

# National Academies of Science, Engineering & Medicine Electric Vehicles Workshop

New Supply Chain Needs Specific to BEVs Celina J. Mikolajczak

October 26, 2021



## Lithium-Ion Cell Supply Chain



#### Raw Materials:

- Lithium
- Nickel
- Cobalt
- Manganese
- Aluminum
- Graphite
- Copper
- Steel
- Separator (polymer)
- Electrolyte
   (petrochemical +
   lithium salt



**EV Batteries** 





### Raw Materials:

- Wheat
- Water





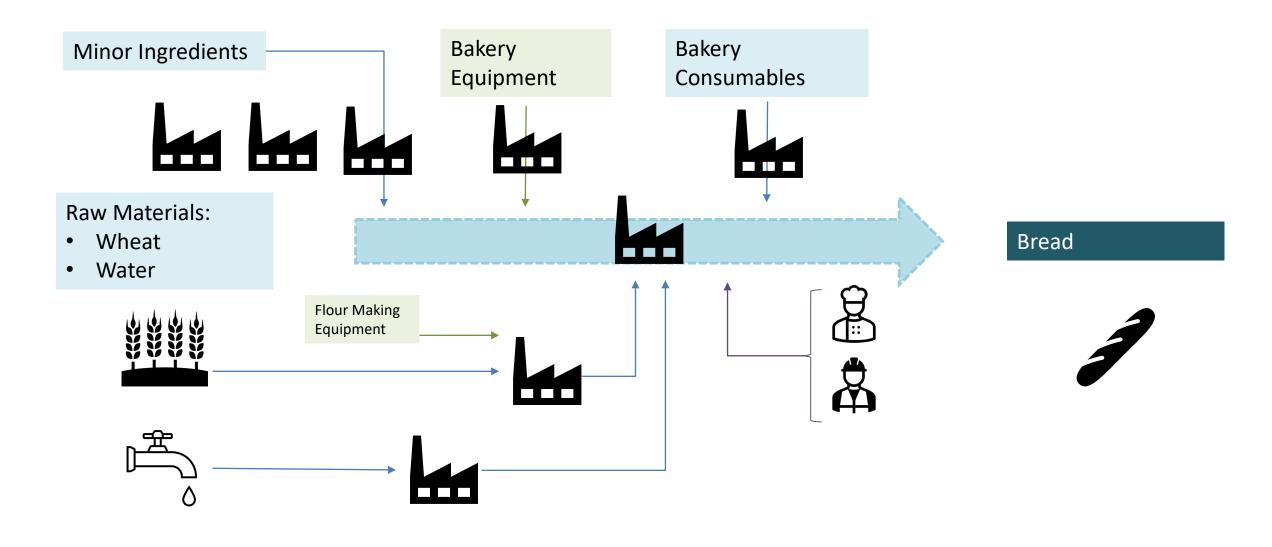


Bread



## **Bread Supply Chain**





## Lithium-Ion Cell Supply Chain



#### Raw Materials:

- Lithium
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- Cobalt
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- Graphite
- Copper
- Steel
- Separator (polymer)
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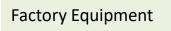
**EV Batteries** 





Cathode raw materials (LiOH, NiOH, CoOH, MnOH, AlOH, additives)









Anode raw materials (graphites, Silicon, additives)









Separator raw materials (PE, PP)





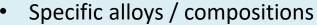


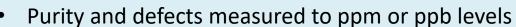
**EV Batteries** 

Current collector raw materials (Cu, Al)



Materials entering a cell factory are <u>all</u> highly engineered:







- Specific, highly defined morphologies
- Edge/burr defects measured in microns
- Extreme cleanliness requirements
- Moisture sensitive, or limited shelf life

Electrolyte raw materials (EC, DC, LiPF6, additives)



Cans, caps, Tabs, tapes

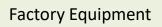


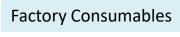




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Anode raw materials (graphites, Silicon,

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Separator raw materials (PE, PP)

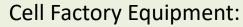


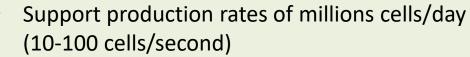


**EV** Batteries

Current collector raw materials (Cu, Al)

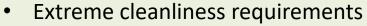








Hold micron-level tolerances



 Substantial automated data collection (advanced SCADA & MES requirements)

Electrolyte raw materials (EC, DC, LiPF6, additives)



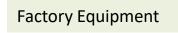
Cans, caps, Tabs, tapes





Cathode raw materials (LiOH, NiOH, CoOH, MnOH, AlOH, additives)

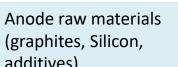
























Separator raw materials (PE, PP)

additives)

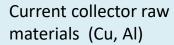




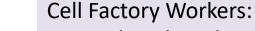




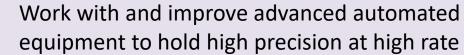


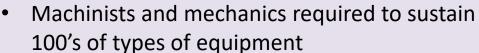




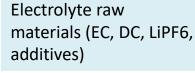




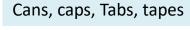




Numerous engineers, scientists and data analysts required on site to work with production teams







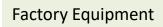






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Anode raw materials (graphites, Silicon, additives)











Separator raw materials (PE, PP)





**EV** Batteries

Current collector raw materials (Cu, Al)



Almost none of the engineered cell materials or cell making factory equipment is available from US suppliers at this time.



Electrolyte raw materials (EC, DC, LiPF6, additives)



Cell making factories struggle to find sufficient production and engineering staff

Cans, caps, Tabs, tapes

