



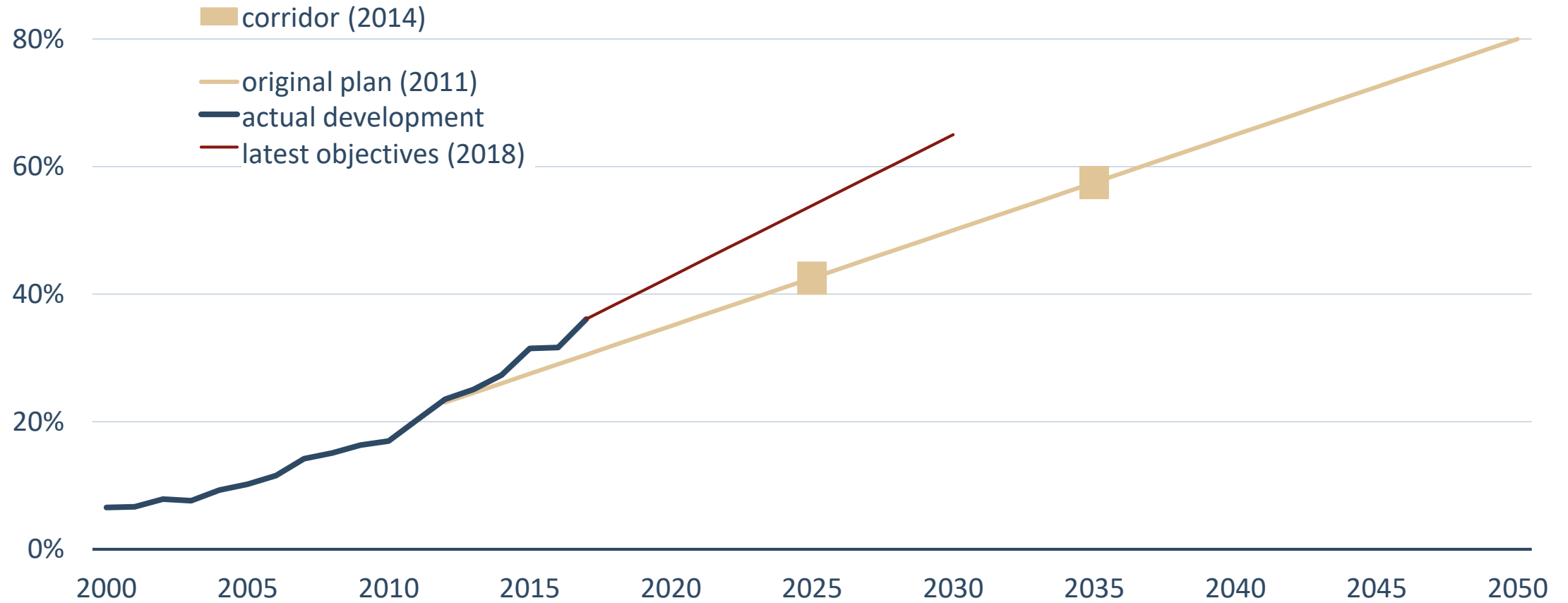
# Resource Risks associated with Raw Materials for the Energy Transition



# E-Mobility 1899 – Lohner Porsche



# Objectives: Expansion of Renewable Energies



Sources: AG Energiebilanzen, 2015; EEG, linear update

# Elements with high additional demand caused by new energy technologies

potential additional demand until 2035 as share of 2013 mining production  
(high demand scenarios)

Technology	Element	Additional demand up to...
solar-thermal power plant	Magnesium	12 %
Stationery fuel cell (SOFC)	Scandium	122 %
Lithium-Ion batteries for passenger cars	Cobalt	84 %
	Nickel	7 %
	Lithium	368 %
Vanadium-Redox batteries	Vanadium	37 %
Micro harvesting	Dysprosium	9 %
	Neodymium	4 %
Windmills	Molybdenum	6 %
	Tin	6 %
	Neodymium / Praseodymium (Light Rare Earths)	48 %
	Dysprosium / Terbium (Heavy Rare Earths)	50 %

Source: based on Marscheider-Weidemann et al, 2016

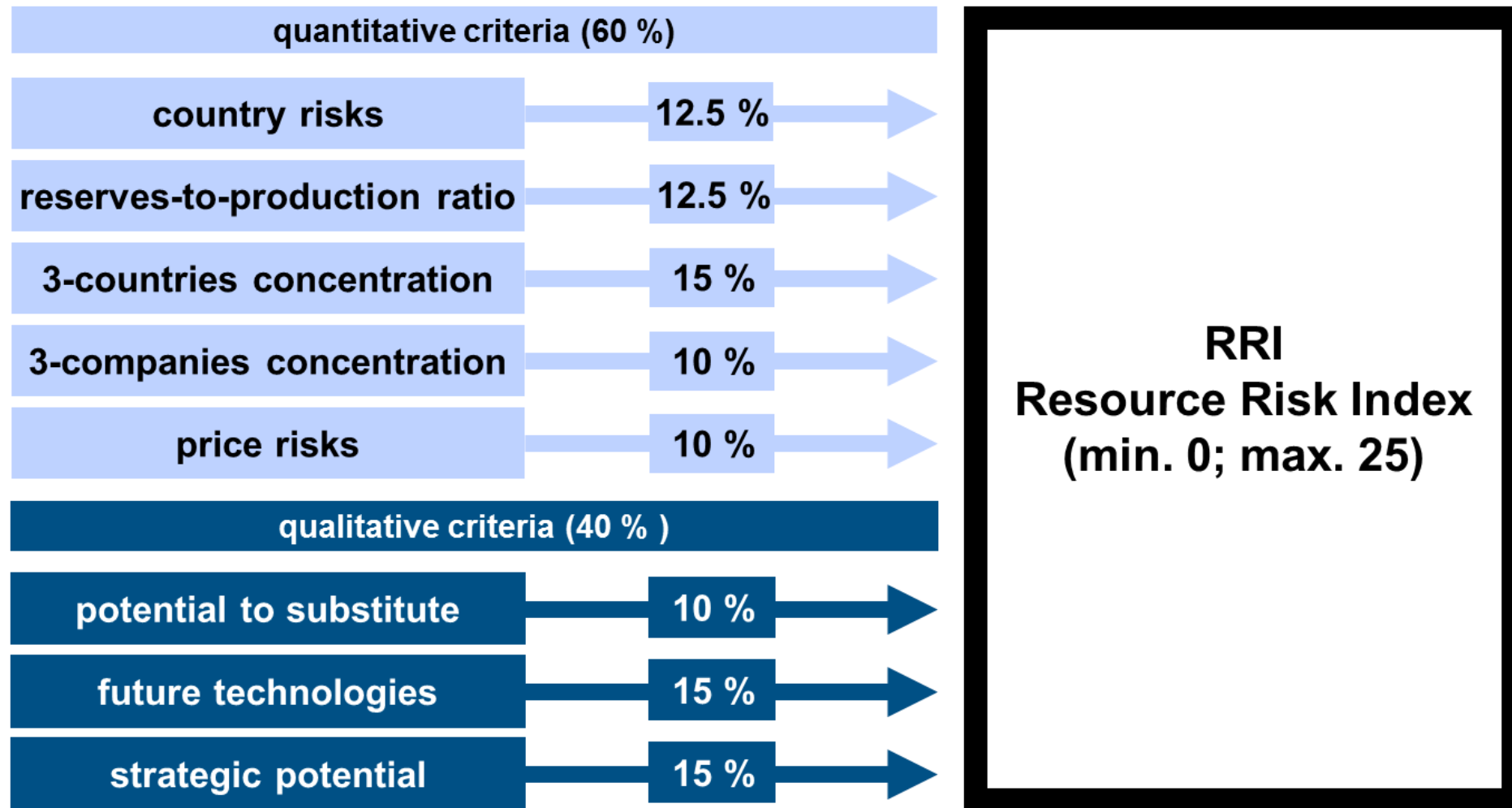
# Supply Risks for Metals

Answers from companies on a scale from 1 (very little risk) to 6 (very high risk)

	Total
Price rise	4.3
Price volatility	4.2
Short-term loss of supply	2.9
Insufficient supply	2.7
Discrimination compared to competitors	2.6
Political risks	2.5
Bureaucracy	2.5
Trade barriers	2.4
Transport risks	2.3

Source: Bardt / Kempermann / Lichtblau, 2013

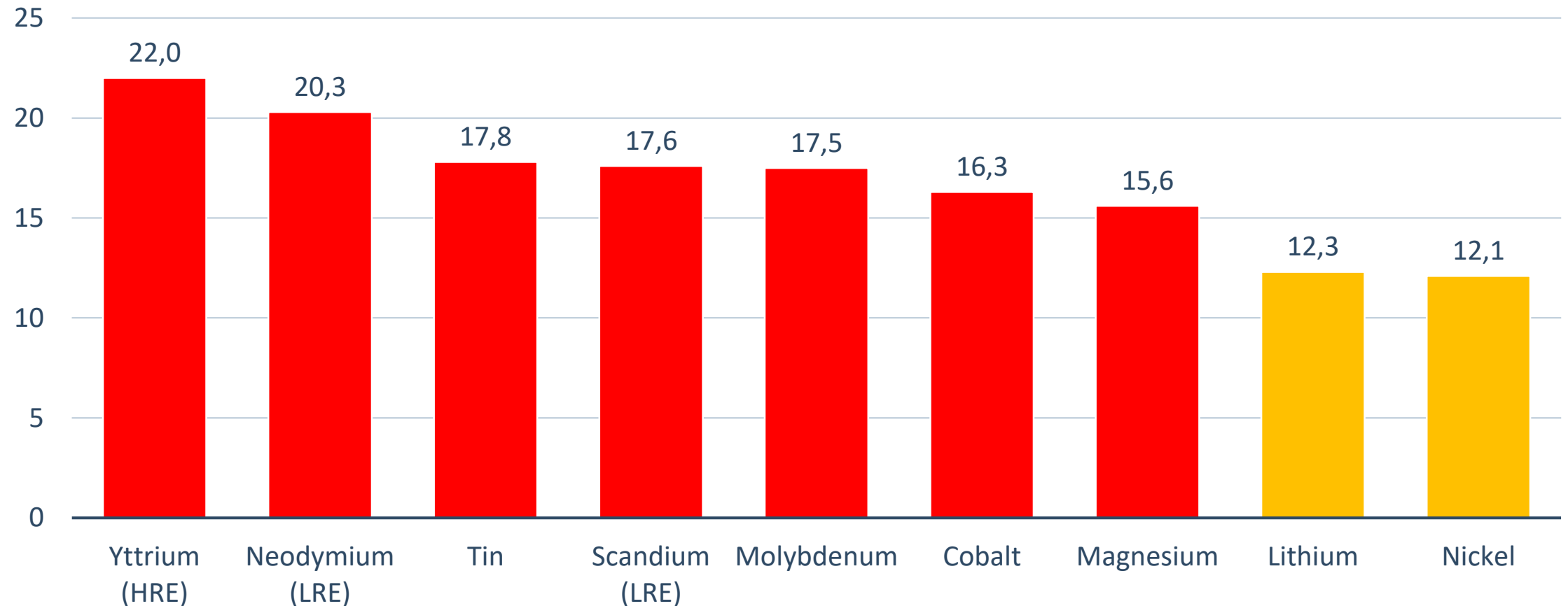
# Composition of the Resource Risk Index (RRI)



Source: vbw / IW Consult, 2017

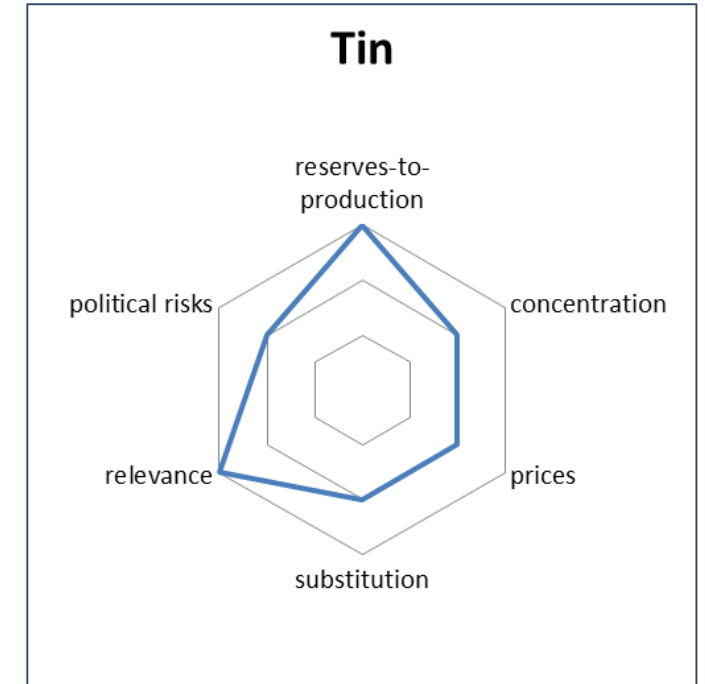
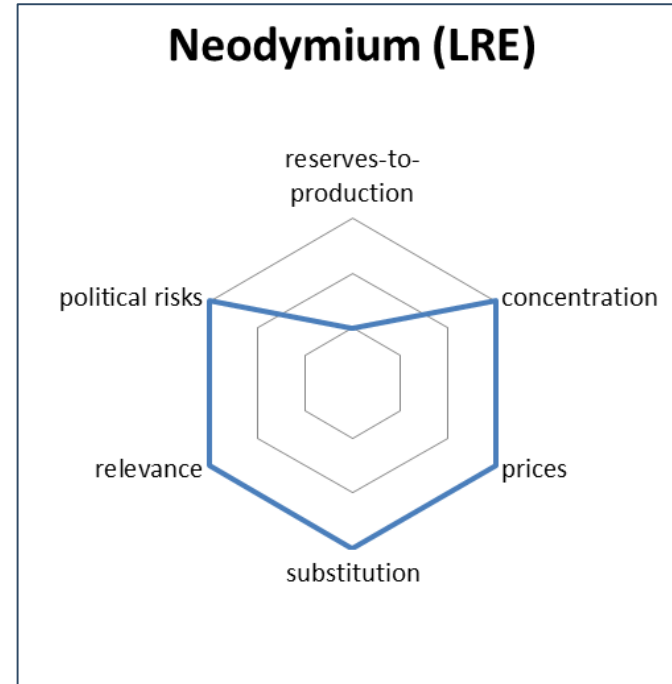
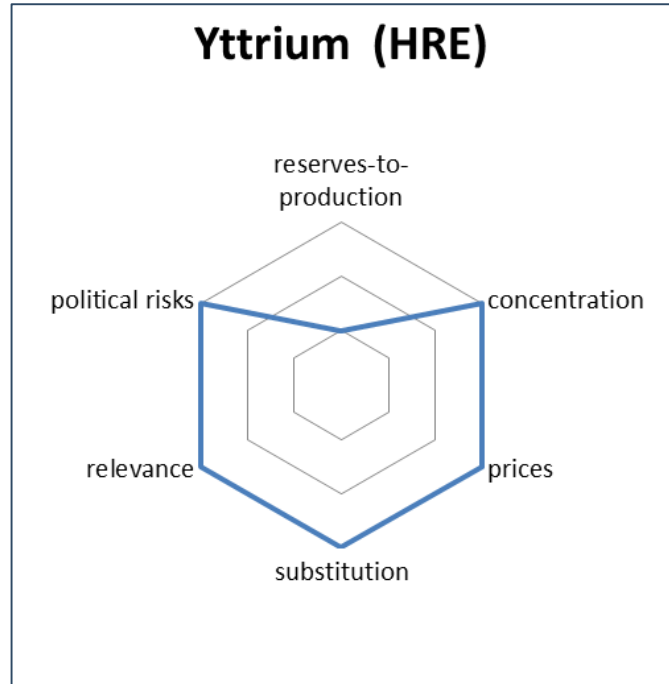
# Resource Risk Index (RRI) of Energy Technology Resources

RRI-scale from 0 (no risks) to 25 (maximum risks)



Source: vbw / IW Consult, 2017

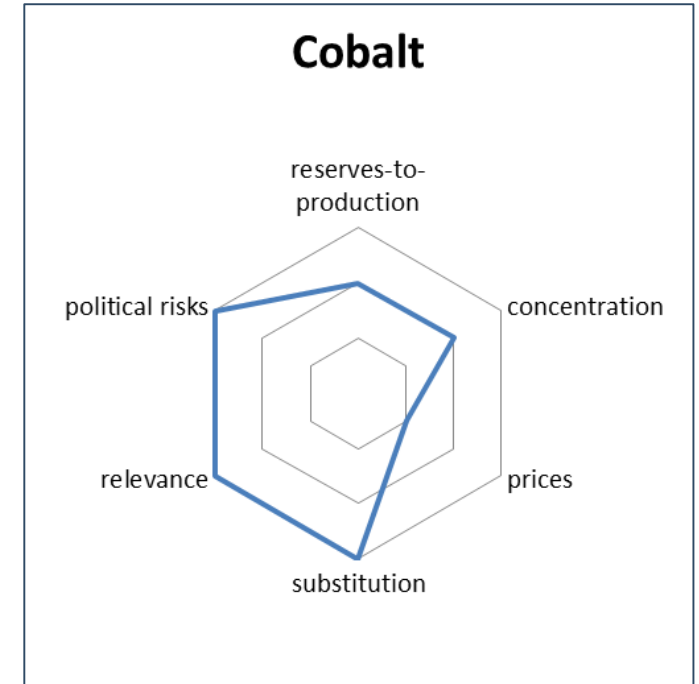
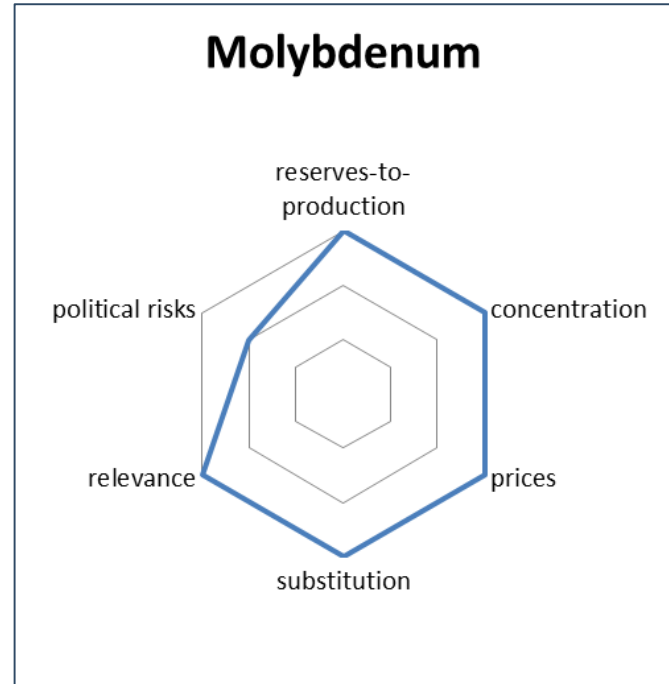
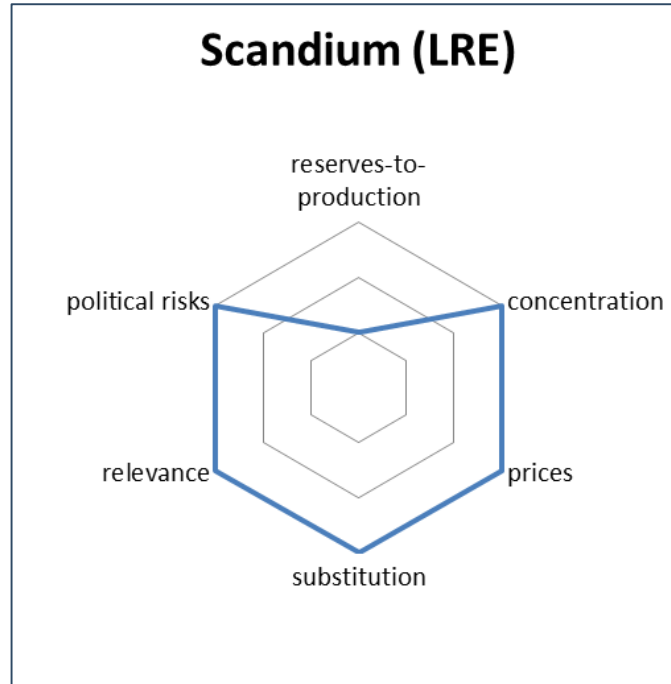
# Risk Profiles of Energy Technology Resources (1/3)



inside: lower risk, outside: higher risk  
Source: based on vbw / IW Consult, 2017

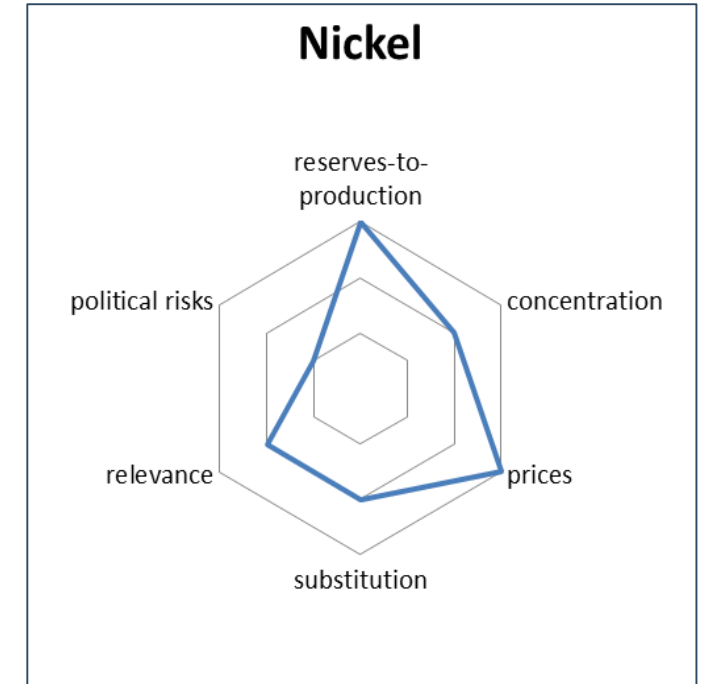
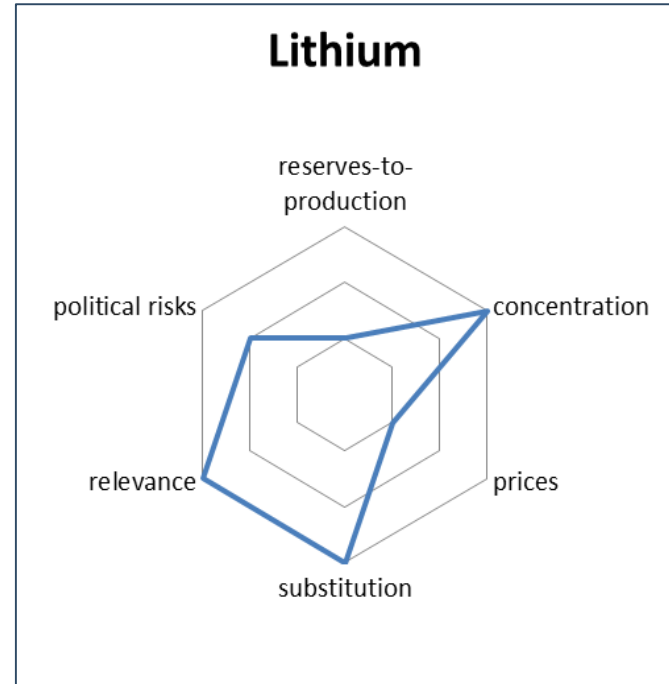
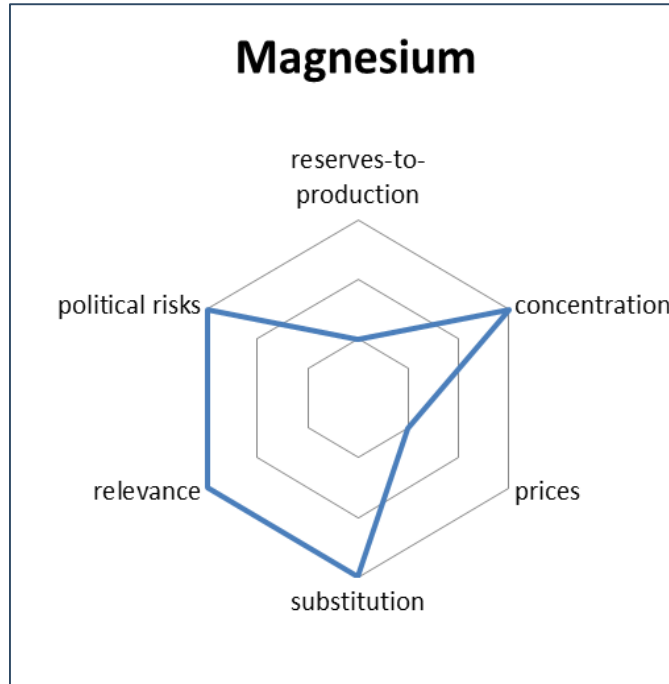


# Risk Profiles of Energy Technology Resources (2/3)



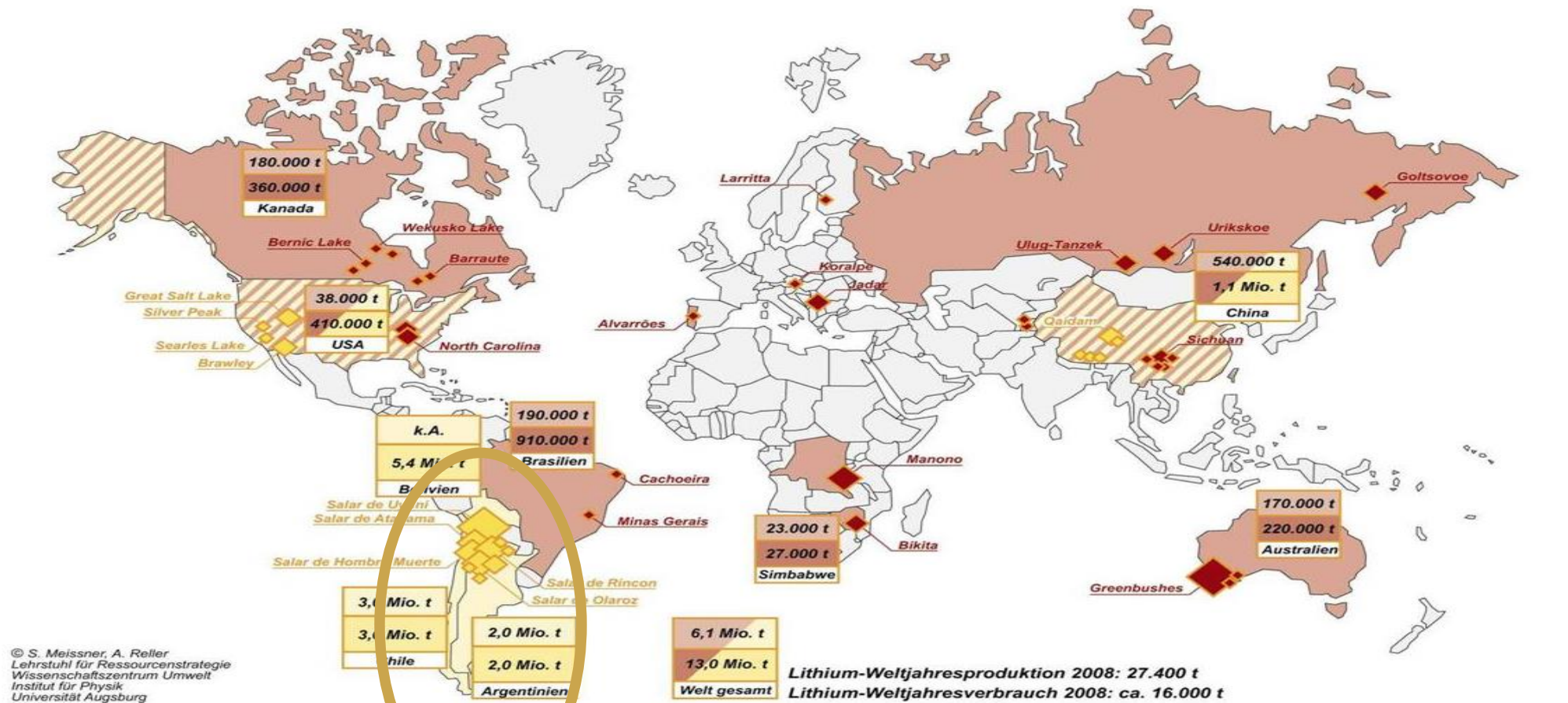
inside: lower risk, outside: higher risk  
Source: based on vbw / IW Consult, 2017

# Risk Profiles of Energy Technology Resources (3/3)



inside: lower risk, outside: higher risk  
Source: based on vbw / IW Consult, 2017

# Global Distribution of Lithium



## Erz- und Solelagerstätten

- Erzlagerstätten (Pegmatit / Spodumen)  
Solelagerstätten (Salare)
- ◆ ◆ sehr hohe Lithiumanteile
  - ◆ ◆ hohe Lithiumanteile
  - ◆ ◆ geringe Lithiumanteile

## Lithium-Reserven

- Länder mit bedeutenden Lithiumreserven  
(Pegmatit, Spodumen - rot / Sole - gelb)
- (derzeit wirtschaftlich abbauwürdige) Reserven
- Reservenbasis (= derzeit wirtschaftlich abbauwürdige Reserven + zukünftig wirtschaftlich und technisch mögliche abbauwürdige Reserven)

## Jahresproduktion von Lithium (Raffination in 2008)

1. Chile: 12.000 t
2. Australien: 6.900 t
3. China: 3.500 t
4. Argentinien: 3.200 t
5. Kanada: 710 t
6. Portugal: 570 t
7. Simbabwe: 300 t
8. Brasilien: 180 t
9. Bolivien: k.A.
10. USA: k.A.

# Measures to Cope with Supply Risks

Answers from companies, in percent

	Small company	Medium company	Large company	Total
<b>Long-term supply contracts</b>	31.9	59.1	69.2	59.5
<b>Diversification of supply</b>	38.4	48.4	57.0	49.9
<b>Increase in resource efficiency</b>	31.5	42.7	40.4	41.0
<b>Price hedging</b>	9.5	28.7	47.7	32.3
<b>Research and development</b>	8.6	18.6	28.0	20.3
<b>Substitution and secondary resources</b>	6.4	13.0	18.6	14.0
<b>Recycling</b>	11.0	12.5	17.1	13.7
<b>Pooling of demand to increase market power</b>	8.3	10.9	16.7	12.3
<b>Nothing</b>	24.7	9.5	6.1	10.0
<b>Investment in resource-rich countries</b>	0.7	1.5	3.1	1.9
<b>Investment in mining companies</b>	0.4	0.7	1.4	0.9

Small companies: less than 1-million-euro turnover; medium companies: 1 to 50 million euro turnover; large companies: more than 50 million euro turnover  
Source: Bardt / Kempermann / Lichtblau, 2013

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