AMO Introspective Performance Assessment Methodology with Verification and Validation (IPA/V&V) of R&D Projects

AMO Strategic Analysis (StA) Team

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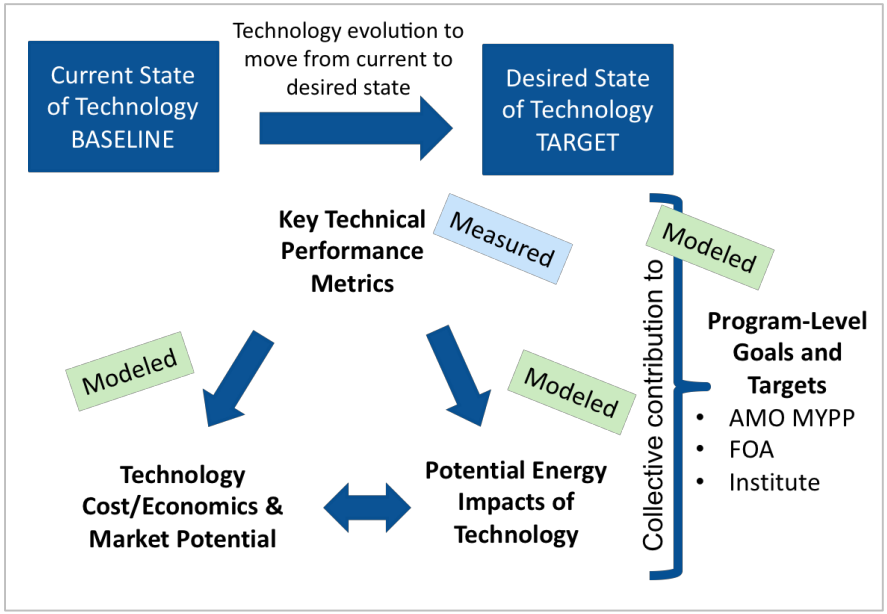
The multi-laboratory (Argonne National Laboratory, Lawrence Berkeley National Laboratory, National Renewable Energy Laboratory, and Oak Ridge National Laboratory) AMO Strategic Analysis (StA) Team provides independent, objective, and credible information to inform decision-making.

The AMO portfolio spans a broad spectrum of 14 interconnected advanced manufacturing technology areas that have the potential to significantly improve manufacturing energy efficiency and minimize the life-cycle energy of manufactured products. AMO's Multi-Year Program Plan (MYPP) lays out the technology-specific performance, economic and energy metrics for each technology area. AMO assesses the impacts of their investments from three perspectives: retrospective (tracking past investments in technologies that are now commercialized), introspective analysis (assessing and validating current investments), and prospective analysis (strategic analysis and projections to inform future investments).

The **AMO Introspective Performance Assessment Methodology with Verification and Validation of R&D Projects (IPA/V&V)** effort is focused on strengthening AMO's introspective analysis through implementation of a transparent, consistent and standardized office-wide IPA/V&V methodology. The methodology will establish a formal process to assess and communicate the progress and contribution of currently funded projects to the Office's foundational technology areas, and ultimately to AMO's strategic goals and success indicators.



Overview

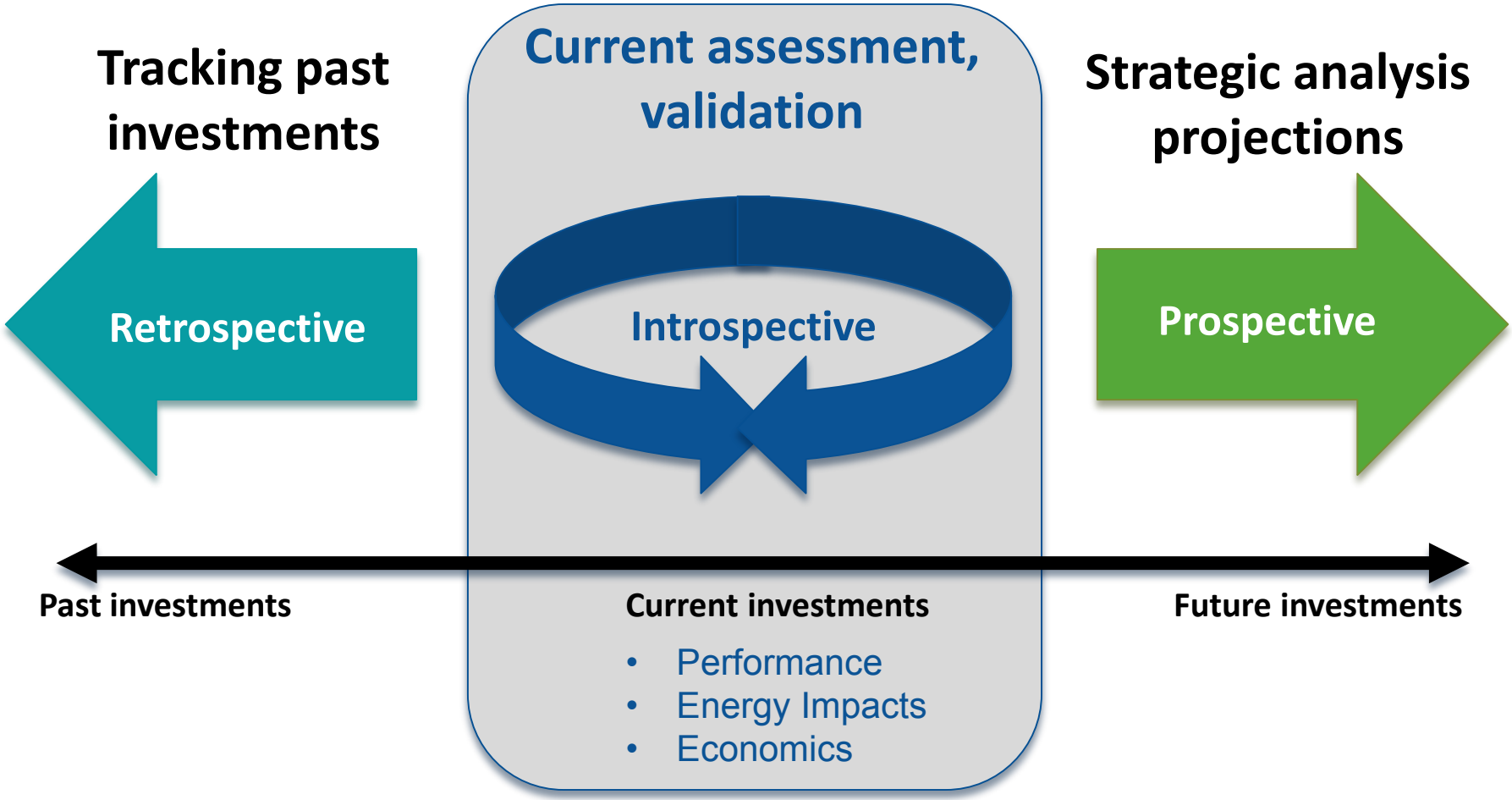
- **Multi-year Effort:** Three-year development plan with staged approach for establishing and implementing MP&P to consistently set and assess technical, economic, and energy performance metrics for AMO technologies and supporting R&D projects
- **Two-Tier Framework: Tier 1** will aim to collect and report basic performance metrics for all AMO-funded R&D projects, using existing Active Project Management practices where possible. **Tier 2** will focus on selected R&D projects and will involve a more rigorous V&V assessment procedure.
- **Leverages Existing Methodologies, Tools and Processes:** Current and past methodologies and tools used across EERE/AMO to assess and track program and project performance will be evaluated, and modified or integrated with others to meet AMO IPA/V&V requirements
- **Pilot and Implement:** The initial Tier 2 MP&P will be piloted on select FY19 projects, revised based on pilot results, then expanded to additional projects in the broader AMO portfolio in FY20 and FY21. Training will be provided to stakeholders—technology managers, principal investigators, analysts, subcontractors, etc.

Vision

- Vision
  - Establish a formal process to assess and communicate progress and contribution of currently funded projects to AMO's foundational technology areas, and ultimately to strategic goals and success indicators.
- Supports AMO Technology Manager Needs
  - "We need consistency in impacts at the project level"
  - "Why are we doing project X, what was the impact?"
  - "How do we measure results in the opportunity space?"
  - "Having the feedback loop from evaluation helps us define what is needed"
- Addresses AMO 2018 Peer Review Panel Recommendations
  - ... expand the use of techno-economic assessment ... in proposal selection and initial project implementation, particularly for early-stage research efforts.
  - ... expand collaboration among AMO Technology Managers to identify best practices ... and disseminate to other projects or activities that may benefit from those best practices.

Context – AMO Analysis Framework

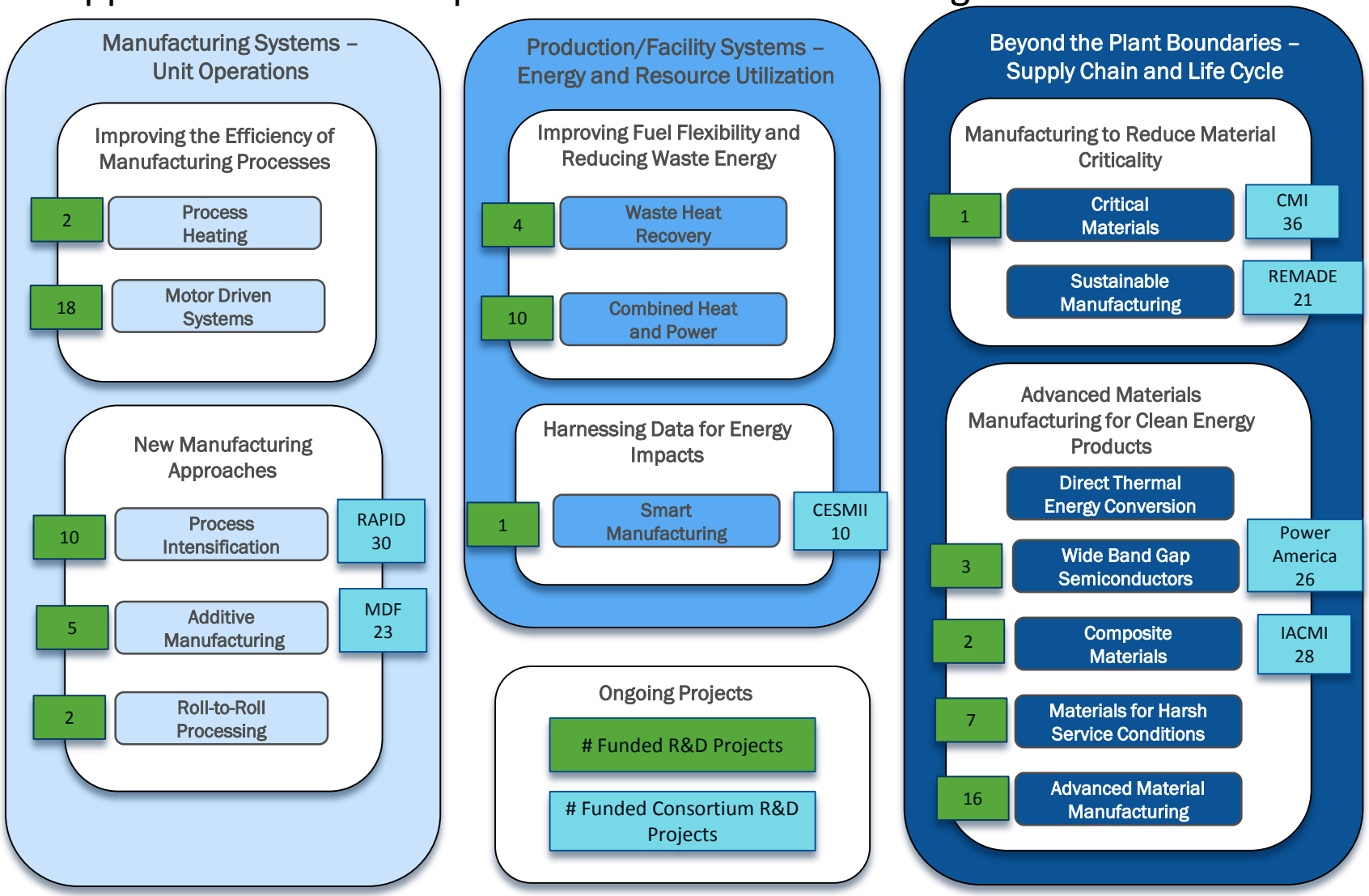
Analysis Objective: Provide independent and credible information to inform AMO decision-making



Cycle of prospective, introspective and retrospective helps AMO gain a sense of investment impacts across time

Context – AMO Technology Framework

- Support AMO's diverse portfolio of funded technologies

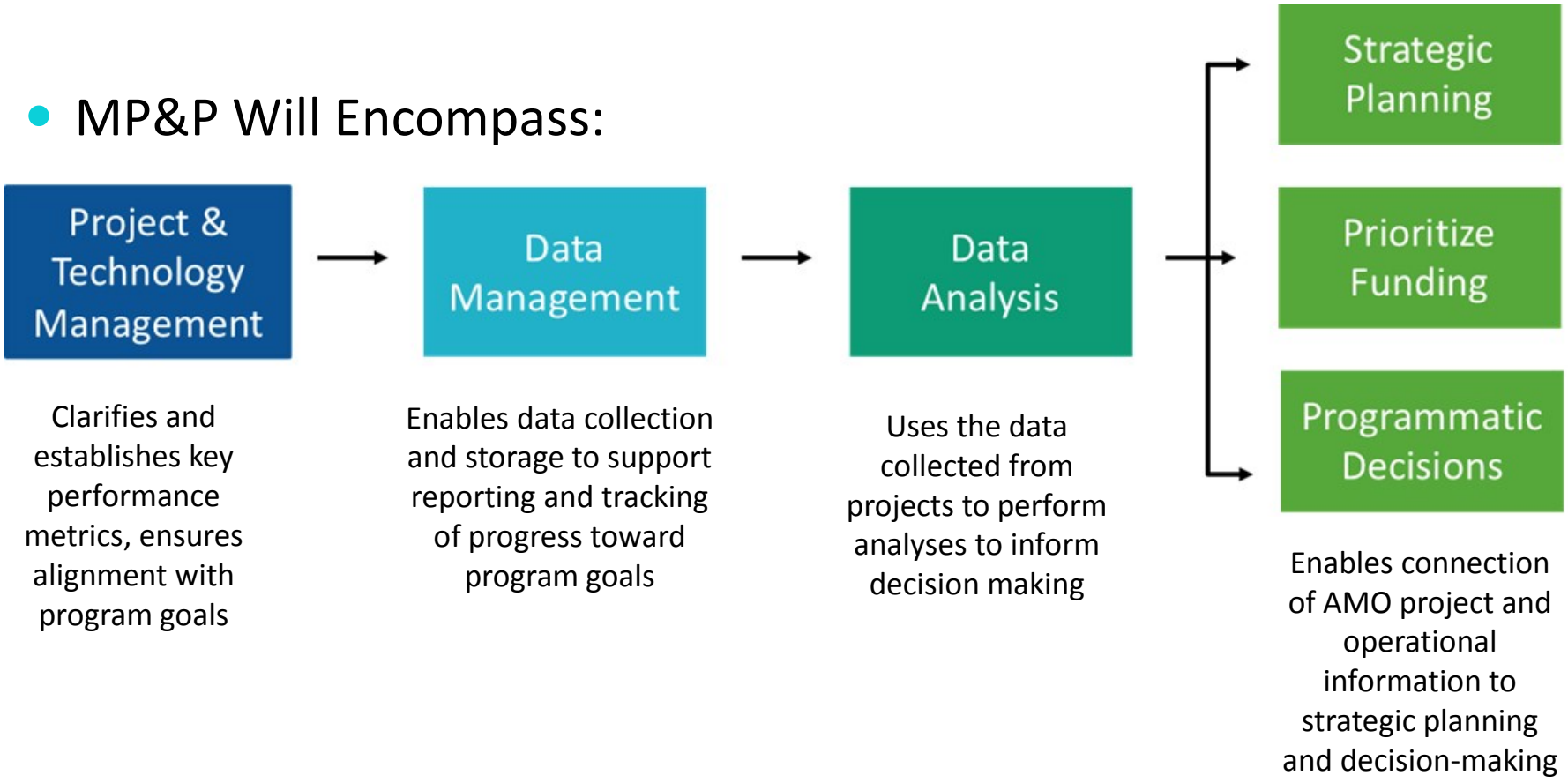


AMO Multi-year Program Plan (MYPP) lays out targets for fourteen AMO manufacturing technology areas, organized around three manufacturing system levels as described in the DOE's 2015 Quadrennial Technology Review (QTR).

Objectives

- Develop and codify a **methodology, process and procedures (MP&P)** to provide AMO a consistent, transparent and defensible accounting of anticipated benefits of currently funded technologies and supporting R&D projects

- MP&P Will Encompass:



Metrics

Verify and report progress in terms of:

Cost

- Develop **techno-economic analyses to help understand economic implications** of specific advanced manufacturing technologies and applications relative to the current state of the art

AMO Energy Success Indicators

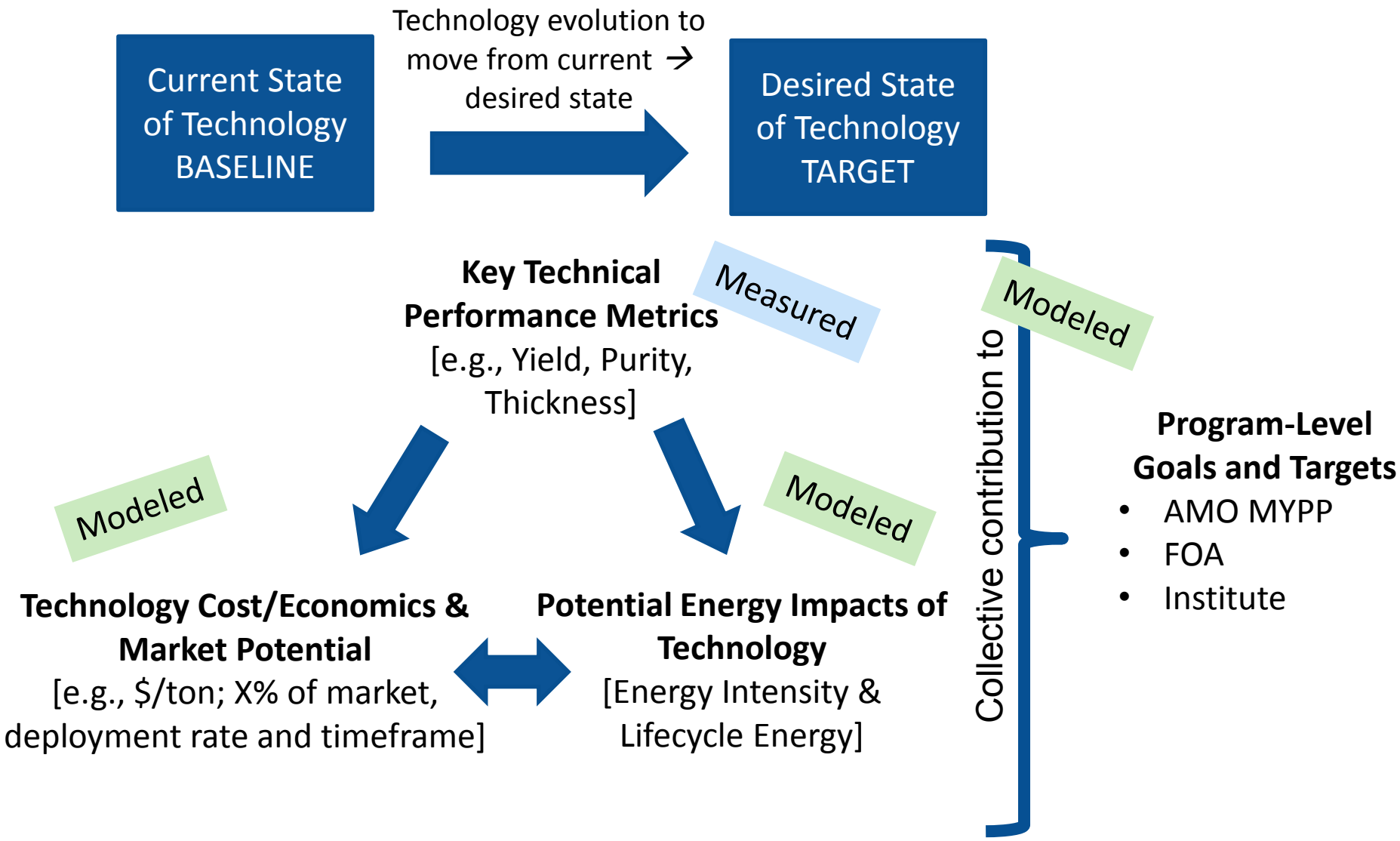
Energy Intensity

- Validate advanced materials, processes, and technologies that **reduce manufacturing energy intensity** by 20% by 2023 compared to the 2015 average technology.

Lifecycle Energy

- Advance materials and manufacturing technologies with the potential to **reduce life cycle energy** by 50% by 2023 compared to the 2015 state-of-the-art.

Goals and Data Needs



General Concept for Data Collection/Reporting

Project/Technology Information/Overview				
Project/Technology Title	Description	Focus Area	Partners	Drivers of Cost/Energy Improvement
Application(s)/End Use(s)	TRL/MRL	Barriers	Market Potential	Technology Maturation/Uptake Plan

Project/Technology Metrics					MYPP Link
	Project/Technology			Commercial Potential	
	Baseline State of Technology (SOT), Date	Interim Target, Date	Final Target, Date	Target, date	
Design/Model Assumptions and Technical Performance					
Technology/Process					
Scale					
Key Technical Metric 1					X
Key Technical Metric etc.					X
Economics					
Cost Metric Calculation	Model/Tool/Key Assumptions Documentation/Link				
Capital Cost					
Operating Cost					
Unit Cost (e.g. $/kg)					X
Energy					
Energy Metric Calculations	Models/Tools/Key Assumptions Documentation/Link (EI and LC Energy)				
Energy Intensity (e.g. J/kg)					X
Lifecycle Energy Impact					X

Development Approach

Multi-year Effort

- Three-year development plan with staged approach for establishing and implementing methodology, process and procedures (MP&P)
- Consistently set and assess technical, economic, and energy performance metrics for technologies and supporting R&D projects

Establish Two-Tier Framework

- **Tier 1** – Collect and report basic performance metrics for all AMO-funded R&D projects, using existing Active Project Management practices where possible
- **Tier 2** – Given large number of R&D projects, select representative cross-section for more rigorous V&V assessment procedure

Leverage Existing MP&P

- **Evaluate** (and modify/integrate to meet AMO IPA/V&V requirements) current and past EERE/AMO methodologies and tools used to assess and track program and project performance

Pilot & Implement

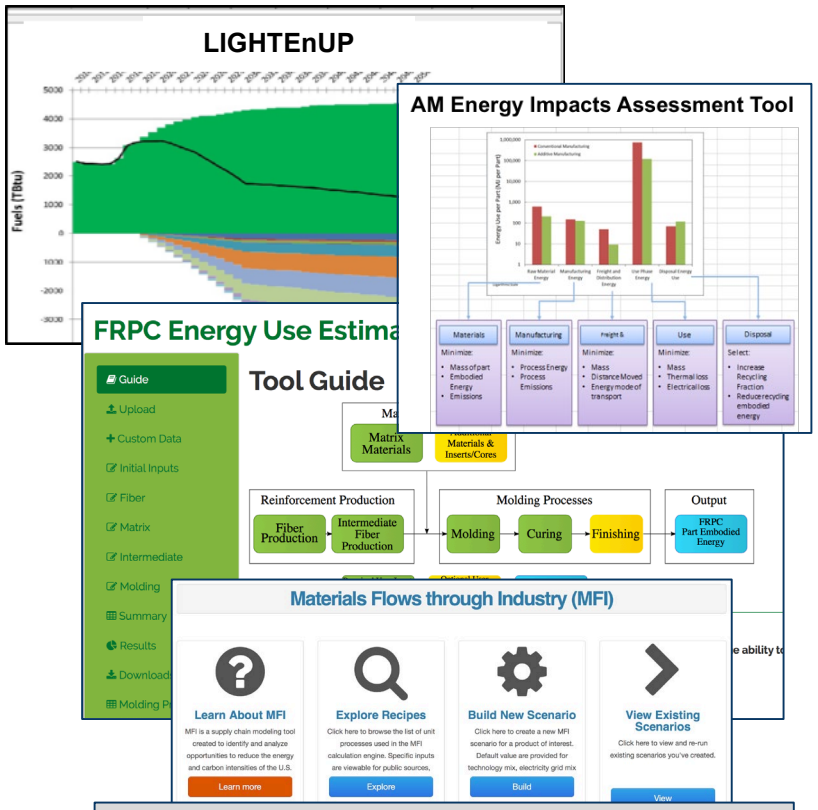
- **Pilot** Tier 2 MP&P on select FY19 projects, revise based on pilot results, then expand to additional projects in broader FY20/FY21 AMO portfolio
- **Train** stakeholders (technology managers, principal investigators, analysts, subcontractors, etc.)

FY19 Tier 2 Pilot Focus

- **Goal:** Include multiple technology areas and project types (i.e., direct R&D and Institute-funded) to ensure flexibility of methodology, process, and procedures (MP&P)
  - Select ongoing funded projects from:
    - Institute for Advanced Composites Manufacturing Innovation (IACMI)
    - Rapid Advancement in Process Intensification Deployment (RAPID) Institute
    - Process Intensification R&D projects
  - New projects in process of scoping/defining in:
    - Clean Energy Smart Manufacturing Innovation Institute (CESMII)
    - Cybersecurity Institute for Energy Efficient Manufacturing

Existing AMO Tools and Models to Support IPA/V&V

- **Cross-cutting Energy Assessment Tools/Models**
  - Life Cycle GHG, Technology and Energy through the Use Phase (LIGHTEn-UP) Tool (LBNL)
  - Material Flows Through Industry (MFI) – Supply Chain Focus (NREL)
- **Technology-Targeted Energy Assessment Tools/Models**
  - Carbon Fiber Reinforced Plastic (CFRP) Energy Estimator Tool (ORNL)
  - Additive Manufacturing Energy Impacts Assessment Tool (ORNL)
- **Technology Cost Assessment Tools/Models**
  - Wind turbine blade manufacturing cost model (NREL/ORNL)
  - Auto components (e.g., floor pan, door inner, hood inner) cost model (ORNL)
  - Wide Bandgap (WBG) for motor drives manufacturing cost model (NREL)
- **Outside-AMO Tools/Models**



Additional data needs for projecting longer term impacts of R&D projects:

- *Market Potential (e.g., fraction of market impacted)*
- *Technology Maturation*
- *Technology Adoption Rate and Timing*

Tasks and Tentative Timeline