
PHASE AND GATE ANALYSIS ADMINISTRATION

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ORGANIZATION

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LIST OF ACRONYMS

CPM's	critical path milestones
MST's	management support tools
DST's	decision support tools

EXECUTIVE SUMMARY

Phase and Gate Administration included developing Management and Decision Support Tools for the NARA project and utilizing those to ensure the project stayed on track to meet deliverables. Management Support Tools (MST) included Critical Path Milestones (CPM's) and cross-team focus areas. Decision Support Tools (DST) included the Phase and Gate process and Gate Review frameworks and facilitation.

Management Support Tools

The first type of MST's are CPM's to allow the NARA Leadership and teams to understand how project team milestones fit together to enable NARA to meet the

deliverables at the project completion. To do this, a set of CPM's were created for the NARA project to allow the NARA leadership to view how all the CPM's for each team fit together to meet the overall NARA deliverables and to ensure that course corrections could be made as the project progressed. The first CPM's mapped the overall NARA project by year. Figure PG-ES.1 shows the NARA CPM's by year. These were further broken down into CPM's for the major team elements of the NARA project: Biorefinery, Communities and Education (Figures PG-ES.2, PG-ES.3, PG-ES.4). These were revised as the project progressed and timing on key milestones were adjusted to enable the overall deliverables to be met where team-dependent milestones affect another team.

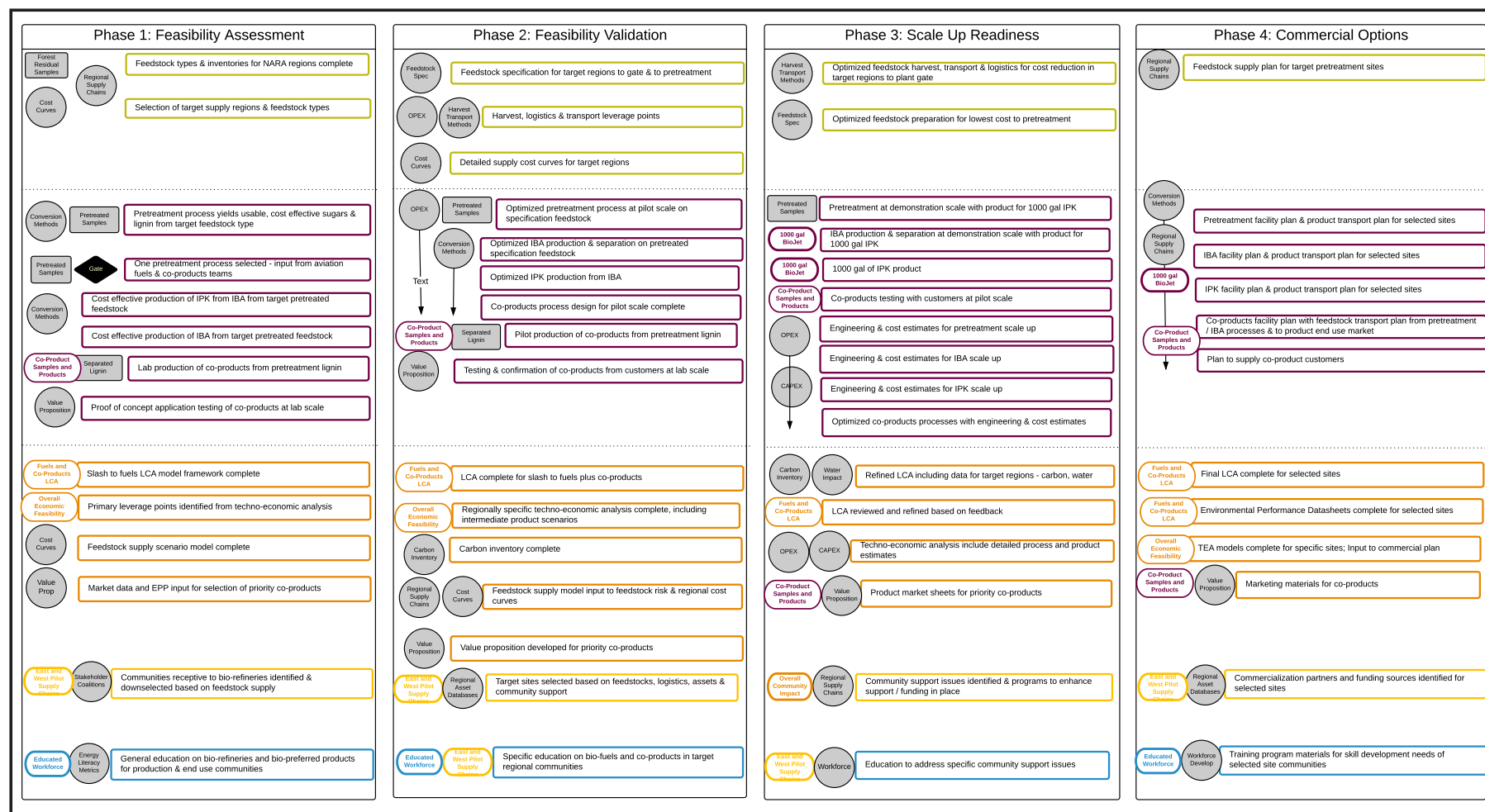


Figure PG-ES.1. Overall NARA CPM's by Year

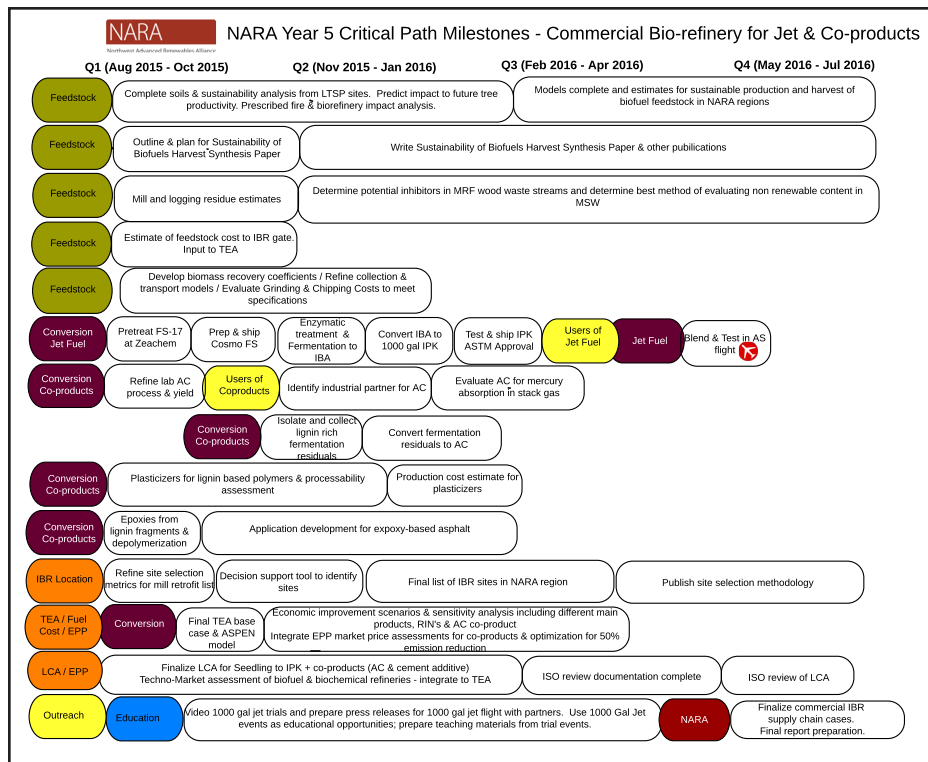


Figure PG-ES.2. Biorefinery CPM's

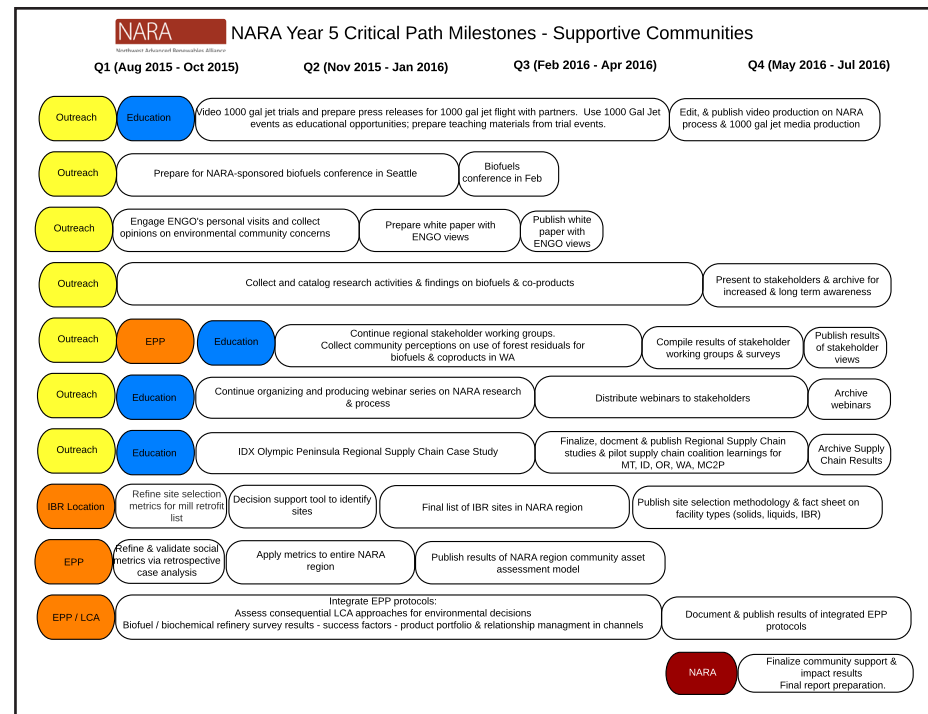


Figure PG-ES.3. Communities CPM's

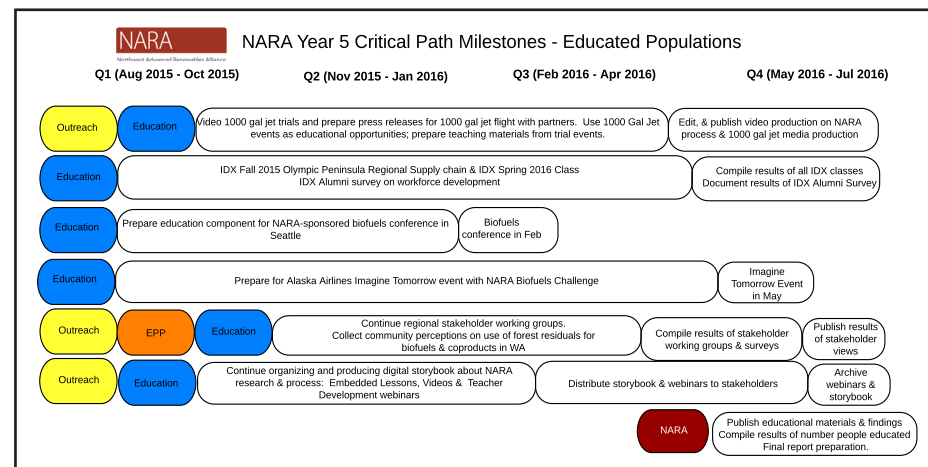


Figure PG-ES.4. Education CPM's

A second set of CPM's were created to guide team interaction and completion of specific deliverables. Production of 1000 gallons of jet fuel is a key deliverable for the NARA project (Figure PG-ES.5). In addition, the NARA team, along with the USDA NIFA and NARA Advisory Board identified nine specific areas that NARA should focus

on in the last year of the project. This led to creation of Specialty CPM's to guide completion of these specific areas. Additionally, a tracking sheet (Figure PG-ES.6) was developed to status progress against the Specialty CPM's as a MST.

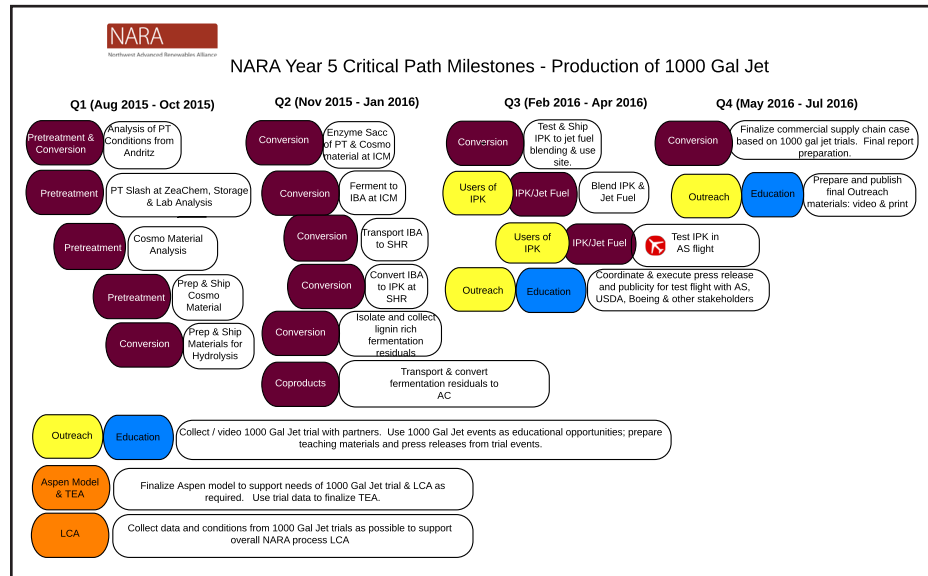


Figure PG-ES.5. 1000 Gal Jet Fuel Production CPM's

CPM	Leads	Template	Graphic CPM	Tracking Sheet
Alternative IBR's	J Gao			
Quantify Investable IRR at Commercial Scale	G Marrs			
Co-product Development & Industrial Partners	T Spink			
LCA Sensitivity	I Eastin & G Johnston			
Location of Future Facilities	J Hatten & N Martinkus			
Pathway to Commercial Scale	T Spink			
Public-Private Partnerships for Lowering IRR Requirement	P Moulton, R Cavaliere & M Wolcott			
Reach and Engage Policy Makers	M Gaffney			
Real World Impacts of Biomass Removal	G Johnson & J Sessions			

Figure PG-ES.6. Tracking Sheet for Specialty CPM's

The second type of MST's was used to further facilitate timely completion of NARA's overall deliverables. This involved formal identification of the cross-team interactions and CPM's required to complete major portions of the NARA project. For each key project area, cross-team meetings were developed toward that specific project area to ensure communication, transfer of knowledge on key milestones, and to iron out any timing or other issues. Cross-team meetings were held at NARA Annual Meetings based on the specific project areas that needed focus, in addition to using ad hoc face-to-face meetings and regular conference calls between Annual Meetings. These were a very effective means of creating team interaction and tight focus on specific project areas.

Together, the CPM's and formalized cross-team meetings dovetailed to enable NARA Leadership to provide focus on the important project deliverables and understand the relative pacing of CPM completion. These MST's were especially important for a project as complex and large as the NARA project. It is recommended that these MST methodologies be used for similar projects and that they are deployed even earlier, at the time of proposal, to understand the relative overall budget and timeline distribution for the project. The MST's can then be revised throughout the project to provide a snapshot and direction of how the project is pacing toward completion.

Decision Support Tools

A set of DST's were custom developed for the NARA process to allow NARA Leadership to make fact-based decisions. This included development of a customized Phase and Gate Process for the NARA project. A summarized version is shown in Figure PG-ES.7. The Phase and Gate Process includes Phases to cover the project as it progresses from initiation to completion. For each Phase, there are a comprehensive set of elements that need to be considered. These elements include: Technical; Market; Partnering; Business Model and Supply Chain Integration; Manufacturing; Financial; Health; Safety; Legal; Regulatory and Environmental; and Intellectual Asset Management. At each Phase, some elements are more critical to focus on than others, but all should be assessed to make sure that nothing is missed in that Phase. At the end of each Phase, there is a Gate. These Gates may include a formal Gate Review with a Gatekeeper making the decision to proceed with the next phase.

NARA		NARA Phase & Gate Process			
Northwest Advanced Renewables Alliance		Revised 9/6/2012			
		Gate 1	Gate 2	Gate 3	Gate 4
		Phase 1 Feasibility Analysis 1	Phase 2 Feasibility Validation 2	Phase 3 Scale Up Readiness 3	Phase 4 Commercial Options 4
		Determine the most feasible approaches & downselect	Optimize approaches across supply chain & validate for scale up	Demonstrate scale up & next scale planning for supply chain	Provide options for commercialization
Technical	-Technical approach demonstrated at lab scale or regional plot scale w/target FS	-Technical approach demonstrated at pilot scale	-Technical approach demonstrated at demo scale or large, multiple region scale	-Integrated technical process complete & commercial scale design ready	
Market	-Market segmentation complete selected & product fit vetted	-Product testing at lab or pilot scale	-Product tested with customer at lab, pilot or demo scale & approved for limited commercial use or final testing	-Final product testing complete, product accepted by customer & plan for commercial use	
Partnership, Business Model, Supply Chain Integration	-Determine best partners for going to market	-Partner relationships in place & business models mapped	-Specific relationships for regions of interest	-Target sites selected for biorefinery with favorable logistics & community support	
Manufacturing	-Manufacturing alternatives & readiness considered along side technology development	-Manufacturing process identified & high level capex/economics evaluated	-Manufacturing process design modeled & capex/opex economics estimated	-Manufacturing process design and capex/opex estimate complete	
Financial	-Process economic estimate complete based on background and lab information	-Process economic estimate revised based on pilot scale work	-Process economic estimate revised based on demo scale & focus area cost improvement work	-Revised Slush to Fuel economic estimate complete & show favorable ROI	
Health, Safety, Legal, Regulatory, Environmental	-HSURE issues identified for all processes of supply chain	-HSURE issues & processes understood for potential commercial or demo sites	-HSURE issues & processes for commercial scale regional sites input to identify best regional sites	-HSURE issues & processes for commercial scale regional sites understood and issues being addressed	
Intellectual Asset Management	-Prior art search complete	-Patent applications complete & govt disclosure	-Patent applications complete	-Right to practice complete	

Figure PG-ES.7. Summarized Version of the NARA Phase and Gate Process

For the NARA project, Gate Reviews were used at two critical junctures. A Gate 1/2 was used for the downselect to the NARA-preferred wood pretreatment process. A specialized Gate template was developed. The Gate 1/2 Review compared the Bisulfite and Wet Oxidation pretreatment processes in all of the elements. After

preparing a comprehensive Gate 1/2 Packet, and completing a facilitated review, the decision was made to downselect to the Bisulfite pretreatment process, and the decision process was documented in a Gate Form. A Gate 3 was used at the second critical juncture for making the decision to invest in the production of 1000 gal jet fuel and where to complete the conversion of wood to jet fuel. A custom Gate template was created, as this was a major funding decision for NARA Leadership. The expenditure and timeline outlined in the Gate 3 Review did not meet the NARA requirements so the Gate was not passed. A Gate 3 Review Recycle was completed with the revised budget and timeline for the production of 1000 gal jet fuel. This was approved by Gatekeeper Ralph Cavalieri and documented on a Gate Form (Figure PG-ES.8).

Gate 3 Review Recycle Form – Start Up Readiness

NARA Confidential

Date:

August 7, 2015

Topic Reviewed:

Schedule for production of 1000 Gal Jet: **Completion on 2/9/2016**

Overall cost for production of 1000 Gal Jet and budget recommendation

Reviewers:

Ralph Cavalieri, NARA Project Director (Gatekeeper)

Mike Wolcott, NARA Associate Project Director (Advisor to Gatekeeper)

Overall Budget Authority for 1000 Gal Jet:

\$ 1,513,000 additional expense / 1,600,000 total

Pending receipt of ICM estimate within the proposed budget

Gatekeeper Signature:

Ralph P. Cavalieri

Date:

August 7, 2015

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NARA

Figure PG-ES.8. Gate 3 Review Recycle Approval Form

The DST's developed for NARA have been effective at providing the structure and information necessary for NARA Leadership to make fact-based decisions. It was important that the Phase and Gate Process and the Gate templates be customized for a project like NARA, where it is more than research, but not building a commercial process. The processes developed for NARA worked well for the nature and deliverables of the project.

INTRODUCTION

NARA is a complex and comprehensive project. To enable effective management and decision making, several MST's and DST's were developed and used throughout the project. The MST's include CPM mapping for the project and subcomponents of the project. The CPM's also highlighted the critical areas for formal cross-team meetings to focus on achieving the deliverables and enhance communication. DST's were also created to enable fact-based decision making. The DST's included a Phase and Gate process, Gate templates and facilitated Gate Reviews.

TASK 1: DEVELOP AND REFINE CPM'S FOR ALL NARA TEAMS

Task Objective

The objective of Task 1 is to develop CPM's for the NARA project. CPM's are one of the MST's created for the NARA project. This will enable NARA Leadership and teams to understand the timeline required for completion of major milestones across the project. Team interdependencies are highlighted as well. The CPM's are revised as the project progresses to provide guidance on cross-team dependent milestones so that the NARA deliverables can be met.

Methodology

CPM's are developed for different levels of the NARA project. To better understand the connectedness and dependencies of the NARA project, a map of the overall NARA project (Figure PG-1.1) was developed based on a mapping of initial milestones developed by each team (Figure PG-1.2). The first set of CPM's developed was for the overall NARA project, by year. The NARA project is extremely complex, with different key milestones being completed by different teams, some of which are needed for other teams to complete their work. The CPM's for the overall NARA project provide a view of these important interdependencies, as well as an understanding of the completion timing of critical deliverables and milestones. Figure PG-1.2 shows the overall project CPM's by year. These were revised with slight changes in the NARA team scope of work and with timeline revisions.

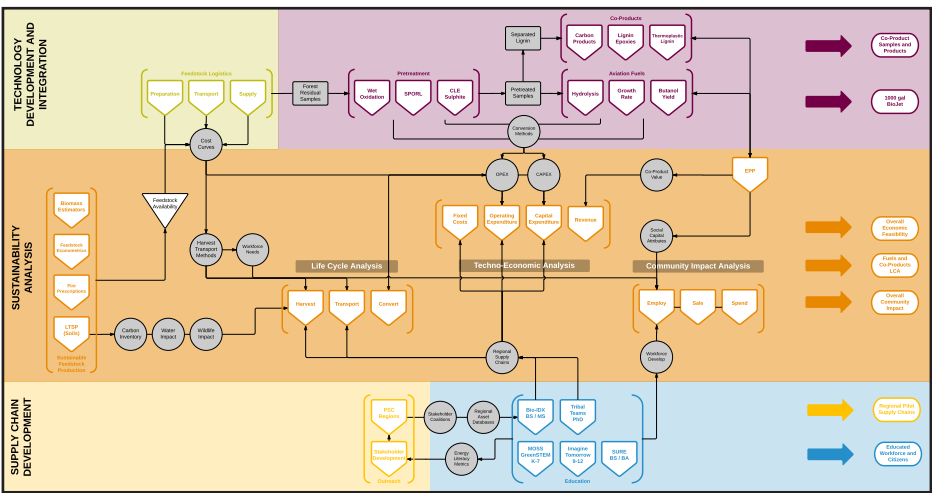


Figure PG-1.1. Deliverable Map of Overall NARA Project



To provide the next level of MST's, the CPM's for the three major areas were further broken down into CPM's for key deliverables. A hallmark area is the production of 1000 Gal Jet and the CPM's for this were developed for Years 4 and 5, the timeframe when this deliverable was being worked. The final CPM's for the production of 1000 gal jet fuel in Year 5 is shown in Figure PG-ES.5. These CPM's were used to revise the initial Gantt chart schedule for the production of 1000 gal jet fuel and to ensure that the deliverables would be completed by the end of the NARA project.

Through feedback from the NARA team, the USDA NIFA and the Advisory Board, there were nine additional deliverable focus areas identified. Specialty CPM's were developed for eight of these (Figures PG-1.3 through PG-1.10). For each Specialty CPM, there was a tracking sheet for milestone completion developed. In addition, an overall tracking sheet (Figure PG-6) was put in place to provide a summary of the status of the Specialty CPM's.

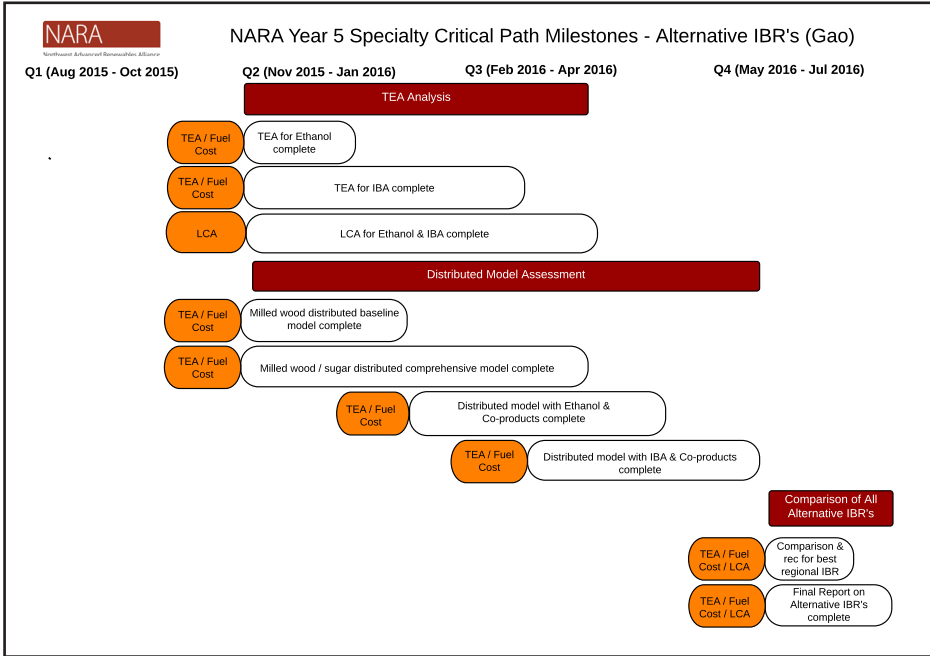


Figure PG-1.3. Specialty CPM's for Alternative Integrated Biorefineries

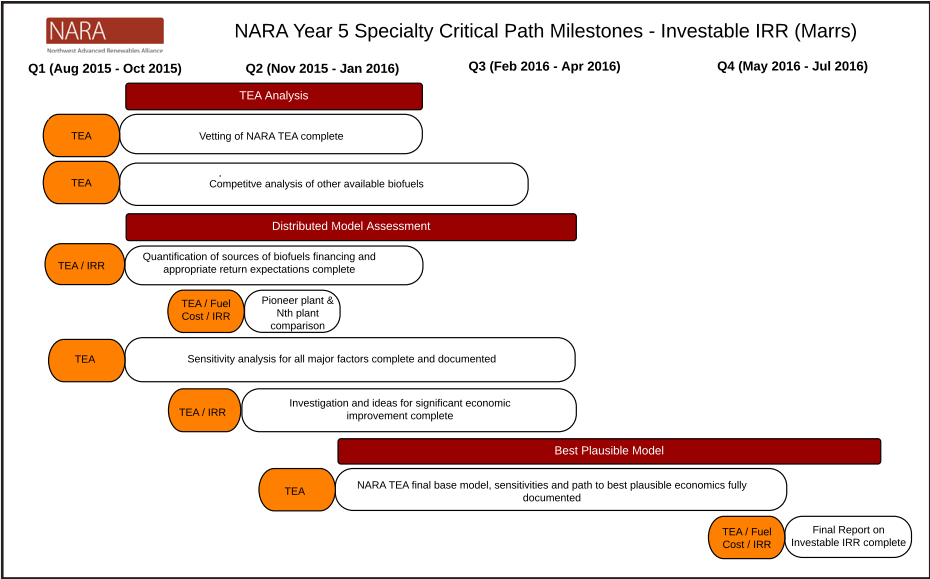


Figure PG-1.4. Specialty CPM's for Quantifying Investable IRR at Commerical Scale

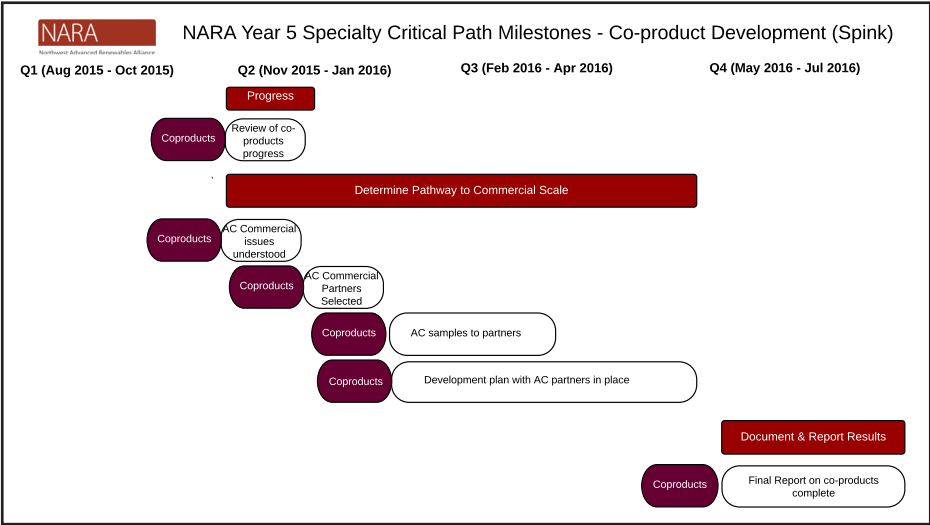


Figure PG-1.5. Specialty CPM's for Co-product Development and Industrial Partners

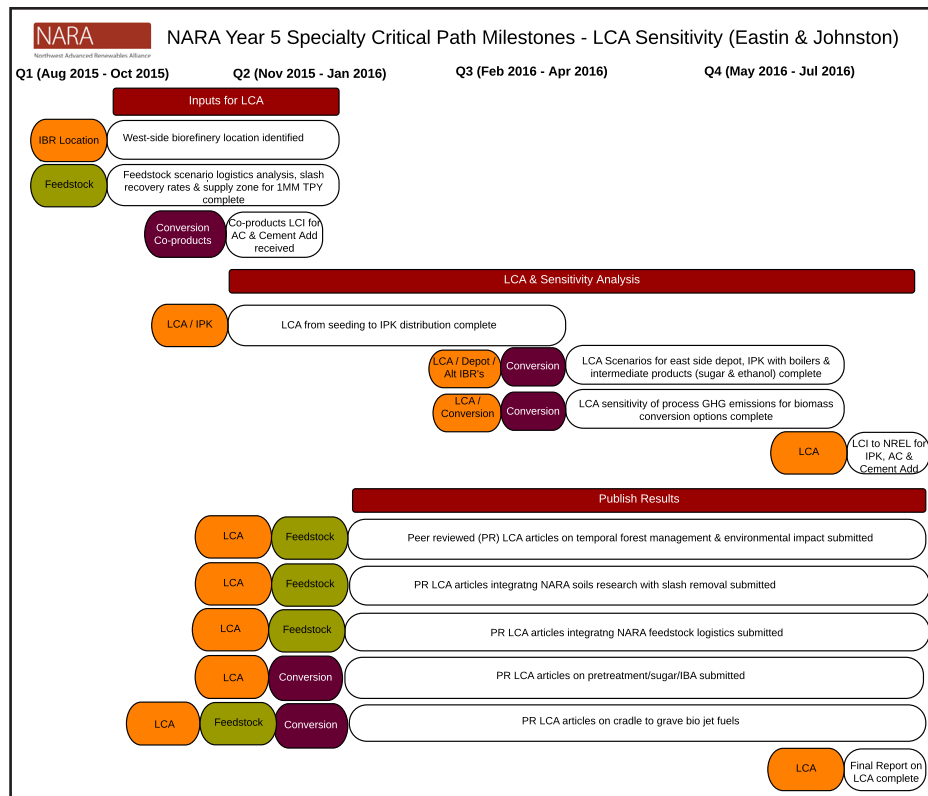


Figure PG-1.6. Specialty CPM's for LCA Sensitivity

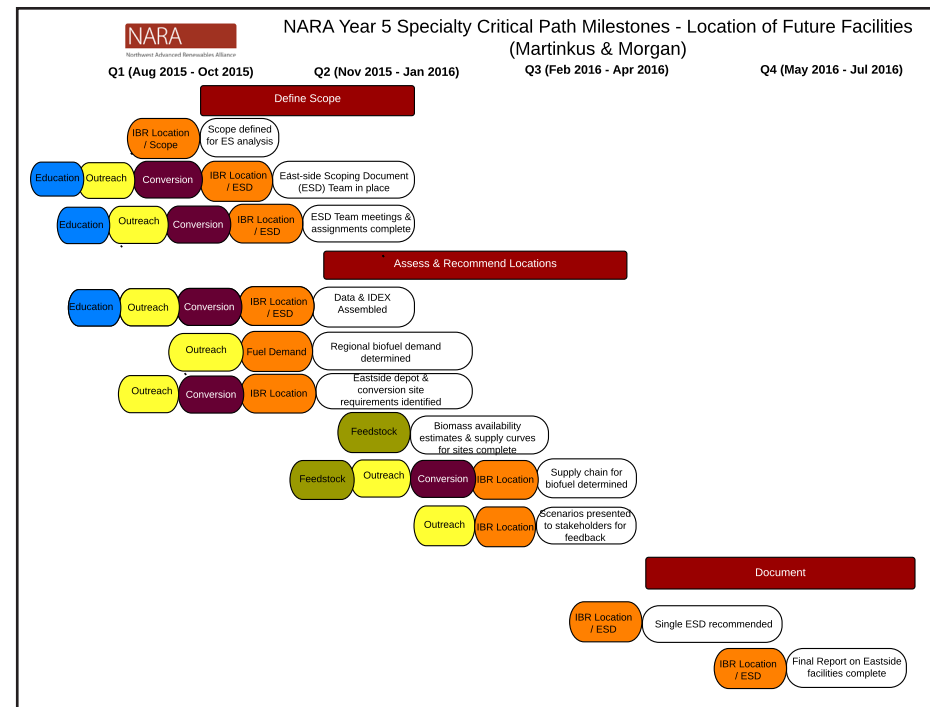


Figure PG-1.7. Specialty CPM's for Location of Future Facilities

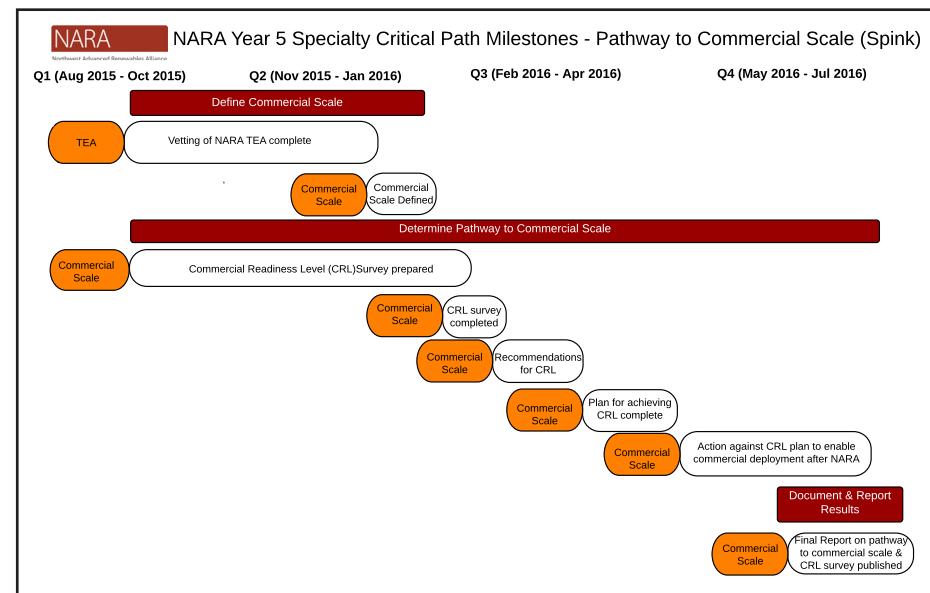


Figure PG-1.8. Specialty CPM's for Pathway to Commercial Scale

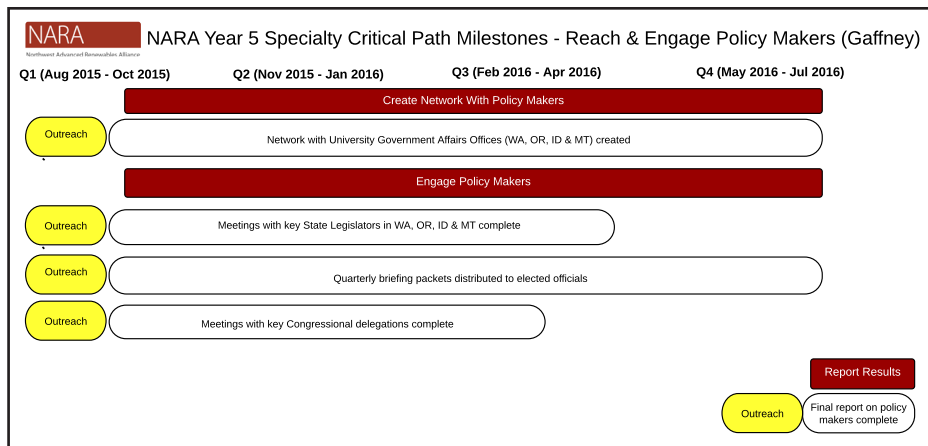


Figure PG-1.9. Specialty CPM's for Reaching and Engaging Policy Makers

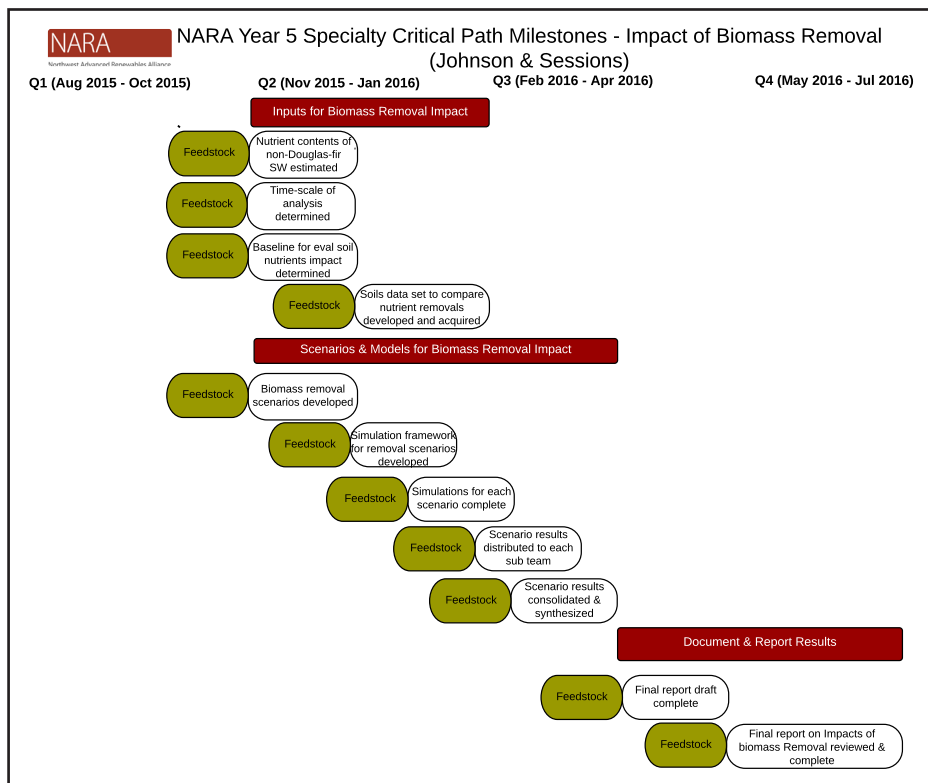


Figure PG-1.10. Specialty CPM's for Real World Impacts of Biomass Removal

Results

The mapping of the CPM's for the NARA project, from the overall project level down to a level focusing on a specific deliverable, was an effective method of understanding how project team work is inter-related at a high level and at a more granular level. It allowed the development of cross-team efforts toward making sure the specific deliverables in an area were completed and that interdependent tasks were completed in a timely enough and with the right information to be used by the other team stakeholders. The CPM's were revised as the project progressed and enabled NARA Leadership to focus on the areas needed to move the project forward.

Conclusions/Discussion

Utilization of MST's, specifically CPM's, is a very effective way to visualize and manage interdependencies in key team milestones for a project that is as complex and broad reaching as NARA. The use of CPM's for the overall project level, as well as for major project elements and key specialty deliverables, allows project leaders to focus on the important milestones at a high level and at a more granular level. Using the CPM methodology for specific deliverables is very important for making sure all milestones toward that deliverable are coordinated and completed in the proper timing. One important result of using CPM's is that cross team interdependencies in milestones can be established and managed more effectively. It is recommended that that overall project CPM's be established for future projects at the proposal phase so that budget, work statement and team planning can be effectively managed during the planning phase of the project.

TASK 2: DEVELOP GATE FRAMEWORKS TO SUPPORT DECISIONS

Task Objective

Develop and utilize Phase and Gate processes to be used by NARA Leadership as DST's.

Methodology

The NARA project is unique and complex in that it seeks to develop a commercially ready sustainable aviation fuel process using a large, diversely located team. NARA encompasses both research and pilot level deliverables, which will set the foundation for future commercialization. In addition, the teams are comprised of both academic and commercial entities that generally have different focuses. Typically, Phase and Gate processes are built to focus on either Research and Development or Commercial Development. NARA crosses both of these, so a customized Phase and Gate process was developed to span the range of NARA activities and deliverables (Figure PG-2.1). The Phase and Gate process requires assessing across a comprehensive set of elements, including: Technical; Market; Partnership, Business Model and Supply Chain Integration; Manufacturing; Financial; Health; Safety; Legal; Regulatory and Environmental; and Intellectual Asset Management. In addition, custom Gate templates and forms were developed and utilized for Gate Reviews where NARA Leadership was making critical decisions.

Results

The NARA-specific Phase and Gate process was utilized when important NARA project decisions were made. The process starts with Phase 1: Feasibility Analysis, where the comparison of approaches and research results is completed. This may involve the removal of a program, which was done with the feedstock genetics program.

During Phase 1, NARA initially had four pretreatment approaches. Those were assessed for commercial feasibility. Based on the comparative feasibility results, the acid hydrolysis pretreatment was eliminated. The SPORL and Mild Bisulfite pretreatments delivered similar results and were combined into one Bisulfite approach for Phase 2, leaving two pretreatment options for Phase 2, Bisulfite and Wet Oxidation.

Phase 2: Feasibility Validation, allows programs to be optimized across the supply chain and to be validated for their scale-up potential. During the NARA project, the two remaining pretreatment processes, Bisulfite and Wet Oxidation, were comparatively assessed for commercial applicability. This involved reviewing each process across all the elements of the Phase and Gate process. A comprehensive Gate Packet was developed comparing the two pretreatment processes in each of the Phase

NARA Northwest Advanced Renewables Alliance	NARA Phase & Gate Process <i>Revised 9/6/2012</i>			
	Phase 1 Feasibility Analysis <i>Determine the most feasible approaches & downselect</i>	Gate 1 1 <i>Optimize approaches across supply chain & validate for scale up</i>	Phase 2 Feasibility Validation <i>Demonstrate scale up & next scale planning for supply chain</i>	Gate 2 2 <i>Provide options for commercialization</i>
	Phase 3 Scale Up Readiness <i>Demonstrate scale up & next scale planning for supply chain</i>	Gate 3 3 <i>Provide options for commercialization</i>	Phase 4 Commercial Options <i>Provide options for commercialization</i>	Gate 4 4 <i>Provide options for commercialization</i>
Technical	-Technical approach demonstrated at lab scale or regional pilot scale w/target FS -Supply chain interactions determined through lab assessment & incompatibilities resolved -High level M&E balance assessed -Input and output specifications in place	-Technical approach demonstrated at pilot scale or multiple region scale -Supply chain compatibility proven through batch processing -M&E balance known -Improve cost on critical unit operations	-Technical approach demonstrated at demo scale or large, multiple region scale -Supply chain compatibility proven through semi-integrated or large batch processing -M&E balance confirmed at demo scale	-Integrated technical process complete & commercial scale design ready
Market	-Market segmentation complete selected & product fit vetted -Value proposition articulated & product fit vetted -Specifications for market use established -Raw material supply and cost understood. Select specific target regions.	-Product tested with customer at lab or pilot scale & approved for larger scale tests -Demand / price estimates & confirmation of value proposition complete -Detailed specifications in place -Raw material supply & quality vetted for target regions	-Product tested with customer at pilot or demo scale & approved for limited commercial use or final testing -Demand / price estimates & confirmation of value proposition revised -Final demand and price estimates complete	-Final product testing complete, product accepted by customer & plan for commercial use
Partnership, Business Model, Supply Chain Integration	-Determine best partners for going to market -Supply chain represented in region -Logistics routes to market identified for regions of interest -Regional acceptance for bio-refinery determined	-Partner relationships in place & business partnerships in place -Channels to market identified & partnerships in place -Specific supply chain logistics mapped for target regions -Short list of regional bio-refinery locations identified	-Specific relationships for regions of interest -Supply chain coalition in place & focussed on resolving barriers for target regions -Target biorefinery sites selected	-Target sites selected for biorefinery with favorable logistics & community support -Commercial supply chain design for selected regions
Manufacturing	-Manufacturing alternatives & readiness considered along side technology development	-Manufacturing process identified & high level capex/economics evaluated	-Manufacturing process design modeled & capex/opex/economics estimated	-Manufacturing process design and capex/opex estimate complete
Financial	-Process economic estimate complete -High level Slash to Fuel economic estimate complete indicates current approach economical	-Process economic estimate revised based in pilot scale work -Revised Slash to Fuel economic estimate complete. -Economics highlight focus areas for cost improvement	-Process economic estimate revised based in demo scale & focus area cost improvement work -Revised Slash to Fuel economic estimate complete, including capex/opex -Economics highlight focus areas for cost improvement	-Revised Slash to Fuel economic estimate complete & show favorable ROI -Economics include a sensitivity analysis to highlight areas for optimization
Health, Safety, Legal, Regulatory, Environmental	-HSURE issues identified for all processes of supply chain -HSURE issues & processes completed for pilot scale	-HSURE issues & processes understood for short list commercial sites -HSURE issues & processes for demo scale sites addressed	-HSURE issues & processes for commercial scale regional sites input to identify best regional sites	-HSURE issues & processes for commercial scale regional sites understood and issues being addressed
Intellectual Asset Management	-Prior art search complete -Patent applications complete & gov disclosure -IAM strategy draft -Licensing of technology as required	-Patent applications complete & gov disclosure -Licenses identified -Trademark applications complete -IAM strategy complete -Licensing of technology as required	-Patent applications complete -Licenses complete -Trademark applications complete -IAM strategy revised & followed -Licensing of technology as required	-Right to practice complete -Trademarks in place -IAM strategy executed -Licensing of technology as required

Figure PG-2.1. NARA Phase and Gate Process

element areas. A Gate Review was held, facilitated by Steadfast Management Inc., which decided to downselect the Bisulfite process as the NARA-preferred pretreatment process. The decision was documented in a Gate Form.

Phase 3: Scale Up Readiness, provides for demonstration of the NARA processes at pilot scale. The goal is to demonstrate what could be done at commercial scale. A Gate 3 Review was held to approve the demonstration of producing jet fuel from forest residuals. There were several options for where to complete the Bisulfite pretreatment, as well as significant budget and timing issues with the whole process demonstration. The Gate 3 Review covers all of the Phase elements, and ultimately it was concluded that the budget and timeline needed revision to fit what NARA could support. Once the revisions were in place, a Gate 3 Review Recycle was held covering the budget and timeline changes from the Gate 3 Review. The Gate 3 Review Recycle was approved and documented in a Gate Form (Figure PG-8). The Gate 3 process required strong collaboration between teams, setting a standard for cross team partnering. For the Gate 3 process, and all Phase and Gate processes, templates, forms and facilitation were provided by Steadfast Management Inc.

Phase 4: Commercial Options, envisioned NARA facilitating commercial entity partnerships for the implementation of the NARA process at commercial scale. Although NARA has worked with numerous external, commercial stakeholders, there is not currently a certain path to commercialization. Therefore, there has not been a need to hold a Gate 4 Review to discuss options for commercialization. Many of the Specialty CPM's are centered on developing commercial scale pathways at returns that would make sense for partner investment.

Conclusions/Discussion

Phase and Gate methodology, when tailored to a project like NARA, is a very effective means for fact-based decision making. By addressing all of the elements, it allows a holistic picture to compare processes for better decision making. Decisions are formalized in a Gate Form and signed by the Gatekeeper. All projects, small or large, should use a Phase and Gate methodology, if only to make sure the broad set of elements are addressed and that all the information needed is presented and the entire picture is reviewed before decisions are made.

TASK 3: PROVIDE INPUT FOR CROSS TEAM INTERACTION TO MEET CROSS CUTTING CRITICAL PATH MILESTONES

Task Objective

As CPM's were developed, it became clear that extensive cross team collaboration was required in order to meet the NARA deliverables. This task is aimed at identifying the specific deliverables where cross team work is required and the exact teams that need to be working together.

Methodology

As discussed in Task 1 of this report, CPM's have been developed for multiple levels of the NARA Project, starting from an overview map of the project interdependencies to detailed CPM's for specialty deliverables. For the completion of deliverables, it often requires results from one team to be given to another team so they can complete their work. This cross team interdependency is the norm in the NARA project. As the CPM's were developed, teams were developed around specific deliverables, which included members from teams across NARA. These specific cross team efforts were formalized into working groups where face-to-face and conference call meetings were set up to work toward timely completion of CPM's required for the specific deliverable to be met. The cross team meetings are an important MST to augment the CPM's.

Results

The cross team groups, developed around specific deliverables, proved to be very important for providing a coordinated approach to specific deliverables. Specific teams were formed around Feedstocks, Conversion (including feedstock sourcing, pretreatment, fermentation and coproducts), Regional Supply Chain Development, Stakeholder Engagement, Life Cycle Assessment and others. Some specific deliverable areas remained the same over the years and other areas were identified for a short period until the work was complete. Team meetings were centered around the NARA Annual Meeting and then continued by conference call and ad hoc face-to-face meetings. Some teams adopted regular face-to-face meetings because

they found them to be so effective. For a team as geographically dispersed and with such a wide range of work products, it would seem natural to have cross team meetings. However, in NARA, we found that most individual teams focus on what they need to accomplish and do not manage the interfaces with other teams well. This is where the CPM's, and the early identification of cross team efforts, were very valuable. By developing cross team efforts around goals for deliverables, it provided a common focus. Leaders were appointed for each cross team effort to make sure the work was driving to the deliverables. These cross team efforts became so important that there was often not enough time adjacent to the NARA Annual Meetings to fit all the cross team meetings. This was especially the case because some team members were on multiple cross team efforts, and in some cases, NARA members, not necessarily a part of the cross team but with an interest, wanted to participate to learn. Overall, the cross team groups became an important MST for managing the NARA project.

Conclusions/Discussion

Cross team groups, focused on specific deliverables identified by the CPM's, are a very important MST. They serve to provide work alignment, both in output and timing, and to educate team members on what other teams are doing. When cross teams are developed based on the CPM's, they become powerful management tools for complex projects like NARA. It is recommended that cross team be used in tandem with CPM's from as early as proposal phase. If cross teams are utilized when a proposal is developed, there will be less overlap in work scope and better Gantt chart development by each proposal team. In a complex project, it is often difficult for individual teams and team members to understand how their work is connected to the overall work of others and the project as a whole. By utilizing cross teams during proposal development, it will provide this context from the beginning of the project.

NARA OUTPUTS

NARA Outputs from the Phase and Gate Administration effort include:

- Overall map of the NARA project and process
- CPM's for the overall NARA project
- CPM's for the major NARA focus areas: Biorefinery, Communities and Education
- CPM's for production of 1000 gal jet fuel
- Specialty CPM's for eight deliverable topics
- Tracking sheets for Specialty CPM's
- Customized NARA Phase and Gate process
- Customized Gate packet templates and Gate Review Decision forms
- Gate 1/2, Gate 3 and Gate 3 Recycle Review packets and decision forms
- Lists of recommended cross team meetings based on CPM's and deliverables
- Cross team meetings at three NARA Annual Meetings plus many other ad hoc face-to-face and conference call meetings
- Four presentations on Phase and Gate Administration at Annual Meetings. Focus on CPM's and how the methodologies are used at MST's and DST's.

NARA OUTCOMES

NARA Outcomes from the Phase and Gate Administration effort include the following changes in knowledge:

- Understanding of the interdependencies of the NARA project by team members through NARA mapping, creation of CPM's and development of cross team focus areas.
- Better informed decision making by use of the Phase and Gate process.

NARA Outcomes from the Phase and Gate Administration effort include the following changes in action:

- Adoption of the Phase and Gate process for major NARA decision points to provide holistic, fact-based decisions. Specifically, decisions for removal of programs, down-selection to the NARA-preferred pretreatment and proceeding with the production of 1000 gal jet fuel.
- Use of mapping of the NARA project and processes and development of CPM's allowed teams to understand how their part of the project fits with other parts and to work more effectively.
- Cross team coordination meetings provided focus on key deliverables and enabled more timely flow of information between teams.

NARA Outcomes from the Phase and Gate Administration effort include the following changes in condition:

- The use of CPM's, deliverable-based cross teams and Phase and Gate methodologies provided for better management of the NARA project.

FUTURE DEVELOPMENT

Future projects based on NARA results or projects with the complexity of NARA should employ MST's and DST's similar to NARA. CPM development and deliverable-based cross teams are effective and would be even more effective if used during the proposal phase. These approaches may provide for less overlap in scope of work and less need for refinement in work scope over the project life. These tools also provide a better picture of the overall project and how the team deliverables fit together, enabling more effective budget and timeline management. In addition, projects should use a Phase and Gate process to enable informed, fact-based decisions. A Phase and Gate process can be tailored to a project. Introduction of the Phase and Gate methodology and expected elements in a Phase and Gate templates early in the project, provide a structured approach for teamwork product management and decisions. Overall these MST's and DST's proved valuable for NARA and should be employed in other projects.