

# Vehicle electrification and other lithium end-uses: How big and how quickly?

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# Outline

- **2011 Market Update**
- **Automotive electrification**
  - **Sales performance in 2011**
  - **New vehicles for 2012**
- **Grid storage**
- **Other end-uses**

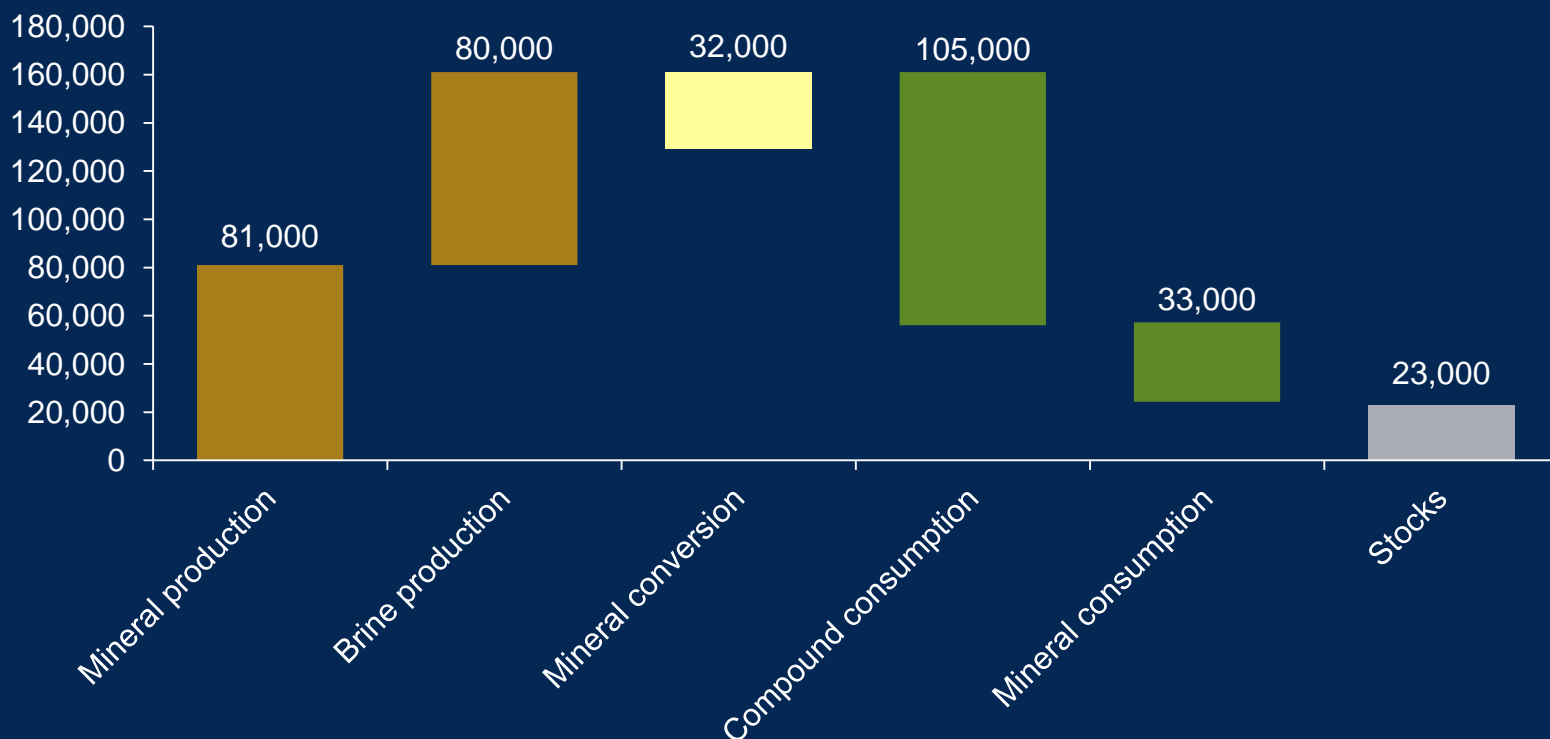
# 2011 market update

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# Mineral output slightly exceeded brine output in 2011, bringing to an end over a decade of brine dominance

World: Preliminary mass balance of the lithium market, 2011e (t LCE)



Source: Roskill estimates

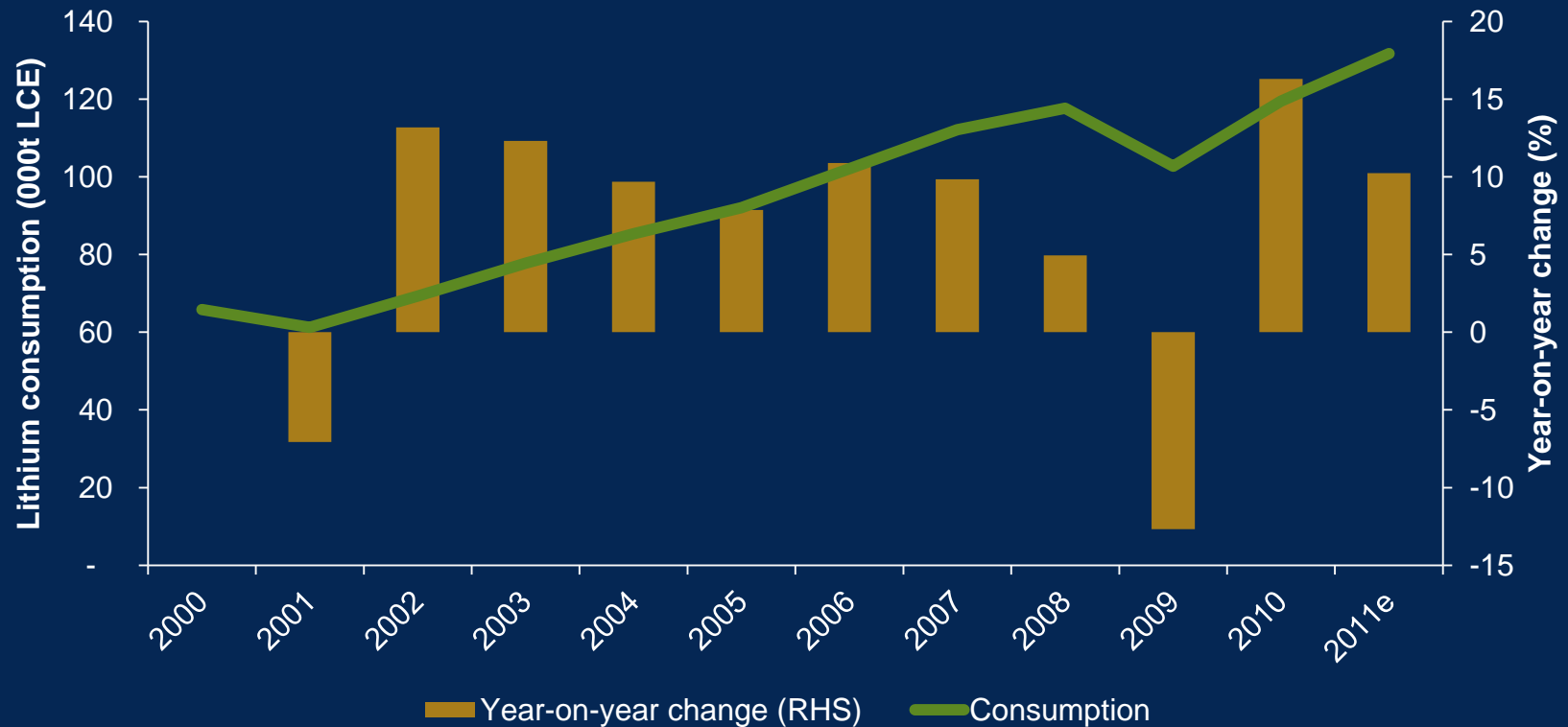
Note: Stocks include spodumene shipped from Galaxy in Australia to China which is awaiting conversion in 2012

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# Global lithium consumption rose by 10% in 2011; lower than in 2010, but still at pre-global economic downturn levels

World: Growth in lithium consumption, 2000-2011e



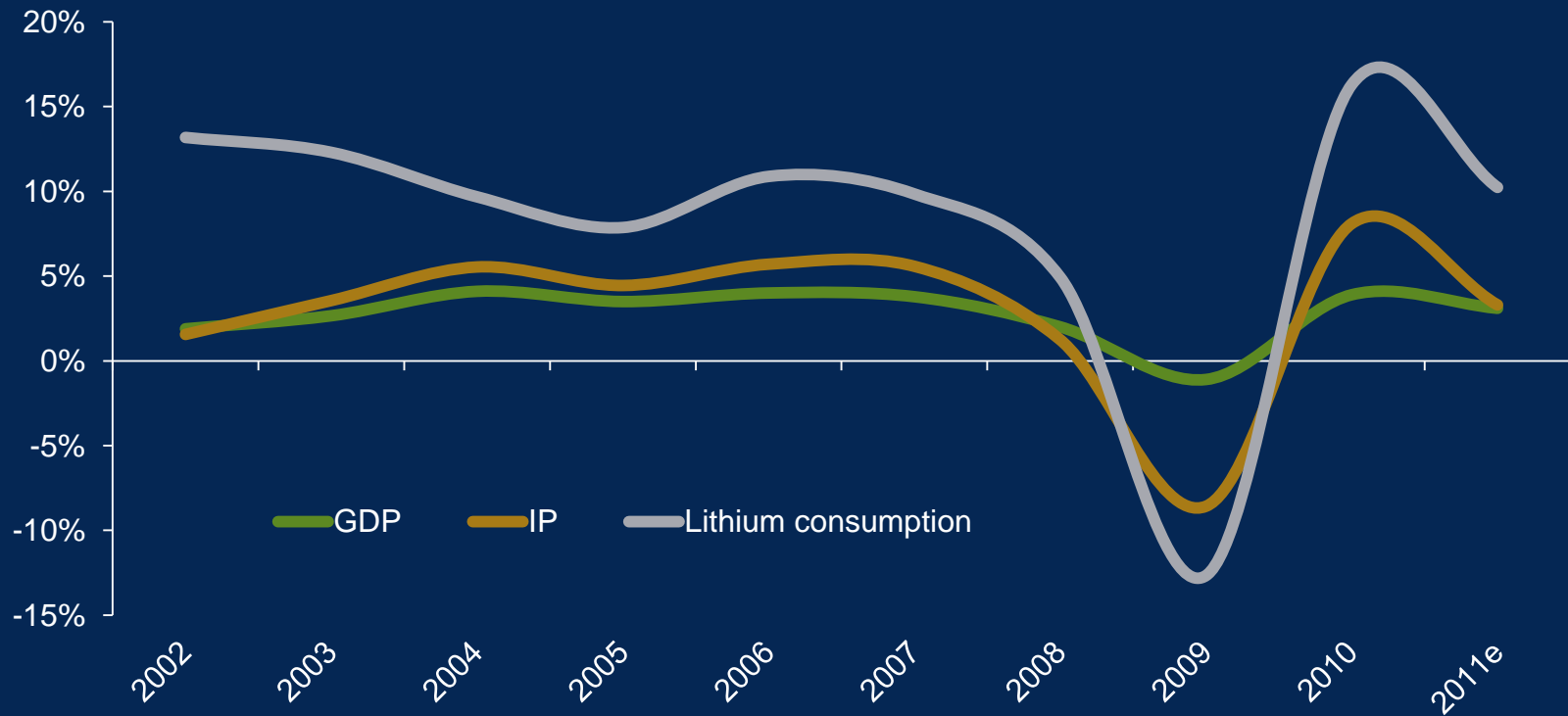
Source: Roskill estimates

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# The lithium market is not immune to global economic trends, but consumption has outperformed IP and GDP since 2002

World: Year-on-year change in GDP, IP and lithium consumption, 2002-2011e



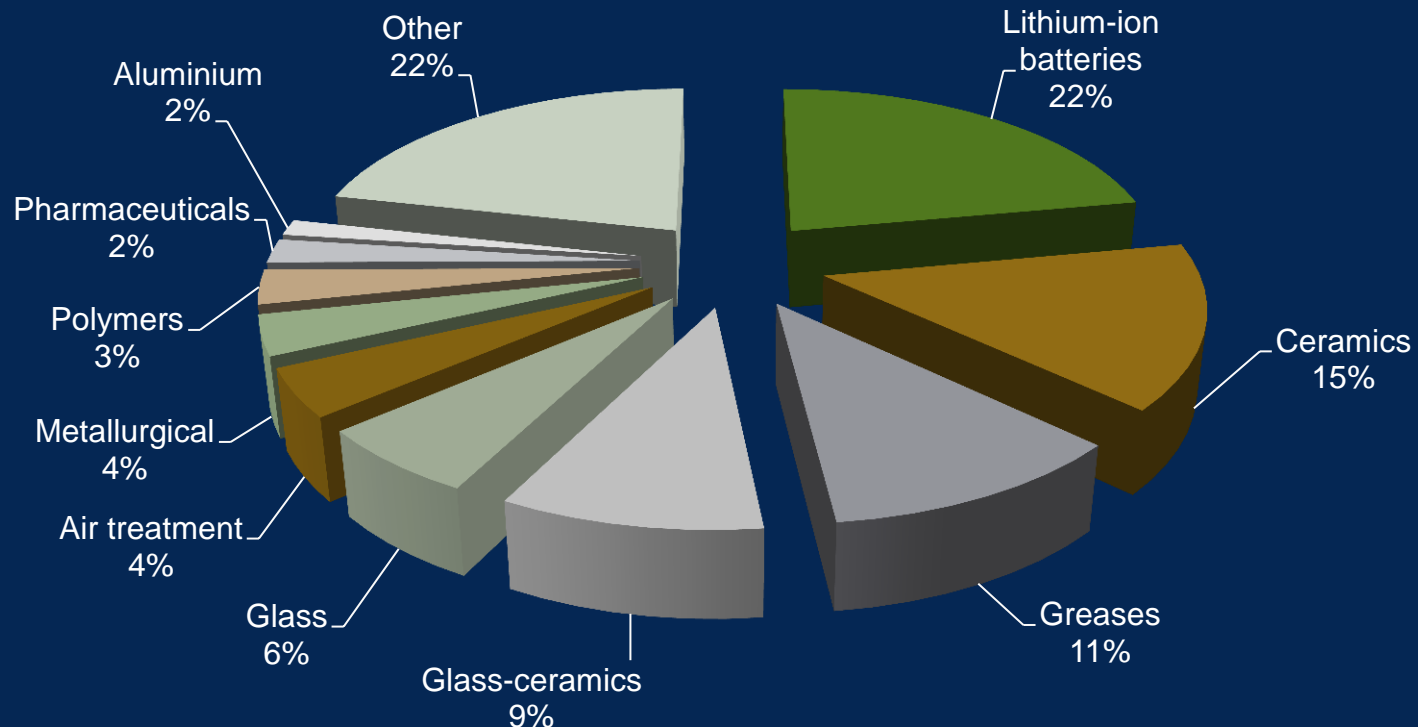
Source: GDP & IP – Economist Intelligence Unit; Lithium consumption – Roskill estimate

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# Lithium-ion batteries are the largest single end-use for lithium, but glass & ceramics, and greases, are still important

World: Estimated lithium consumption by end-use, 2011



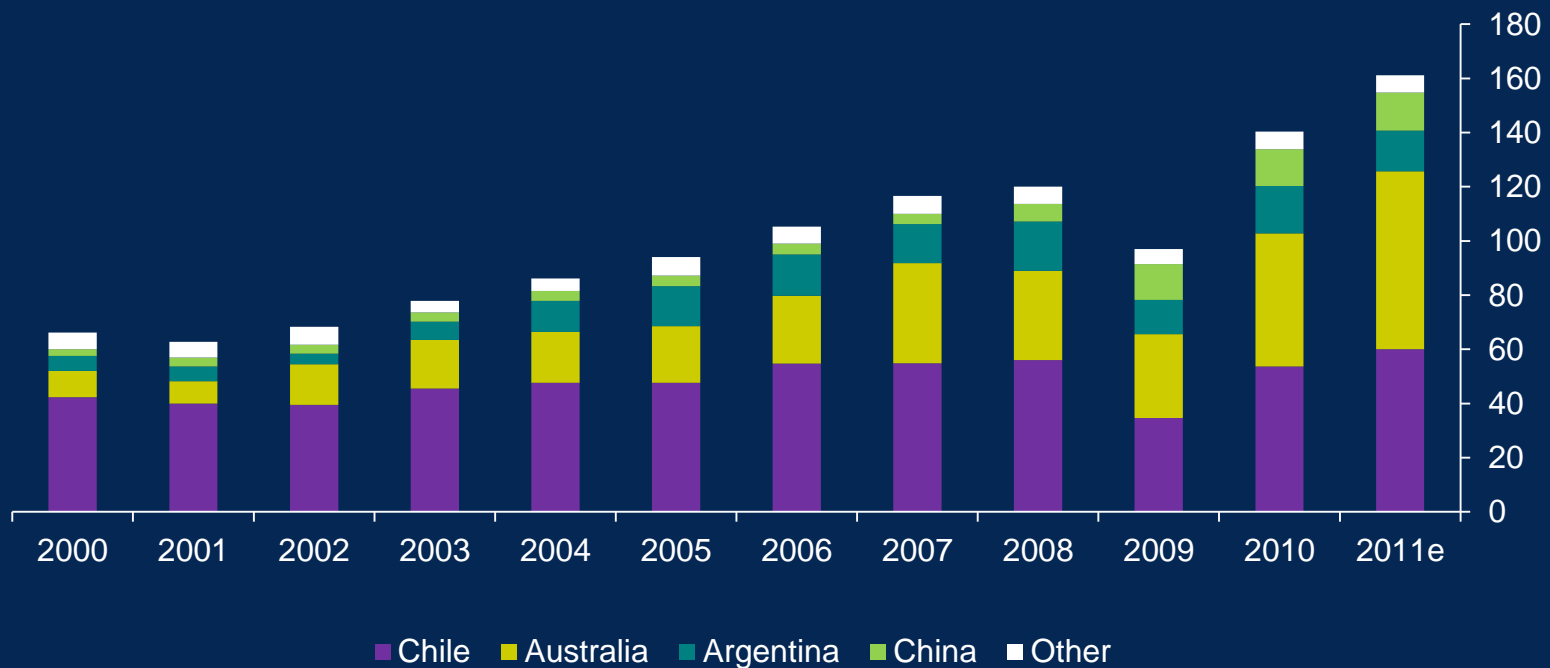
Source: Roskill estimates

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# Australia now accounts for ~40% of “mined” lithium output; Chile has seen little increase since 2006

World: Production of lithium (mined) by country, 2000-2011e (000t LCE)



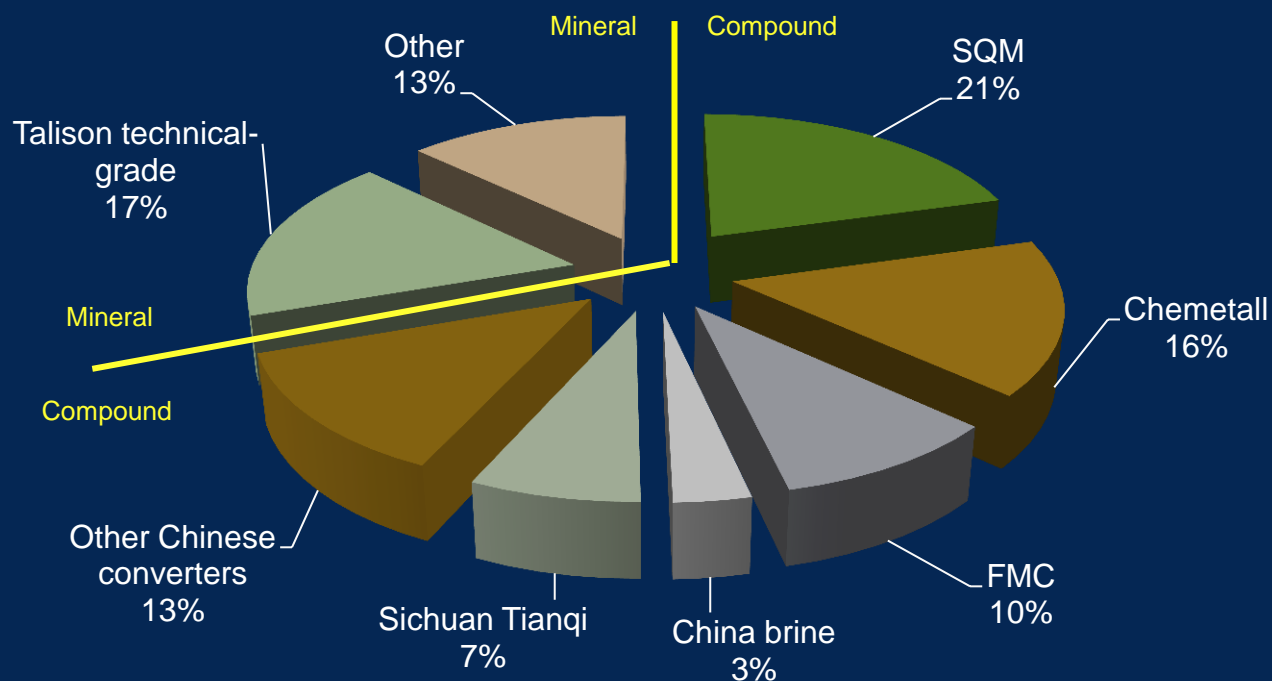
Source: Roskill estimates

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# Lithium compound output is dominated by Chile, Argentina and China, while Talison is the major supplier of technical-grade minerals

World: Supply of “refined” lithium by producer/producing country, 2011

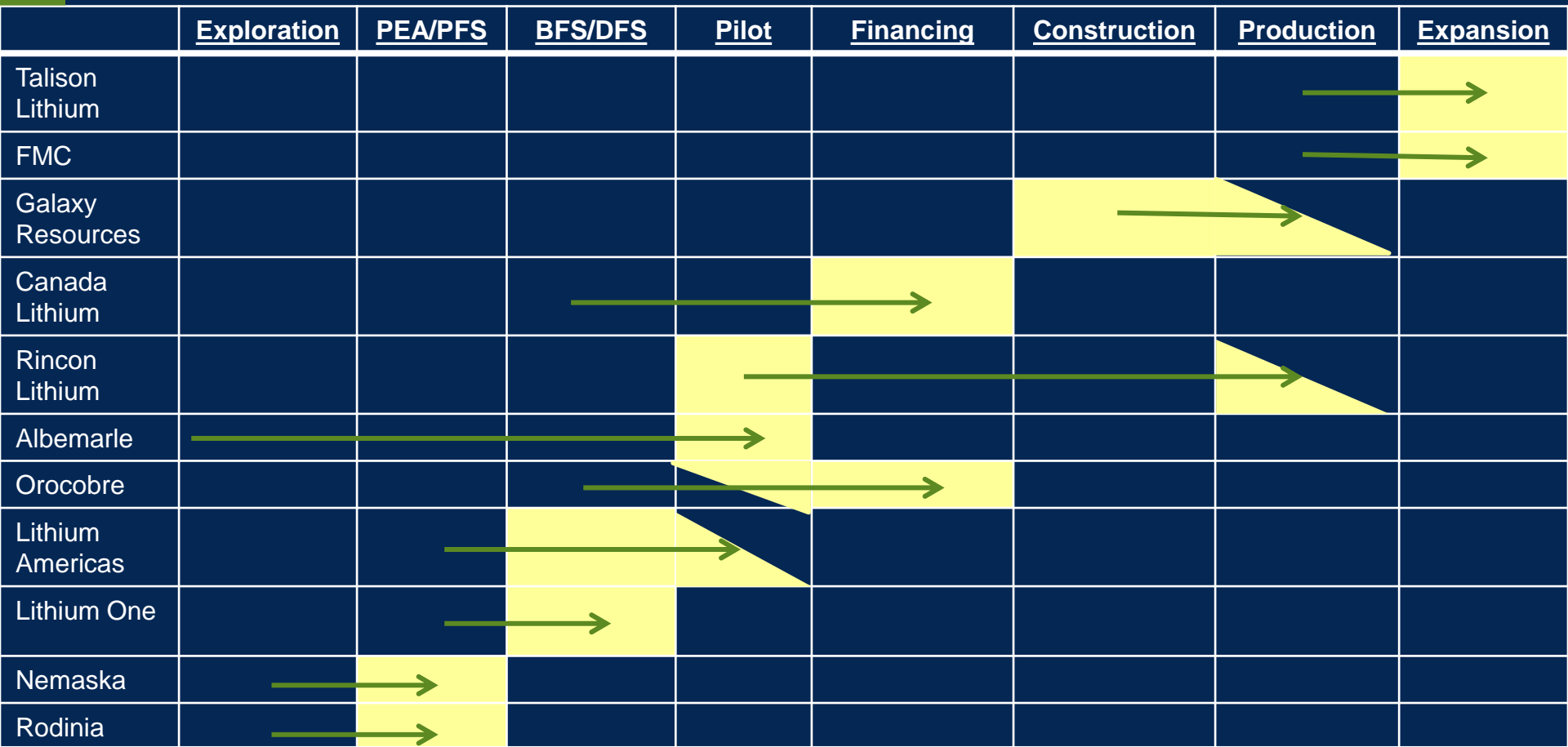


Source: Roskill estimates

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# 2011 was a busy year for lithium producers and project developers



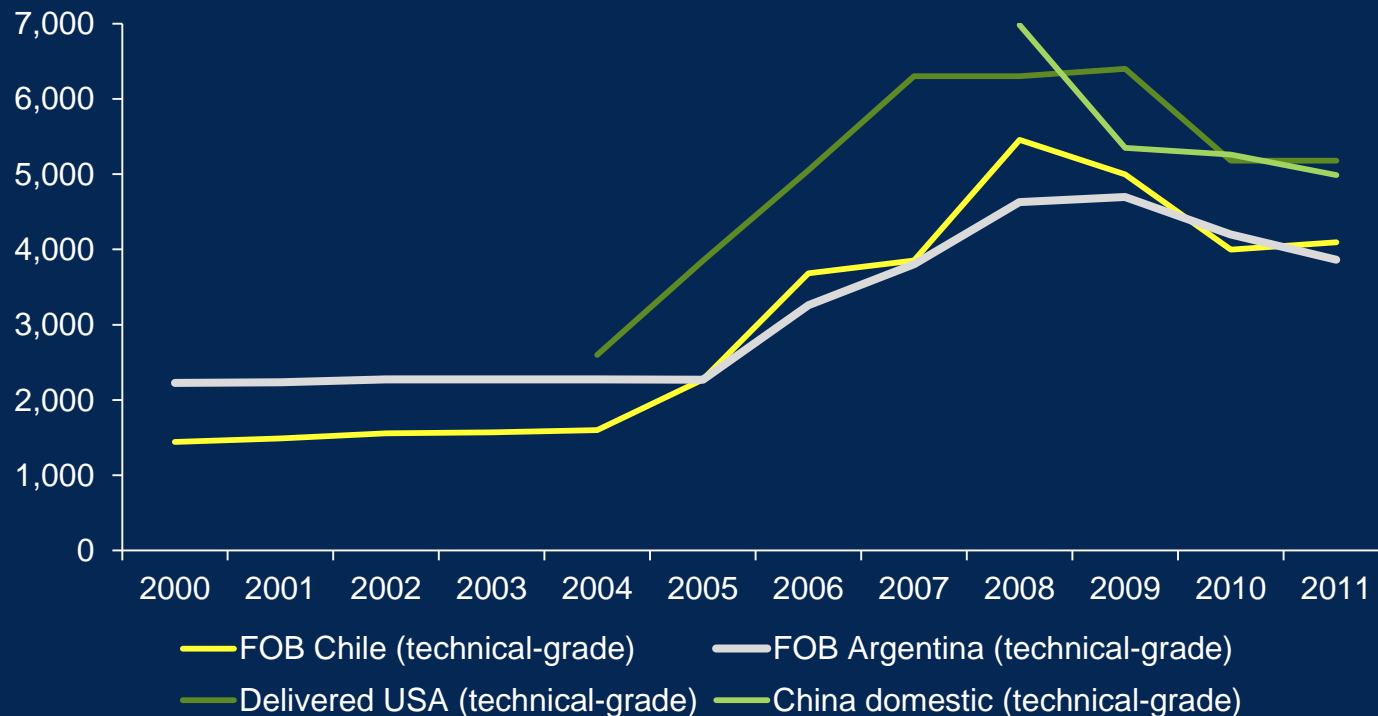
Source: Company data

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# Prices have stabilised in 2011, after falling in 2009/10, but remain well above early 2000 levels

Chile, Argentina, USA & China: Average annual prices for lithium carbonate, 2000-2011 (US\$/t)



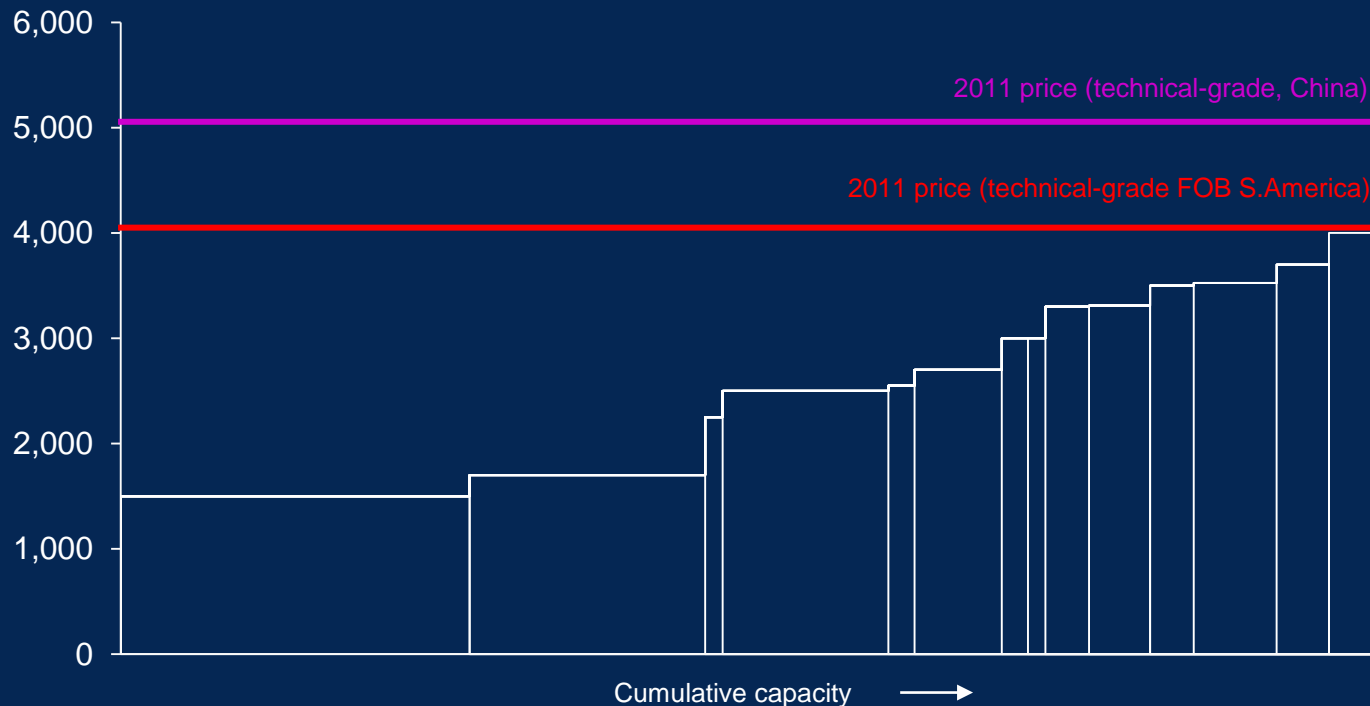
Source: Global Trade Atlas, Industrial Minerals; Asian Metal

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# Current pricing remains favourable for those at the lower end of the cost curve, margins squeezed at upper end

World: Cash cost of lithium compound production, 2011 (US\$/t)



Source: Company data; Roskill estimates

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# Automotive electrification

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# Automotive seen as golden goose of lithium industry, but it's been slow progress

- "The Leaf is meeting its business plans but it's a car that's going to take a while to be accepted in the market." (Nissan)
- BYD dealer in Shanghai sold only one electric car and two hybrid cars in 2011: "People hesitate to choose cars with a high price... although the government can provide subsidies for alternative-energy cars, the lack of charging stations is a main concern"(BYD sales manager)
- "The [Chinese] government is re-visiting [its] strategy on (fully) electric vehicles. This is why they push more into the hybrids" (Ipsos, China)
- "NHTSA does not believe that Chevy Volts or other electric vehicles pose a greater risk of fire than gasoline-powered vehicles. Generally, all vehicles have some risk of fire in the event of a serious crash" (NHTSA)

# Volume sales of lithium-ion equipped automobiles in 2011 dominated by GM, Nissan, Mitsubishi & Hyundai

## PHEV

- **Volt:** Launched Dec 2010
- Planned: 2011 = 16,000, 2012 = 60,000
- Sales: 7,671 (to end-2011)



## EV

- **MiEV:** Launch: July 2009
- Planned: 2011 = 25,000, 2012 = 40,000
- Sales: >17,000 (to Oct 2011)



## HEV

- Sonata Hybrid & Kia Optima: 2011
- Sales: >19,672 (to Dec 2011)



- **Leaf:** Launched Dec 2010
- Planned: 2011 - 12,000 (US only)
- Sales: >21,000 (9,674 in US)



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# In 2012, new models emerge to increase variety. Large number of Li-ion HEVs in the line-up

## PHEV

Prius Plug-in (planned 60,000):



Ford CMAX Energi:



Tesla Model S:



## EV

Focus Electric:



Honda Fit :



Coda Sedan:



## HEV

Ford Fusion & CMAX:



Chevrolet Malibu:



Buick Regal & LaCrosse: BMW Active Hybrid 3 & 5:



VW Jetta:



Prius MPV / + / Alpha:

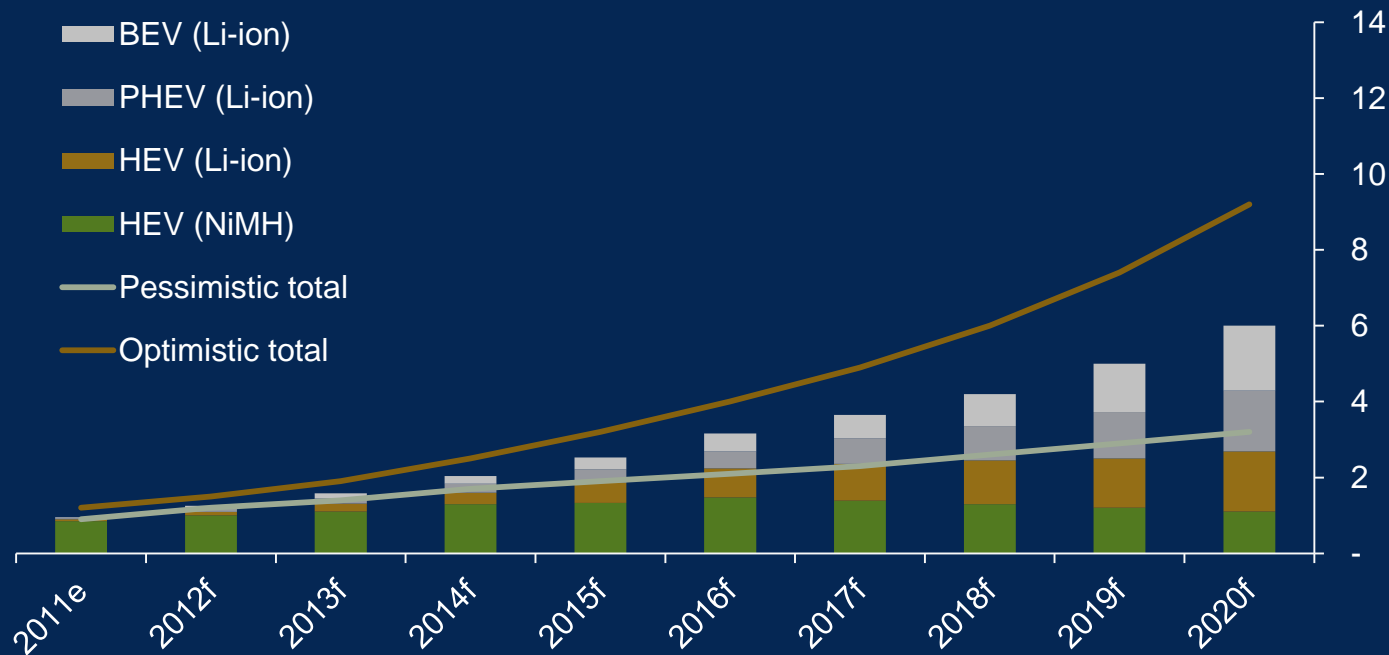


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# Roskill continues to support its forecast of 5% HEV/PHEV/EV penetration by 2020, but has pushed back its assessment of sales by 1 year

World: Production of HEVs, PHEVs & BEVs 2011-2020 (M units)



Source: Roskill estimates

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# Grid storage

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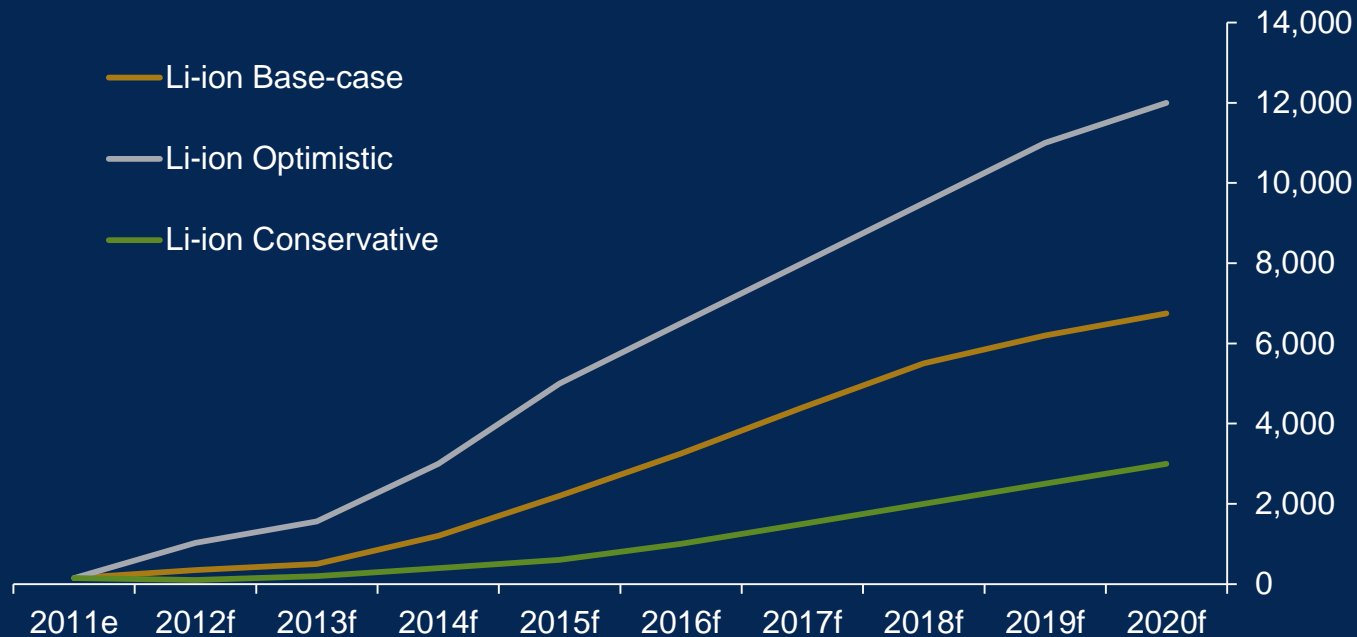
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# Many lithium-ion start-ups have shifted emphasis to grid storage due to the slow ramp-up in EV output

- **AES Energy Storage & A123 Systems** – 32MW wind-farm storage project , Virginia, USA
- **BYD** and the State Grid Corporation of China – 36MWh wind and solar storage project, Hebei, China
- **Altair Nanotechnologies & Energy Storage Holdings** - 1.8 MW energy storage system in New Jersey, USA
- **Electrovaya & Canadian Government** - 1.2MWh demonstration project to support renewable energy generation in Ontario
- **EnerDel & Itochu** – Smart grid storage project in Japan
- **Saft** – NiceGrid & Millener projects in France – 2.7MWh and 3MWh lithium-ion systems

# Roskill has pulled forward its assessment for grid storage by two years to reflect recent growth and size of projects

World: Demand for lithium-ion in grid storage 2011-2020 (MW)



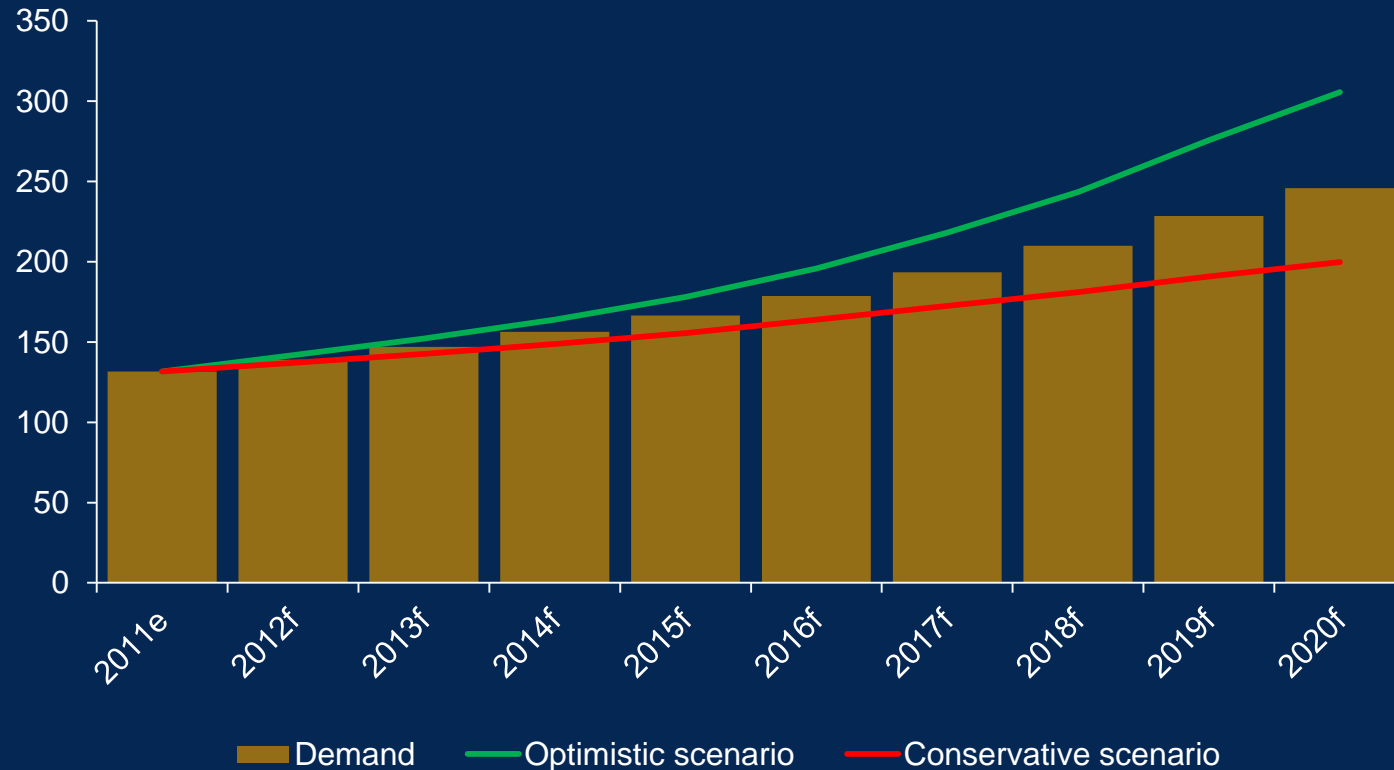
# Other end-uses

# Battery industry remains growth driver, other end-uses are in positive territory but increase will be low single-digits

<u>Sector</u>	<u>AAGR to 2020 (%)</u>	<u>Outlook</u>
Ceramics & Glass	4	Residential construction sector still depressed, isolated growth spots
Batteries	15	Li-ion battery production impacted by Japanese earthquake & tsunami; but tablet-PC market especially strong in 2011, increased automotive contribution now being seen
Grease	5	Remains IP-related, some growth spots but generally weaker than pre-global economic downturn
Aluminium	-20	Prices depressed, several plants shuttered and remaining Soderberg plants being converted to "pre-baked" technology
Air-treatment	3	Industrial and commercial property depressed in some regions, now relying on energy-saving impact
Metallurgical	3	Steel production down 8-9% in 2009, recovery in world output in 2010 and 2011, further growth forecast but lower than mid-2000s.
Polymers	5	Increased SSBR capacity, but Li-SBR under threat from Nd-SBR
Pharmaceuticals	4	Generally GDP-related, reliant on new products for growth

# Base-case demand is forecast to grow by 7.5%py through 2020, but potential upside of 10%py

World: Forecast demand for lithium 2011-2020 (000t LCE)



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# Recent Consultancy Assignments on Lithium



Company: Orocobre  
Location: Argentina  
Commodity: Lithium  
Work: Market Study for DFS  
Status: Financing



Company: Mining Company X  
Location: Europe  
Commodity: Lithium  
Work: In-depth Market Study  
Status: Pre-feasibility



Company: Lithium One  
Location: Argentina  
Commodity: Lithium  
Work: Market Study for DFS  
Status: Feasibility



Company: Min Feng Lithium  
Location: Sichuan, China  
Commodity: Lithium  
Work: China-focused Market Study  
Status: Operational



Canada Lithium Corp.

Company: Canada Lithium  
Location: Quebec  
Commodity: Lithium  
Work: Price Forecast for DFS  
Status: Financing



Roskill's multi-client report  
referenced in several IPOs,  
feasibility documents and  
presentations

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# Questions

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# Lithium: Market Outlook to 2016

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