Li-Bridge:

Bridging the Lithium Battery Supply Chain Gap

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Li-Bridge

Introduction to Li-Bridge

Context

Li-Bridge is a public-private partnership tasked with developing a national strategy that creates a sustainable & robust US supply chain for lithium batteries.

Li-Bridge's scope includes:

- Lithium-based batteries
- All applications
- Full value chain
- Both supply and demand policy levers

Argonne National Labs serves as facilitator between private industry & the federal agencies and Departments

Private industry participation is facilitated by an alliance of NAATBatt, NY-BEST, and New Energy Nexus.

2022 key objectives

Establish a clear strategy for building a domestic supply chain for batteries that is:

- Competitively advantaged
- Economically sustainable
- Environmentally sustainable
- Resilient
- Leverages the best of the US's public and private companies, institutions, and networks

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Last year's blueprint the starting point; Li-Bridge to inform priorities



GOALS TO ACHIEVE OUR VISION

1. Secure access to raw and refined materials and discover alternates for critical minerals for commercial and defense applications
2. Support the growth of a U.S. materials-processing base able to meet domestic battery manufacturing demand
3. Stimulate the U.S. electrode, cell, and pack manufacturing sectors
4. Enable U.S. end-of-life reuse and critical materials recycling at scale and a full competitive value chain in the U.S.
5. Maintain and advance U.S. battery technology leadership by strongly supporting scientific R&D, STEM education, and workforce development

2022 Li-Bridge strategic objectives

Setting a measurable ambition to serve as a 'North Star'

- An end-to-end view of thriving, domestic ecosystem in ideal target state (mfg'ing + supply chain + know-how)
- Quantifiable goals that establish how big to dream

Sizing the gap versus where we want to be

- An assessment of where the US has fallen behind, and by how much
- Crystallization of what is holding the US back

Developing recommendations to drive systemic change

- A plan that answers 'what does it take' to build and sustain the flywheel, with & without long-term support
- Clear priorities on where coordination and focus will change the game in favor of US industry & communities

Delivering outcomes that are a win for US companies and the public

- Quantification of impact (on jobs, returns on investment, environmental performance, …)
- Activation of public & private that translates into near-term action and seizes the moment before us

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Team structure: an organizing committee, central PMO, and topic commit

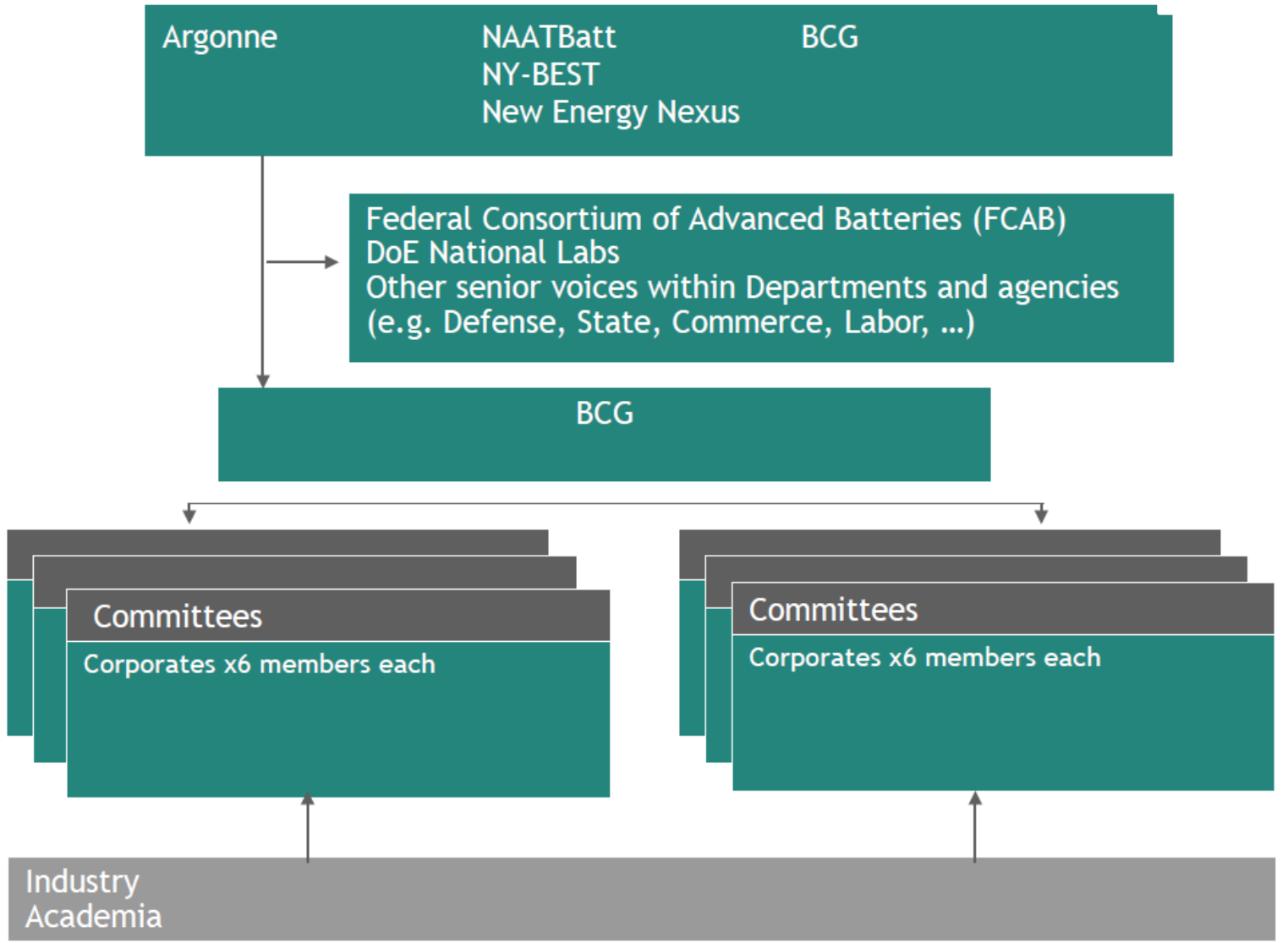
Organizing Committee
- Review/approve process
- Set expectations for team output

USG stakeholder teams
- Coordinate public-private interdependencies

PMO
- Manage day-to-day coordination and synthesis

Topic committees
- Generate hypotheses
- Perform fact gathering and analysis

Industry & Academia
- Respond to surveys
- Observe select proceedings



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Highest-level strategic questions fall into a two-part framework



'Where to play'

- What are the most important sources of value-creation in the battery ecosystem?
- Can the US be competitive on market terms?
  - E.g., can target cost be achieved with a 100% N. American-made, green supply chain (in 2030, 2040)?
  - E.g., can the US be a major net-exporter of battery know-how and goods?
- What/if any discontinuities in the forecasted evolution of battery market can be exploited and that reset the game?



'How to win'

- What does it take to realize and sustain the targeted future state?
  - E.g., how do we get competitive on non-market terms, if less competitive outright on market terms?
- How does the US create permanent access to what is likely to be a globally supply-constrained market?
- What are the priorities to action first?

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Series of sprints will involve industry via surveys and representation in committees and forum discussions

Surveys facilitated thru Li-Bridge Organizing Committee to secure broadest voice of industry



Topic committees to build fact base and develop recommendations

- 6 committees
- 6 representatives each

Forums to discuss strategic choices & manage interdependencies

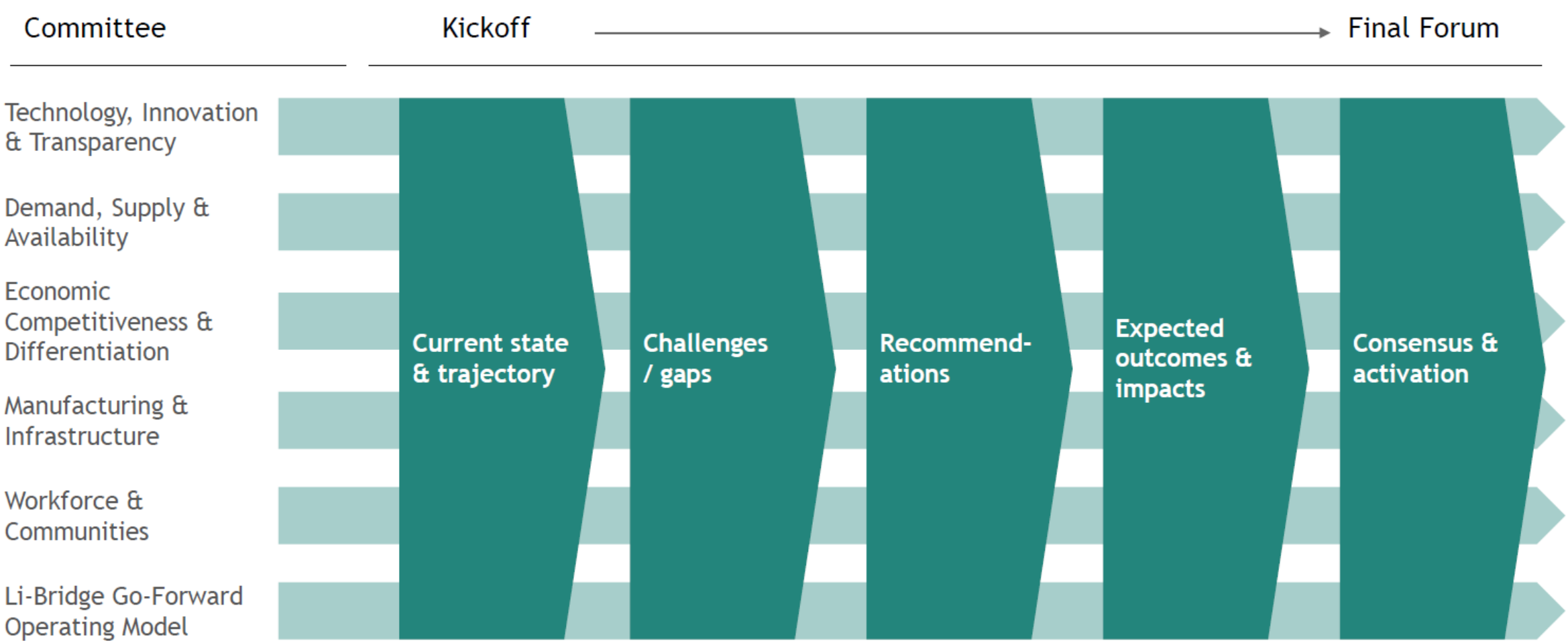
- ~5 Forums
- 30-40 senior-level attendees

Post-Forum working group to synthesize decisions, document strategy, and socialize findings

- Organizing Committee
- Other gov't representatives

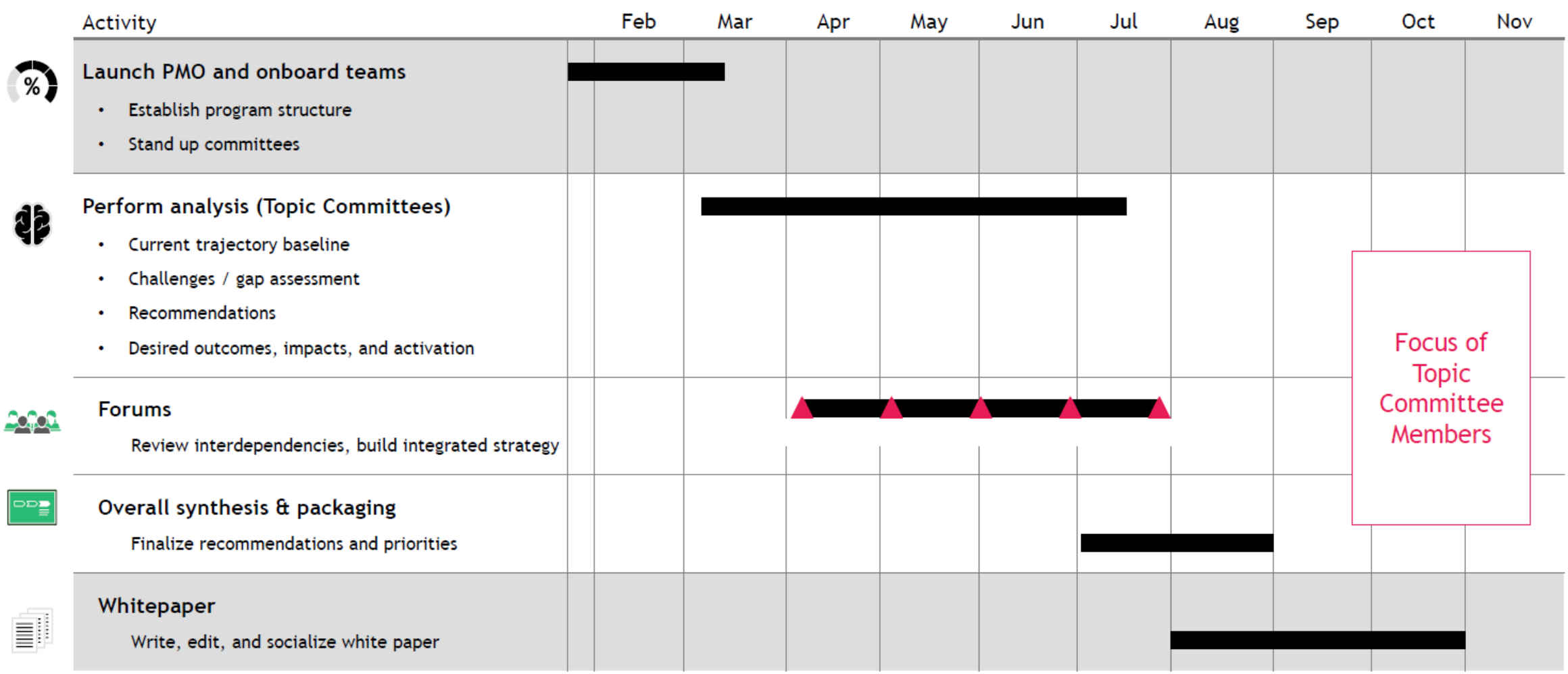
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Topic committee activities (incl. Forums) will progress discussion from cu trajectory and gaps to prioritized recommendations to expected impact



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Need to complete forums by July to enable proper socialization



Above dates are ***preliminary*** - final dates to be scheduled with committee members

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Forum Updates

Forum 1

Meeting objective and activities

Li-Bridge's first forum was held April 5 in Chicago with over 40 participants from industry, academia, and national labs. The main objective was to define a shared ambition and target state for the US lithium-based battery supply chain. Participants worked in breakout groups to define several unique target states, shared these target states with the broader group for discussion, and then synthesized the common threads into a unified target state (below).

Forum 2

Meeting objective and activities

Li-Bridge's second forum was held May 4 in Detroit, MI with over 40 participants from industry, academia, and DOE national labs. The main objective was to determine which areas along the US lithium-based battery supply chain should be prioritized for government intervention. To inform this discussion, committees presented findings from their analyses of the gaps and challenges along the US lithium-based battery supply chain. The following summary highlights a selection of key themes that emerged.

Briefing memo: Li-Bridge Forum #1, "Defining our Ambition and Target State"

April 5, 2022

I. Key themes that emerged from group discussions

- **a. Capturing jobs & economic value is the #1 priority for Li-Bridge initiative**
  - i. Debate centered around how central national security needs to be within the to-be-developed industrial policy. Will a doubled-down focus on jobs serve as sufficient impetus to break free from the momentum case (business-as-usual path resulting from expected demand growth)?
  - ii. Desire to prevent situations like the semiconductor shortage in auto or Germany's dependence on Russian oil/gas
- **b. Immediate action is needed**
  - i. US lithium-based battery industry viewed as behind China and Europe
  - ii. Broad consensus that the Li-Bridge roadmap must focus on immediate actions that generate results in the next 1 to 5 years
- **c. Strong sentiment that US must shift the value-cost paradigms to spur domestic production**
  - i. Support for using regulations (example: EU's carbon border adjustment mechanism or Battery Passport proposal) to favor domestic production and level the playing field vs imports, e.g., ESG, transparency, and/or carbon content requirements
  - ii. Desire to leverage US companies' strengths in understanding/anticipating customer needs to shape products brought to market and the business models in which they will be sold
- **d. Creating an attractive environment for investors is critical to increasing the manufacturing base**
  - i. Gap remains between the industrialization needs of companies and the expectations of capital market; further discussions required on levers to align and adapt
  - ii. Concern that uncertainty from US elections/political parties' differing agendas has negatively affected capacity investments in the US
- **a. Building the workforce is a chicken-and-egg challenge**
  - i. Talent shortage is acute and readily apparent today
  - ii. Need to synchronize site selection, supply chain strategy, and re-training programs for maximum impact
- **b. Strong eagerness among participants to accelerate discussion toward "How to win"**, e.g., incentives, regulations, standards, etc.
  - i. Desire for government to align targets and incentives, e.g., offering higher incentives to manufacturers that produce higher performing cells (similar to China)

II. Path forward

With a common ambition for the US lithium battery supply chain created and agreed to, and with committee charters and workplans defined, the topic committees are now set to begin working towards Forum #2 "Where to Play" (May 4). In Forum #2, participants will share assessments performed by the committees on economic attractiveness, strategic importance, and ability to maintain a competitive advantage. The objective of Forum #2 will be to develop a prioritized list of areas warranting differential policy support.

Briefing memo: Li-Bridge Forum #1, “Defining our Ambition and Target State”

Unified target state: The preferred choice of customers & manufacturers

1. **Sufficient cost competitiveness to enable scale and robustness**
   - Global cost competitiveness enables exports, driving greater scale and enabling further cost reductions
2. **Innovation targeted at where it matters most**
   - Leapfrogging existing technologies
   - Removing supply chain and geopolitical constraints, e.g., replacement for cobalt
3. **Owning the customer-centric ecosystem**
   - Deep understanding of customer needs (end-user and OEM) that enables the US to anticipate and create new markets
   - Creating and defining dimensions (e.g. standards, business models) in which producers must compete to attract consumers
4. **Strong end-to-end manufacturing/industrialization know-how and capacity**
   - Domestic knowledge of how to design, build, quickly/efficiently ramp up, and operate new production lines
   - Key manufacturing equipment produced domestically

Industry Led

5. **Attractive returns on investment, from both financial and Total Societal Impact (TSI)[1] perspective**
   - Capital markets view industrialization investments as offering attractive returns
   - Market demand highly stable despite alternating agendas of elected officials
   - Producers are rewarded for practices that adhere to high environmental, social, and governance standards
6. **Cohesive policy environment**
   - Every aspect of the industry working toward common high-level goals in a coordinated manner, including those a "half-step" outside of battery manufacturing, e.g., fire safety, regulatory bodies, education institution
   - Processes and regulations simplified and harmonized across US

Total Societal Impact (TSI): Total benefit to society from a company's products, services, activities; related to total shareholder return (TSR)

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Briefing memo: Li-Bridge Forum #2, "Where to Play"

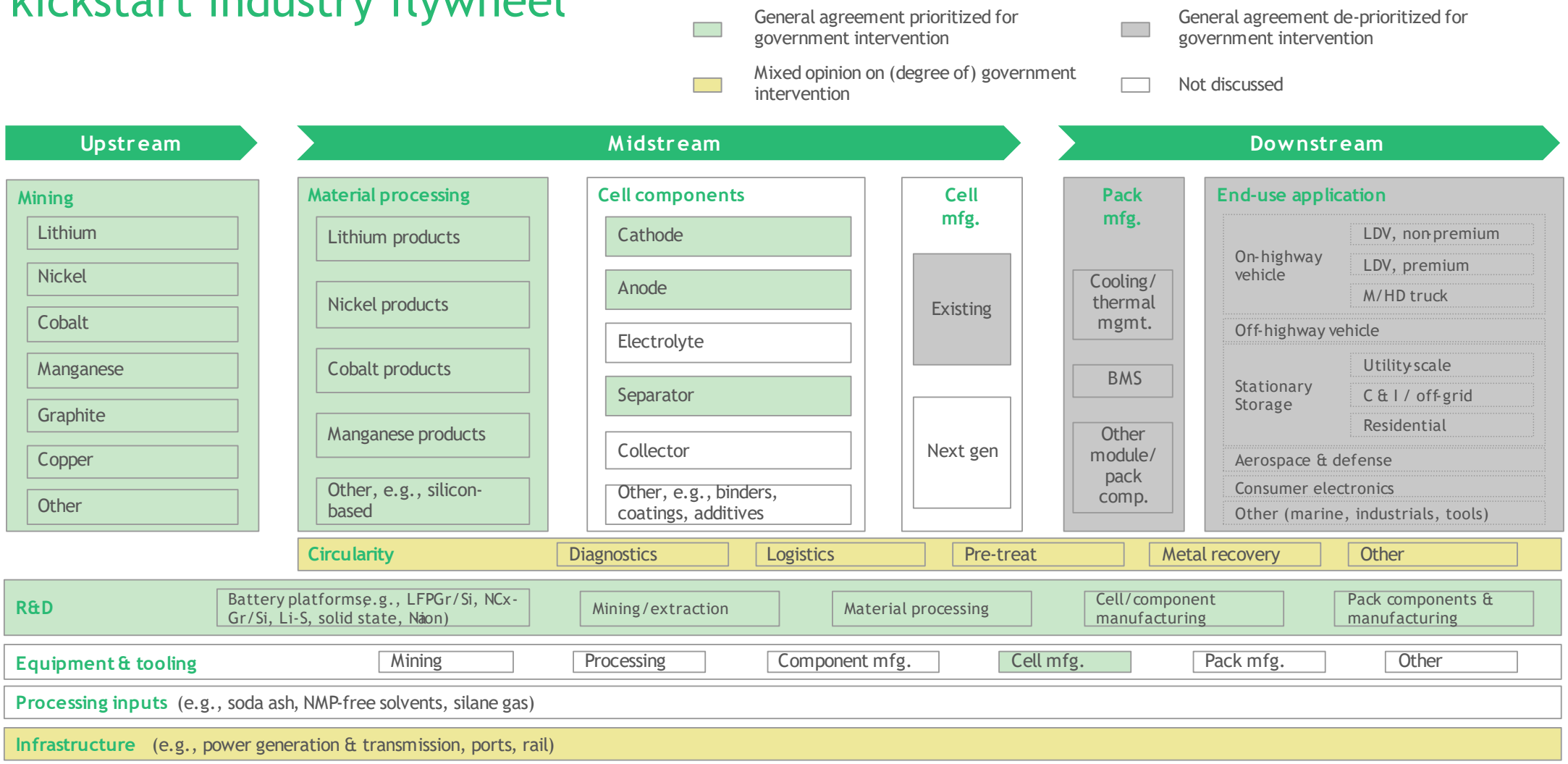
May 4th, 2022

I. Key themes that emerged from group discussions

- **a.** **Customer requirements & technology roadmap**: Customers/OEMs will look for more than just energy density in the future
  - i. Despite industry's current single-minded focus on energy density (and GWh sold/installed), there is a need to develop other points of differentiation that are meaningful to customers + to think expansively about the ecosystem (e.g., including charging); real metric could/should be clean energy vehicle miles travelled (or equivalent for other end product markets)
  - ii. Despite evolving technology roadmaps, several 'no regrets' materials needed for scaling upstream, e.g., Ni, Li, Mn, Li-metal anode
- **b.** **Demand**: In an unconstrained supply world, there is more upside potential than downside risk to the GWh demand figures presented for 2030
- **c.** **Investor lens**: Payback period identified as the primary tension between investor expectations and current battery projects, not steady state margins; Participants expressed differing views on both expected and realistic timelines to breakeven, from 2-3 years to 5-7 years from major capital investment
- **d.** **Manufacturing supply-demand gap**: Broad concern that cell capacity and component supply will be tight for next 5-8 years as new projects will take longer than expected to ramp up
- **e.** **Material supply-demand gap**: Diverging views on US Lithium supply forecast
  - i. Long-term material supply unclear (Li, Ni, Mn, Co) as there was disagreement among participants on how fast/ready projects will be coming online
  - ii. Recognition that US holds sizeable Lithium reserves (ground + brine) which could potentially support much higher levels of US Lithium production than currently projected; however, questions remain on the economics and timeline for developing these reserves
- **f.** **Industrialization journey**: Companies facing many hurdles including long/uncertain permitting processes, long equipment procurement lead times, and limited pilot line availability for testing/validating new technologies
- **g.** **Infrastructure**: Challenges identified with interconnection queue and limited clean energy (near- & longer-term challenges), and shipping delays (near-term)
- **h.** **Workforce**: Despite significant (re)-training needs, lack of workforce not adversely impacting investment decisions
  - i. Opportunity to retrain workers in US' traditional automotive and transition oil & gas/ petrochemical industries
  - ii. Several participants acknowledge there is risk in their company's workforce plans, e.g., assuming the talent will be there by start of production vs proactively getting involved
- **i.** **Risks**: Geographic concentration of supply was identified as the greatest risk to a secure US supply chain; nations are increasingly willing to pull levers that geo-politicize/weaponize trade
  - i. The US cannot count on friendly countries to meet supply needs, as these other nations may prioritize their own markets in times of supply shortages
  - ii. US needs to be a market leader in *some* part of the value chain so that it possesses a bargaining chip(s); US end market size is not likely sufficient on its own
- **j.** **Where to play (priorities for government intervention/support)**
  - i. Even in momentum case, downstream pack and cell manufacturing likely to have significant localized capacity, whereas other midstream & upstream activities (e.g., cathode, anode, refining) will always have global competition
  - ii. Establishing minimum base level capacity (i.e., 0 to 1) across entire supply chain seen as a critical and urgent need for (i) supply security and (ii) to gain experience
  - iii. In parallel, US should seek to position itself at the cutting edge of industrialization by investing in opportunities that are both (i) innovative and (ii) come with a high chance of industrialization, e.g., direct lithium extraction

Briefing memo: Li-Bridge Forum #2, "Where to Play"

'Where to Play': Value chain segments where government intervention prioritized to kickstart industry flywheel



Government intervention may be needed across value chain to stimulate demand for US-made products during the ramp-up period, when US-made products are not be competitive with international options.

LDV = Light-duty vehicle; M/HD = Medium/Heavy-duty vehicle; C&I = Commercial & Industrial

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Briefing memo: Li-Bridge Forum #2, “Where to Play”

•*Path forward*
In Forum #3 “How to Win” (June 15), committee members will
•Revisit US supply chain gaps and align on forecasted values and key challenges
•Assess potential policy measures against these challenges
•Prioritize policy measures and put on a timeline
•*Li-Bridge participating organizations*



Questions