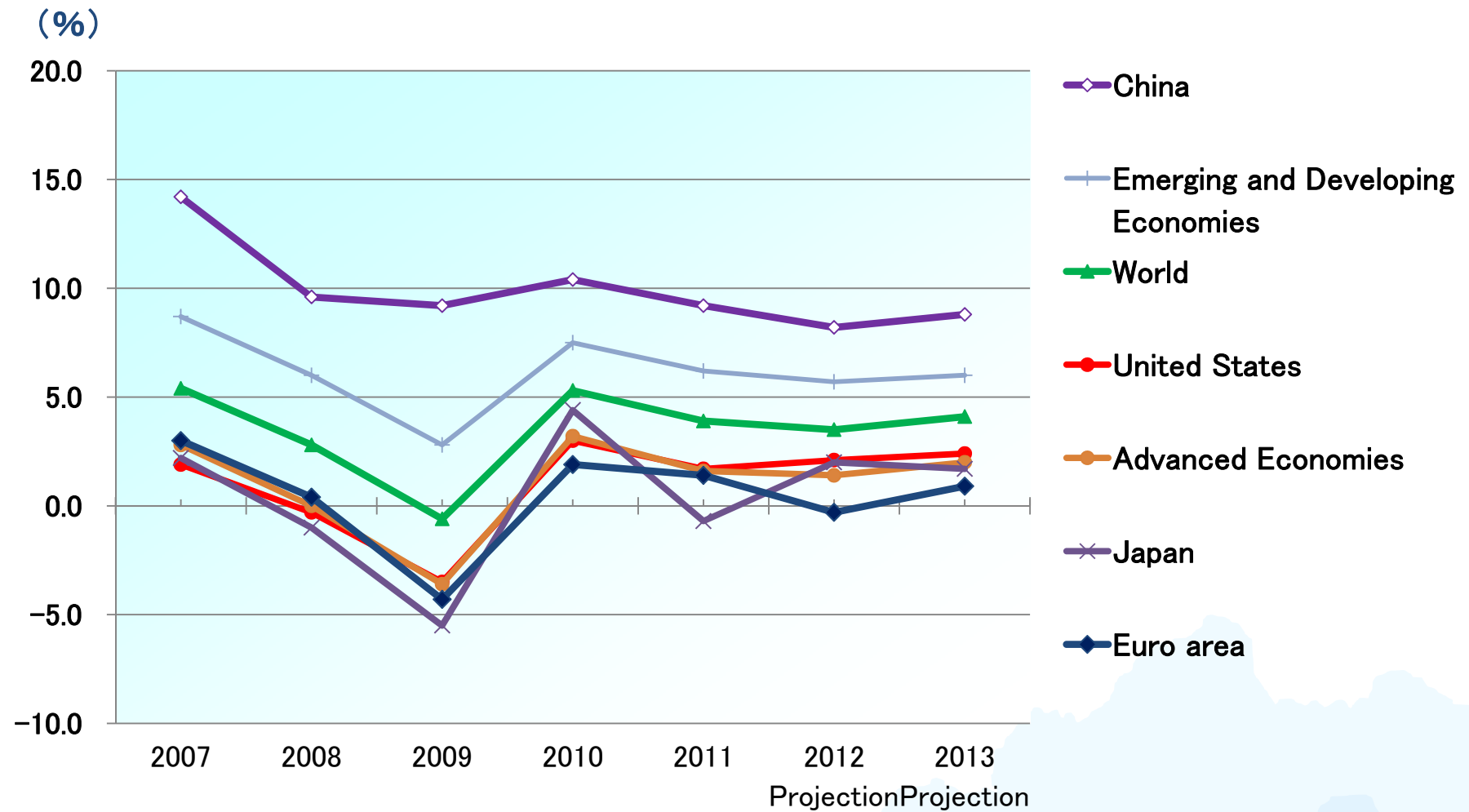


## III. External Environment



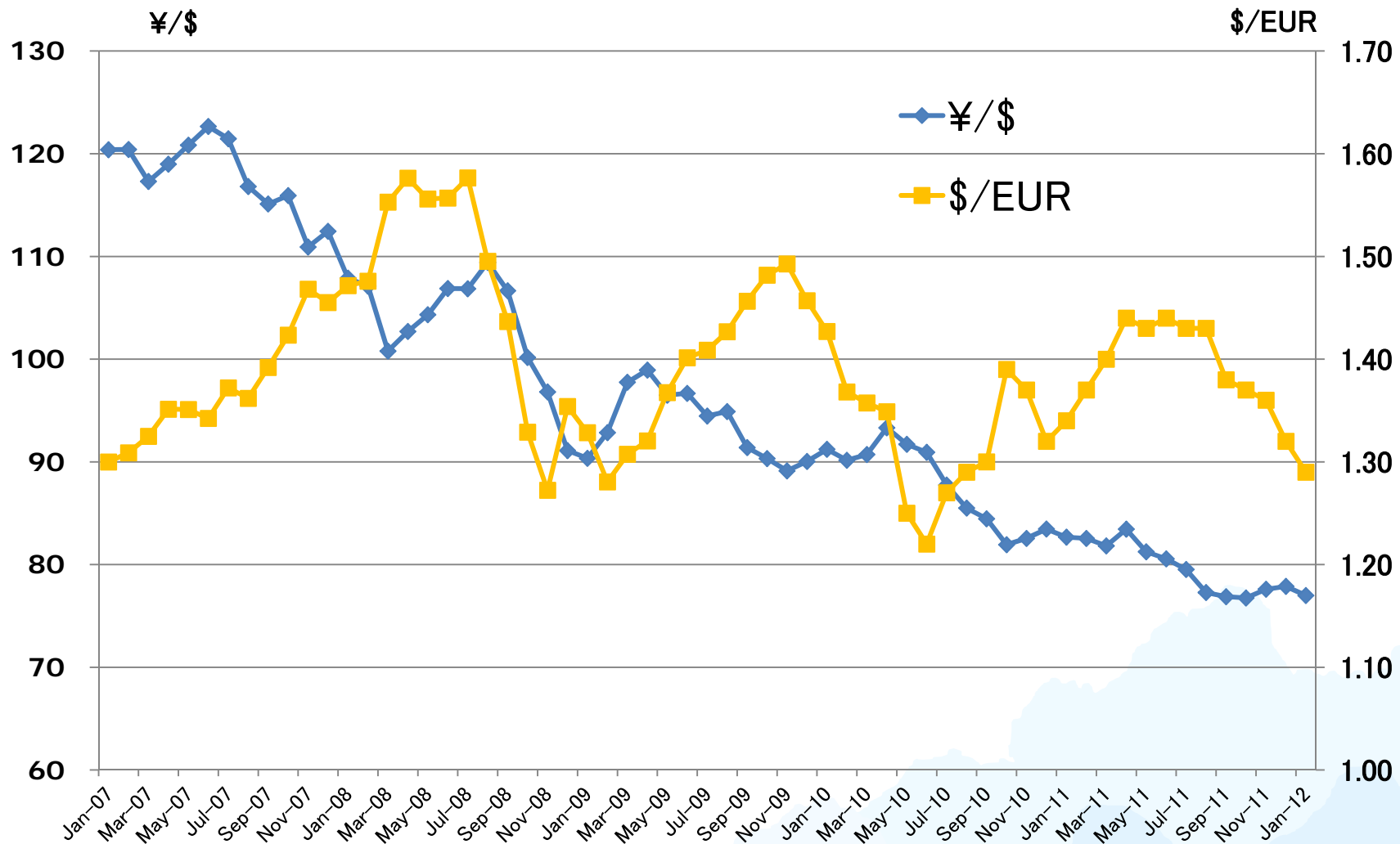
**Sierra Gorda Residential facilities**

# 1) GDP Outlook



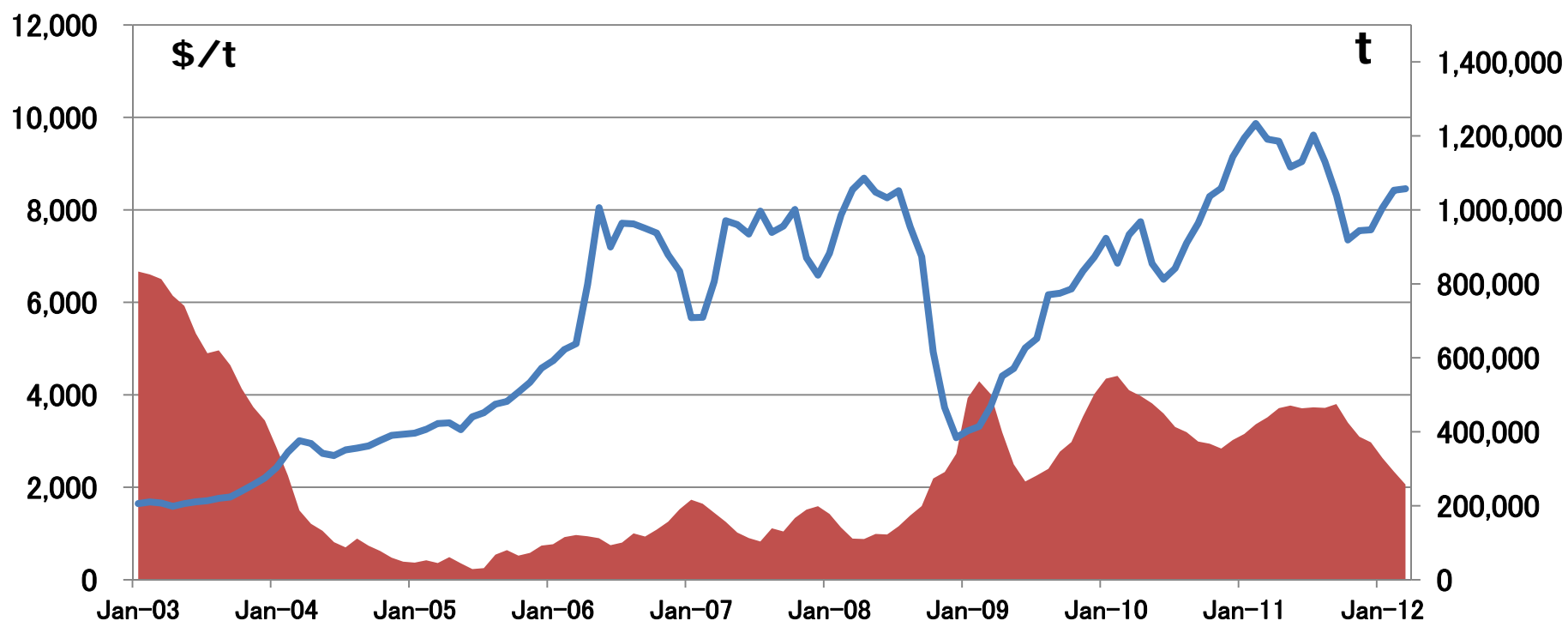
(Source: IMF 2012 Apr.)

## 2) Foreign Exchange trend





### 3) Copper – Price /Supply & demand balance

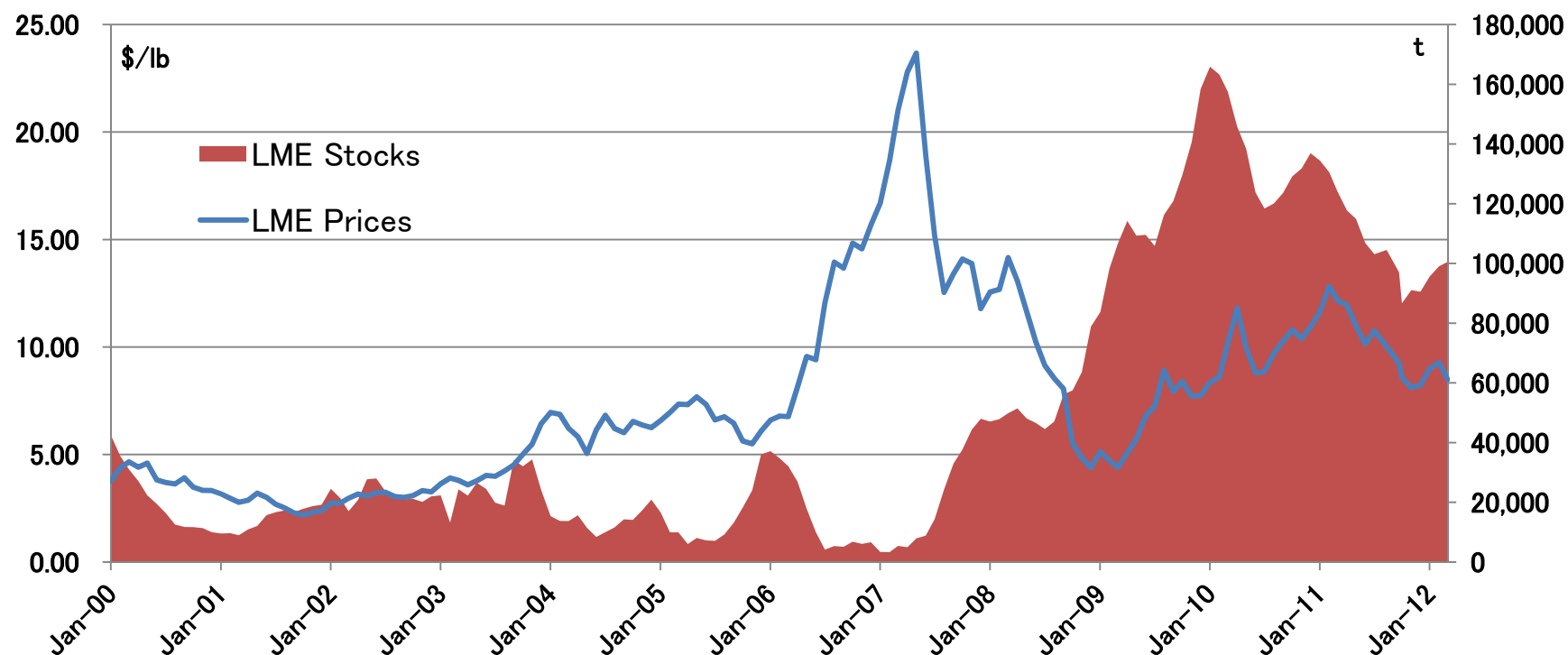


[ICSG Estimation 2012/4]

	2011	2012	2013
Production	19,650	20,149	21,549
Usage	19,885	20,386	21,188
Balance	▲235	▲237	361

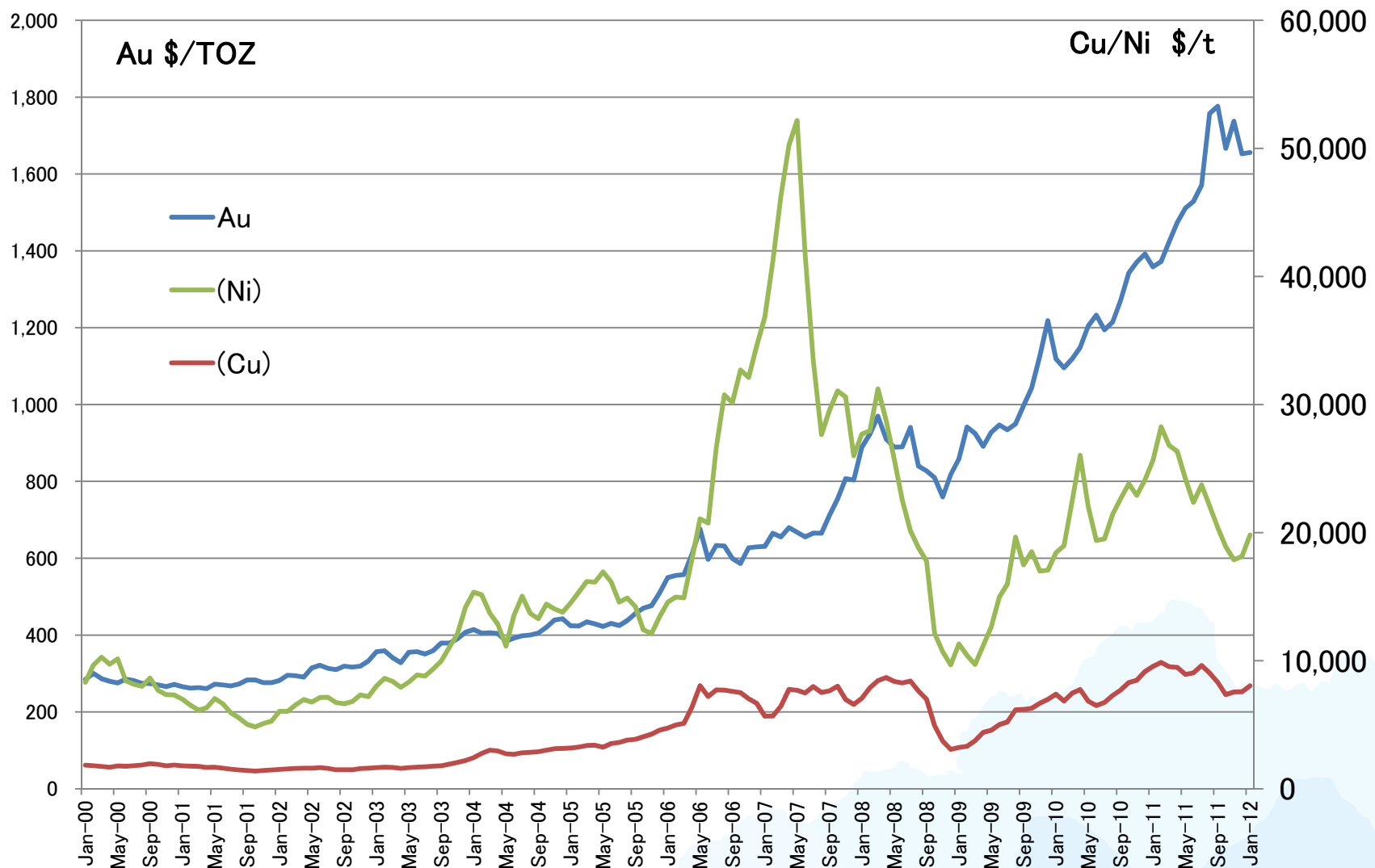
(kt)

## 4) Nickel – Price / Supply & demand balance



	INSG Estimation 2012/4(kt)			SMM Estimation 2012/4(kt)		
	2010	2011	2012	2010	2011	2012
Production	1,440	1,600	1,694	1,425	1,605	1,725
Usage	1,480	1,573	1,640	1,488	1,582	1,670
Balance	▲40	27	54	▲63	23	55

## 5) Au - Price



## IV. Financial Highlights, Sensitivity and Information Materials



**Sierra Gorda Canteen at camp**

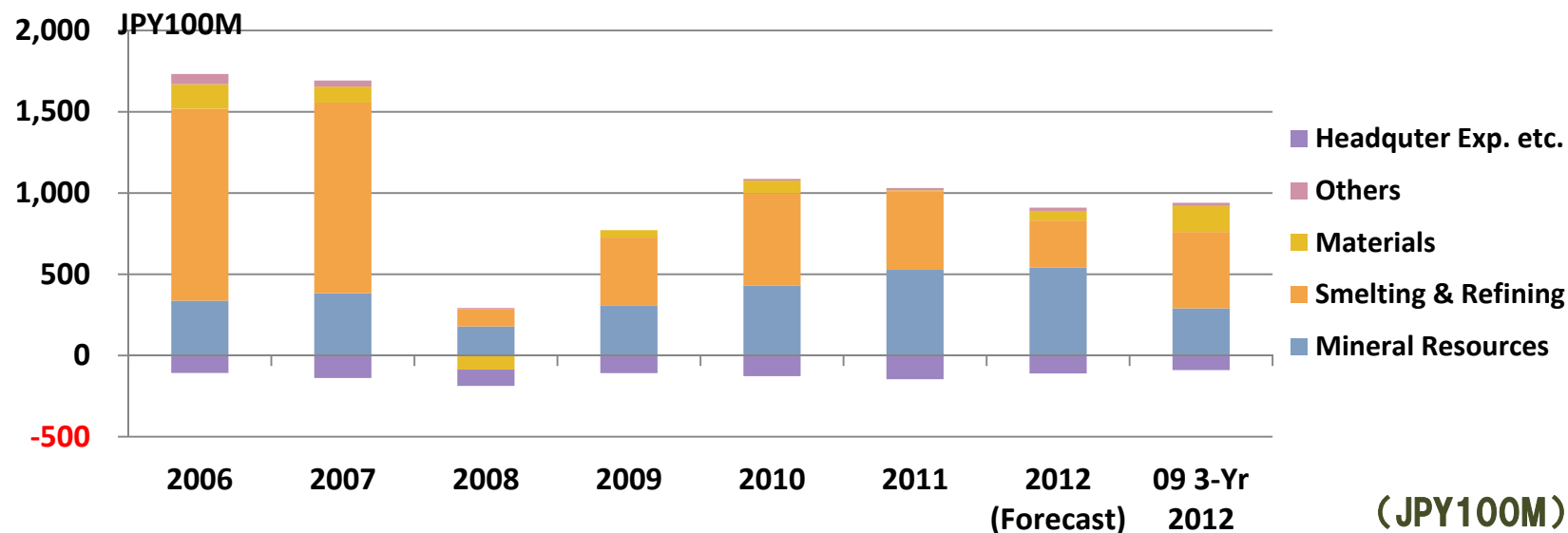
# 1) Trends of financial summary

(JPY100M)

	2006	2007	2008	2009	2010	2011	2012 Forecast	09 3-Yr 2012
Net Sales	9,668	11,324	7,938	7,258	8,641	8,479	8,140	7,800
Operating Income	1,626	1,554	105	663	960	885	800	850
Recurring Profit	2,053	2,179	326	878	1,237	1,088	920	1,100
Equity Method profit	467	740	315	261	348	232	160	300
Net Income	1,261	1,378	220	540	840	652	680	700
ROA(%)	14.8	13.6	2.2	5.8	8.3	5.9	N/A	6
ROE(%)	29.0	25.4	4.0	9.9	13.8	10.1	N/A	10
Dividend Per Share(¥)	27.0	30.0	13.0	20.0	32.0	28.0	28.0	N/A
Copper (\$/t)	6,970	7,584	5,864	6,101	8,140	8,485	8,500	6,000
Nickel (\$/lb)	14.0	15.5	7.5	7.7	10.7	9.6	8.0	8.0
Gold (\$/Toz)	629	766	867	1,023	1,294	1,646	1,650	1,000
Zinc (\$/T)	3,579	2,986	1,560	1,934	2,187	2,101	2,000	2,000
Exchange(¥/\$)	117.0	114.4	100.7	92.9	85.7	79.1	80.0	90.0

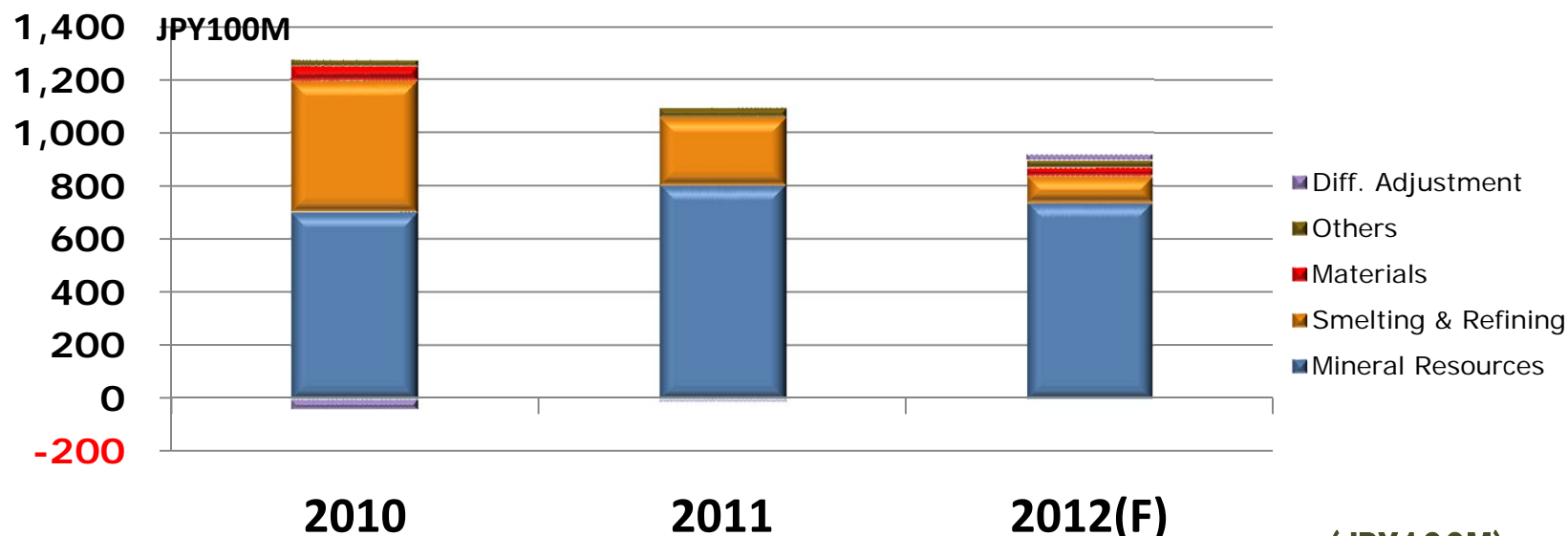


## 2) Operating income by segment



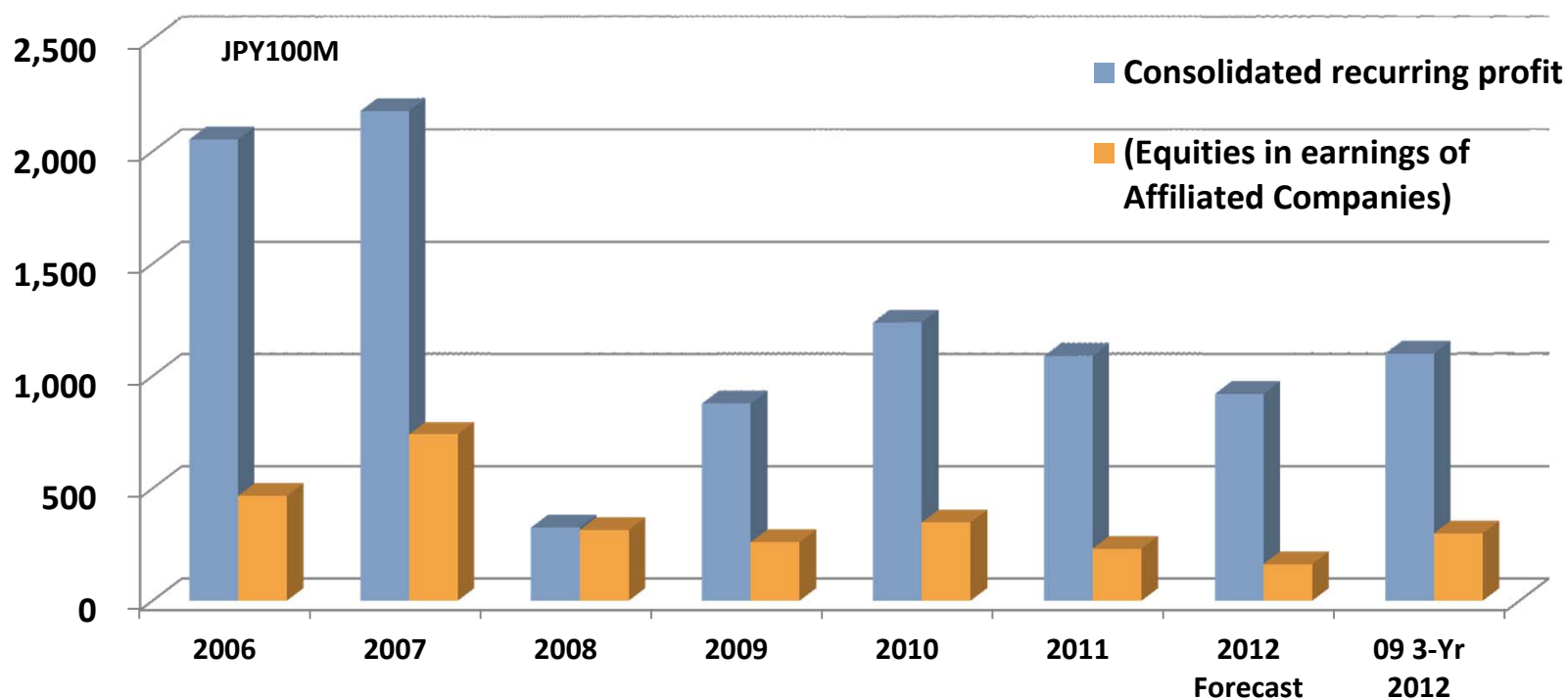
	2006	2007	2008	2009	2010	2011	2012 Forecast	09 3- Yr 2012
Mineral Resources	337	383	179	309	430	527	540	290
Smelting & Refining	1,181	1,174	107	417	569	480	290	470
Materials	152	98	▲87	45	78	10	60	150
Others	63	37	6	▲1	10	14	20	20
Headquarter Exp. etc.	▲107	▲138	▲100	▲107	▲127	▲146	▲110	▲80
Op. income Total	1,626	1,554	105	663	960	885	800	850

### 3) Contribution margin by segment



		(JPY100M)		
		2010	2011	2012 Forecast
Contribution Margin	Mineral Resources	704	805	740
	Smelting & Refining	495	257	100
	Materials	54	▲3	30
	Others	23	34	30
Diff. Adjustment		▲39	▲5	20
Recurring Profit Total		1,237	1,088	920

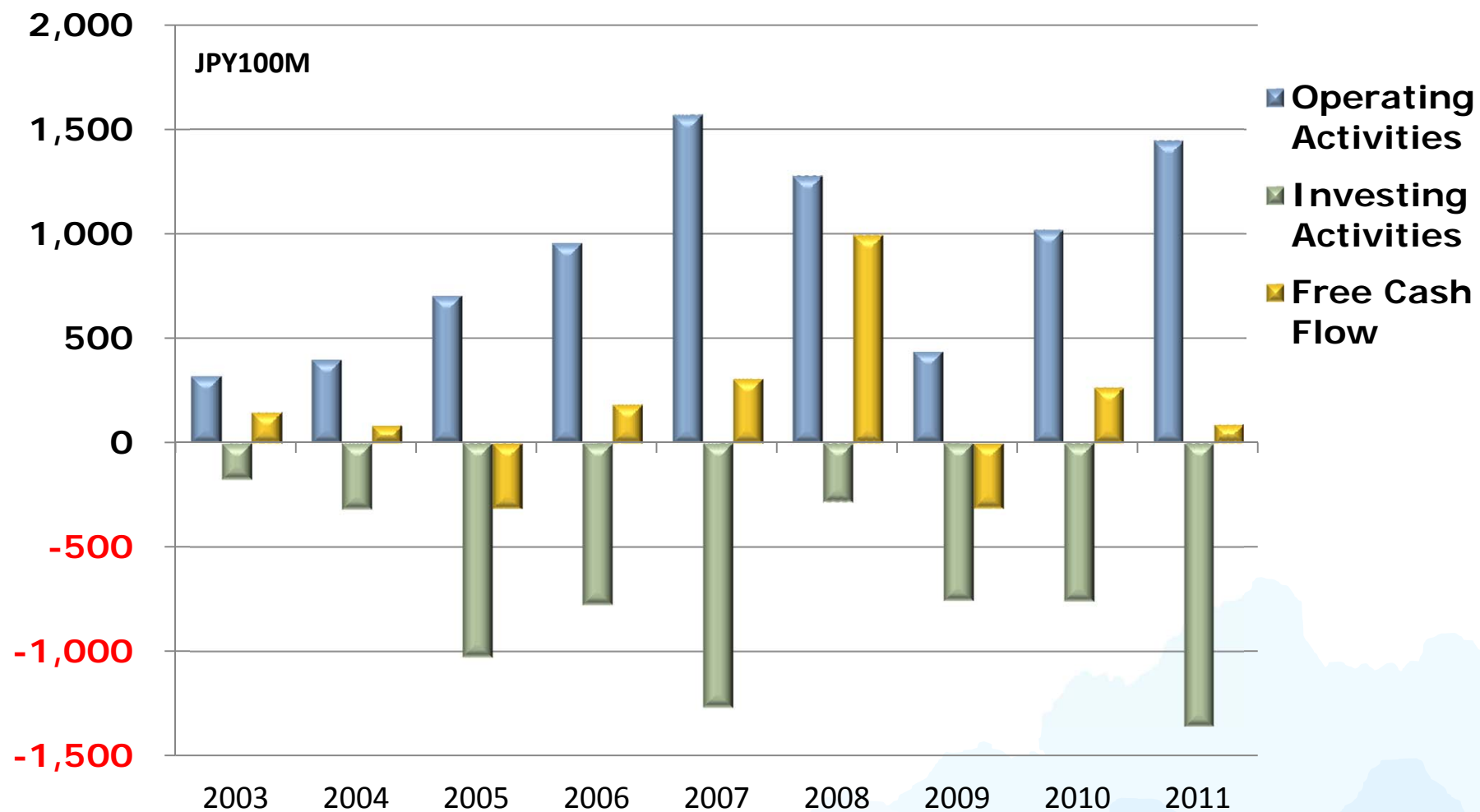
## 4) Earnings from Equity in affiliated Companies



(JPY100M)

	2006	2007	2008	2009	2010	2011	2012 Forecast	09 3-Yr 2012
Recurring Profit	2,053	2,179	326	878	1,237	1,088	920	1,100
(Equities in earnings of Affiliated Companies)	467	740	315	261	348	232	160	300

## 5) FCF



## 6) Sensitivity

(JPY100M/Year)

	Fluctuation	FY2012 Profit up/down
Cu	±100\$/t	5/10
Ni	±10¢ /lb	8/9
Au	±10\$/TOZ	4/4
¥/\$	±¥1/\$	11/11

(Remarks)

Operating income/Recurring profit

USD/JPY translation applied to RC-related only.

(Overseas profit effects excluded).



# 7) Glossary

## Mineral resources and metals

### 1) Metal trading

#### London Metal Exchange (LME)

The LME specializes in trading of non-ferrous metals such as copper, nickel, aluminum, lead and zinc. The LME trading prices for metals are used as the international pricing benchmarks for sales of refined metal and purchases of refining ores.

#### TC/RC

Treatment Charge (TC) and Refining Charge (RC) are commonly used in the terms of purchase for copper concentrate or nickel ore for refining. They are amounts designed to cover refining costs. For example, copper concentrate contracts may define a purchase price based on the LME price at a certain date, minus the TC or RC being used at the time.

#### London fixing

Gold is not traded on the LME. Its price is determined for each transaction between market participants. The financial institutions in the London Bullion Market Association (LBMA) agree a standard price for gold based on these transactions and publish it on the morning and afternoon of each trading day. This “London fixing” price is the benchmark for trading in gold.

#### Pound (lb)

Part of the imperial system of measures, the pound is the standard unit of weight used in measuring and pricing base metals such as copper and nickel, and in TC/RC calculations. One pound is equal to 453.59 grams; an imperial ton equals 2,204.62lb.

#### Troy ounce (toz)

The troy ounce is the standard unit of weight for precious metals such as gold and silver. It equals approximately 31.1 grams. It is named after Troyes, a city in the Champagne region of central France that was the site of a major market in Europe in medieval times. Originally used as a unit of exchange for valuing goods in terms of gold or silver weights, the troy ounce is still used today in gold trading.

### 2) Metal refining

#### Smelting and refining

Refining processes extract valuable metals from ores or other raw materials. They fall into two basic types: hydrometallurgical (wet) and pyrometallurgical (dry). At SMM's Toyo facilities in Ehime Prefecture, the copper concentrate pre-processing undertaken at Saijo uses pyrometallurgical processes and the nickel refining at the Niihama site uses hydrometallurgical processes entirely. The term ‘smelting’ is used for the extraction of metal from ores using melting and heating (pyrometallurgy). The term ‘refining’ refers to any process that increases the grade or purity of a metal.

#### Pyrometallurgical refining

The precursor ore is melted at high temperature in a furnace, and refining techniques are applied to separate the metal in a molten state. Although large amounts of ore can be processed at one time, the equipment needs periodic maintenance for heat proofing.

#### Hydrometallurgical refining

The ore and impurities are dissolved in a solution, and chemical reactions are used to separate out the metal. This approach allows continuous and stable refining, but incurs additional costs due to the refining chemicals consumed.

### 3) Metal ores

#### Sulfide ores

These ores contain copper, nickel or other metals chemically bonded to sulfur. Since the application of heat breaks these bonds, releasing the sulfur, such ores are generally refined using pyrometallurgical techniques.

#### Oxide ores

These ores contain metals in oxidized forms. Unlike sulfide ores, oxides need much more energy to achieve melting. For this reason, the hydrometallurgical approach is generally used to refine these ores.

#### Copper concentrates

Used as raw materials in copper smelting, copper concentrates have a copper content of about 30% by weight. The remainder consists mostly of sulfur and iron. Copper concentrates are made mostly from sulfide ores. Ores extracted from overseas mines have a typical grade of about 1%. The ores are then “dressed” at the mine to increase the purity and produce concentrate. Most of the copper ores imported by SMM for smelting in Japan are concentrates.

#### Nickel oxide ores

Whilst the higher-grade sulfide ores are used predominantly in nickel refining, nickel oxide ores are more prevalent than nickel sulfides. The sulfide-oxide ratio in current nickel reserves is believed to be about 3:7. High refining costs and technical issues have limited use of oxide ores in nickel refining to date, but SMM has succeeded in refining nickel from low-grade oxide ores based on HPAL technology.

#### Mixed sulfide (MS) ores

CBNC produces a mixed nickel-cobalt sulfide intermediate containing about 60% nickel by weight. This is used as a raw material in electrolytic nickel production.

#### Matte

A matte is another term for metal sulfides. For raw material, electrolytic nickel production at SMM also uses a nickel matte (of about 75-80% purity) sourced from PT Inco.

#### Proprietary ore ratio

This ratio is the proportion by volume of ore procured from overseas mining interests relative to the overall volume of smelting ores used as raw materials. Typically, off-take rights are proportional to the equity interest in a mine. In the case of Cerro Verde, SMM has secured 50% off-take rights for the first ten years of production from 2006, based on a 21% equity interest.

# 7) Glossary

## 4) Nickel production process

### Coral Bay Nickel Corporation (CBNC)

Based in the Philippines, this SMM subsidiary produces mixed nickel-cobalt sulfides using HPAL technology and exports the raw materials to the SMM Group's nickel refining facilities in Niihama, Ehime Prefecture.

### High Pressure Acid Leach (HPAL)

HPAL technology enables the recovery of nickel from nickel oxide ores that traditionally were difficult to process. SMM was the first company in the world to apply it successfully on a commercial scale. The oxide ores are subjected to high temperature and pressure and reacted under stable conditions with sulfuric acid to produce a nickel-rich refining intermediate.

### Matte Chlorine Leach Electrowinning (MCLE)

MCLE is the technology used in the manufacturing process at SMM's nickel refinery. The matte and mixed sulfide ores are dissolved in chlorine at high pressure to produce high-grade nickel using electrolysis. MCLE is competitive in cost terms, but poses significant operational challenges. Other than SMM, only two companies are producing nickel based on this kind of technology.

## 5) Main applications for metals

### Copper

Copper is fabricated into wires, pipes and other forms. Besides power cables, copper is used widely in consumer applications such as wiring in vehicles or houses, and in air conditioning systems.

### Electrolytic nickel

This form of nickel, which has a purity of at least 99.99%, is used in specialty steels, electronics materials and electroplating, among other applications. SMM is the only producer of electrolytic nickel in Japan.

### Ferronickel

Ferronickel is an alloy containing nickel (about 20%) and iron. Its main use is in the manufacture of stainless steel, which is about 10% nickel by weight. Based in Hyuga, Miyazaki Prefecture, SMM Group firm Hyuga Smelting produces ferronickel.

### Gold

Gold is in demand worldwide for investment and decorative purposes. Gold is widely used in Japanese industry within the electronics sector because of its high malleability and ductility. Part of SMM's gold production goes to SMM Group companies engaged in fabricating and selling bonding wire.

## Semiconductor and advanced materials

### Copper-clad polyimide film (CCPF)

CCPF is a polyimide film that is coated using a copper base. It is used as a material for making COF substrates. SMM commands a global market share of over 70% of the CC PF supplied for use in large liquid crystal displays.

### Chip-on-film (COF) substrates

COF substrates are electronic packaging materials used to make integrated circuits for LCD drivers. They connect these circuits to the LCD panel.

### Lead frames (L/F)

Lead frames are electronic packaging materials used to form connections in semiconductor chips and printed circuit boards. They contain thin strips of a metal alloy containing mostly nickel or copper.

### Bonding wire

Composed of gold wire that is just a few micrometers thick, bonding wire is used to make electrical connections between lead frames and the electrodes on semiconductor chips.

### Secondary batteries

Secondary batteries are ones that can be recharged and used again. SMM supplies battery materials that are used in the anodes of nickel metal hydride batteries and lithium-ion rechargeable batteries, which supply power for hybrid vehicles or notebook computers, among other consumer applications.

# Note

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