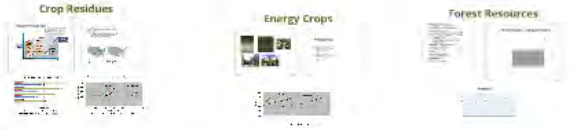
Comparison with 2005 BTS

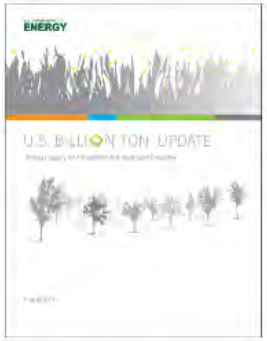
Methodology

Feedstocks

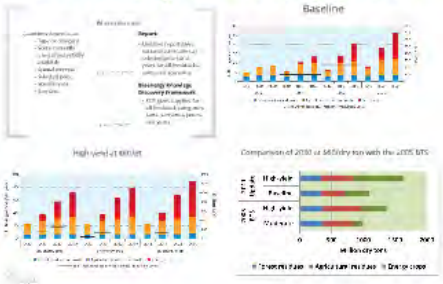


Billion-ton Update: An Overview

EPSCoR April 10th, 2012



Summary and Comparison



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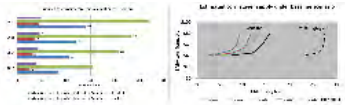
Annual changes in county land use, production, and prices



Billion-ton Update: An Overview

EPSCoR April 10th, 2012

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

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Prezi

Baseline

OK

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Richard G. Nelson

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P. Daniel Cassidy

USDA Natural Resources Conservation Service
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University of Illinois
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Comparison with 2005 BTS

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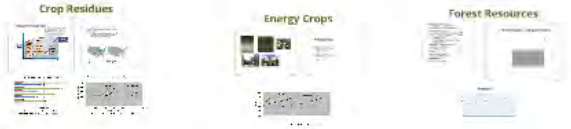

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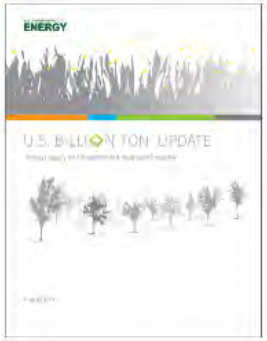

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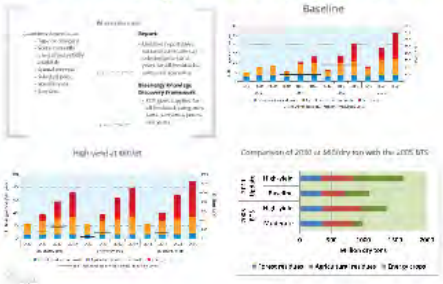

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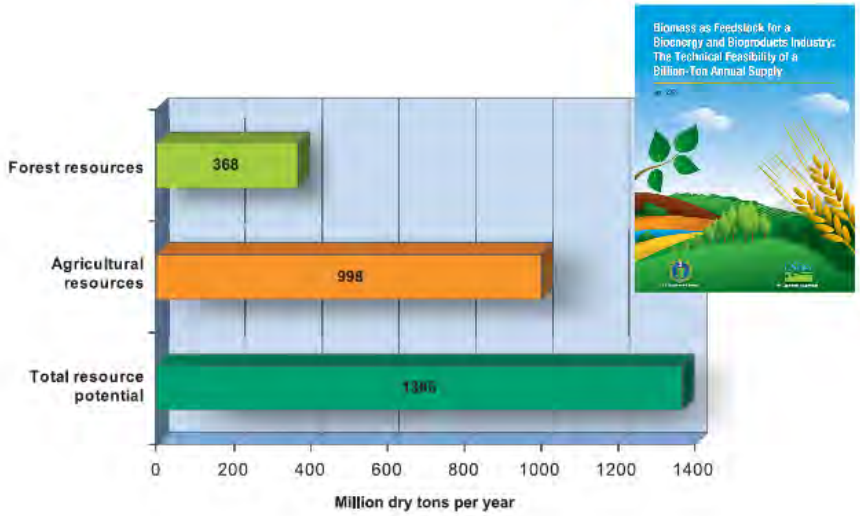

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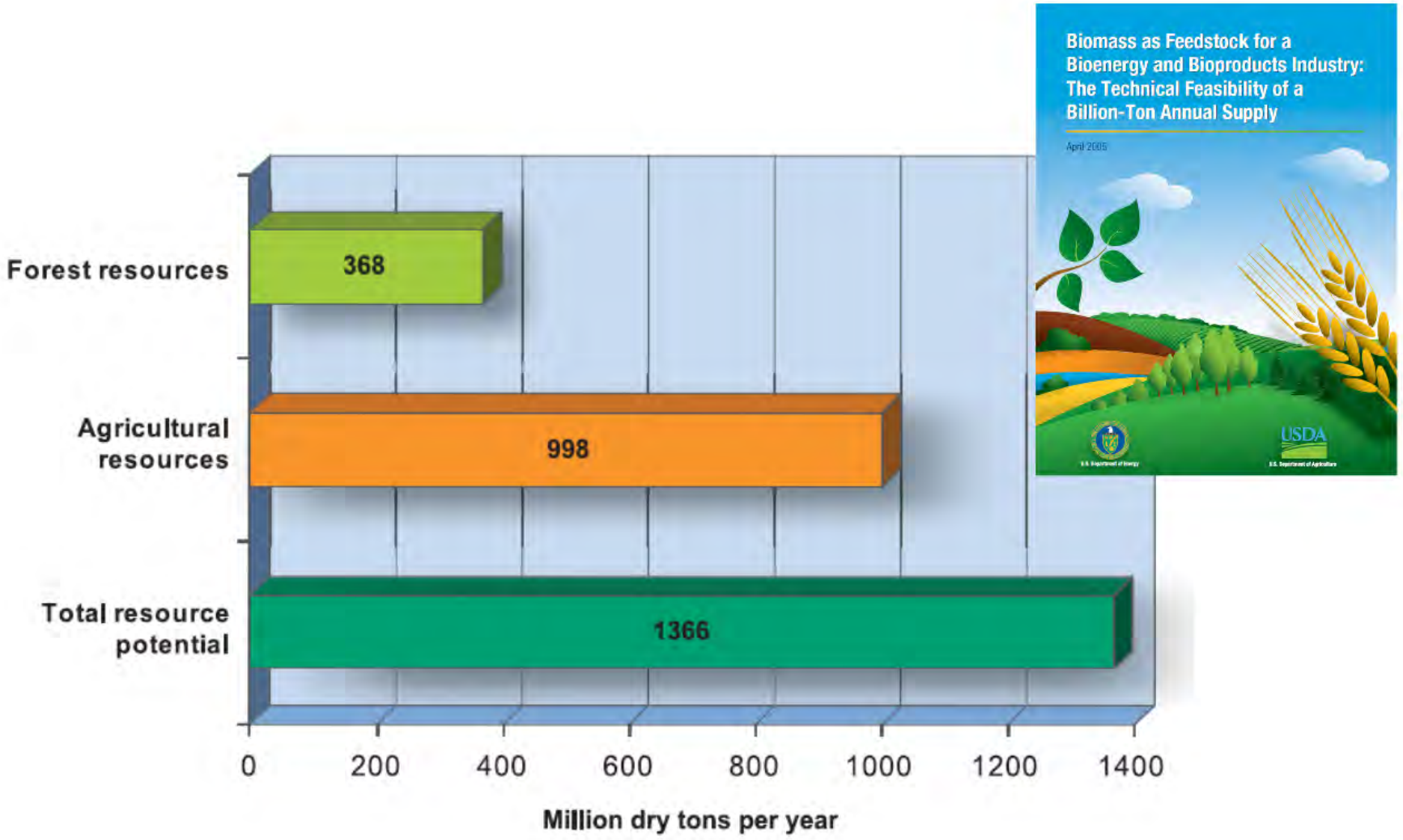
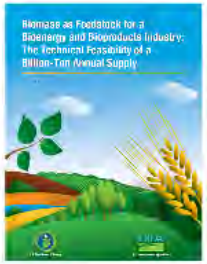
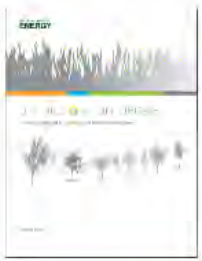
  - Evaluate biomass resource potential
  - Improve upon the 2005 *BTS*
    - Adds in-depth production and cost analyses and sustainability studies
    - Explicitly models land-use change and demand for food, feed, industry, and exports
- Significant findings of the 2011 study
  - Enough resource potential to meet the 2022 advanced biofuel goals
  - Potential resources are widely distributed
  - Energy crops are the single largest source of new feedstock

2005 BTS	2011 Update
National estimates – no spatial information	County-level with aggregation to state, regional and national levels
No cost analyses – just quantities	Supply curves by feedstock by county – farmgate/forest landing
No explicit land use change modeling	Land use change modeled for energy crops
Long-term, inexact time horizon (2005; ~2025 & 2040-50)	2012 – 2030 timeline (annual)
2005 USDA agricultural projections; 2000 forestry RPA/TPO	2010 USDA agricultural projections; 2010 FIA inventory and 2007 forestry RPA/TPO
Crop residue removal sustainability addressed from national perspective; erosion only	Crop residue removal sustainability modeled at soil level (wind & water erosion, soil C)
Erosion constraints to forest residue collection	Greater erosion plus wetness constraints to forest residue collection


Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply
April 2005
USDA
Forest resources
368
Agricultural resources
998
Total resource potential
1366
0
200
400
600
800
1000
1200
1400
Million dry tons per year





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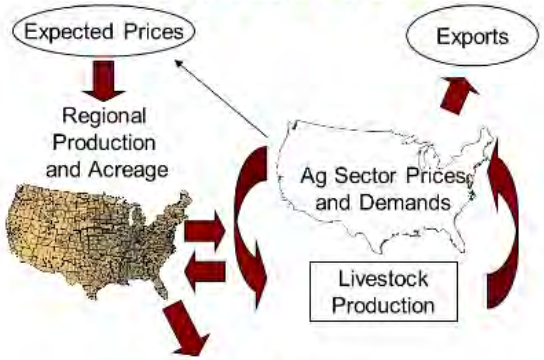
Methodology

Resource Base

- About one-half of the land in the contiguous U.S.
  - Forestland resources: 504 million acres of timberland, 91 million acres of other forestland
  - Agricultural resources: 340 million acres cropland, 40 million acres idle cropland, 404 million acres pasture (cropland pasture & permanent pasture)
- Agricultural resources
  - Crop residues
  - Grains to biofuels
  - Perennial grasses
  - Perennial woody crops
  - Animal manures
  - Food/feed processing residues
  - MSW and landfill gases
  - ***Annual energy crop (added for 2011)***
- Forest resources
  - Logging residues
  - Forest thinnings (fuel treatments)

  (Combined into composite)
  - ***Conventional wood (added for 2011)***
  - Fuelwood
  - Primary mill residues
  - Secondary mill residues
  - Pulping liquors
  - Urban wood residues

POLYSYS



Annual changes in county land use, production, and prices

Scenarios

Baseline

- USDA Projections extended to 2030
- National corn yield: 160 bu/ac (2010) increases to 201 bu/ac in 2030
- Assumes a mix of conventional till, reduced till, and no-till
- No residue collected from conventionally tilled acres
- Stover to grain ratio of 1:1
- Energy crop yields increase at 1% annually attributable to experience in planting energy crops and limited R&D

High-yield

Same as Baseline Scenario except for the following

- Corn yields increase to a national average of 265 bu/acre in 2030
- Higher amounts of cropland in reduced and no-till
- Energy crop yields increase at 2%, 3%, and 4% annually (more R&D)

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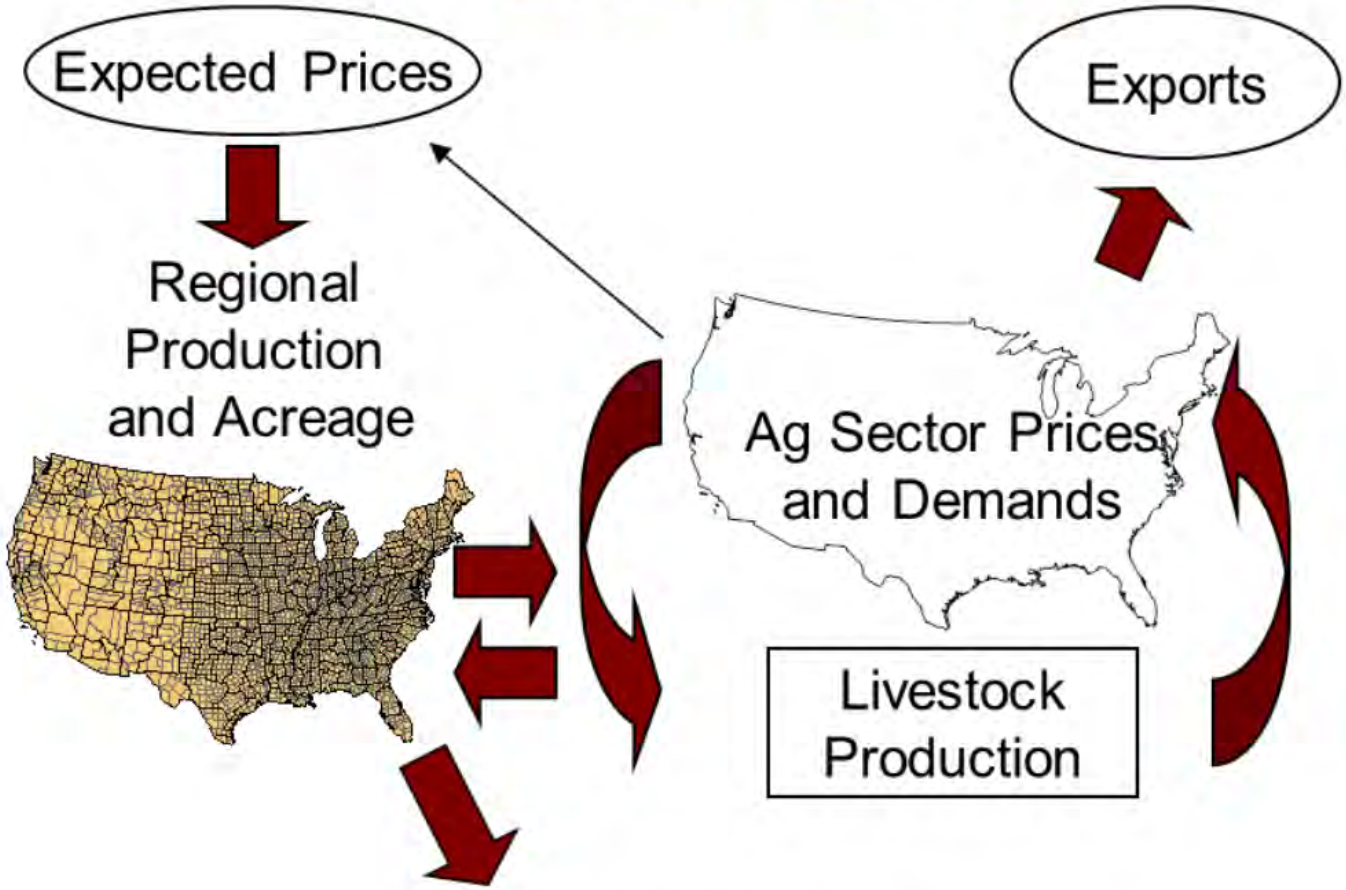

Annual changes
in county land
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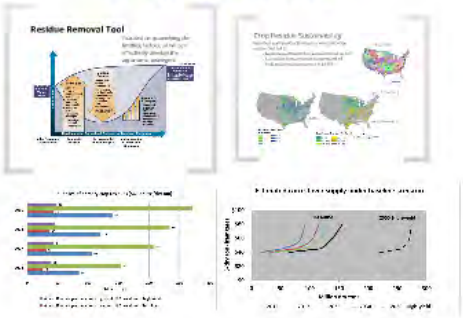
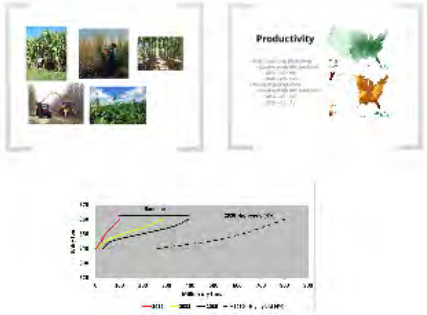
Feedstocks

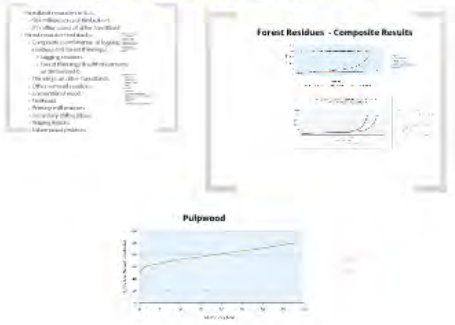
Crop Residues



Energy Crops

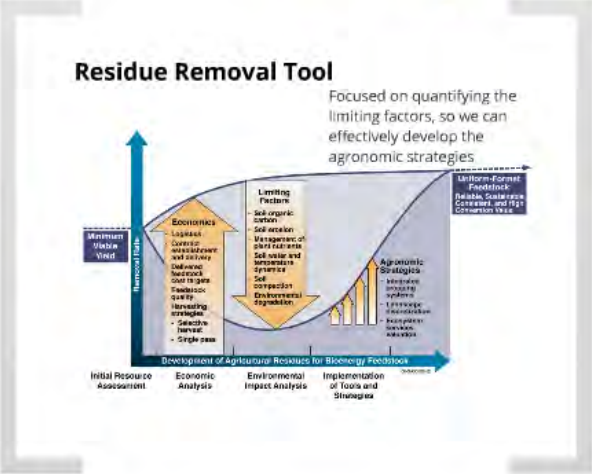


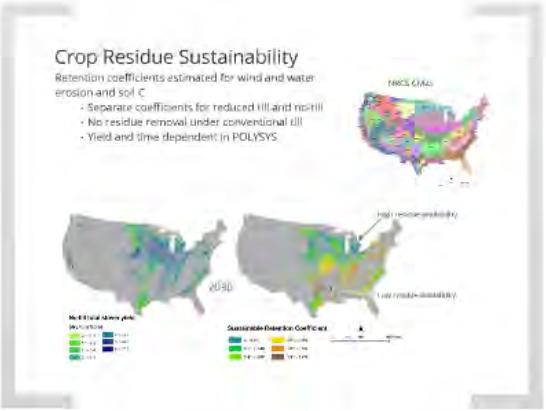
Forest Resources

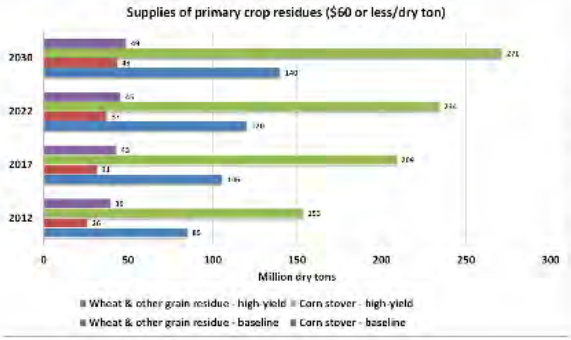


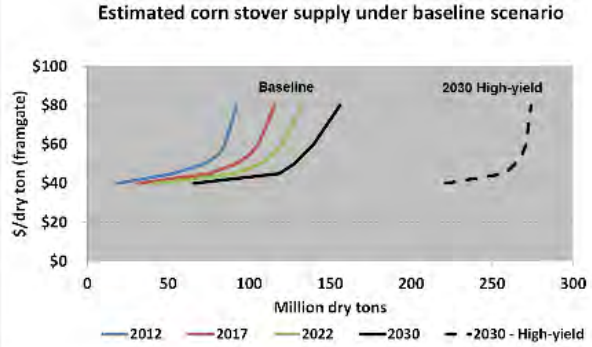
U.S. DEPARTMENT OF ENERGY

Crop Residues



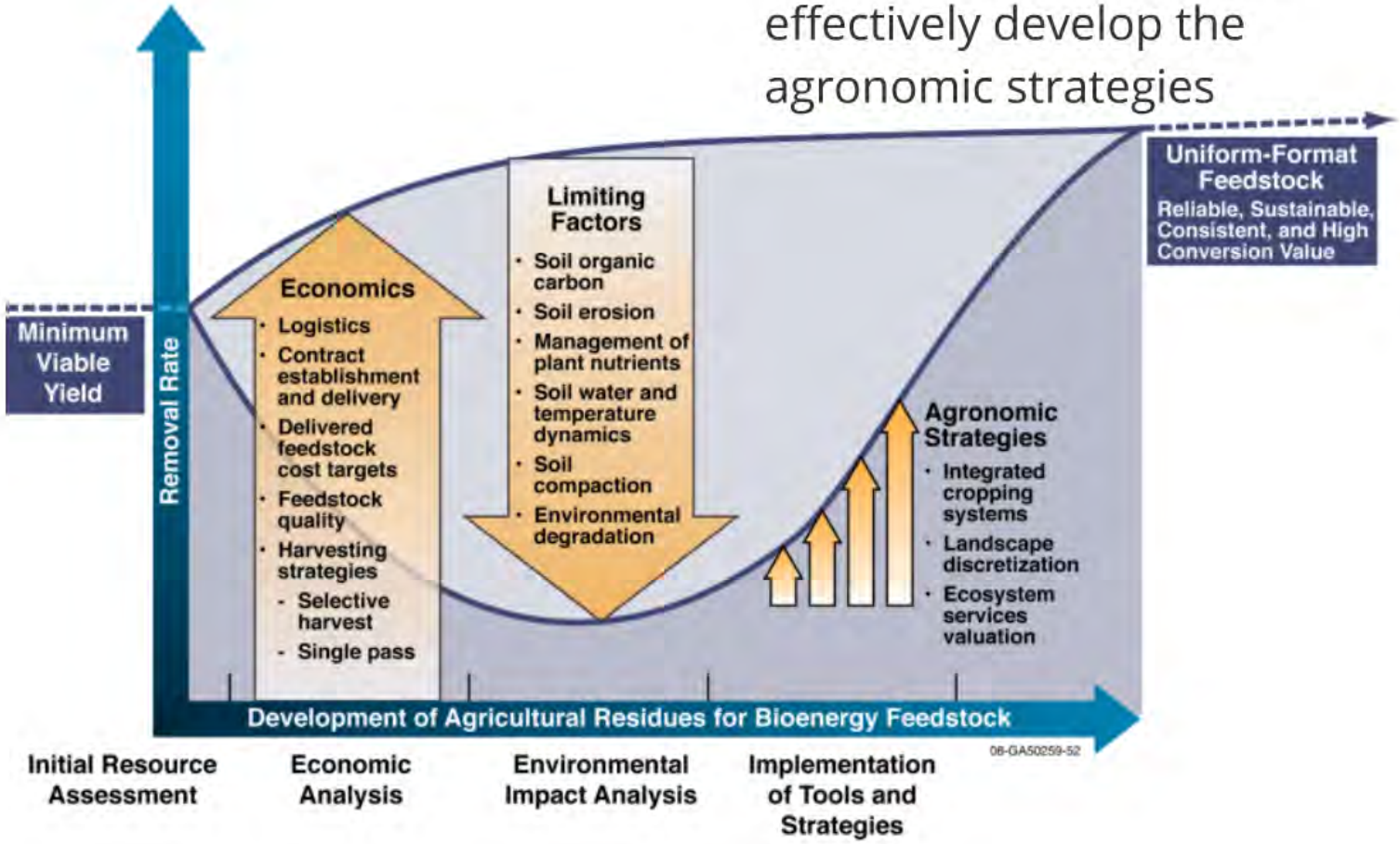






Residue Removal Tool

Focused on quantifying the limiting factors, so we can effectively develop the agronomic strategies

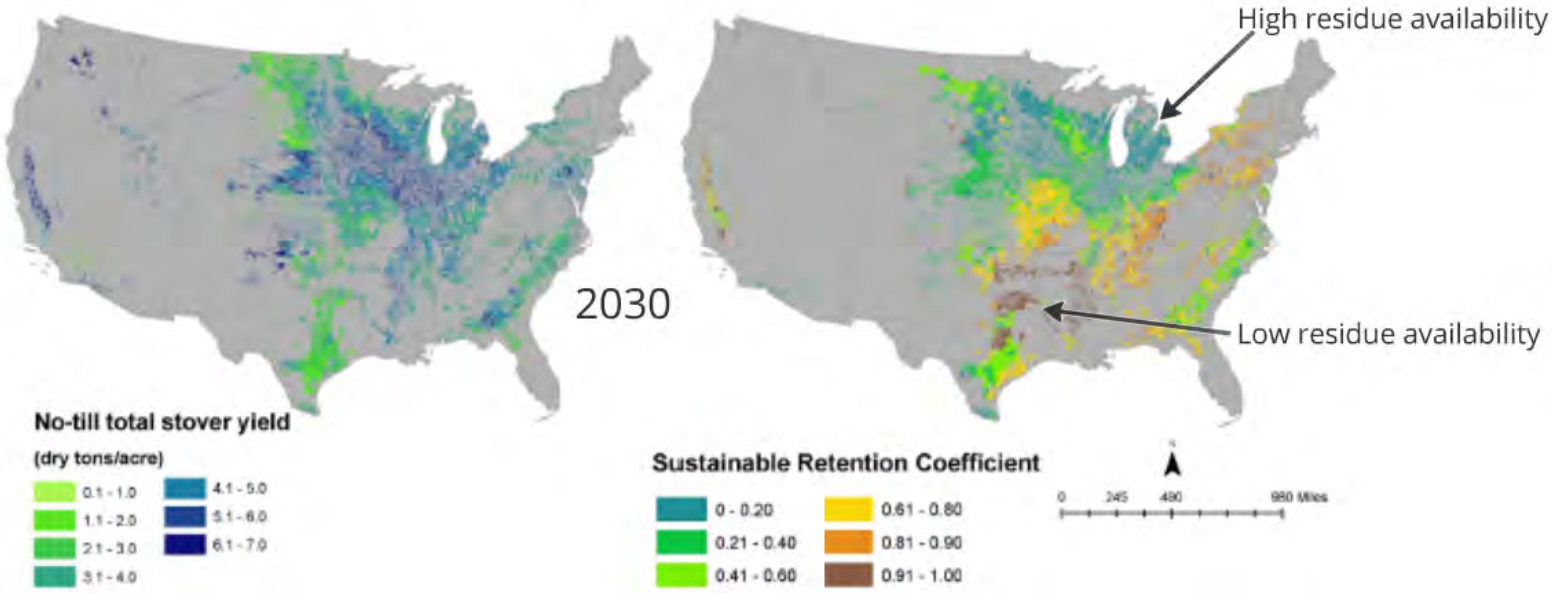


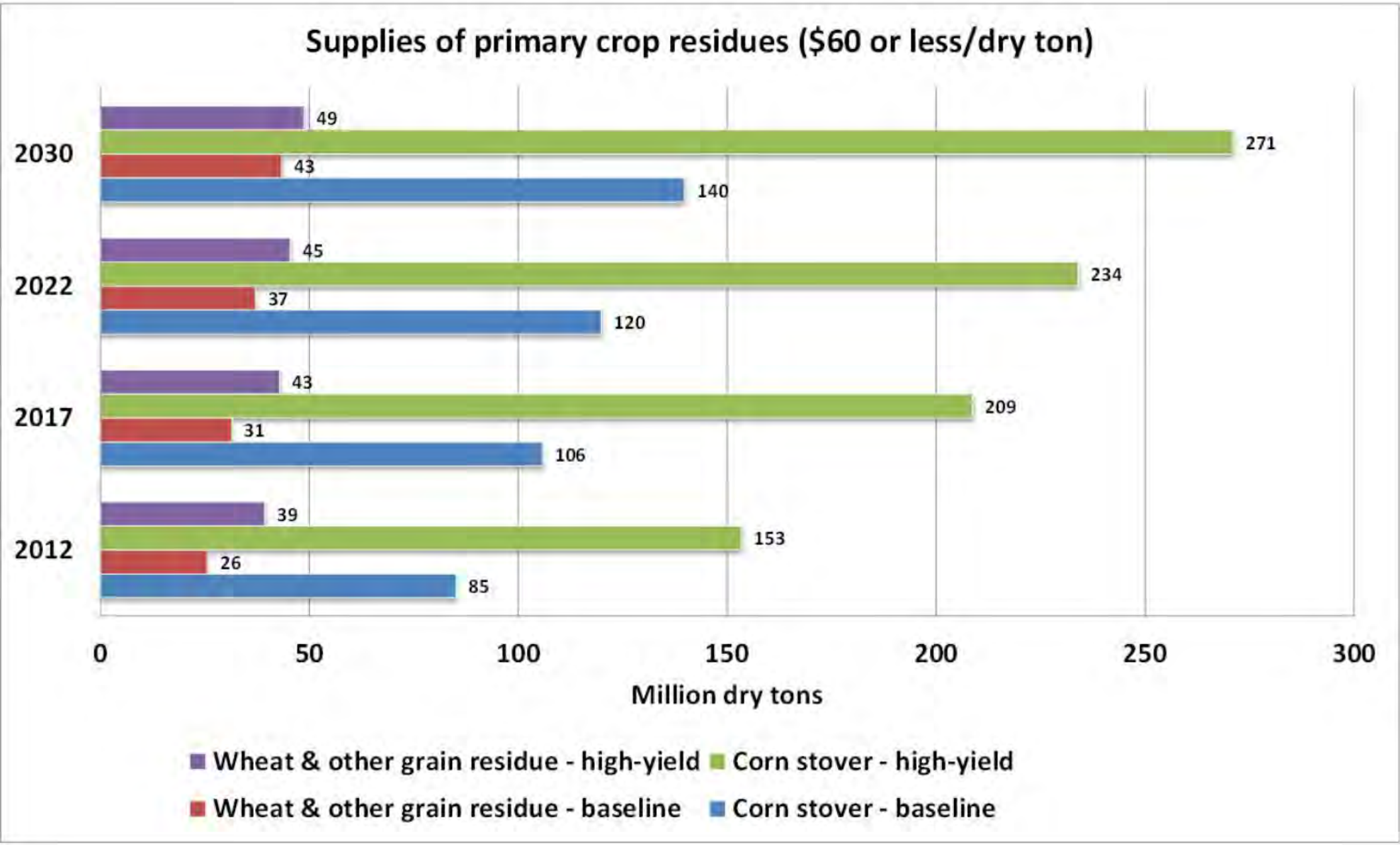
Crop Residue Sustainability

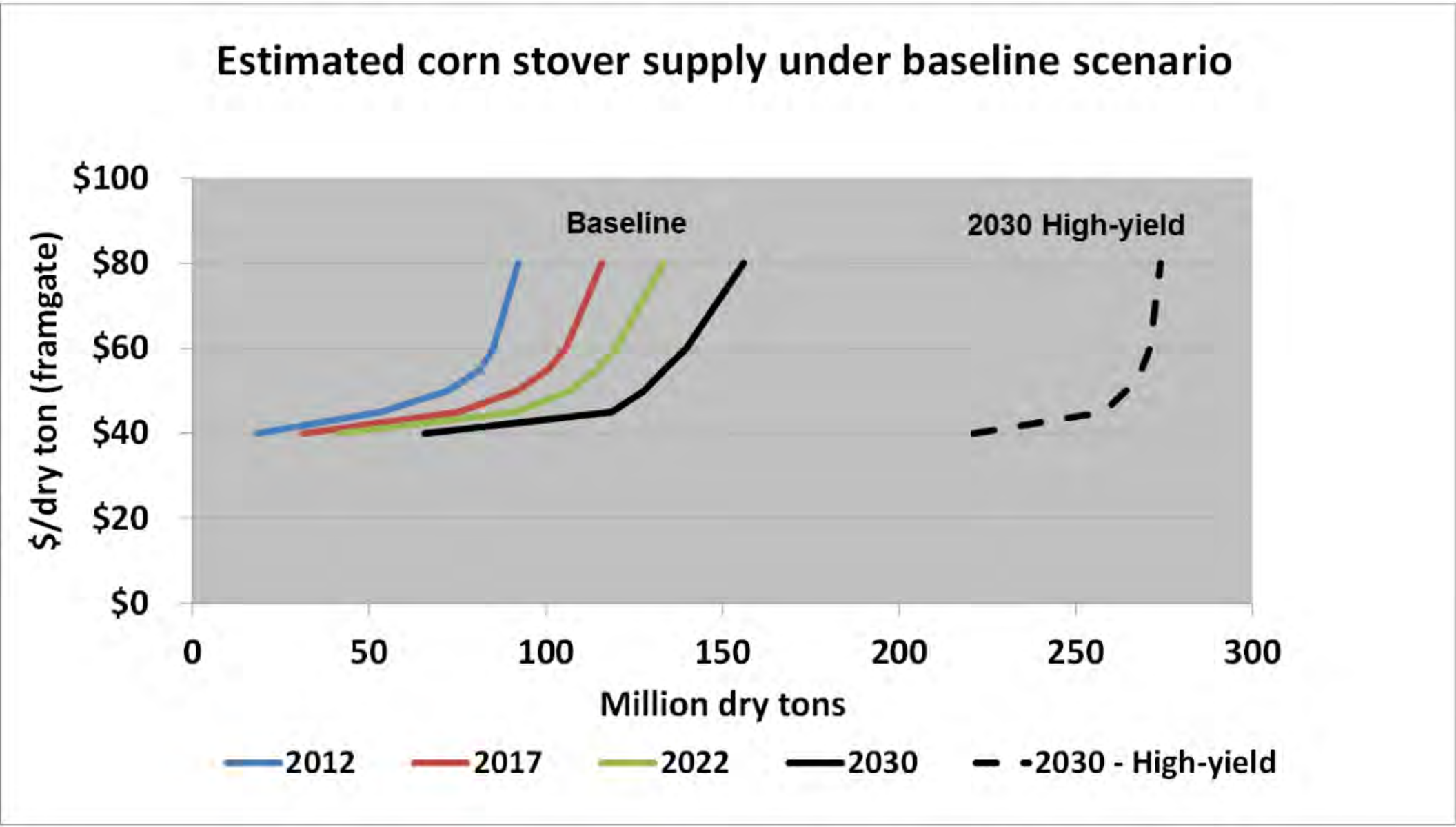
Retention coefficients estimated for wind and water erosion and soil C

- Separate coefficients for reduced till and no-till
- No residue removal under conventional till
- Yield and time dependent in POLYSYS

NRCS CMZs



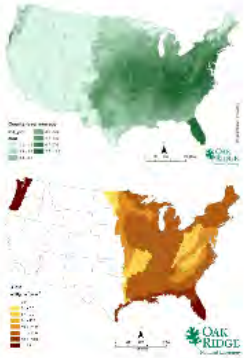

Supplies of primary crop residues ($60 or less/dry ton)
2030
2022
2017
2012
49
271
43
140
45
234
37
120
43
209
31
106
39
153
26
85
0
50
100
150
200
250
300
Million dry tons
Wheat & other grain residue - high-yield
Corn stover - high-yield
Wheat & other grain residue - baseline
Corn stover - baseline

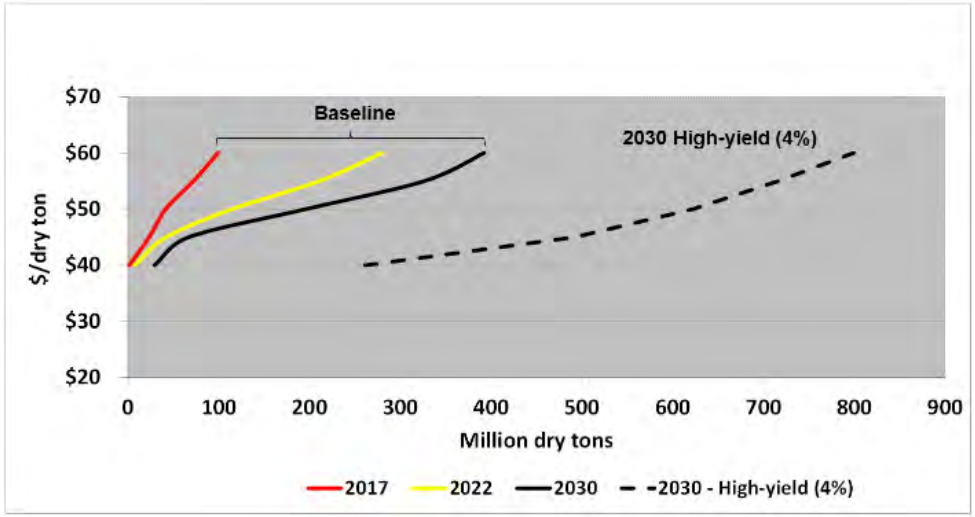

Estimated corn stover supply under baseline scenario
$100
$80
$60
$40
$20
$0
$/dry ton (framgate)
Baseline
2030 High-yield
0
50
100
150
200
250
300
Million dry tons
2012
2017
2022
2030
2030 - High-yield

Energy Crops

Productivity

- Herbaceous crop productivity
  - Baseline yields (dry tons/acre)
    - 2014 – 3.0 - 9.9
    - 2030 – 3.6 - 12.0
- Woody crop productivity
  - Baseline yields (dry tons/acre)
    - 2014 – 3.5 - 6.0
    - 2030 – 4.2 - 7.2





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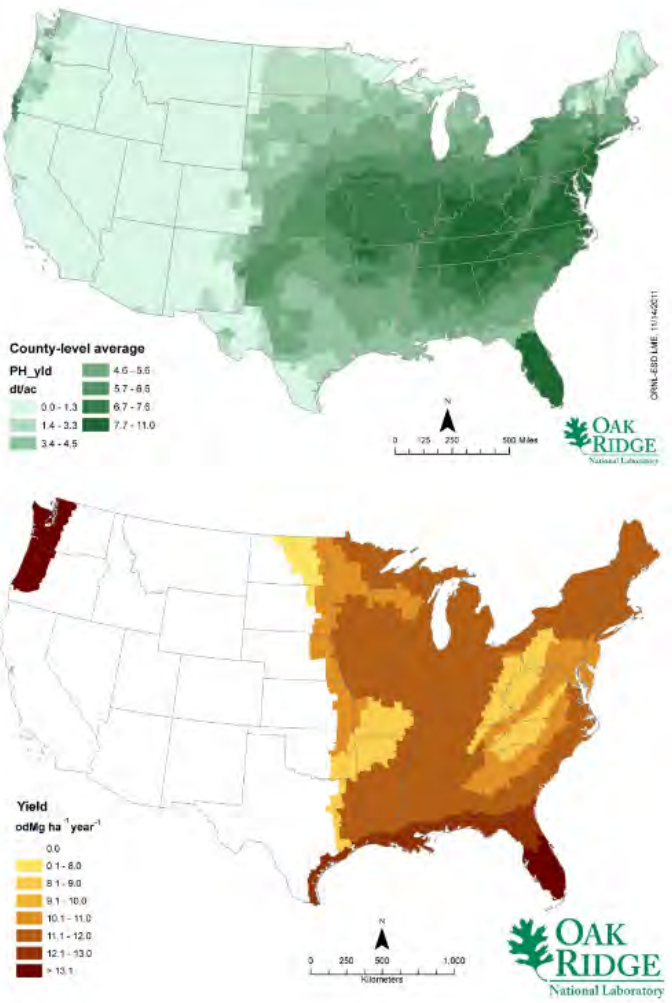
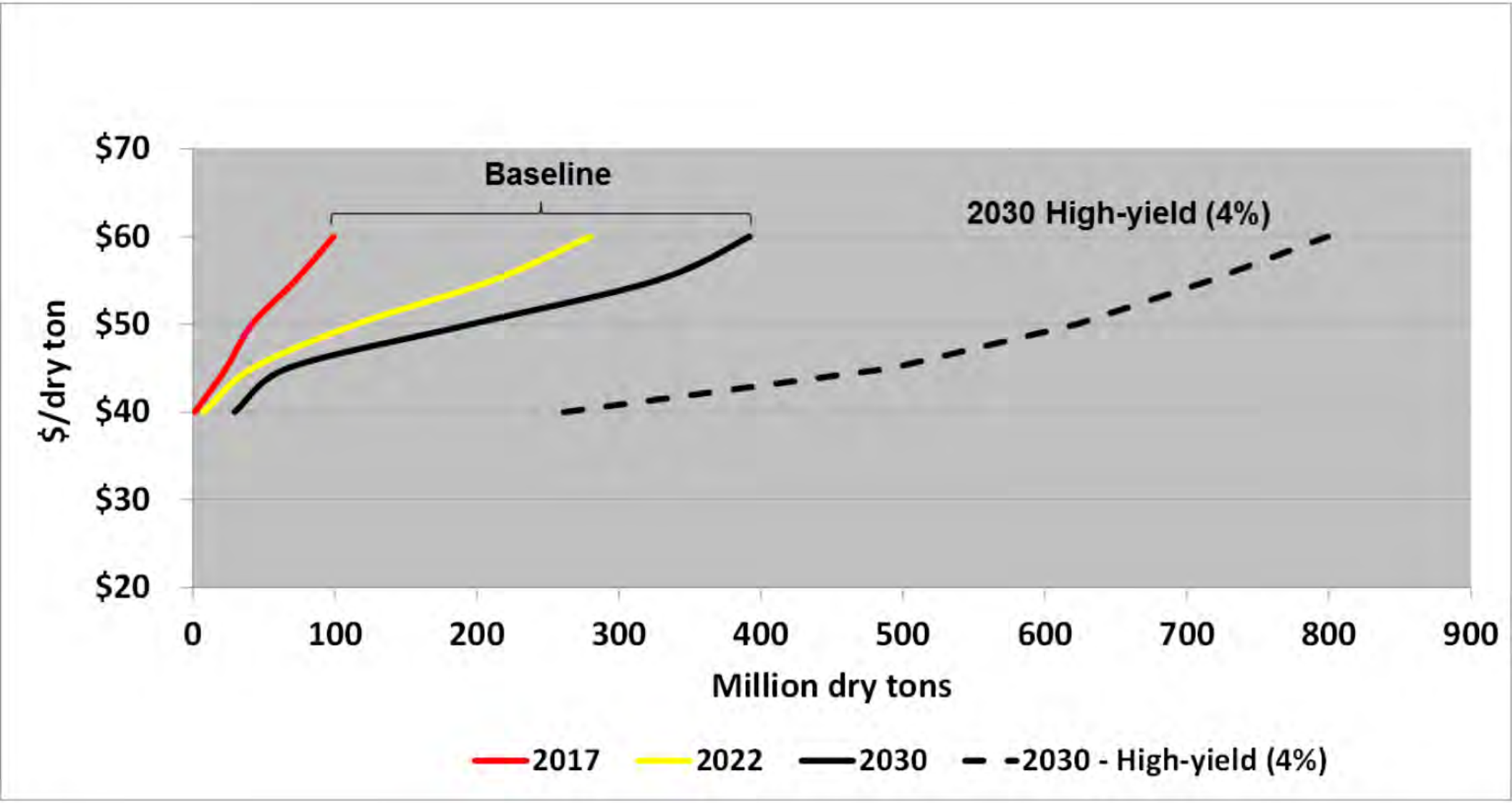
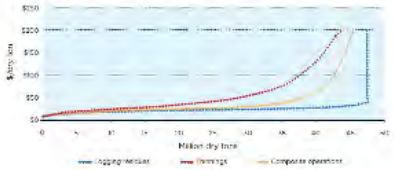


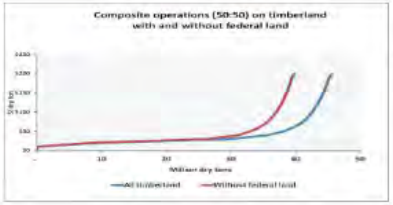

$70
$60
$50
$40
$30
$20
$/dry ton
Baseline
2030 High-yield (4%)
0
100
200
300
400
500
600
700
800
900
Million dry tons
2017
2022
2030
2030 - High-yield (4%)

Forest Resources

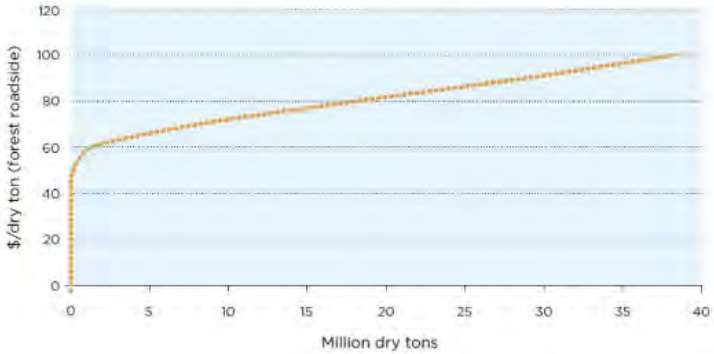
- Forestland resources in U.S.
  - 504 million acres of timberland
  - 91 million acres of other forestland
- Forest resource feedstocks
  - Composite (combination of logging residues and forest thinnings)
    - Logging residues
    - Forest thinnings (health treatments on timberlands)
  - Thinnings on other forestlands
  - Other removal residues
  - Conventional wood
  - Fuelwood
  - Primary mill residues
  - Secondary mill residues
  - Pulping liquors
  - Urban wood residues

Forest Residues - Composite Results





Pulpwood



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Forestland – minimal of 1 acre and 10% live tree cover

Timberland – capable of growing 20 ft3/acre/year
Other Forestland – other than timberland or reserved land

Reserved forestland – administratively removed from production

Currently used
- Fuelwood
- Mill residue
- Pulping Liquor
- MSW

Potential
- Composite
- Other removal residue
- Thinnings on other forestlands
- Mill residues
- Urban
- Conventional wood to energy

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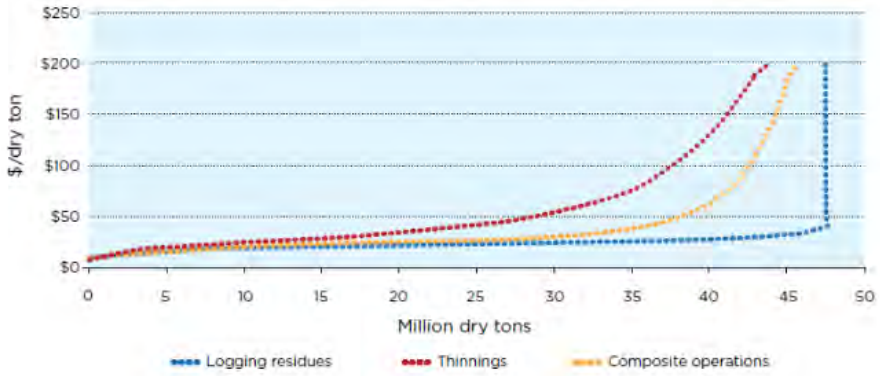
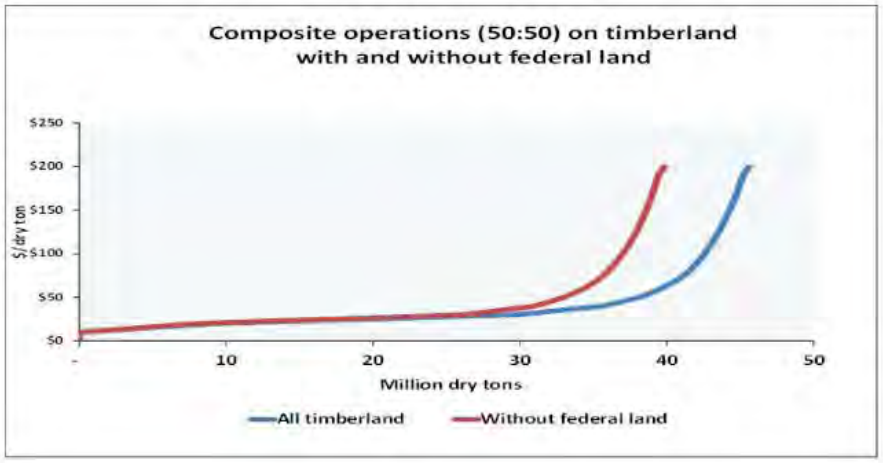
Forest Residues - Composite Results



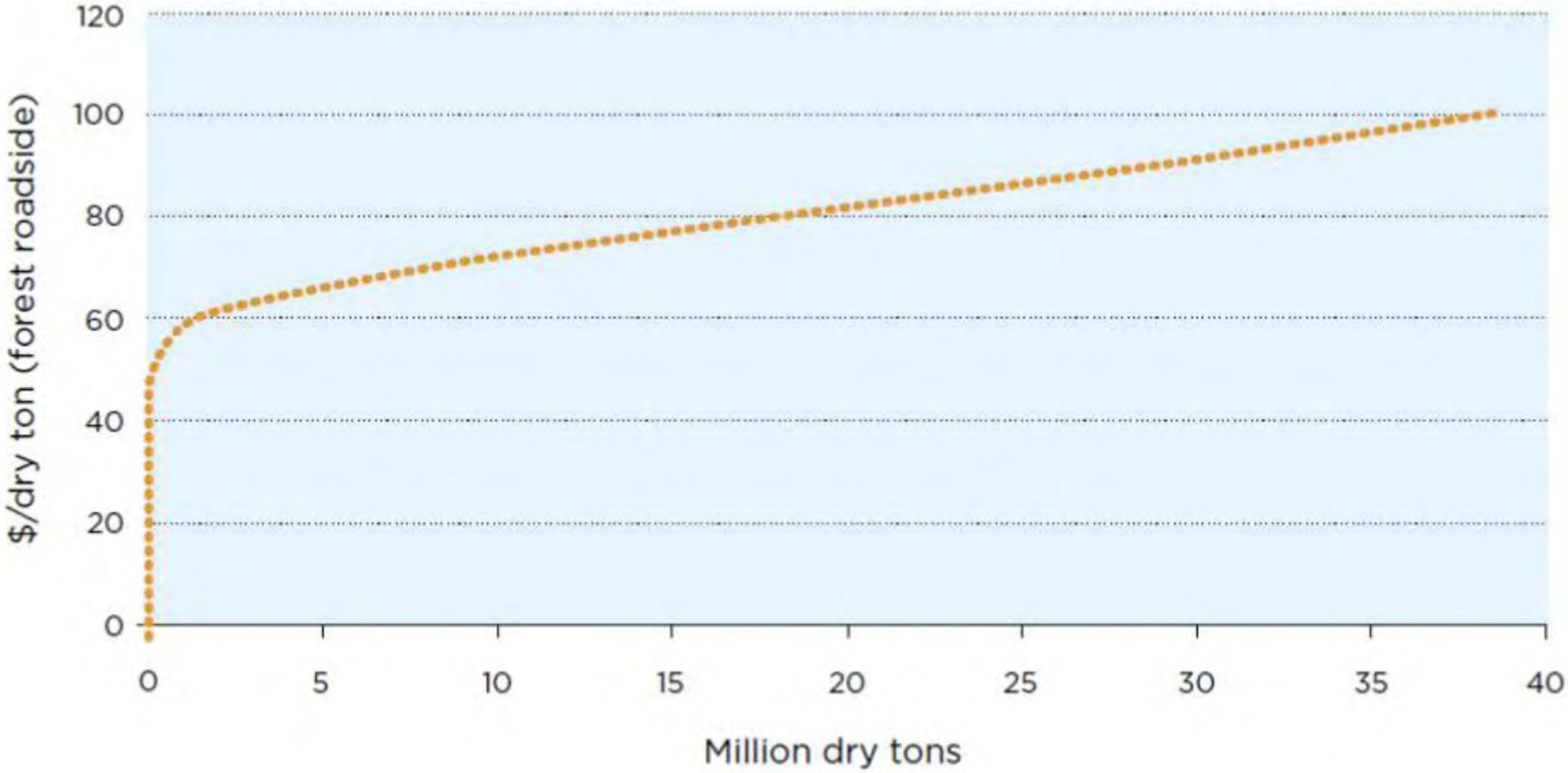
Estimates
$20-$200/dry ton
Current - 2012
Potential – 2017-2030
Federal and non-federal (ESIA exclusion)



Roadside supply curves

- Includes stumpage & chipping costs
- Fuel Reduction Cost Simulator model for harvesting
- Projections based on latest RPA/TPO
- With & without federal land
- Based on integrated logging

Pulpwood



Summary and Comparison

Quantities depends on:

- Type or category
- Sorts: currently used or potentially available
- Spatial interest
- Selected price
- Specific year
- Scenario

Where's the data?

(google "Billion-Ton Update")

Report:

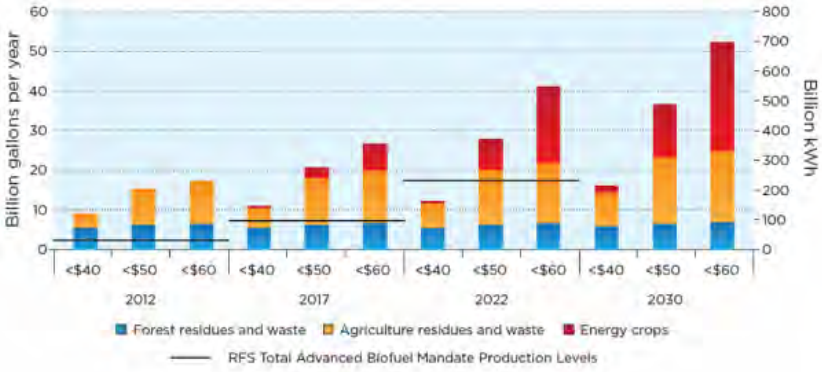
- Updated report gives national summaries at selected prices and years for all feedstocks, sorts, and scenarios

(google "Bioenergy KDF")

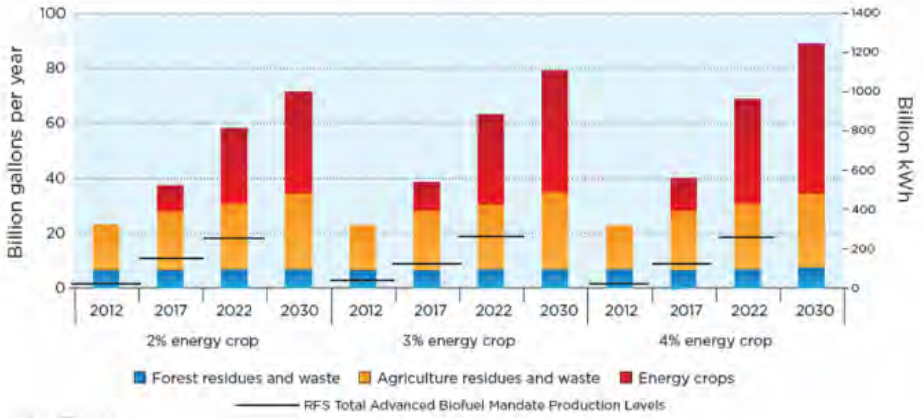
Bioenergy Knowlege Discovery Framework

- KDF gives supplies for all feedstock categories, sorts, scenarios, prices, and years

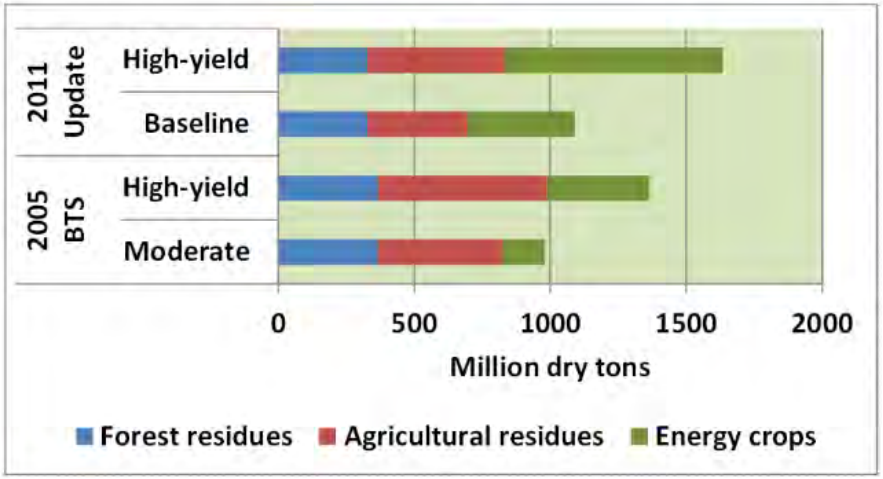
Baseline



High-yield at $60/dt



Comparison of 2030 at $60/dry ton with the 2005 BTS



Where's the data?

Quantities depends on:

- Type or category
- Sorts: currently used or potentially available
- Spatial interest
- Selected price
- Specific year
- Scenario

(google "Billion-Ton Update")

Report:

- Updated report gives national summaries at selected prices and years for all feedstocks, sorts, and scenarios

(google "Bioenergy KDF")

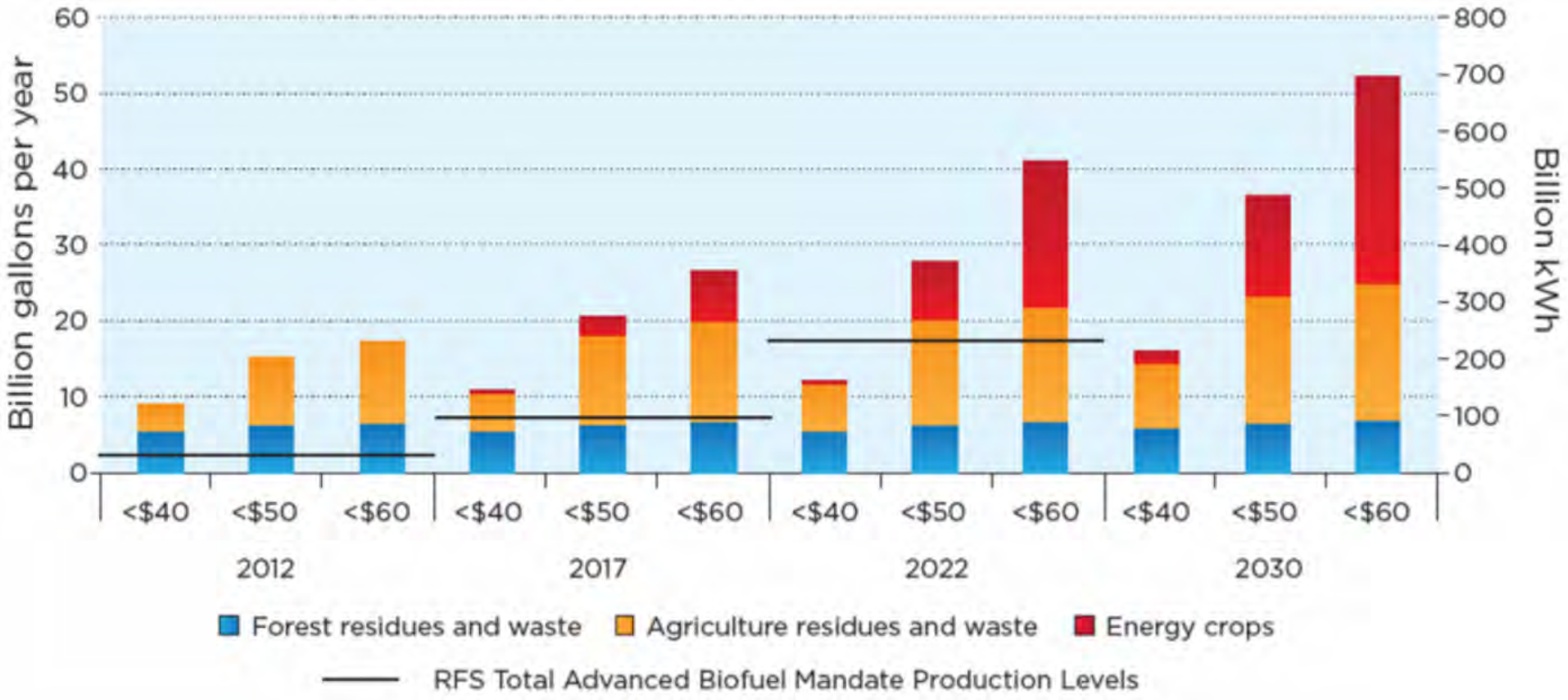
Bioenergy Knowlege Discovery Framework

- KDF gives supplies for all feedstock categories, sorts, scenarios, prices, and years

High yield at $60/dt

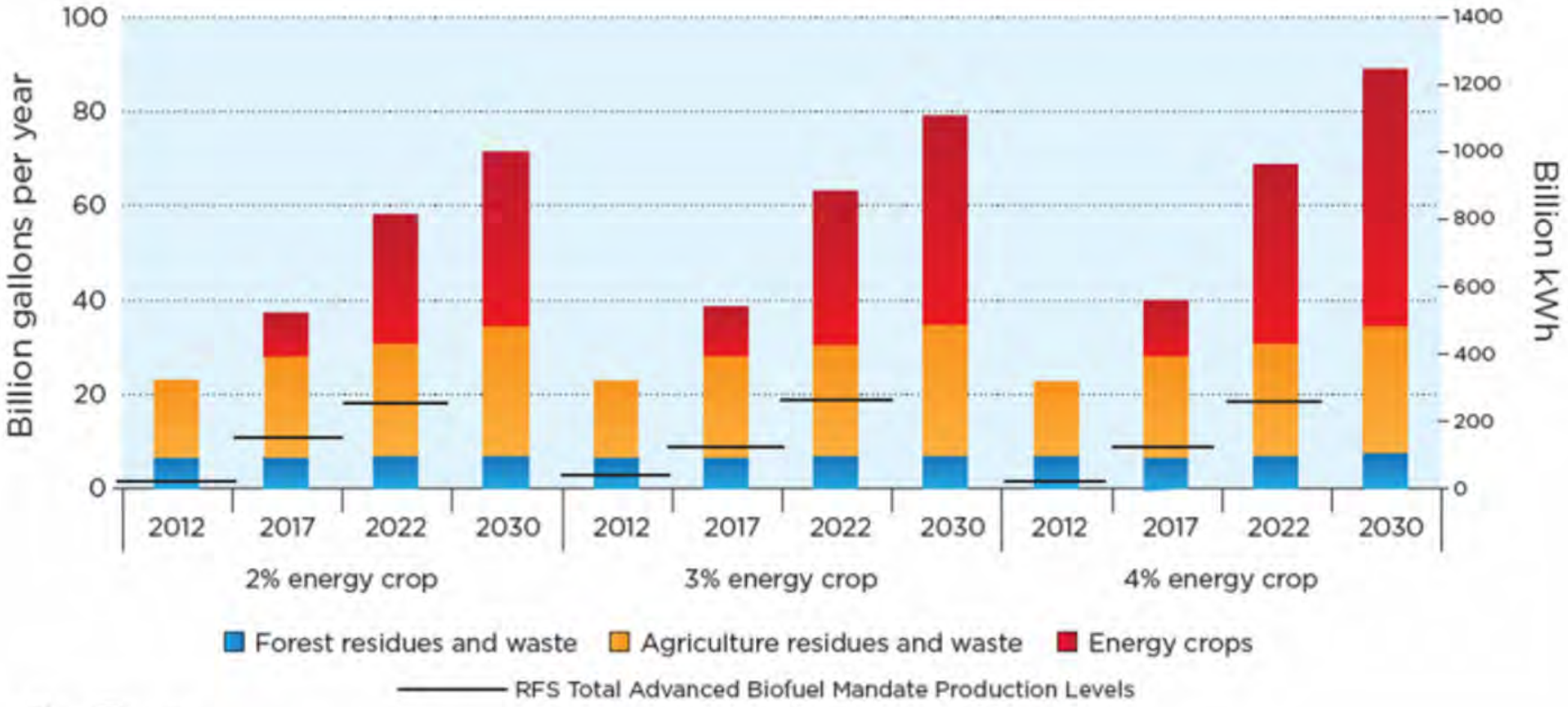
a comparison

Baseline



(google "Bioenergy KDF")

High-yield at $60/dt



Comparison of 2030 at $60/dry ton with the 2005 BTS