



Scale	Environmental Progression Description	Risk Assessment			Risk Management	
		(1) Feedstock	(2) Fuel Producer	(3) Life Cycle	(1) Feedstock	(2) Fuel Producer
1	Basic Principles	Evaluate potential risks of feedstock introduction (e.g., Weed Risk Assessment) and potential impacts on biodiversity and land use.				
2	Concept Formulated	Evaluate feedstock for compliance with regulatory requirements for likely production environments				
		Estimate production impacts on multiple resources concerns ¹				
		Formulate a plan including best practices to address regulatory requirements				
		Comply with any feedstock pre-importation regulations				
3	Proof of Concept	Perform preliminary evaluation of water use and consumption (e.g., irrigation requirements) and potential soil impacts, as well as air and water quality impacts		Perform screening level analyses to identify lifecycle stages and issues relating to mass/energy balance, GHG emissions, and freshwater consumption using information gained from proof of concept	Identify appropriate best management practices to minimize environmental risks.	
4.1	Preliminary Technical Evaluation	Re-evaluate feedstock for potential invasiveness concerns.	Preliminary evaluation of water use/consumption, potential air, water and soil impacts for processing technique	Perform preliminary GHG analysis in accepted GHG life cycle tool (e.g., GREET) using theoretical data for commercial scale production	Develop/refine weed risk management protocols	Consider an independent review of GHG LCA to identify any methodological issues or conversion process concerns
		Consider "dry run" of sustainability evaluation under a well-accepted sustainability framework		Improve estimates of mass/energy balance, GHG emissions, and freshwater consumption using information gained from preliminary technical evaluation	Develop conservation plan and associated best management practices to address resource concerns for a feedstock production system. Consider an independent review of GHG LCA to identify any methodological issues or feedstock concerns.	
				Consider approaching regulatory agencies to discuss pathway-level qualification steps for particular programs (e.g., RED, RFS2)	Develop soil conservation and feedstock production management plans	
4.2						
5.1	Scale up Validation of Initial Assessments	Improve estimates of potential water use and consumption requirements, potential soil impacts	Evaluate potential water use and consumption, air, water and soil quality, land use change and biodiversity risks associated with fuel facility scale up	Improve estimates of mass/energy balance, GHG emissions, and freshwater consumption using information gained from scale-up	Draft NEPA (EA or EIS), if required, and other required permitting documents	
5.2					NEPA documents, conservation plan, and other required permit applications approved	NEPA documents, conservation plan, and other required permit applications approved
5.3		Evaluate land use change and biodiversity risks associated with feedstock production scale up.			Ascertain that land under consideration for full-scale feedstock production complies with renewable definition under appropriate regulations (e.g., RFS2, RED) and other sustainability frameworks	
5.4						
6.1	Full-Scale Feedstock Impact Evaluation	Improve estimates of potential water use and consumption, air, water and soil quality, land use change and biodiversity risks associated with commercial feedstock production.	Improve estimates of potential water use and consumption, air, water and soil quality, land use change and biodiversity risks associated with full-scale conversion/fuel production	Confirm pilot scale results on mass/energy balance, GHG emissions, and freshwater consumption and compare with original estimates; improve commercial-scale estimates of same using information gained from full-scale evaluation	Begin planning environmental management system components	
6.2					Feedstock producer approved for all relevant environmental permits, regulatory compliance is complete	Environmental management system and best management practices implemented
6.3						
6.4						
7	Full-Scale Fuel Producer Impact Evaluation	Improve estimates of water use and consumption, air, water and soil quality, land use change and biodiversity risks associated with commercial scale fuel facility		Finalize qualification for any incentive programs, and/or certification under voluntary sustainability frameworks	Fuel producer approved for all Federal, State and local permits, regulatory compliance is complete	
8	Commercialization			If needed, perform facility-specific study-comprehensive analyses for mass/energy balance, GHG emissions, and freshwater consumption using information gained from scale-up, use for voluntary sustainability certification	Regulatory compliance is ongoing, environmental management system and best practices result in maintained or improved environmental performance, voluntary sustainability certification completed as needed	
9	Sustainable Feedstock and Fuel Supply Established			Continuously monitor mass/energy balance, GHG emissions, freshwater consumption, etc. to validate LCA and identify process efficiency improvements.	Annual reporting of air and water pollutant emissions, water use, energy balance, GHGs, soil quality, biodiversity, land use, and invasive species impacts	