

Introduction to Breakout #2

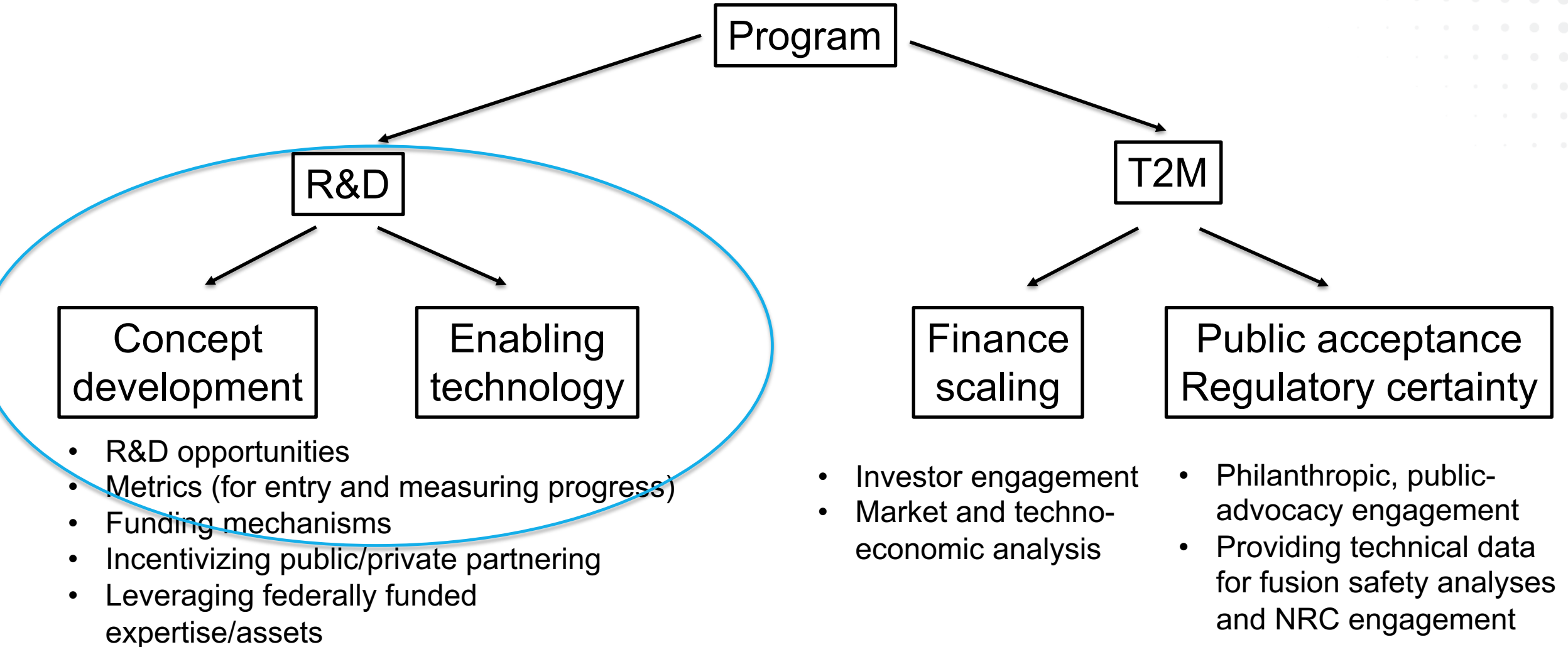
Technical R&D opportunities including plasma core and enabling technologies

August 14, 2019

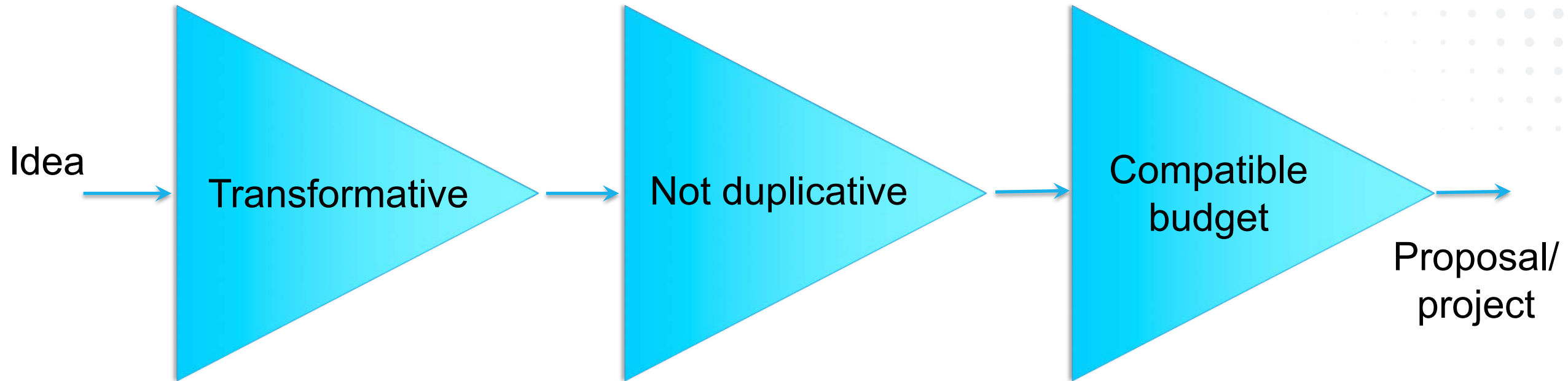
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Objective: present our thoughts and solicit your feedback/input on the following *to inform and refine my program pitch*



Reminder: What makes a good ARPA-E proposal/project?



Potential to disrupt development trajectory based on present state-of-the-art projections

Impactful project result for $\leq \$10M$ (federal funds), ≤ 3 years that will catalyze further support/effort

Metrics for category A: concept development (10 minutes)

- ▶ Please comment on eligibility for Category A:
 - Concept has the potential to eventually reach transient engineering $Q_{DT,equiv} > 1$ (using DD) for $\lesssim \$100M$ major-component cost (not including the building, diagnostics, non-specialized infrastructure)
 - Budget requests over \$1M require rudimentary TEA that identifies and justifies projected concept development costs based on market considerations
 - Concept exploration proposals under \$1M do not require TEA but must satisfy first criterion
- ▶ Please comment on potential major milestones:
 - 2D analysis/simulation showing that energy gain is possible
 - Demonstrate plasma formation/assembly technologies
 - Demonstrate integrated plasma formation and stability with scalability
 - Demonstrate stable plasma at ~ 100 eV, then 1 keV (T_e and T_i), at reasonable densities (concept dependent)
 - Advance $nT\tau$ with sequential metrics of $10^{18}, 10^{19}, 10^{20}$ keV s/m³ (possible prize)
 - Demonstrate transient Lawson-equivalent $nT\tau$ conditions using DD (possible prize)

Opportunities for category A: concept development (15 minutes)

- ▶ Where are opportunities for low-cost concept development (at all levels of maturity)? For example:
 - Untried, new idea? Or major twist on old idea?
 - New development or understanding that warrants revisiting an old idea?
 - An idea that is likely to advance significantly by fully leveraging state-of-the-art capabilities, tools, diagnostics, expertise, and adequate support?
 - ??

Metrics for category B: enabling technologies (10 minutes)

- ▶ Please comment on eligibility for Category B (technology or testing capability):
 - Proposer must identify quantitative enabling-technology metrics derived from at least one commercially viable fusion concept (examples: tritium-extraction rate or HTS neutron irradiation limit needed by ARC, electrode properties needed by Zap, testing/qualification facility requirements needed by multiple concepts, etc.)
 - Proposer must identify quantitatively how proposed solution is projected to exceed known state-of-the-art, and qualitatively how it can accelerate commercially viable fusion energy
- ▶ Please comment on potential milestones (technology or testing capability):
 - Benchtop validation of basic principles
 - Minimum viable demonstration of a scalable prototype (prize?)
 - Demonstration of required characteristics in a testing environment OR demonstrate a prototype enabling technology (prize?)

Opportunities for category B: enabling technologies (15 minutes)

- ▶ Where are the opportunities for enabling technology development (at all levels of maturity)? For example:
 - Enabling use of thick liquid molten salt or lead lithium at temperatures up to 1200 K
 - Technologies/materials/processes needed to minimize tritium inventory
 - Low-cost, accelerated paths to testing/qualification of subsystems
 - Efficient solid-state power electronics and repetitive pulsed power
 - Technologies/means to drastically reduce the cost of higher-TRL concepts (e.g., HTS magnets, permanent magnets, next-gen laser drivers)
 - Technology requirements demanded by advanced power cycles or advanced fuels
 - Transformative use of advanced manufacturing
 - ??

Logistics

- ▶ Every attendee is assigned to a breakout group
- ▶ Each breakout group will include a representative mix of workshop participants and address the exact same topics/questions
- ▶ An ARPA-E PD will lead/moderate the discussion
- ▶ A BAH tech SETA will take summary notes (not verbatim)
- ▶ A workshop attendee from each group will summarize high-level findings afterward

Please be concise and give specific feedback that will help us identify priority R&D opportunities, impactful milestones within 3 years, and approximate budget.



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