Approach to rare earths issues

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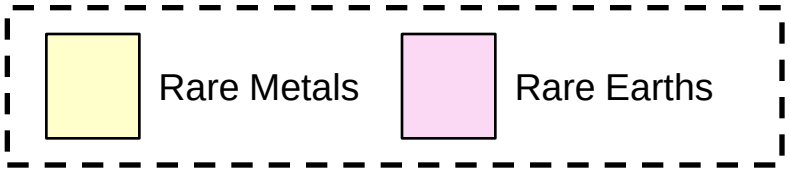
What is “Rare Earths” ?



1																	18
1 **H** 1.008	2											13	14	15	16	17	2 **He** 4.0026
3 **Li** 6.94	4 **Be** 9.0122											5 **B** 10.81	6 **C** 12.011	7 **N** 14.007	8 **O** 15.999	9 **F** 18.998	10 **Ne** 20.180
11 **Na** 22.990	12 **Mg** 24.305	3	4	5	6	7	8	9	10	11	12	13 **Al** 26.982	14 **Si** 28.085	15 **P** 30.974	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.948
19 **K** 39.098	20 **Ca** 40.078	21 **Sc** 44.956	22 **Ti** 47.867	23 **V** 50.942	24 **Cr** 51.996	25 **Mn** 54.938	26 **Fe** 55.845	27 **Co** 58.933	28 **Ni** 58.693	29 **Cu** 63.546	30 **Zn** 65.38	31 **Ga** 69.723	32 **Ge** 72.63	33 **As** 74.922	34 **Se** 78.96	35 **Br** 79.904	36 **Kr** 83.798
37 **Rb** 85.468	38 **Sr** 87.62	39 **Y** 88.906	40 **Zr** 91.224	41 **Nb** 92.906	42 **Mo** 95.96	43 **Tc** (98)	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57-71 *	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89-103 #	104 **Rf** (265)	105 **Db** (268)	106 **Sg** (271)	107 **Bh** (270)	108 **Hs** (277)	109 **Mt** (276)	110 **Ds** (281)	111 **Rg** (280)	112 **Cn** (285)	113 **Uut** (284)	114 **Fl** (289)	115 **Uup** (288)	116 **Lv** (293)	117 **Uus** (294)	118 **Uuo** (294)

* Lanthanide series	57 **La** 138.91	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.36	63 **Eu** 151.96	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.05	71 **Lu** 174.97

Examples of Global Supply Chain (1)

➢The supply chain is integrated on a global scale.

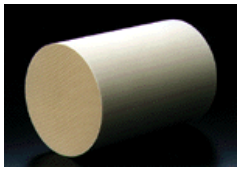
Personal Computer

Abrasives → Hard disk platters (Japan) → Hard disk drives (U.S.) → Personal Computers (China)

Rare earth
- Cerium oxide

Exhaust Gas Catalysts

Catalyst material → 3-way catalysts (Japan & EU) → Catalytic converters → Automobiles (Worldwide)



Rare earth
- Cerium carbonate

Optical Glass

Glass material → Optical glass (Japan) → Digital Cameras

Rare earths
- Lanthanum oxide

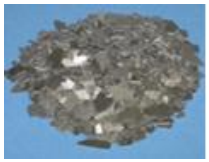
Examples of Global Supply Chain (2)

Permanent Magnets

Japan

Magnet material → Magnet alloy → Permanent magnets → Motors → Automobiles / Hard disk drives / Wind-power generation

Rare earths
- -Dysprosium metal
- - Neodymium metal
- - Samarium metal

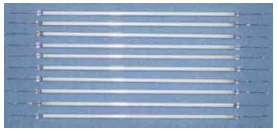





Phosphor

Phosphor material → Phosphor → CCFL (Cold-cathode fluorescent lamps) / Fluorescent lights → Flat Panel Displays

Rare earths
Yttrium oxide
Europium oxide
Terbium oxide

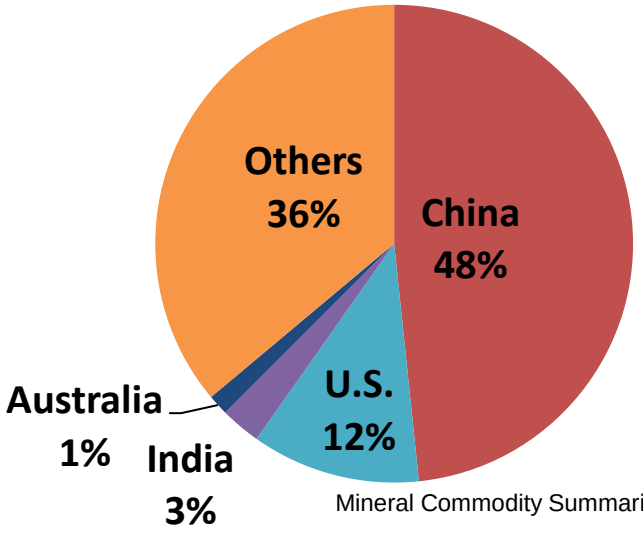
Fluid Catalytic Cracking (FCC) Catalyst

Catalyst material → FCC catalyst → Oil refineries

Rare earths
- Lanthanum oxide
- Cerium chloride

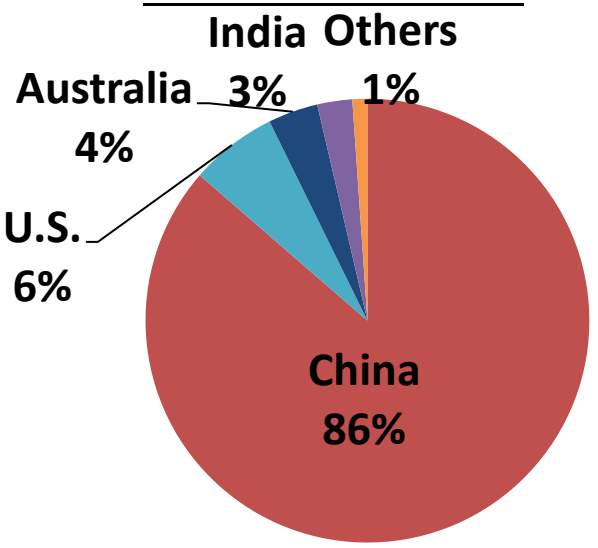

Current Situation on Rare Earths

Global Deposits



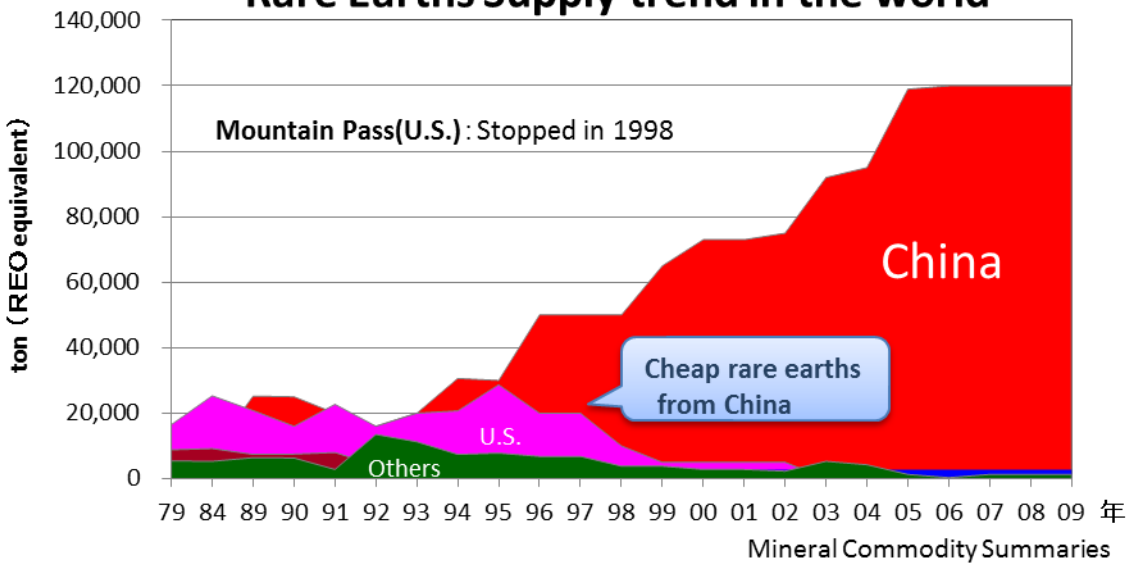
Mineral Commodity Summaries2013

Global Production



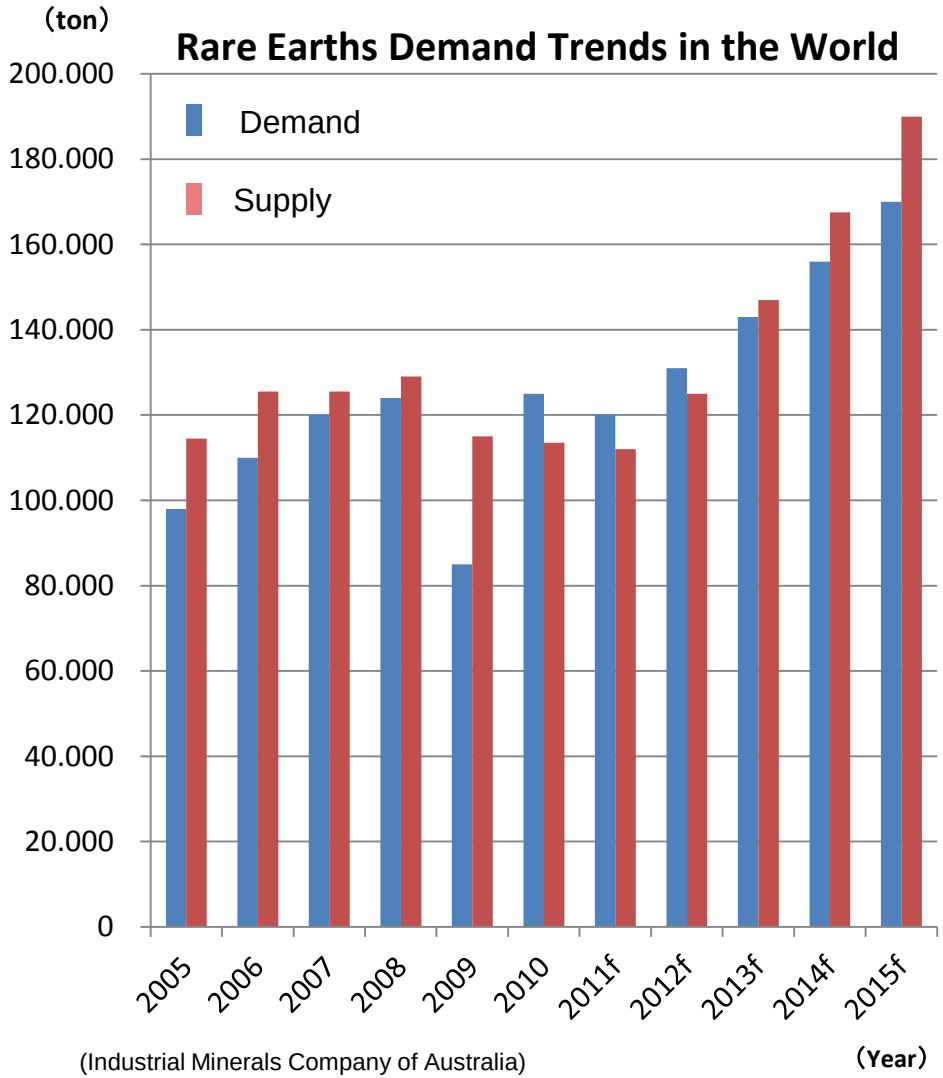
Mineral Commodity Summaries2013

Rare Earths Supply trend in the world

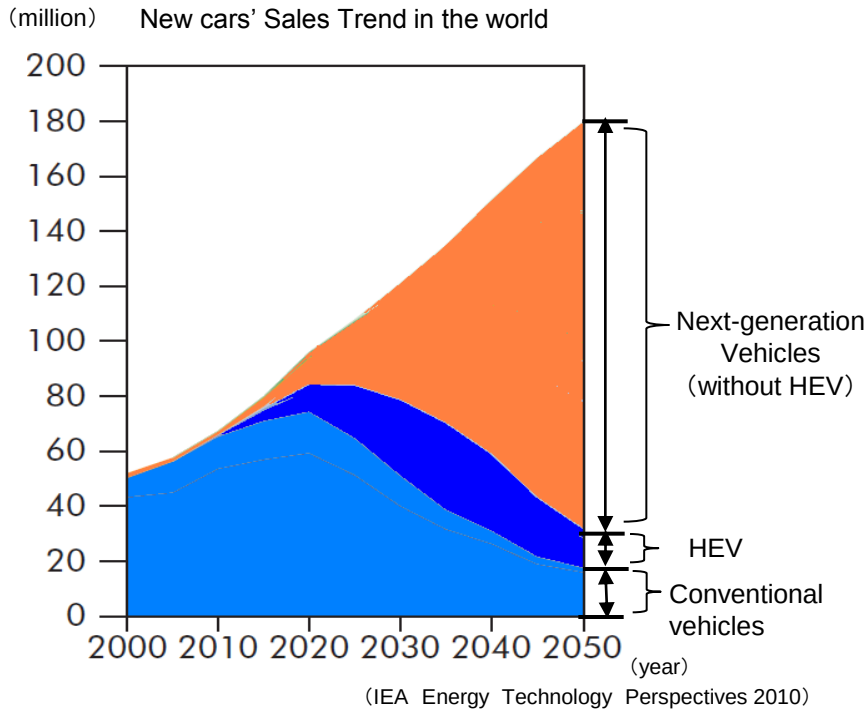


Rare Earths Demand Trends in the World

➢The demand for rare earths is expected to increase due to the popularization of hybrid vehicles, electric vehicles and wind-power generation.



(Industrial Minerals Company of Australia)

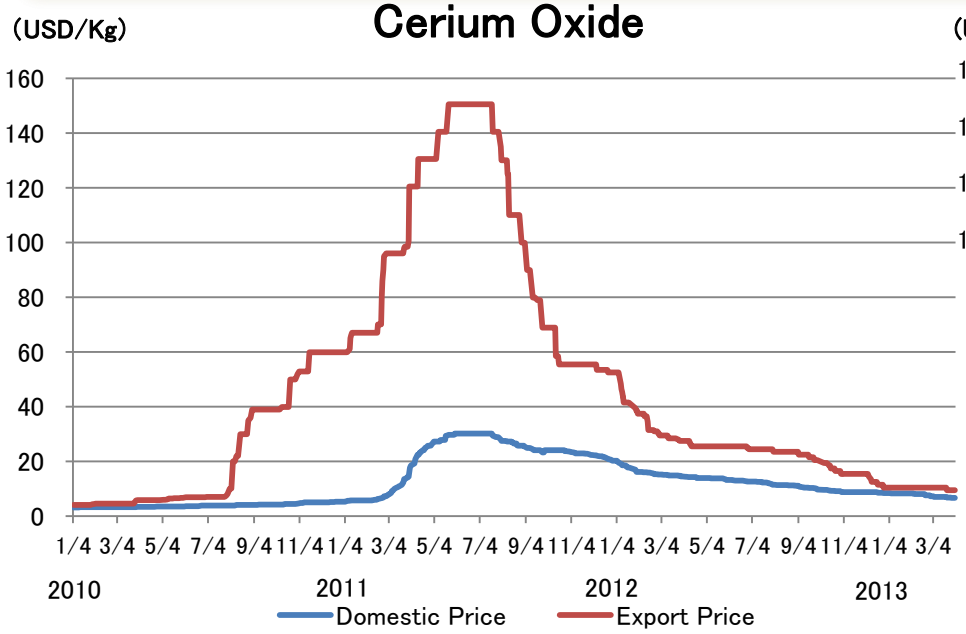


(IEA Energy Technology Perspectives 2010)

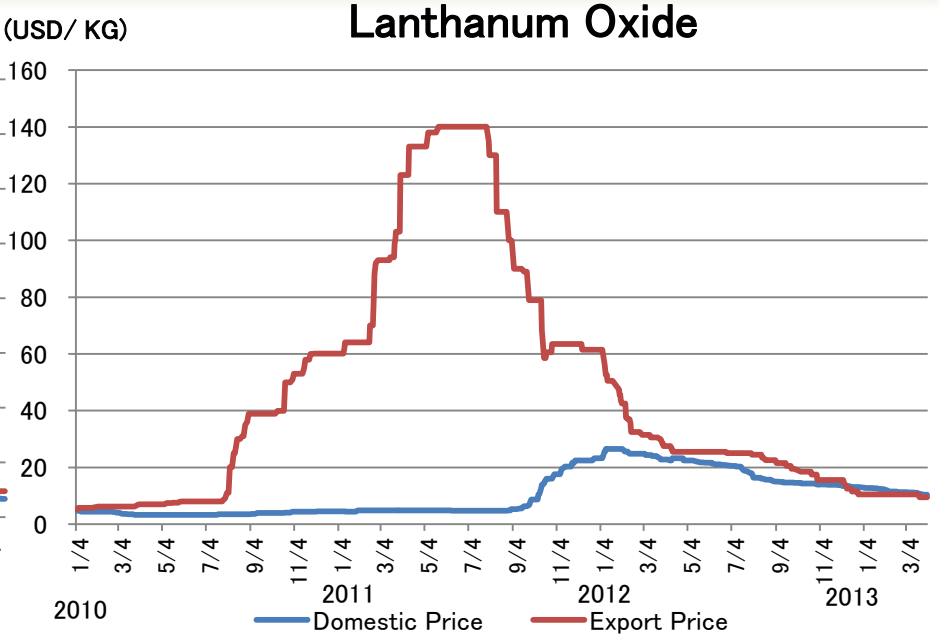
The prices of Rare Earths

(Asian Metal)

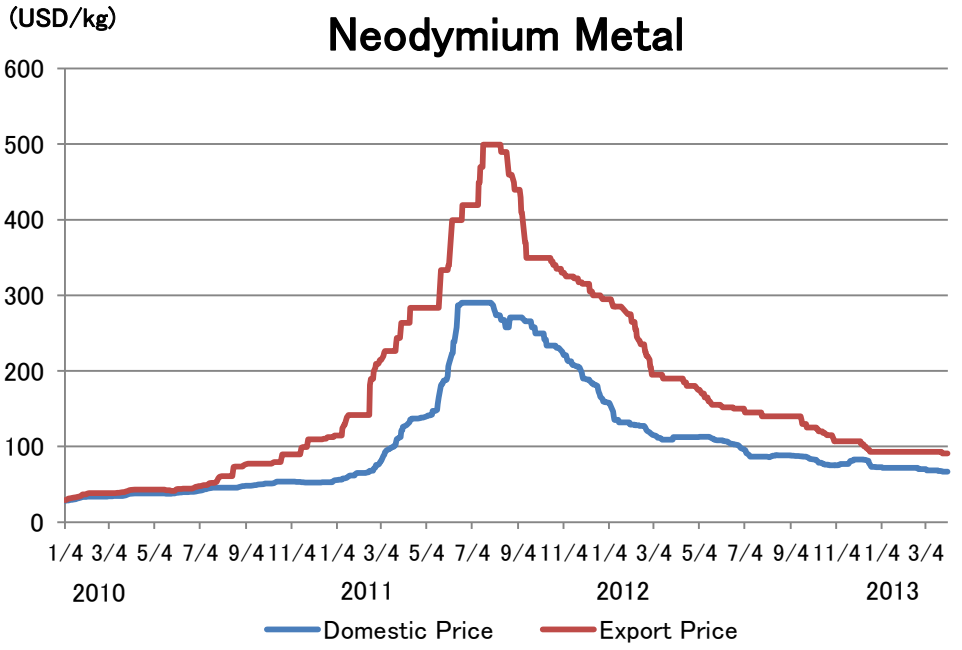
Cerium Oxide



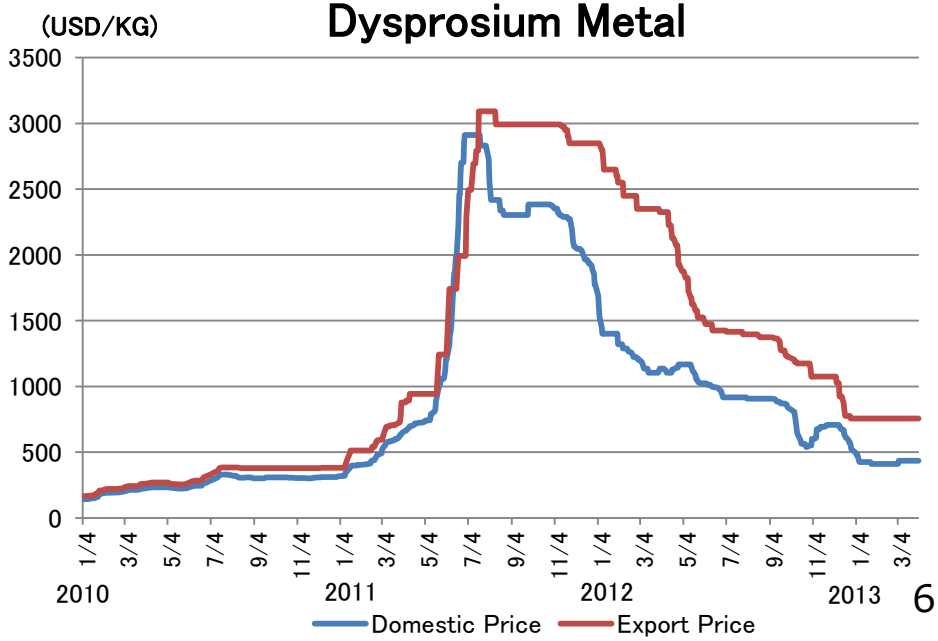
Lanthanum Oxide



Neodymium Metal



Dysprosium Metal



Measures for Consuming Countries

- Rare earths consuming countries need to take the following measures, “ABCD+R”.

Alternatives : use substitute materials

Broader international cooperation

Conservation : Reducing resource use

Diversifying supply sources

Recycling

Policy Packages to Secure Rare Earths

FY 2010

*1USD = 100JPY

1. Development of substitute materials and technologies to reduce resource use — **US$120 million** — A C

2. Promotion of introducing manufacturing facilities to reduce resource use and use of substitute materials — **US$420 million** — A C R

3. Diversifying supply sources of rare earths and other scarce resources — **US$460million** — D

FY 2011

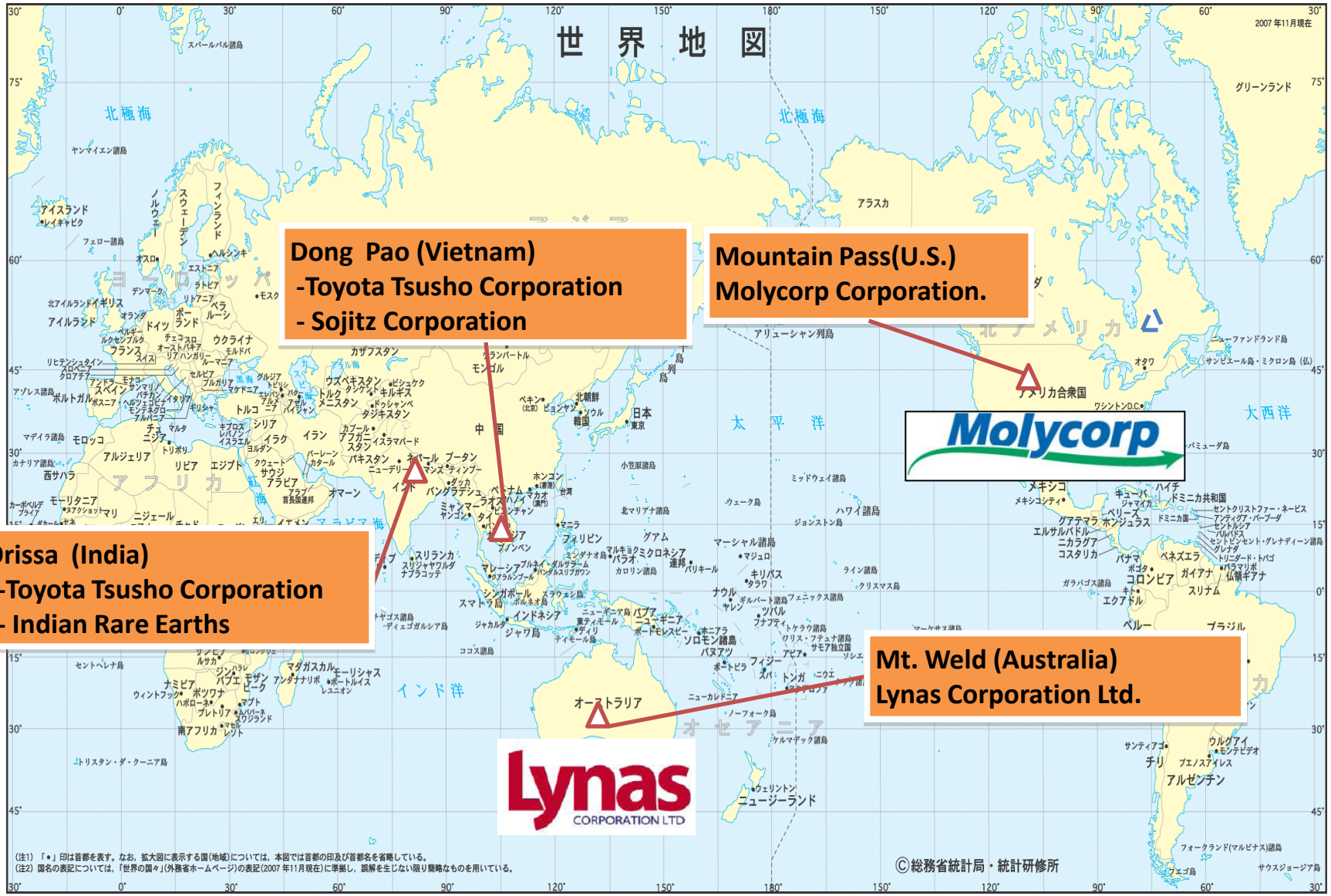
1. Development of substitute materials and technologies to reduce resource use — **US$85million** — A C

FY 2012

1. Development of substitute materials and technologies to reduce resource use — **US$3million** — A C

Global Rare Earths Projects

Diversifying supply sources



Policy Packages to Secure Rare Earths and Other Scarce Resources 2013

FY 2013

Development Rare Earth Free Motors

US$30million

A C

As the first project of "the future development research system※", they develop the Rare Earth Free Magnets through the industry-university-public cooperation. As for the motors, they design and product trial manufactures to develop the motors which can reduce a energy-loss by 25%.

※ the future development research system；Japan promotes the project which need more than 10 years to turn to practical use.

Development of substitute materials and technologies to reduce resource use

US$8.2million

A R

Establishment of the sustainable recycle route and technology of dismantling.
Recycle the motors for air-conditioners and vehicles.

Conclusions

- It is expected that demand for rare earths will increase with the popularization of hybrid electric vehicles, electric vehicles, wind power generators, etc.

- It is important to share the correct understanding of the effects of rare earths issues on global industries throughout the supply chain.

- We need to achieve the sustainable Rare Earths industrial world for not only consuming countries but also resource countries through bilateral cooperation. Whole world should be blessed with Rare Earths.