

Az elektromobilitás elektronikai technológiai kihívásai

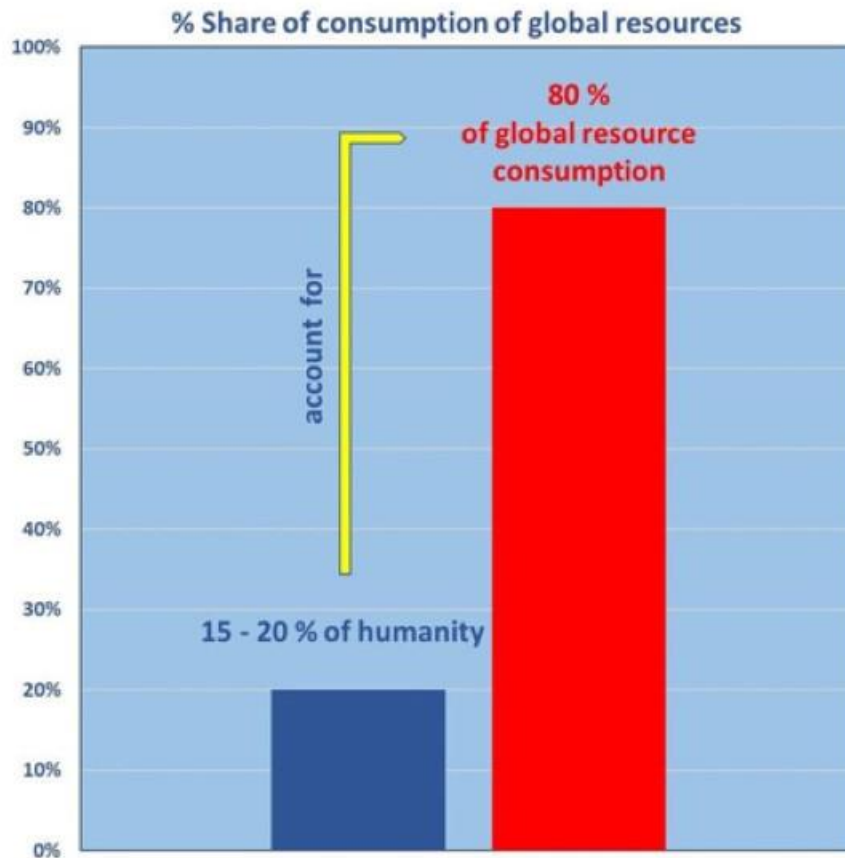
Környezeti-társadalmi háttér

Dilemma of Mankind: Sustainability

We live in a *finite* world, but behave as if it were inexhaustible.

Options:

1. Giving up on growing our current economy - means the *risk* of economic and social collapse.
2. Maintaining growth - means the *risk* of destroying global ecosystems that are our basis of existence.



If all the people in the world lived like citizens in Switzerland, then we would need three planets as big as our Earth.



The greenhouse effect is a natural phenomenon, but the increase in greenhouse gases is linked to human activities

Climate experts believe that human-caused greenhouse gases are the **main cause** of global warming by:
fossil fuels, deforestation, intensive farming, waste disposal, mining, overconsumption.

- Obviously we need an energy revolution;
- We have to replace fossil fuel-based grids and fossil fuel-powered vehicles;
- Clean, carbon-free grids, and electric vehicles that charge off them are needed.

„The fight against „climate change” is a real opportunity to transition to a low carbon society - creating jobs, innovation and social justice locally and internationally.”

<https://solarimpulse.com/global-warming-solutions>

There's, however, a big problem:

High-tech energy infrastructure of tomorrow requires a host of metals and minerals from across the periodic table and the planet.

https://earthworks.org/cms/assets/uploads/2019/04/MCEC_UTS_Report_lowres-1.pdf

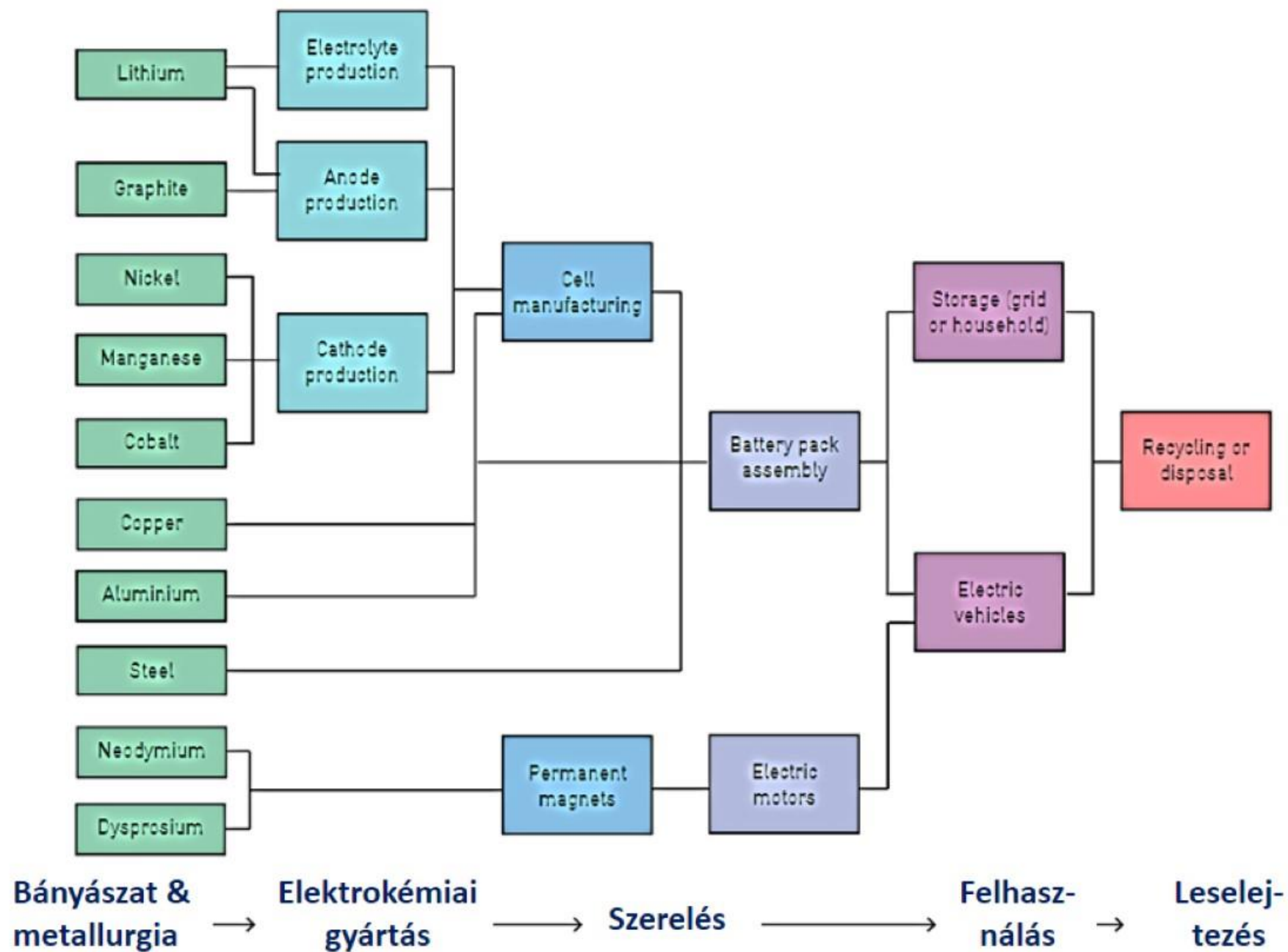
A megújuló energiaforrások gyártásának technológiai anyagigénye

	 Batteries			 Solar PV			 Wind Power	
	Li-ion	Li-S	EV	c-Si	CIGS	CdTe	PMG	Non-PMG
Aluminium	X	X		X	X	X	X	X
Cadmium						X		
Cobalt	X							
Copper	X	X		X	X	X	X	X
Dysprosium			X				X	
Gallium					X			
Indium					X			
Lithium	X	X						
Manganese	X							
Neodymium			X				X	
Nickel	X							
Silver				X				
Selenium					X			
Tellurium						X		

http://www.ren21.net/wp-content/uploads/2018/06/178652_GSR2018_FullReport_web_final_.pdf

<http://www.scopus.com/inward/record.url?eid=2-s2.0-84929404255&partnerID=tZOtx3y>

A lítium-ion akkumulátor gyártási folyamata és életciklusa



Tesla develops a battery recycling system at its Gigafactory 1 plant that will “process both battery manufacturing scrap and end-of-life batteries” with the aim of recovering critical metals.

American Manganese, which has [partnered](#) with the **Department of Energy's Critical Materials Institute** on battery recycling, recently [patented a technology](#) to efficiently *extract all of the metals from the cathode of lithium-ion batteries, including lithium* not recycled at all today.

A világ elektromos energiatermelése összetételének alakulása a jelenlegi trendek szerint várható arányeltolódásokkal

Electricity generation (TWh/ year)	2015	2020	2025	2030	2035	2040	2045	2050
Hard coal (& non-renewable waste)	7,662	8,334	8,942	10,237	11,389	12,495	13,083	13,589
Lignite	1,780	1,767	1,773	1,803	1,832	1,901	1,962	1,982
Gas	5,743	6,179	6,998	8,159	9,294	10,428	11,422	12,285
Oil	877	739	633	512	446	382	330	287
Diesel	122	122	125	131	137	141	148	153
Nuclear	2,545	2,991	3,218	3,452	3,638	3,825	4,018	4,218
Hydrogen	0	0	0	0	1	1	1	1
Renewable H2	0	0	0	0	0	0	0	0
Hydro	3,888	4,299	4,684	5,202	5,583	5,964	6,320	6,667
Biomass (& renewable waste)	471	649	785	953	1,082	1,211	1,354	1,514
Geothermal	80	104	130	178	230	281	344	426
Solar thermal power plants	9	25	38	58	94	130	183	260
Ocean energy	1	2	4	7	16	25	37	53
Wind	838	1,394	1,948	2,431	2,894	3,358	3,856	4,389
PV	247	662	1,057	1,460	1,826	2,192	2,645	3,209
Total renewables	5,534	7,133	8,645	10,290	11,725	13,160	14,740	16,517
Total generation	24,262	27,266	30,333	34,584	38,461	42,332	45,702	49,032
Share of renewables	23%	26%	29%	30%	30%	31%	32%	34%

Az elektromobilitási energiaigények és az elektromos energiatárolási kapacitások várható alakulása

Share of renewables	23%	26%	29%	30%	30%	31%	32%	34%
No of vehicles (thousand vehicles)	2015	2020	2025	2030	2035	2040	2045	2050
Battery Electric Vehicles (BEV)	1,074	5,596	12,952	27,619	47,396	72,691	144,325	218,591
Plug-in Hybrid Electric Vehicles (PHEV)	56	441	1,377	3,759	8,326	16,070	28,221	46,683
Commercial Vehicles (CV)	102	432	1,209	3,001	4,800	6,004	7,016	7,480
Buses	184	368	1,061	2,429	4,283	5,991	7,067	7,914
Total electric vehicles	1,416	6,837	16,600	36,807	64,805	100,756	186,628	280,668 200x
Battery capacity (GWh)	2015	2020	2025	2030	2035	2040	2045	2050
Battery Electric Vehicles (BEV)	41	224	557	1,326	2,465	4,143	8,659	13,553
Plug-in Hybrid Electric Vehicles (PHEV)	0	3	11	38	100	209	395	700
Commercial Vehicles (CV)	26	130	423	1,200	2,160	3,002	3,859	4,488
Buses	9	22	61	128	227	311	382	453
Total battery capacity	76	378	1,053	2,691	4,951	7,665	13,295	19,194 25x

A világ elektromos energiatermelése összetételének alakulása

a 1,5°C hőmérséklet-emelkedési korlát betartásához szükséges arányeltolódásokkal

Electricity generation (TWh/ year)	2015	2020	2025	2030	2035	2040	2045	2050
Hard coal (& non-renewable waste)	7,638	7,323	4,931	2,164	439	20	0	0
Lignite	1,780	1,609	445	182	80	0	0	0
Gas	5,743	6,245	6,636	5,896	4,879	3,056	1,234	0
Oil	877	737	502	269	43	5	0	0
Diesel	122	103	68	22	0	0	0	0
Nuclear	2,545	2,921	2,250	1,515	841	182	12	0
Hydrogen	0	0	34	278	754	1,719	2,620	3,127
Renewable H2	0	0	16	210	643	1,596	2,547	3,127
Hydro	3,888	4,299	4,495	4,625	4,743	4,823	4,909	4,988
Biomass (& renewable waste)	471	823	1,683	2,395	2,660	2,933	3,156	3,286
Geothermal	80	113	314	908	1,568	2,266	2,848	3,324
Solar thermal power plants	9	32	329	1,834	3,772	5,709	7,211	8,147
Ocean energy	1	2	41	168	414	705	991	1,178
Wind	838	1,545	4,536	9,075	13,677	17,622	20,300	21,567
PV	247	918	3,917	7,483	11,396	15,633	18,439	19,695
Total renewables	5,534	7,732	15,331	26,699	38,873	51,286	60,402	65,311

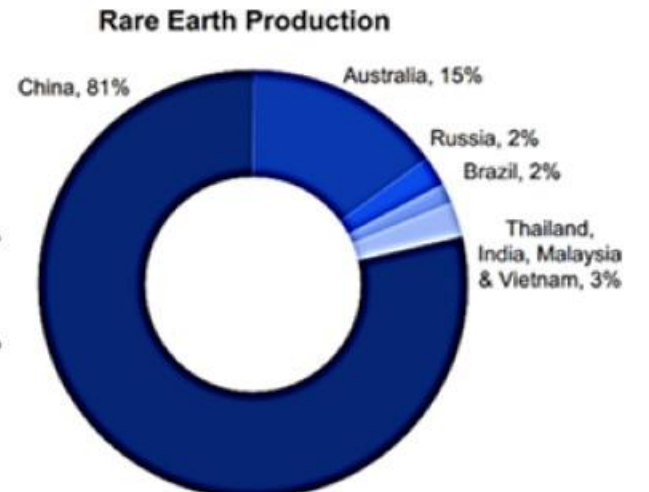
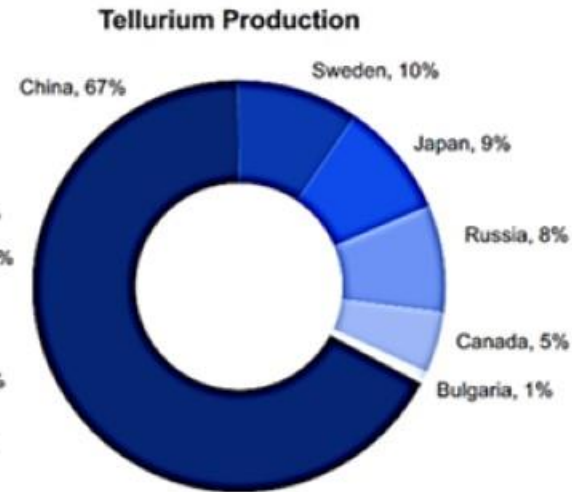
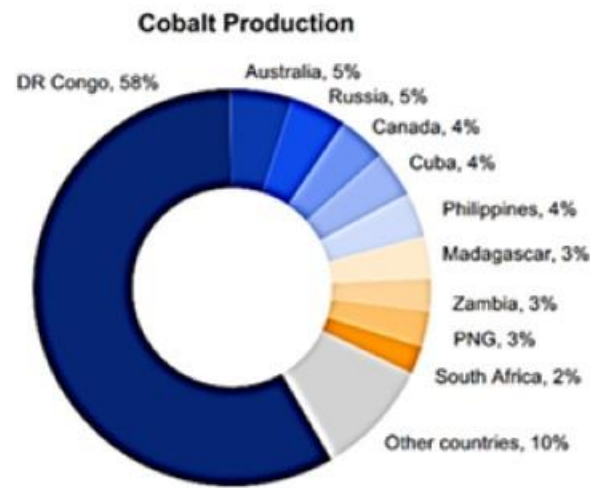
Elektromobilitási energiaigények és az elektromos energiatárolási kapacitások elvárt alakulása a klímakímélő megoldások figyelembevételével

Share of renewables	23%	29%	51%	73%	86%	94%	98%	100%
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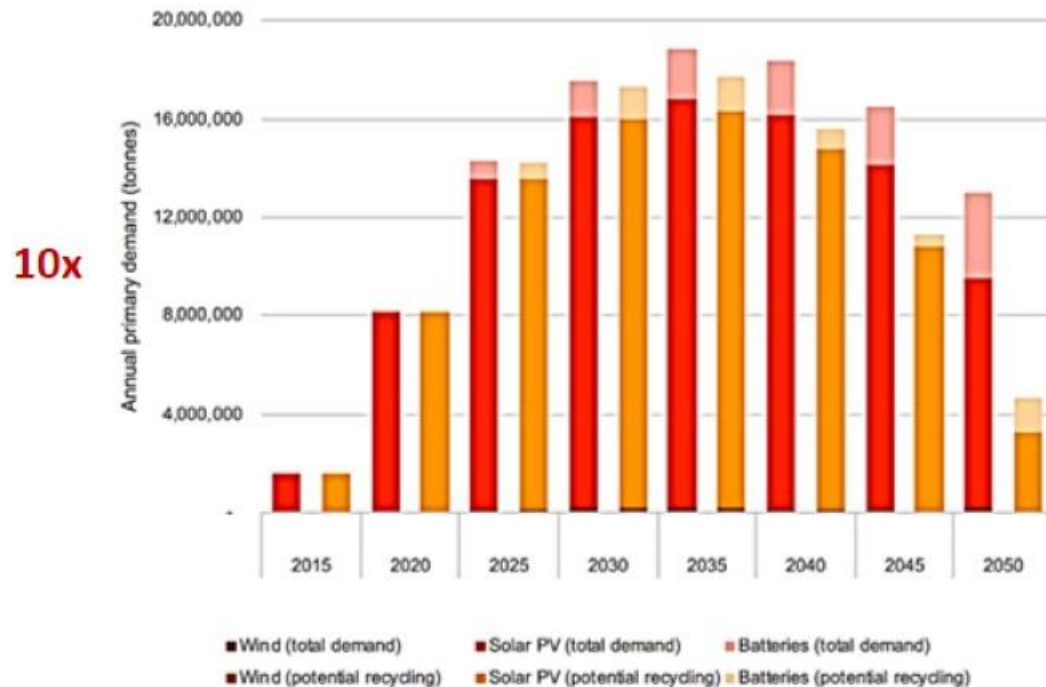
No of vehicles (thousand vehicles)	2015	2020	2025	2030	2035	2040	2045	2050
Battery Electric Vehicles (BEV)	1,345	10,158	102,132	284,926	495,630	677,357	772,588	916,469
Plug-in Hybrid Electric Vehicles (PHEV)	85	2,889	55,147	129,023	183,240	158,563	92,885	56,932
Commercial Vehicles (CV)	102	1,333	10,673	40,600	81,416	87,430	90,078	91,248
Buses	184	368	1,061	2,429	4,283	5,991	7,067	7,914
Total electric vehicles	1,716	14,748	169,014	456,978	764,570	929,341	962,618	1,072,563 620x

Battery capacity (GWh)	2015	2020	2025	2030	2035	2040	2045	2050
Battery Electric Vehicles (BEV)	51	406	4,392	13,676	25,773	38,609	46,355	56,821
Plug-in Hybrid Electric Vehicles (PHEV)	0	17	441	1,290	2,199	2,061	1,300	854
Commercial Vehicles (CV)	26	400	3,736	16,240	36,637	43,715	49,543	54,749
Buses	9	29	229	782	1,148	1,354	1,497	1,595
Total battery capacity	87	852	8,797	31,989	65,757	85,740	98,695	114,019 1310x

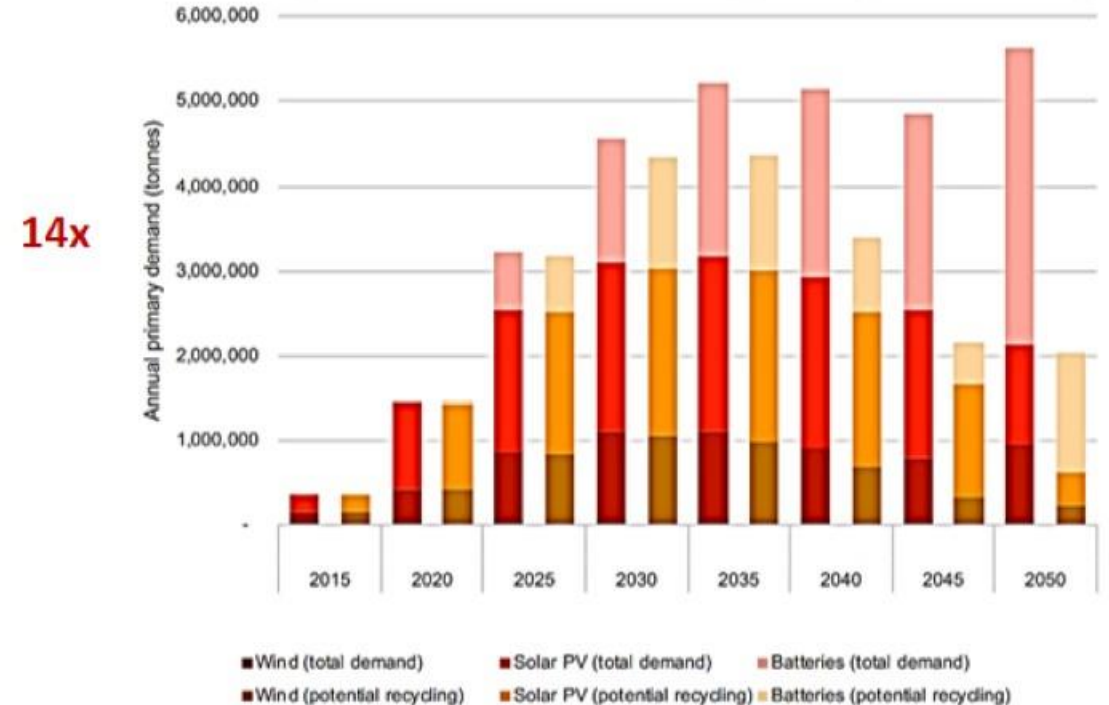
A kobalt, tellúr és ritka-földfémek kitermelése és előállítása forrás-országok szerinti bontásban(2017)



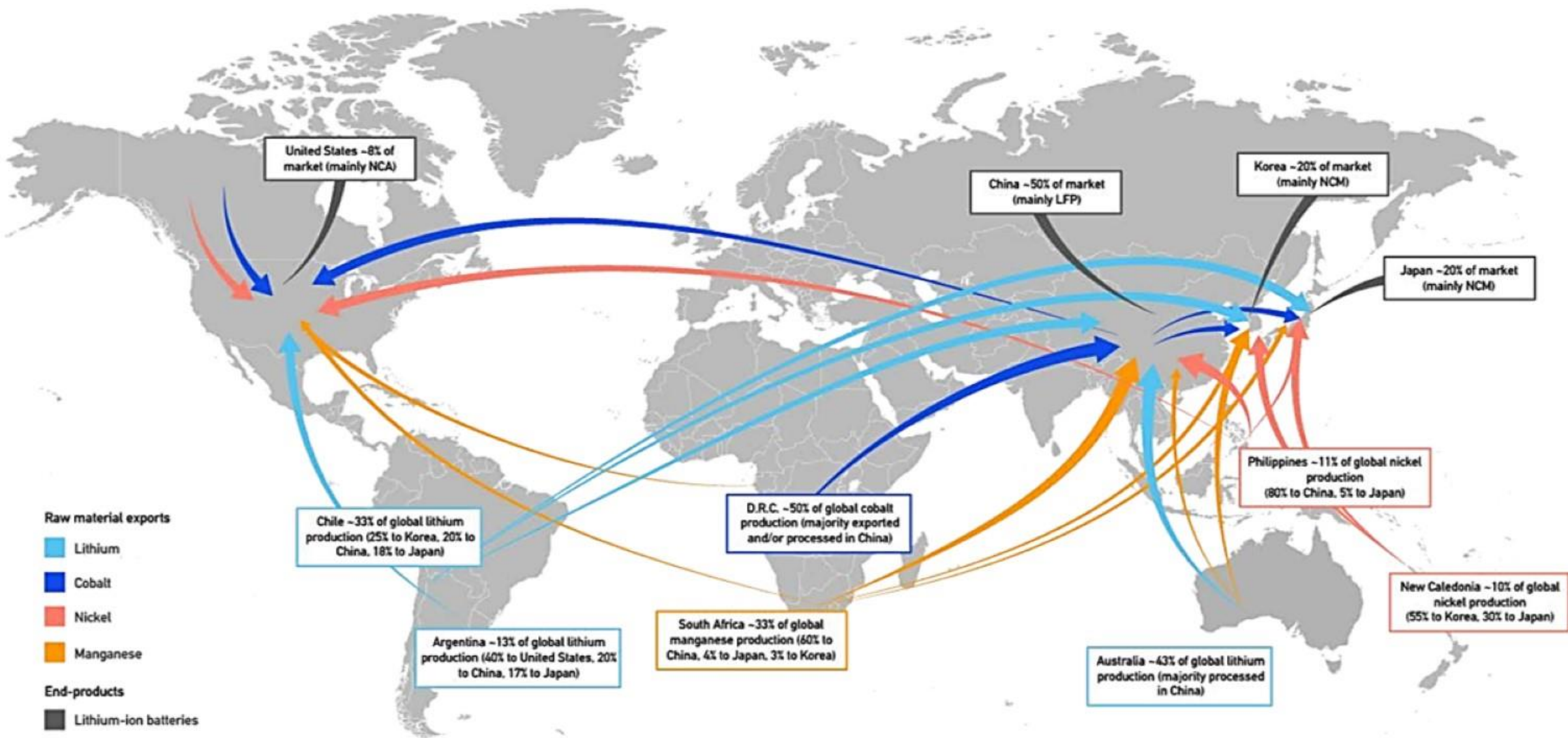
A szélenergia-, PV- és akkumulátorgyártás primer Alumínium igénye



A szélenergia-, PV- és akkumulátorgyártás primer Réz igénye



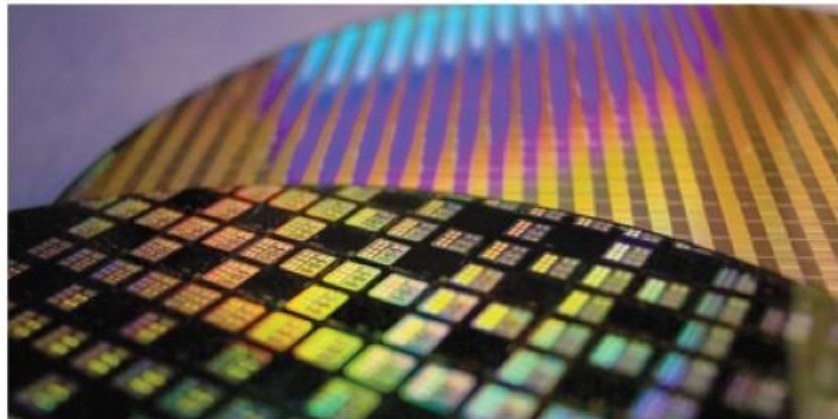
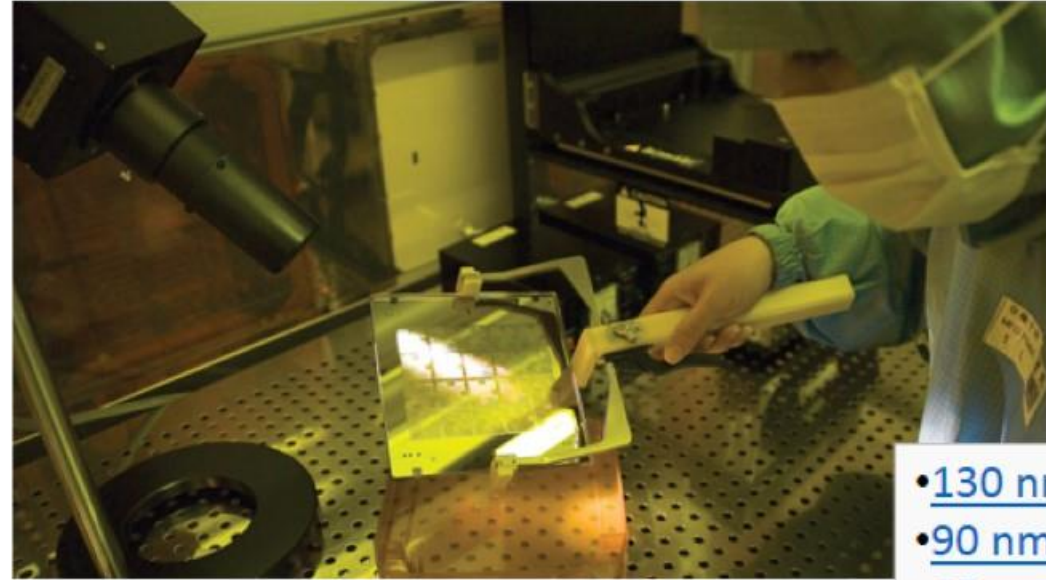
Lítium-ion akkumulátor előállítás: nyersanyagtermelés és termék gyártás



More Moore - still more?

TSMC :

- Started volume manufacturing of high-performance 7nm parts according to [DigiTimes](#);
- its high-performance 7nm parts hit the market in 2H 2019 through AMD;
- Intel's equivalent 10nm parts are expected to arrive later by the end of 2019;
- TSMC started risk production of 5nm parts even and expect volume production by 2020.
- Their secret: **EUV with a wavelength of 13.5nm**
- *minimum possible etch using standard patterning is just under 7nm.*



TSMC will manufacture **3D Stacked WoW Chips In 2021.**

After completing world's First 3D IC package **Mass production of 5nm WoW built chips starts in 2021 .**

80% packing density and 1.5x speed increase expected with transition (AMD)

- [130 nm](#) – 2001
- [90 nm](#) – 2004
- [65 nm](#) – 2006
- [45 nm](#) – 2007
- [32 nm](#) – 2010
- [22 nm](#) – 2012
- [14 nm](#) – 2014
- [10 nm](#) – 2017
- [7 nm](#) – 2018
- 5 nm – ~2020
- [3 nm](#) – ~2024

[Half-nodes](#)

Stacked dies

- 3D chip production techniques are common in the storage world (Samsung);
- TSMC's Wafer-on-Wafer stacking (WoW) will apply this concept to computing silicon;
- TSMC developed the technology with California based Cadence Design Systems as an extension of the company's [InFO \(Integrated Fan-out\)](#) and CoWoS (Chip-on-Wafer-on-Substrate).

Wafer-on-Wafer stacking *WoW 3D packaging*

- Alsó szeleten a kis disszipációjú alrendszerek
- Felső szeleten a nagy teljesítményfelvételű 36 magos processzor
- Közöttük a TSV összeköttetés

Patented by TSMC

