



UNIVERSITY  
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Asia - Europe Institute

# Rare Earth: Towards a Greener Future

AEI Occasional Paper 12

Dato' Mash'al Ahmad

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### ***“Rare Earth: Towards a Greener Future”***

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# **Rare Earth: Towards a Greener Future**

Dato' Mash'al Ahmad

Bismillahirrahmanirrahim, Assalamualaikumwarahmatullahiwabarakatuh, distinguished guests, members of the press, ladies and gentlemen.

I'm sure many of you are here today with a lot of questions. Therefore, my objective today is to provide you with satisfactory answers by the time you leave the hall. I hope I will be able to answer your questions so that you can go home and sleep in content. Nevertheless, before I begin, allow me to officially invite members of the press to put on record that I am inviting members of the public to raise questions about the operations of Lynas. I have with me here Professor Ismail Bakhari, a Nuclear Scientist, and my General Manager of Communications, En. Amin. This lecture is also to invite members of the public to come and visit Lynas because you have half a day to see and touch for yourself. To see and touch is different from just knowing the theory. Due to time constraint, I shall now begin.

For your information, I am the Managing Director of Lynas Malaysia as well as the Vice President for Lynas Australia. The amount of money that we have spent to build the plant is as of today, 2.5 billion. Normal operations cost 600 million ringgit per year. There are 354 permanent staff and 100 employees with technical degrees ranging from Bachelor to PhD. I have daily contract staff of about 200 people, and Lynas Malaysia is 100 percent maintained by Malaysians, except for four rare earth experts from China and one rare earth expert from India.

In this industry where Lynas has spent RM 2.5 billion, raw material is needed. Because of this raw material requirement, the supplier has to build an acid plant which will increase the cost to touch RM 3 billion. Lynas is receiving technical support from Rodia in France. Rodia's plant has been in operation since 1960. With regard to technology, as Dato' has correctly mentioned, my career growth has been in operating plants. I have operated ICI Malaysia; for ICI Australia I built an ammonia urea plant, LNG, refinery you name it. However, in the context of technology, the Rare Earth plant is nothing compared to the plants that I have

been involved in. You talk about LNG, refinery, chemical plant, the Lynas plant is nothing but a series of fibre glass tanks or open concrete tanks. In other words, the pressure is atmospheric pressure. Hence, my first point is that the plant is operating at atmospheric pressure, so there can be no explosion. Secondly, we operate in ambient temperature, meaning you do not have the source to cause emission. Thirdly, when I was a General Manager at LNG, the products that flowed through the sites were quite hazardous, but here the products have been made with sulfonated kerosene ensuring that they do not easily catch fire.

In addition, this is a proven technology taken from Rodia which has been operating for the past 50 years until now. The only difference lately is that they have moved their plant and operations to China. Otherwise, it is all the same. One distinction we have compared to the Rodia plant is that we have scaled up five to six times of what they have. Some people have compared Lynas to Fukushima, a nuclear plant and I always ask them, *Excuse me, have you seen a nuclear plant? If you have not seen a nuclear plant, how could you make such a statement?* The fact is these plants operate at atmospheric pressure and ambient temperature and the products we flow through are not easily flammable. Besides that, the technology is 40 to 50 years old, which is nothing new. All these would give you the basics of what the Lynas plant is all about.

As we know, today China controls about 65% to 67% of the rare earth market. In other words, those who want to use rare earth products have to go to China. The issue is that when you go to China, China is reforming and going all out in complying with international environmental standards. When Lynas becomes operational, Lynas would take 20% of the world market and its operations would comply entirely with local and international environmental regulations. Therefore, you will find big names coming to us, auditing us and confirming that we are compliant and our products can then be labeled as green products. You cannot label your product as a green product if your source of supply or any part of your process does not comply with the World International Environmental Standard. So, today Lynas is the only producer that is compliant and Lynas has been audited by seven different professional bodies. In addition to being compliant with Malaysian law, Lynas also adheres to international regulations. Why? Because of all of our customers, not a single one is in Malaysia; they are all international. So when you go and sell your product to big names, you have to comply with international requirements. Next, we were audited by the most authoritative body in the world that is IAEA (The International Atomic Energy

Agency) as regard to anything radioactive. Moreover, we were also audited by a panel of experts set up by the Malaysian Government that comprises Government agencies, professors from various universities, experts from the Geology Department, the Water Department and from the Public Works Department etc. Then came the Parliamentary Audit Committee, again bringing a team of specialists to audit, followed by another team of experts to look at all the civil structure. The latest one we have is what they call a watchdog committee. This is a public watchdog committee comprising of various Government agencies and NGOs, whether they are pro or anti-Lynas. This auditing by the seven bodies is inclusive of the watchdog committee which continually monitors our process. Nonetheless, to me the most important audit is by our customers because they are the ones who are going to buy our products. Apart from the seven institutional audits, the customers have also audited us.

It is forecasted that rare earth supply would increase by about 5 to 6%. As I have mentioned earlier, the demand in the rare earth market today is about 1200 metric tonnes and we are packing 20% of the world market. Lynas promotes the use of green technology, but this becomes confusing because of the public misconception that all rare earth products that are produced or out there in the world are radioactive.

Rare earth products are not radioactive. The problem lies in the raw material that is used to make a rare earth product. When you look at the periodic table, the rare earth element is found in between uranium and thorium. That is the problem, not the rare earth itself. Thus, when people ask me, *Is your rare earth the same like the Asian rare earth?* My answer is, *We make the same final product, but the raw material is different.* If you start safe, you will remain safe. The first issue we have to consider here is whether the Lynas raw material has a high percentage of uranium and thorium. Secondly, would the raw material still be fissible with the uranium and thorium contained in it? When I brief the local communities or villagers about this, I would say that it is like a durian, where the thorns are the uranium and thorium but the inside is very nice. I have to engage experts to prove that the accusations were wrong and then they come up with other accusations. The fact is, if you base this issue on international and national knowledge, there is no problem. When critics start to say to me, *You are the same as the Asian rare earth,* I will reply, *No, we produce the same product, but the raw material that they use is amah (tahi bijih) which is 40 times more radioactive than ours.*

What is so special about the Lynas raw material? First of all, we have 70% of it. The most important thing is the amount of uranium and thorium in the raw material. The thorium is about 60 hundred ppm, and the percentage is about 0.165%, while the uranium is about 30 ppm. The next question is, what do uranium and thorium do? They cause radiation at six Becquerel per gram. Malaysia follows the international law where anything above one Becquerel per gram is considered radioactive. Lynas is 6% Becquerel per gram, therefore, the Lynas raw material and its waste has no enrichment.

What does six Becquerel do to the workers and the public? In the plant, we have installed proper equipment to ensure that the workers and the public are safe. Yes, six Becquerel per gram creates radiation, but how much radiation? The radiation created is at 0.002 millisieverts per year. This only occurs if all the equipment fails. If the equipment is functioning normally, nothing will happen. However, if you are still concerned about what the 0.002 means, let us look at the following worst case scenario: If you watch television for four hours a day, you will get ten times more radiation than the 0.002 radiation you get from the Lynas plant. Moreover, if you sleep with your partner with the radiation from the television, you will get 200 times more radiation from your partner and vice versa. To continue, the limit for radiation according to Malaysian and international law is one millisievert per year; hence the worst-case scenario from my plant is still 500 times lower than this limit.

Imagine, if you go for your dental x-ray, you will be facing about 0.1 millisievert to 0.4, which is anything between 50 to 200 times. So let's look at our facts, and do not frighten the public with imaginary figures about the radiation caused by Lynas. This data comes from World Domain which can be easily verified. This is just a simple example where some people are creating unwarranted fear to the public.

Today, we have the real data, and we have been operating the plant since November 2012, which is almost a year already. Now we have obtained the actual readings. The public talk about radiation from the plant, so because of that, to appease them, I went to Vienna to buy two units of aerosol monitoring equipment. For those who frequently visit European countries that use nuclear power, for every town or village you go, you will see Dr. Bit. This equipment that measures radiation is all over Europe, in the vicinity of villages or towns. The equipment plus installation cost me one million ringgit each, which I put one in each plant and in the town. Therefore,

when you go to Kuantan, you can see the equipment there, even though we know there is no radiation. We still put the equipment for the public, as it shows real time reading and is connected online directly to the Atomic Energy Licensing Board.

After installing the equipment, everything is online and the public can drive through and see for themselves what the reading is at Kuantan and at the Lynas plant. The machine installed at the Lynas Advance Material Plant (LAMP) showed that before we started operations, the reading was 0.14 microsievert per hour. Now we have been operating for almost a year and our reading is 0.13. There is no difference at all. It is the same if you go to check the machine at Kuantan, Police District HQ where the readings before and after do not show any difference. The other charts talk about radon, thoron and what not, but these are facts and figures which cannot be disputed. The public also talk about Lynas exposing the employees to radiation. Under international law, the maximum radiation to the employees is 20 milisieverts. However, our scientists have found that our readings are actually less than that.

Moving on, I will give more examples of how paranoid and baseless people's information about rare earth can be. Some are worried about the water and even before the plant started, it was said that the fish in Balok (where the plant is situated) had two heads. But, how could this be when the plant had not even started yet? Another ridiculous assumption has it, *You know Dato'Mashal, he lost his hair because of radiation?* My response is, *No, it's because my wife pulls my hair every night, if not she will never sleep!*

Again, this shows that many people just make comments without analyzing the facts and scrutinizing the relevant documents. One naysayer contacted an institute called the German Institute of Occult which came up with a report about Lynas without even visiting the site or scrutinizing the proper documentation. How could that be? On the contrary, we do find those who do their homework like YB Dr. Che Rosli, Parliamentary Member of Hulu Langat, a UKM nuclear scientist and who actually reviewed the documents, checked the samples and reported about them on TV3 News as well as in Parliament. That is why I respect academicians like him who speak up and give credence to our efforts.

Another issue is about waste water. The Government has informed us that before operations start, we have to collect base line data. For example, for dark water, we



have to have wells at various locations in the factory and from the river upstream right into the sea. After this dark water has been collected, we have the base line data for water, air and cancer-causing radiation. This cost millions but it is to be done because it is for protection purposes. Now, if you look at the water, you will find that for each standard B, we have to comply with the Department of Environment (DOE)'s values. For example, the COD is 200 but our readings during operations are only 36, 37, 33. Mind you, all these readings are put online by the AELB, and the DOE has requested us to display the readings at a control room at the main guardhouse as well as online. Therefore, there is monitoring by the DOE online. Who obtains the results? Lynas does not measure the results. They are taken by consultants approved by the DOE. This reflects that it is independent and unbiased. With regards to air admission, the standard for total suspended solid air admission is 400 but Lynas guarantees it cannot be more than 100 where most of the time, we are getting about 40 to 45.

Ladies and gentlemen, all these readings are readily available at the site, are with the authorities, are shown in real time and are conducted by consultants approved by the government. Now, let me return to the point about why the Lynas raw material has low uranium and thorium. Prof. Ismail here together with Australian geologists have the same theory that uranium and thorium have been leaching over billions of years, thus leaving the rare earth on its own and that is why we have such phenomena. In this context, Lynas has raw material that comes with low uranium and thorium. As I have said earlier, uranium is only 30ppm and Thorium is at only 0.16%.

In an article I wrote for the Malaysia Medical Association (MAA), I said that Lynas produces three types of wastes, two of the wastes are non-radioactive, non-toxic and non-leachable so there is no issue here. The other waste is known as Water Leach Purification (WLP) waste. As we use six Becquerel per gram, therefore the waste is also six Becquerel per gram. That is the only waste residue created. Because it is six Becquerel per gram, it has radiation because it has thorium. How much thorium do we have? 0.165%. The WLP waste is 64000 tonnes per year. In an Indian article by the MAA, it was written that if you multiply 0.165% by 64000 tonnes, then Lynas produces a hundred tonnes of thorium per year. That is very dangerous. You see, when you write about radiation, it is not measured in quantity per se, but measured in concentration. So when the press asked me, how do I explain this? I will have great difficulty in explaining so what I did was to give each of them a bottle of mineral water. I told them that I put a teaspoon of sugar in the bottle and I shake it well and

asked them what the sweetness in the mineral water was. The answer was one A. Next, I asked everybody to empty their bottles into a pail. So now, we have emptied about 100 bottles. Each bottle had the sweetness of A. Now, what is the sweetness in the pail? Is it A? Or is it 100 A? The answer is A. What I am trying to show here is that we cannot simplify by just doing simple calculations and frightening people. If we have 100 times of thorium, this means we are making a nuclear plant. Again, this is what we have to be careful about when we talk, we base on data and figures.

Any Lynas product or any rare earth product is towards green technology. What is green technology? In Malaysia, we are at our infancy. If you ask me, I would say green technology is any technology that does not harm the environment. Today when you use fossil fuel, it will be burned and we get the green house effect. The idea is either you do not use it at all, or you reduce in other ways or find alternatives such as rare earth. For instance, when I was 35 or 36 years old and the GM for LMG, I used to visit Tokyo. In Japan, they have refrigeration to receive LMG from Malaysia, Brunei, Oman, Nigeria and Singapore where they have to regasify and then do the reverse. This is one way to replace and reduce fossil fuel consumption.

So now, where does rare earth come in? One of our products is sold to Ausrem, GE and Philips. They use it for energy saving, for example, energy saving bulbs where for the same lumen, you need to consume 40% of the energy but the companies use our product to reduce up to 60% of the energy. In developed countries, you have no option but to use this type of bulb if you want to reduce your consumption. Another example is when you have a magnet where you put a coil of wire to conduct electricity to become a motor. However, if you turn it, it becomes a generator. The rare earth magnet that we produce is 15 times stronger than the conventional magnet. It can be used in cars, for instance, when you move your seat in the car and what not. That is the function of the motor and the motor is very small and able to move at 100km. If you were to use the normal motor, you can imagine it will be 15 times bigger meaning that your car will consume more petrol. Using the rare earth product reduces the wastes from your car, therefore reducing fuel consumption.

The Parliament audit committee has asked whether Lynas can reserve 10% of our production for Malaysia. The issue here is if you look at all our customers, they are in Japan, Europe and America. Even if I sell today in Malaysia, there is not a single company in Malaysia that can take this product and do something with it. This is

because in Malaysia, we do not have the technology. Thus, only big companies like BMW, BSF, Rodia, Toyota, Philips and Osem have a very strong inclination towards making their products green products and want to put the green logo on their products. Therefore, they will try and find their source of material which can comply with international environment standards, such as what Lynas is offering and what China is moving towards too.

Of course, success for Lynas is important to me because of the shareholders. However, look at it this way, ladies and gentlemen, the material produced by Lynas today is exported. Why don't we make our technology in Malaysia on par with what Lynas can produce? This should be the natural progression where Malaysia makes direct use of Lynas resources rather than export them to other places and Malaysia has high esteem for intellectual property unlike some countries. Take for example, hybrid cars like Toyota Prius or Toyota Lexus, their batteries use our product, as well as all the motors inside their engines. Therefore, if Malaysia can become an industrial haven for the rare earth industry, we will obtain the technology for the betterment of the people. In addition, this would create employment opportunities for many Malaysians. The growth of the rare earth industry is only about 30 million while the hybrid car battery industry is going to grow to four billion. I am not talking about making Prius cars in our country, but allowing Malaysia to have the opportunity to bring about a natural progression in the rare earth industry.

Another comparison can be found with the auto catalytic converter industry, which is five billion growing into ten billion. This is done by the Europe-based company, Johnson Matty, which has a factory in Nilai. That is about the only thing that we have here. This should be the way for our rare earth industry whereby we produce the products here, sell them and then bring them back as renewable energy. At one time, Lynas had a 45% share in Siemens. Our objective was to build a super magnet plant next to Lynas, with an investment of about 1.8 billion to create about a thousand employment opportunities in 2002. The business model was to produce the super magnet and send to Serbia. Nevertheless, this project did not materialize because so much noise was made and people became frightened about the effects.

Here at Lynas, we are waiting for government certification. Then the next step we do is the leach ability test again to prove that it is non-leachable followed by the non-toxic test that will be confirmed by an international lab. Since we are now non-leachable,

non-toxic, non-radioactive, we work with international and local consultants like IKRAM to confirm that it can be use for road base, as per JKR specifications. Hence, the status today is that we have submitted all the results confirmed by the international lab to the government and the government is reviewing our submission. We hope they would decide soon as this is a commercial product.

Meanwhile, another major concern people have is regarding the permanent disposal facility (PDF) for the rare earth wastes. Asian rare earth waste is put into drums where their waste is 60 times stronger than ours and they put it in a permanent disposal facility at Bukit Merah. However, that is not the intention of Lynas as we would like to convert the wastes into safe commercial products. When the IEAA came, they interviewed us to find out what we are doing with the products. The IEAA reminded that there should be a plan for a PDF as a safety net. With that, we are currently submitting the plan for security. PDF is a permanent disposary facility to store what IEAA feels has very low-level residue. It will be required only if Lynas cannot convert the raw material into safe commercial products. Currently our products are waiting for government approval. PDF may be needed towards the end of the plant's life because we need to have proper storage of waste management. This requires construction design that would comply with international standard.

We have come to the end of my lecture and I hope you have come to a better understanding of what Lynas is all about.

Thank you.

# LYNAS: TOWARDS GREENER FUTURE

*Enabling eco-friendly societies worldwide*



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## ABOUT LYNAS MALAYSIA

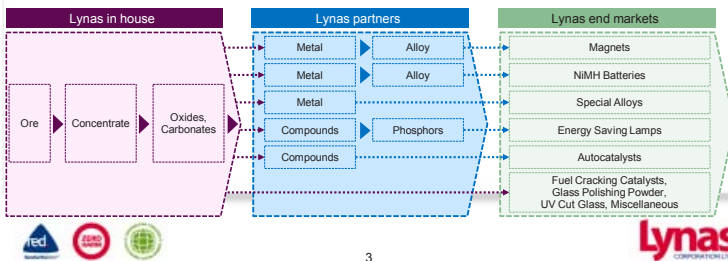
- 100 % owned by Australia (Public Listed in Sydney & New York)
- FDI = RM 2.5 Billion
- Operating Cost = RM600 million per year (local sourcing RM450 million)
- Permanent staff = 354 (around 100 technical degree holders)
- Daily contract staff = 200
- 100% manned and managed by Malaysian except 4 Chinese & 1 Indian rare earth experts
- Supporting industry added another 1000 jobs
- Lynas receives technical support from Rhodia France who has 80 years of experience in operating rare earth plant



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## What does Lynas offer the market?

A Rare Earth supply independent of China regulation
The ability for end users to enter into long term supply contracts securing quantities and prices
Specific partnerships with downstream processors in order to close and secure the supply chain to end users
Significant reserve of 1.2 million Mt of REO versus today's annual global demand of ~100 thousand Mt of REO
Auditable safety and environmental world class standards



3

## RE market outlook – key demand side trends

Based upon forecast demand in key end markets, the global RE market could grow at 5-6% per annum to 2020 with demand for some elements growing at higher rates

A number of key trends will drive the future growth of the global RE market

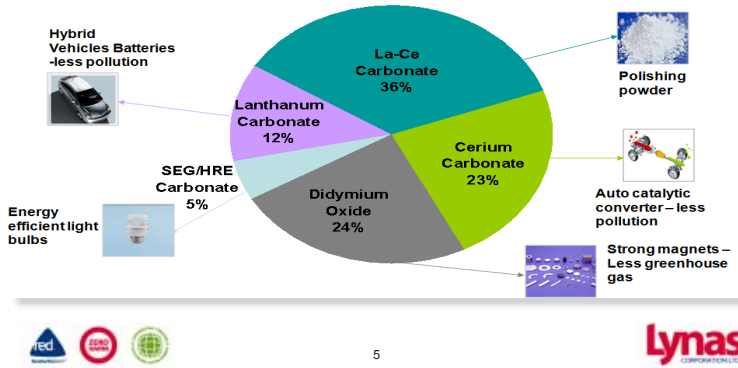
- Energy efficient and green applications continue to accelerate strong NdPr demand growth
  - Wind energy, HEV/EVs, general auto, energy efficient drives for household and industrial applications
  - This will only occur under long term sourcing sustainability of raw materials – price and quantity
- Demand for REs will continue to be supported by large market segments with steady growth rates
  - Autocatalyst market (Ce), FCC market (La)
- Increased demand for NIMH batteries in HEV cars will tighten the Lanthanum supply-demand balance
  - Toyota committed to NIMH battery technology in its market share dominating Prius HEV until at least 2018
  - NIMH is the safest rechargeable battery technology available (and does not have the same safety issues currently being experienced with the competing Li-ion technology)



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## General Overview : Products

Our business promotes a greener society



5

## General Overview : Products

Our business promotes a greener society

Improve Energy Efficiency through lower consumption



- Compact fluorescent lights
- Weight reduction in cars
- Higher oil refinery yields

Environmental Protection through emission control



- Auto catalytic converter
- Diesel additives
- Increase fuel efficiency

Enable Digital Technology smaller & more powerful



- Flat panel displays
- Disk Drives
- iPods / MP3 players

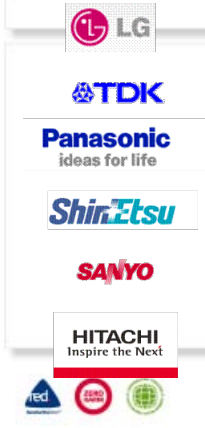


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## GREEN COMPANIES demand GREEN SUPPLIERS

### Enable Digital Technology



### Improve Energy Efficiency

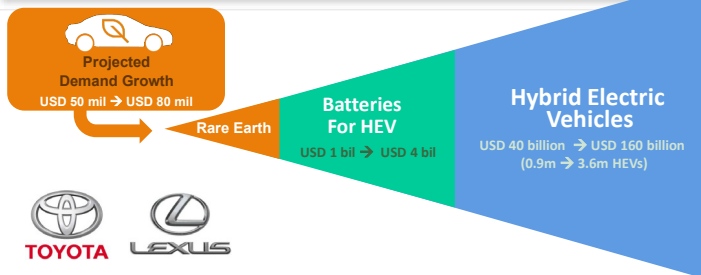


### Environmental Protection



## Magnitude Of Economic Benefits From Rare Earth

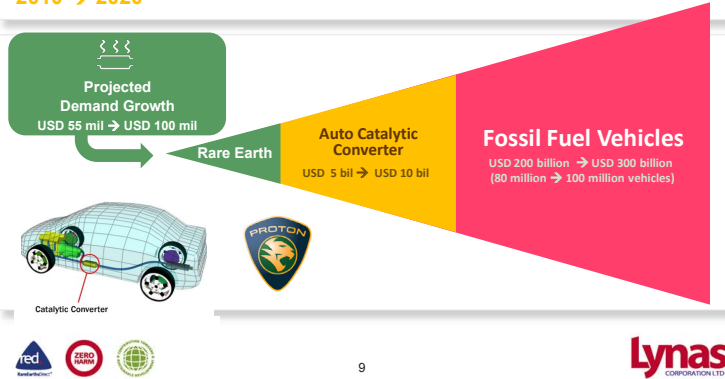
### Hybrid Electric Vehicles (HEV) industry 2010 → 2020





## Magnitude Of Economic Benefits From Rare Earth

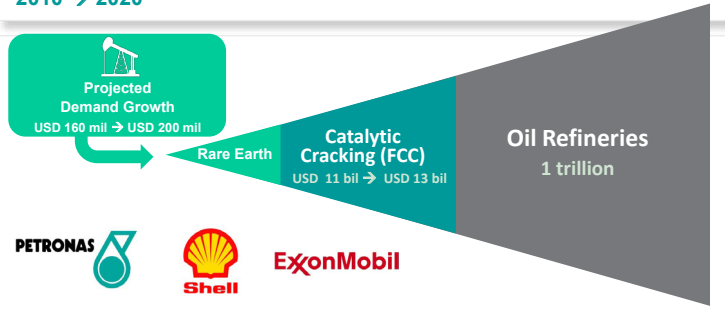
### Auto Catalytic Converter Market 2010 → 2020



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## Magnitude Of Economic Benefits From Rare Earth

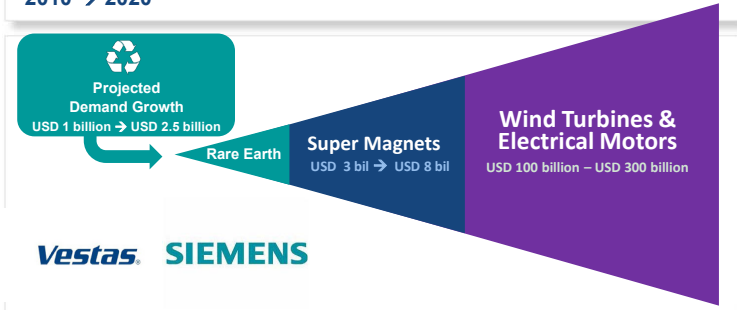
### Oil Refineries 2010 → 2020



10

## Magnitude Of Economic Benefits From Rare Earth

### Renewable Energy (Wind Turbines) 2010 → 2020

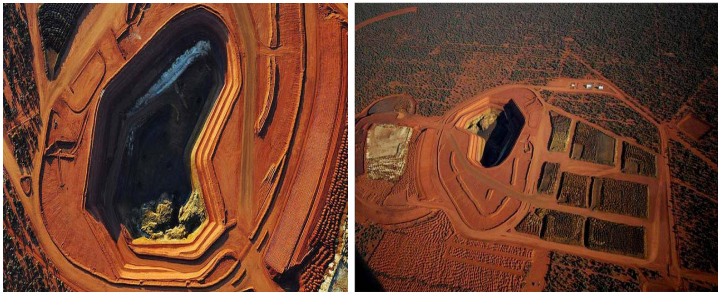


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## Where it started

Lynas Mine at Mt. Weld, Western Australia



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Cont...

Mount Weld >> **Fremantle Port** >> Kuantan Port >> Lynas Advanced Material Plant

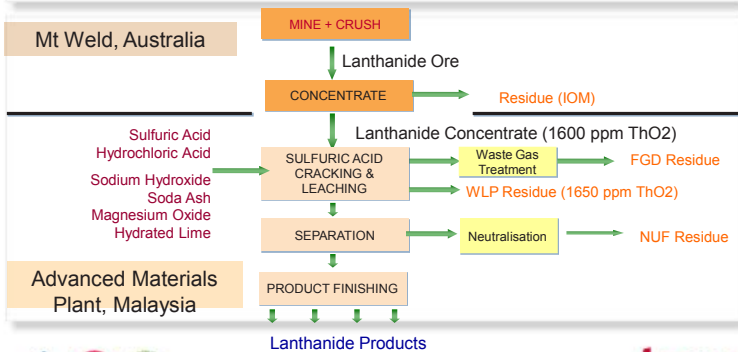


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## Production General Info : Flowsheet

### Process Flowsheet



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## LYNAS PLANT IS SAFE

### 1. LYNAS USES SAFE RAW MATERIAL

- a. Raw material contains LOW level of naturally occurring radioactive material (NORM)
- b. Lynas process does NOT enhance the NORM in the residue/waste (IAEA: Lynas waste is categorized as **VERY LOW LEVEL RADIOACTIVE WASTE**)

### 2. LYNAS IS A SIMPLE CHEMICAL PLANT

- a. It operates at atmospheric pressure, and involve no explosive or highly flammable material
- b. As a consequence, under OSHA, Lynas is not classified as a major hazard installation
  - **Not regulated under CIMAH** (Control of Industrial Major Accident Hazards)



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## Cont...

### 3. LYNAS COMPLIES WITH ALL RELEVANT NATIONAL AND INTERNATIONAL REGULATIONS & STANDARDS (IAEA, AELB, DOE etc)

### 4. LYNAS PROVIDES MONITORING FACILITIES TO THE AUTHORITIES AND PUBLIC

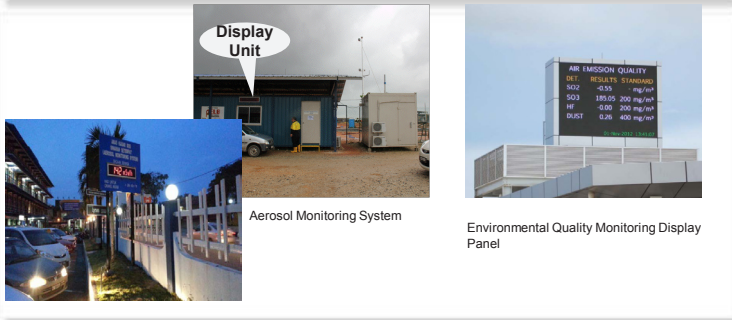
- a. 2 Aerosol Monitoring Systems located on-site and in Kuantan to monitor radiation level in air, and report real-time and on-line readings
- b. Monitor air emission and water discharge: real-time and on-line monitoring information is provided to public and the authorities



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Cont...



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## Lynas Residues: Zero Waste Policy

Converting the residues to safe commercial products

Residues	NUF	FGD	WLP
Characteristics			
Radioactivity	Non-radioactive	Non-radioactive	<b>Radioactive</b> (6 Bq/g)
Leachability	Non-leachable	Non-leachable	Non-leachable
Toxicity	Non-toxic	Non-toxic	Non-toxic



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**Lynas**  
CORPORATE PARTNERS

## Cont...

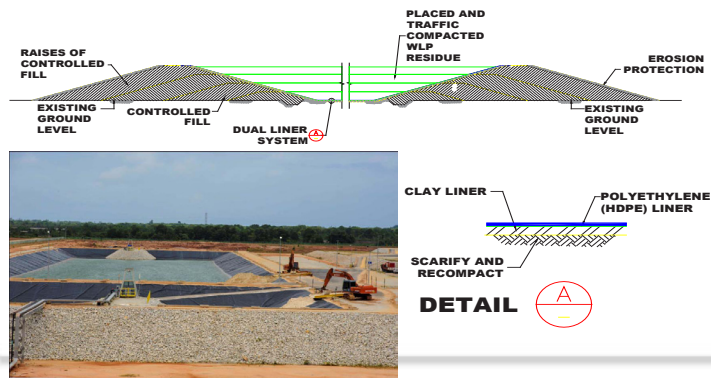
- Lynas residues are temporarily stored in specially engineered Residual Storage Facilities (RSF) before conversion into safe commercial products
- RSF are built according to international standard to prevent any contamination of the environment



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## Residue Storage Facility



-20-



## Residues - Applications

<b>NUF</b> (Neutralisation Underflow)	<ul style="list-style-type: none"> <li>• <b>Construction material:</b> cement and aggregate</li> <li>• <b>Agriculture:</b> nutrient source, soil improvement.</li> </ul>
<b>FGD</b> (Flue Gas Desulfurization)	<ul style="list-style-type: none"> <li>• <b>Building material:</b> gypsum plasterboard, decorative plaster and cement additive.</li> </ul>
<b>WLP</b> (Water Leach Purification)	<ul style="list-style-type: none"> <li>• <b>Synthetic Aggregate</b> : widely used as an alternative replacement for natural aggregate in concrete formulation, e.g. concrete formulation used for coastal protection and artificial reef.</li> </ul>

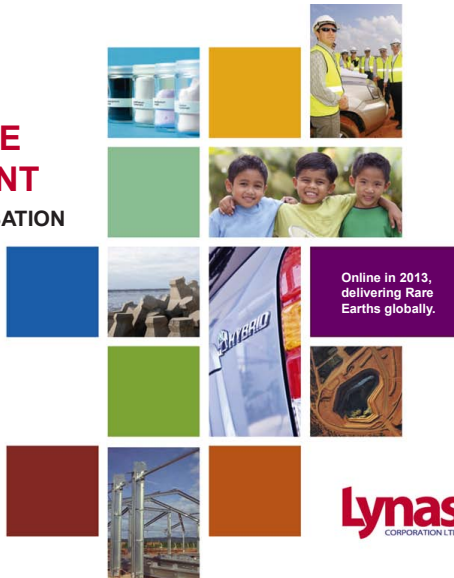


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## SUSTAINABLE DEVELOPMENT

### WLP COMMERCIALISATION



## WLP COMMERCIALISATION

### INTRODUCTION

- Water Leach Purification (WLP)
- Products are co-products generated from the leaching process to recover Rare Earth elements.
- WLP product contains **low levels** of naturally occurring radioactive elements of thorium and uranium.
- Typical activity Concentrations are 6.0 Bq/g of Th-232 and 0.02 Bq/g of U-238



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## FGD, NUF, RB10, RB10SA & BA:

### **SMP SUCCESS:** FGD, NUF, RB-10 & RB10SA are NOT RADIOACTIVE MATERIALS

- RADIOACTIVITY ANALYSIS  
(Radionuclide Analysis)

#### RESULTS.

Product	Th-232 (Bq/g)	U-238 (Bq/g)
RB 10	0.72 ± 0.05	0.039 ± 0.0028
RB 10AS	0.63 ± 0.05	0.044 ± 0.0032
BA	Pending result	Pending result
FGD	<0.003	<0.0062
NUF	<0.012	<0.007

FGD, NUF, RB10 & RB 10SA ARE **NON-RADIOACTIVE MATERIAL**



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## FGD, NUF, RB10, RB10SA & BA:

### • SMP SUCCESS: NON-LEACHABLE

- LEACHABILITY  
(Composition, Toxicity & Leachability Analysis)

#### TEST / METHOD

- Toxicity Characteristic Leaching Procedure - TCLP
- Test Method : USEPA 6010 B, 8270 C, 8260 B
- Testing Parameters: Metal Type 1, Semi Volatile Organics, Volatile Organics, Pesticides & PCB

**All tests conform to Toxicity Characteristic Leaching Procedure (TCLP) criteria**

#### CONCLUSION:

**FGD,NUF, RB 10, RB 10SA & BA *WILL NOT LEACH* TO THE GROUND AND *NON TOXIC***



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## FGD, NUF, RB10, RB10SA & BA:

### • SMP SUCCESS: NON-TOXIC

- COMPOSITION & TOXICITY ANALYSIS

#### TEST / METHOD

- Total Threshold Limit Conc - TTLC
- Test Method : USEPA 6010 B, 8270 C, 8260 B
- Testing Parameters: Semi Volatile Organics, Volatile Organics, Pesticides & PCB

**ALL tests conform to Total Threshold Limit Concentration (TTLC) criteria.**



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## RB10, RB10SA & BA:

### • **SMP SUCCESS:** Mechanical Properties Testing

#### 3. PRODUCT PERFORMANCE (Mechanical Properties Testing)

- Test / Method
- In accordance to JKR 2008 specification
- Testing Parameters: CBR, ACV, Plasticity Index, Liquid Limit, Gradation.

**ALL tests conform with the JKR Specification.**

#### Conclusion:

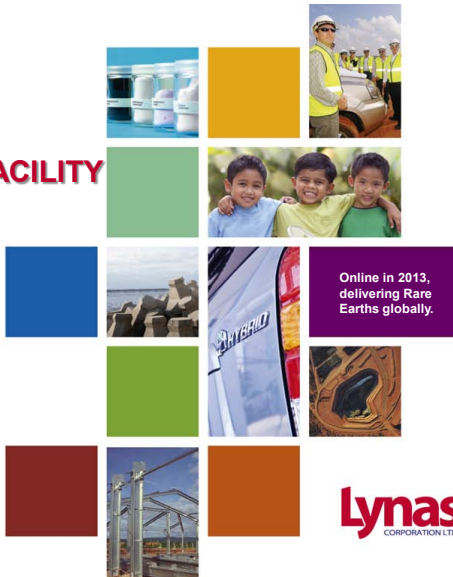
**RB 10 & RB 10SA proved to have good performance as Road base.**



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## PERMANENT DEPOSITORY FACILITY (PDF)



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## What is PDF?

### Permanent Depository Facility (PDF)

- PDF is a permanent depository facility to store the very low level WLP residue.
- PDF is only required **IF** Lynas cannot convert the WLP into safe commercial products.
- PDF **MAY** be needed during the de-commissioning phase to store remnant WLP residue.
- If PDF were to be built, its site selection, design and construction criteria will comply to IAEA standard.



## ENVIRONMENTAL MANAGEMENT PROGRAMS

- Prescribed Under EQA
- Prescribed Under AEAL



## Radiation Monitoring Program



### Environmental Radiation Monitoring Status

- Aerosol Monitoring System report showed LAMP's operation
- (8 months) **DID NOT CAUSE ANY CHANGE IN RADIATION LEVEL**

Area	Period of measurement	Mean External Radiation (uSv/h)	Mean Rn-220 EEC (Bq/m <sup>3</sup> )	Mean Rn-222 EEC (Bq/m <sup>3</sup> )
LAMP	1/6-31/10/2012	0.14	0.12 ± 0.02	2.30 ± 0.46
	1/1 – 26/7/2013	0.13	0.14 ± 0.05	2.33 ± 0.44
Kuantan IPD	1/6 - 31/10/2012	0.15	0.08 ± 0.02	0.92 ± 0.20
	1/1 – 31/8/2013	0.14	0.06 ± 0.04	1.25 ± 0.36



## RIA's Exposure Levels vs Actual Exposure Levels

- RIA assumes the **WORST CASE SCENARIOS** in assessing exposure risk to all sensitive receptors.
- Actual occupational external dose exposures were **LESS** than the Constraint Limit of 6 mSv/y and **MUCH LESS** than the 20 mSv/y AELA's Permissible Limit for radiation workers

SCENARIO	*RIA	ACTUAL	RELATIVE READINGS
	mSv y <sup>-1</sup>	mSv y <sup>-1</sup>	
Truck driver (Kuantan Port to LAMP: external radiation from Lanthanide concentrate (LC) : External radiation, 280 hr/y)	0.06	0.06	Equal (Background)
Workers handling LC stockpile in concentrate building: External radiation, 730 hr/y	2.19	0.77	2.8 x less
Truck driver handling WLP from filter press to RSF: external 576 hr/y	1.48	0.58	2.55 x less
Process Operator at WLP filter press: External radiation, 1332 hr	4.02	1.14	3.52x less
FEL workers at WLP RSF :576 hr/y	2.96	1.45	2.04x less





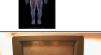




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## RADIATION EXPOSURE TO PUBLIC FROM LYNAS PLANT IS VERY LOW

BY INTERNATIONAL STANDARDS & REGULATIONS:  
 Permissible Limit for Radiation workers = 20 mSv /year  
 Permissible Limit for Public =1 mSv /year

Radiation Sources	Total Dose	
Radiation dose to the lungs from smoking a packet of cigarette per day per year	150mSv 75000x higher than LAMP	
Radiation Dose per year to air crew	9mSv 4500x higher than LAMP	
Doses from each medical and dental X-rays	0.1mSv - 0.39mSv 50-195x higher than LAMP	
Dose from living in concrete houses for 1 year (Radon in home per year)	0.07mSv (2 mSv) 35x higher (1000x higher) than LAMP	
Dose per year from natural radioactivity in the body	0.4mSv 200x higher than LAMP	
Dose from watching TV (CRT TV) for 4 hours per year	0.02mSv 10x higher than LAMP	
Dose to public from LAMP (at LAMP fence) from radon and thoron inhalation	0.002mSv (500 X lower than Permissible Dose Limit for public)	

## Wastewater Monitoring Program



**Water Discharged (critical parameters only):  
ALL BELOW LIMITS and 100% COMPLIANCE with  
DoE Standard B**

Levels (Mean) of Some Critical Parameters, May – July 2013

Parameters	Unit	Std B	May	Jun	July
pH	-	5.5 – 9.0	7.57	7.55	7.58
Iron	mg/L	5	1.67	0.27	0.21
BOD <sub>5</sub> at 20°C	mg/L	50	ND	ND	ND
COD	mg/L	200	36.7	37.7	33.6
Suspended Solid	mg/L	100	5.7	11.2	7.0
Cyanide	mg/L	0.10	ND	ND	ND
Manganese	mg/L	1	0.07	0.19	0.14
Zinc	mg/L	2	0.10	0.08	0.04
Fluoride	mg/L	5	0.95	0.90	1.03
Barium	mg/L	4	ND	ND	ND



## Air Emission Monitoring Program



### AIR EMISSIONS

#### Plant air emission – 100% compliance

Parameters	Unit	CAR 1978* Emission Standards	Limits imposed by DOE's for WGTS Stack	Results		
				May	June	July
Total Suspended Particulates	mg/Nm <sup>3</sup>	400	100	42.4	55.3	34.1
Sulphuric Acid Mist or Sulphur Trioxide or Both	mg/Nm <sup>3</sup>	200	50	ND	ND	1.58
Sulphur Dioxide	mg/Nm <sup>3</sup>	-	500	14.9	25.2	24.4
Hydrogen Fluoride	mg/Nm <sup>3</sup>	100	50	ND	ND	0.08





**Thank You**





## **About the Author**

Y.Bhg. Dato' Haji Mash'al Ahmad is a graduate of Nottingham University, UK and holds a B.Sc in Production Engineering. He has been the Vice-President and Managing Director of Lynas Malaysia Sdn. Bhd. since 2008.

He was born in Penang in February 1957. Upon graduation, he worked in various companies beginning with ICI Malaysia, Petronas, ICI Australia and Eastman Chemicals.

At Eastman from 2001, he was in charge of Technical Services and HSE of five Eastman Chemicals Plants in China and in Singapore. His sterling contribution led him to rise to the position of MD of Eastman Chemicals Malaysia in 2008.



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