The Economic Benefits of Military Biofuels

Presentation to

National Capital Area Chapter
U.S. Association for Energy Economics

Washington, D.C.

July 12, 2013

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Biofuels Potential

- **President's Climate Action Plan:**
  - *Biofuels have an important role to play in increasing our energy security, fostering rural economic development, and reducing greenhouse gas emissions from the transportation sector*
- **Grow a commercial-scale, price-competitive biofuels sector:**
  - **Supply transportation, shipping, industry, and the military**
  - **Provide a major substitute for petroleum fuels**, reducing foreign dependency and the nation's carbon footprint
  - **Foster economic development and job creation**, in rural agriculture and manufacturing, construction, refining & pipelines
- **Government policies and programs help drive this growth:**
  - Renewable Fuel Standard (RFS2), CA's Low Carbon Fuel Standard (LCFS), **DoD's alternative fuels program**

The Biofuels Family

Conventional Biofuels

- **First generation**
- **Starch based ethanol and oil crop biodiesel**
  - Common feedstock: corn, wheat, sugar, soybean, palm oil
  - Reduce carbon intensity (CI) by 5-30% from gasoline baseline; higher than advanced biofuels
- **Often displaces agricultural production**

Advanced Biofuels

- **Second and third generation**
- **Not derived from food crops**
  - Feedstock includes non-corn starch, sugar, lignocellulosic biomass, non-virgin oils, algae
  - Reduces CI 50%+
- **"Drop-In" biofuels:**
  - Similar molecular structure as fossil fuels
  - Compatible with existing equipment and infrastructure

Advanced Biofuels Industry

- **The advanced biofuels market has been expanding domestically and internationally***
  - **NA and EU** and some major **developing nations** (Brazil, China, India) have growing advanced biofuels industries
- **Advanced biofuel companies developing technologically and commercially***
  - **U.S./Canadian capacity expanded** 437 MGY to over 685 MGY in 2012
  - **165 domestic companies** could provide 1.6-2.6 BGY of fuel to U.S. market
  - **Supply chain**: providers of engineering platforms and equipment; oil producers, refineries and distributors
  - **Job estimates:** 1,518 permanent, 6,965 construction and 9,924 indirect jobs from 27 new facilities coming on online by 2015

*** Environmental Entrepreneurs, *Advanced Biofuel Market Report 2012***

Role of Public Policy

- **Help address industry barriers:**
  - **Ability to finance plants** to reach commercial scale production
  - **Maintain market and regulatory certainty**
- **RFS2 and LCFS have helped move advanced biofuels from demonstration to commercialization (E2)**
- **Federal investments into advanced biofuels**
  - **$1.8 billion in federal loans and grants since 2008**—$730 million from DOE; $967 million, USDA (Cleantech Group)
- **Military biofuels program potential:**
  - **Create a large, stable market demand**; investments; R&D
  - **Attract private investment**, accelerate scale up and deployment, help biofuels become cost competitive via economies of scale

Biologically produced aviation fuel has the potential to reduce, even eliminate, the need for foreign oil . . . and offers a long-term solution to energy price volatility by allowing Air Force fuel needs to be filled through domestic production.

—2007 U.S. Air Force report

[Every time the Navy has changed energy sources] there have been doubters. There have been people who have said, you are abandoning one proven and certain technology for an unproven more expensive, less sure one. And every time they have been wrong.

—U.S. Secretary of the Navy Ray Mabus, April 2010

Military Biofuels Program

- **DoD pursuing energy efficiency and clean energy initiatives**
  - **Reduce military energy needs** and ensure domestic sources of fuels
  - **Military one of largest energy consumers** in the U.S. economy
- **Alternative fuels goal:**
  - *A commercially viable advanced biofuels industry providing price-competitive substitutes for petroleum fuels for large-scale military use*
- **Pentagon's OES (March 2012) alternative fuels targets**
  - Air Force: 50 %of aviation fuels by 2016 (387 MGY capacity)
  - Navy: 50% of all energy use afloat by 2020 (300 MGY capacity)
- **Navy, DOE, USDA to invest $510 million over three years**
- **Navy and Air Force demonstrate viability of advanced biofuels in equipment and systems**

Military Alternative Fuels Criteria

- **Drop-in capability**
  - **Comparable energy & performance characteristics** with petroleum-fuels
  - **No equipment modifications** required
- **Feedstock supply and diversity**
  - **Suitable and diverse supplies** of feedstock
  - **Feedstock "agnostic"**
  - **Non-food sources** and will not increase carbon footprint
- **Scalability**
  - **Large-scale production capacity** and commercially available supply
- **Distribution system compatibility**
  - **Use existing fuel distribution system** (railroads, tankers trucks, barges, pipelines)
- **Price-competitiveness**
  - **Prices competitive** with petroleum fuels replaced

Military Service Demonstrations

Navy

- ***Great Green Fleet* demo for RIMPAC, July 2012**
  - USS Nimitz-led carrier strike group: 2 guided-missile destroyers, guided-missile cruiser, oiler+71 aircraft
- **Aircraft, boats, river craft**
  - T-45 Goshawk training aircraft
  - F/18 Green Hornet
  - MV-22 Osprey, MH-60 sea hawk helicopters, etc.

Air Force

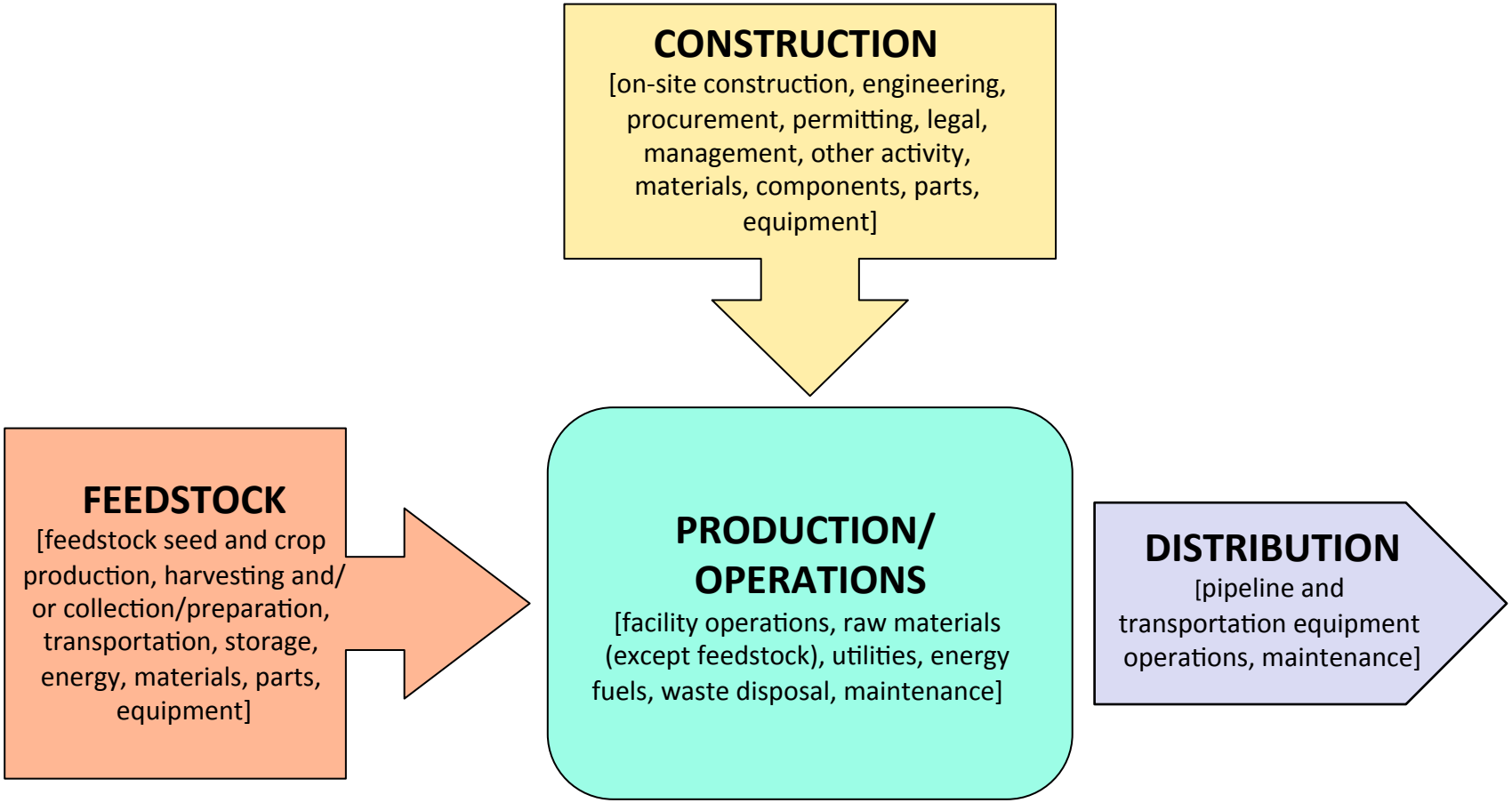
- **Successful demonstrations of 50/50 blend biofuel and JP-8 jet fuels on all major aircraft, e.g.:**
  - A-10 Thunderbolt
  - C-17 Globemaster
  - F-15 Eagle
  - F-22 Raptor

HIGH ROAD STRATEGIES

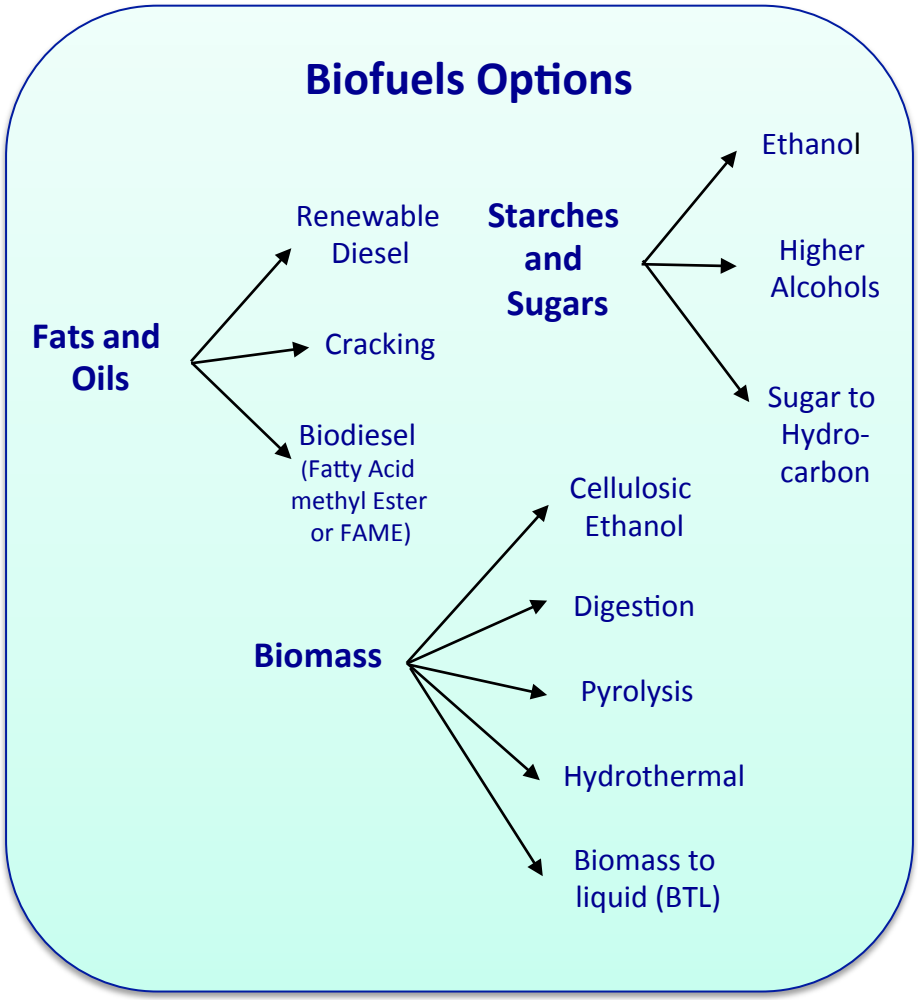
Economic Impact Study (E2-HRS)

- **Assessed the economic consequences of the Pentagon's biofuels program**
  - **To invest in and purchase** biofuels to meet DoD's targets
- **Constructed and used simple input-output model**
  - **First order analysis and bounding exercise** to assess potential economic impacts and benefits of military program
  - **Primary cost structure components** in value-chain
  - **Estimate potential economic and regional impacts** (i.e., *output*, *employment* and *value added*)
- **Report for Environmental Entrepreneurs, *The Economic Benefits of Military Biofuels:***
  - *See www.highroadstrategies.com • www.fuelinggrowth.org*

Advanced Biofuels Value-Chain



Feedstock and Conversion Pathways



"Drop-In" Biofuels

- **Feedstock**
  - Animal fats (tallow)and vegetable grease
  - Plant oils (rapeseed, camelina, canola, jatropha)
  - Plant biomass (agricultural & woody residues)
  - Algae
- **Conversion technologies**
  - Thermochemical-Fischer-Tropsch
  - Pyrolysis-hydrotreating, including co-location with petroleum refineries
  - Hydrogenation-hydrotreating
  - Catalytic conversion of sugars

HIGH ROAD STRATEGIES

Study Methodology

- **Simple spreadsheet model of value chain costs and jobs + BEA RIMS II multipliers to estimate economic impacts**
- **Sources of data and information**
  - **Empirical data from operating** or soon to be operating U.S. plants
  - **Detailed engineering-economic studies** of advanced biofuel facilities
- **Select data points and values based on comparison and analysis of feedstock, conversion pathways, plant characteristics, etc.**
- **Estimate costs and economic impacts (output, jobs, value added)**
  - **Direct expenditures and jobs** by value chain sector (construction, feedstock, operations, distribution) using spreadsheet model
  - ***Direct***, ***indirect*** **and** ***induced*** **economic impacts** based on these expenditures using RIMS II multipliers

Key Assumptions

- **Schedule of capacity growth to meet military supply requirement, 2013-2020**
  - Sizes of and when new plants come on line
  - Total capacity rises to 777 MGY by 2020
- **Construction costs fall over time for each plant size**
  - Learning curve and economies of scale with larger plants
- **Feedstock supply costs and yields decline over time**
- **High and low end of operating costs, distribution costs because of data variability**

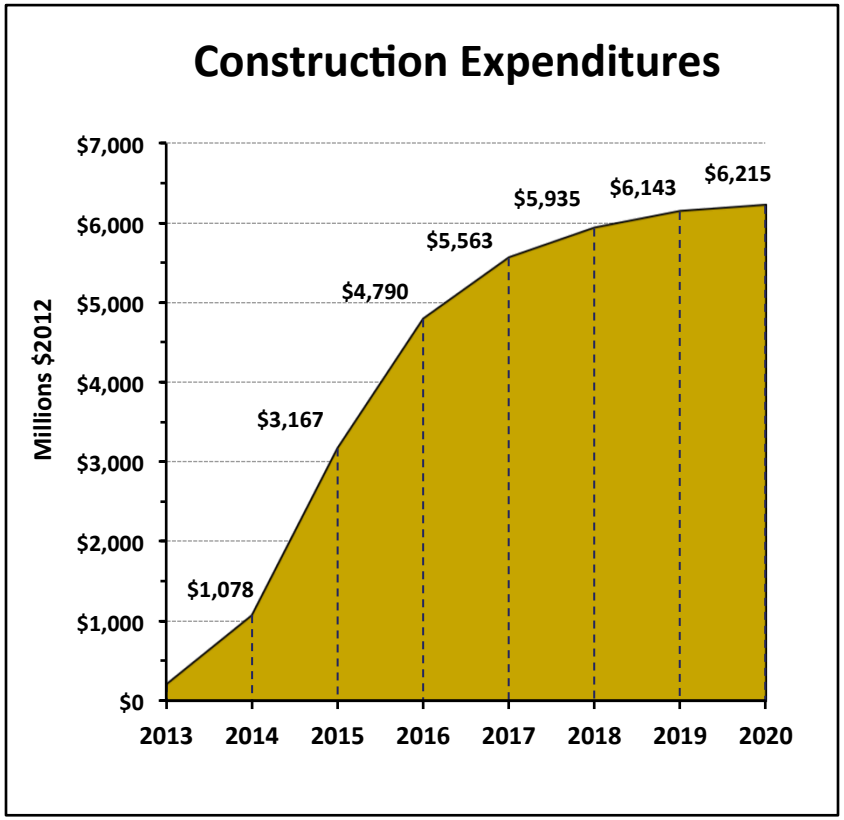
Methodology Issues & Caveats

- **Does not capture industry-wide (military + civilian) markets**
  - Concerned only with tangible benefits of military initiative
- **Agnostic about mix of feedstock and conversion technologies**
  - Not comparing or assessing economics of different options
  - Cannot know which feedstock and conversion pathways might become the most cost competitive and predominant
- **High and low bounds of impacts reflect uncertainties and wide variance in costs of feedstock and conversion pathways**
  - Relatively small number of studies and real-world examples to draw on
- **Chose values to approximate realistic range of costs and benefits associated with value chain sectors**
- **Does not evaluate price-competitiveness of new fuels**

Value-Chain Expenditures

$10-$19 Billion Total—$6 Billion Construction—$1.6-$5 Billion Agriculture

Sector	Low Est.	High Est.
Expenditures 2013-2020 *(Yearly by 2020)*		
Construction	$6.22 Billion	
Feedstock	$1.64 B *($323 M)*	$4.9 B *($963 M)*
Operations	$1.7 B *($385 M)*	$8.6 B*($1,925 M)*
Distribution	$62 M *($14 M)*	$153 M *($35 M)*
Industry total	**$9.63 B** *($0.72 B)**	**$19.2 B** *($2.92 B)**

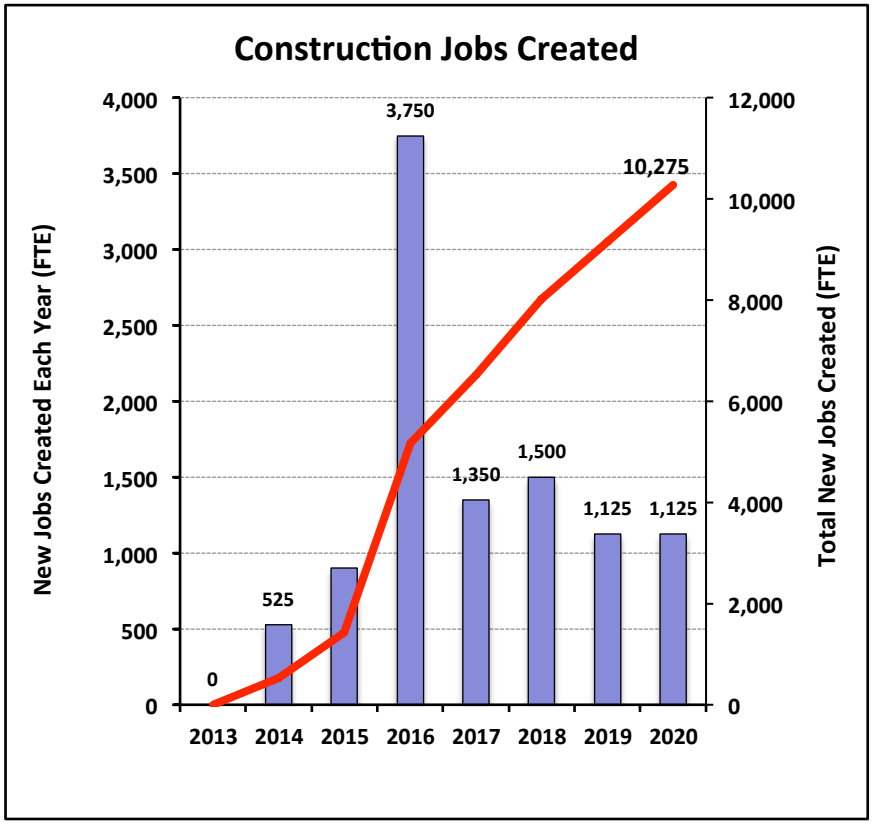


HIGH ROAD STRATEGIES

Advanced Biofuels Direct Employment

10,000 Construction—4,000 to 6,000 Permanent—1,000 to 5,000 Agricultural Jobs

Sector	Low Est.	High Est.
Jobs Created by 2020		
Construction*	10,275	
Feedstock	1,262	4,607
Operations	1,232	
Distribution	52	
Permanent Jobs **	**4,048**	**5,871**



* Temporary jobs lasting duration of construction

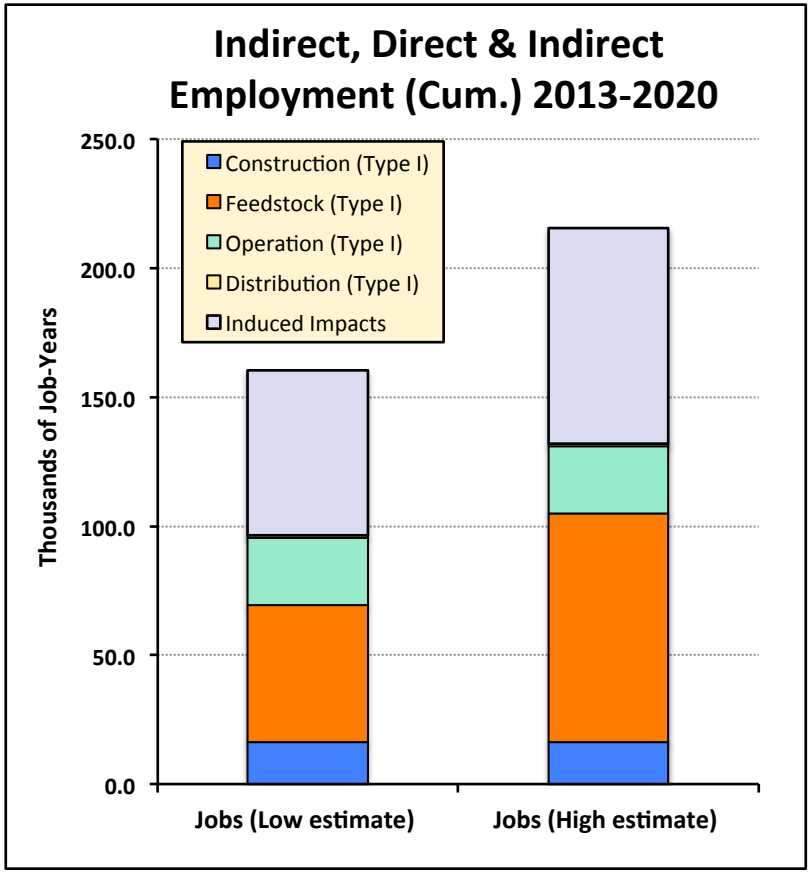
** Jobs created by 2020 in feedstock, operations and distribution to meet military supply needs

HIGH ROAD STRATEGIES

Economic Impacts

Direct + Indirect Impacts: $13-$18 B Output—32-39,000 Jobs—$6-8 B Value Added

Yearly Impacts by 2020	Low Est.	High Est.
Direct & Indirect Impacts		
Output ($ billion)	13.1	18.3
Jobs (thousands)	32.5	39.2
Value Added ($ billion)	6.4	8.2
Direct, Indirect & Induced Impacts		
Output ($ billion)	21.5	28.7
Jobs (thousands)	53.9	6.4
Value Added ($ billion)	11.2	14.1

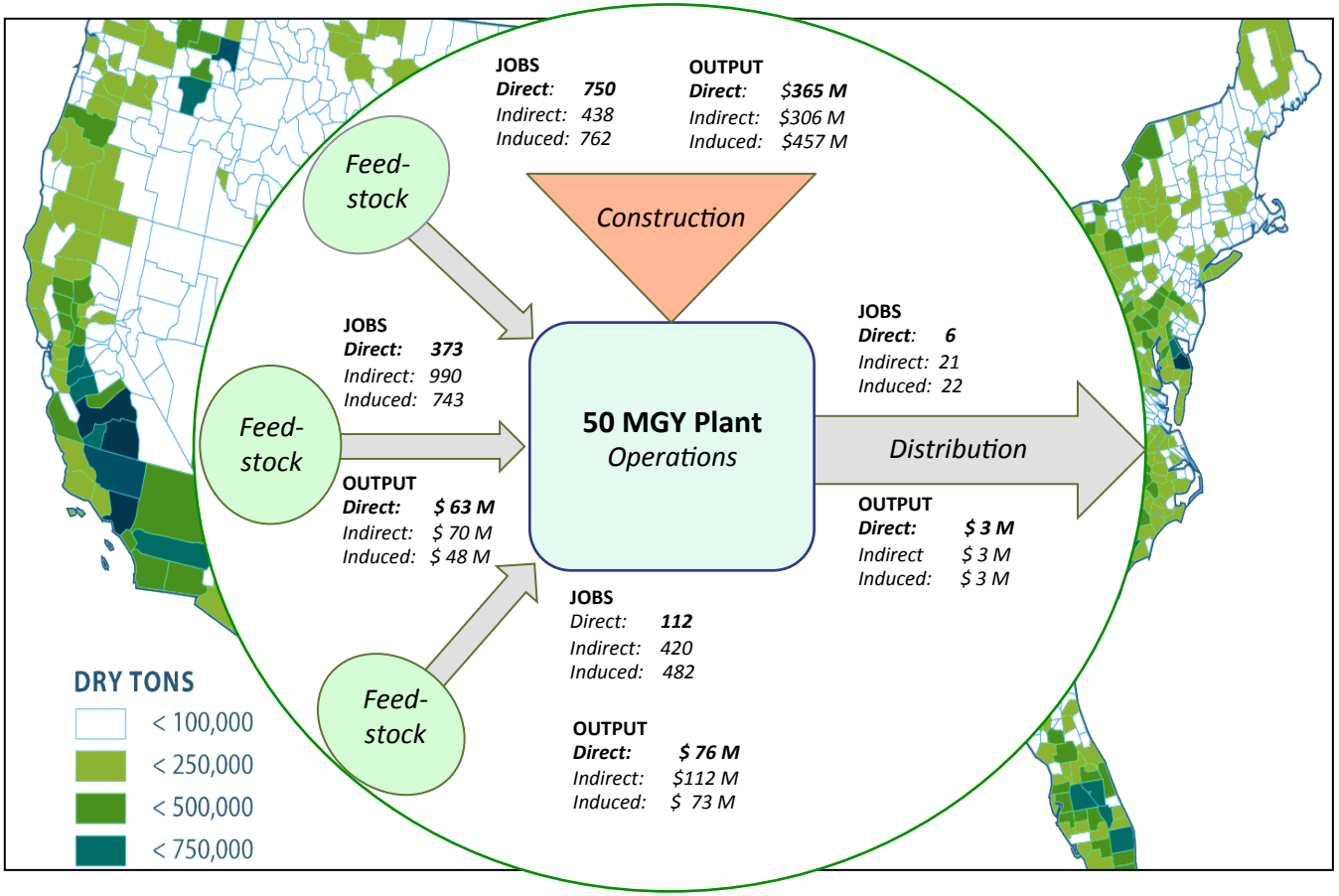


HIGH ROAD STRATEGIES

Regional Economic Impacts

Typical 50 MGY Plant (2013-2020)

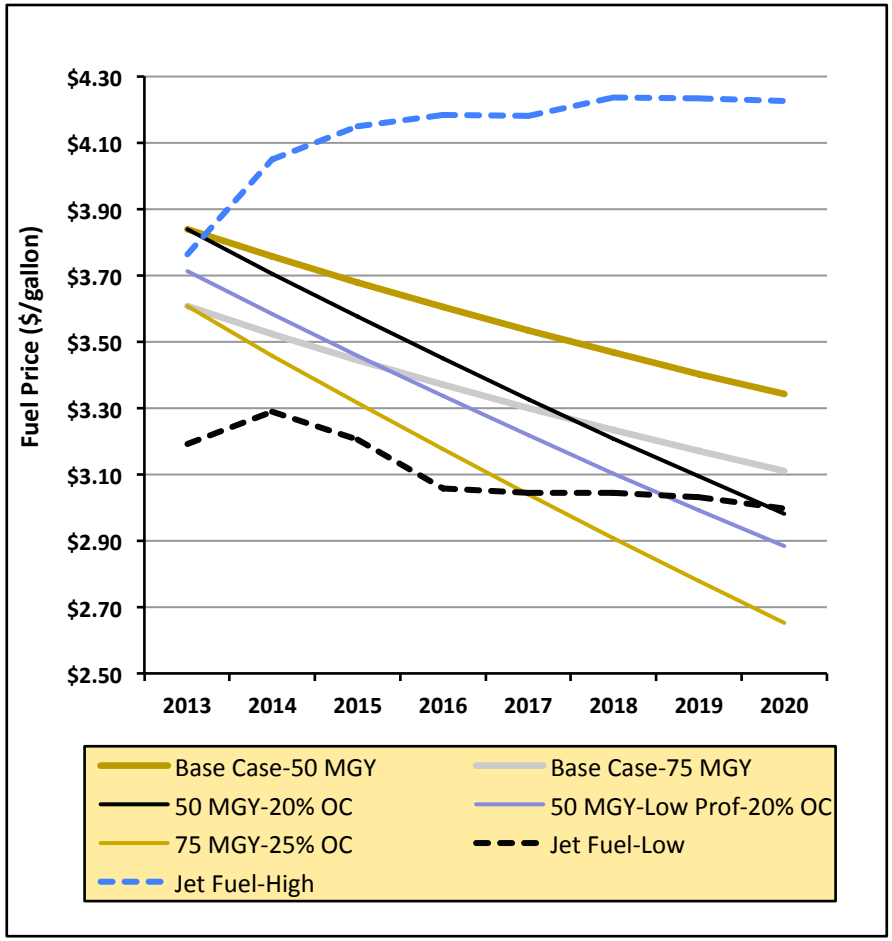
750 Construction Jobs—491 Permanent Jobs—$1.2 billion Output



HIGH ROAD STRATEGIES

Price Competitiveness

- **HRS estimate**
  - Highly speculative;
  - Illustrative purposes only
- **Uncertainties about conversion & feedstock pathways**
- **Cost structure analysis ($/gallon)**
  - Feedstock, operation, construction (amortized), distribution
- **Multiple scenarios**
  - Different pathways, learning curve assumptions, plant-sizes, ROI, profit rates, etc.
- **Comparison with jet fuel projections (EIA)**



HIGH ROAD STRATEGIES

Future Prospects

- **DoD program implications transcend military objectives**
  - **Enormous potential to supply competitively-priced advanced biofuels to** commercial aviation, shipping, auto manufacturing industries
    - **U.S. Air Force fuel requirement equivalent** to a mid-sized airline
    - **U.S. airline and cargo operations** uses ~17.5 BGY of jet fuel
    - DOE's *Billion Ton Study*: advanced biofuels could displace ~1/3 U.S. transportation fuels
  - **DoD partners with Commercial Aviation Alternative Fuels Initiative**, Air Transport Association et al to commercialize & market alternative fuels
  - **Comparable role in "spinoff"** of other major commercially important technologies (e.g., IC's/microprocessors)
- **Congressional opposition and uncertain funding**
  - **Some in Congress oppose program** citing high costs of fuel
  - **Defense spending being cut** and potential impact of sequestration
    - DPA requirement prevents repurposing of biofuels $ to other DoD program
- **Unconventional oil and gas boom implications?**