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NWF Briefing: EPA Report on Environmental Impacts of Biofuels Mandate

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Background

- Knowledge of adverse environmental effects of biofuels in the U.S. was fairly well established by 2011:
    - EPA's 1st Triennial Report (2011) – "Evidence to date from the scientific literature suggests that current environmental impacts from increased biofuels production and use associated with EISA 2007 are negative, but limited in magnitude."
    - NAS Report (2011):
        - Largely consistent with EPA's 1st Triennial Report
        - Pointed out challenges with respect to GHG emissions, air quality, water quality, water quantity, soil quality, and biodiversity

Motivation for DRI study in 2016

- Corn ethanol volumes were approaching limit of 15 billion gallons/year. This equates to 10% ethanol in all gasoline (E10).
- Some organizations were advocating large increases in fuel ethanol, such as E20 nationwide
- Literature review was undertaken to update our knowledge of the environmental impacts of corn ethanol to inform our judgement about increasing from E10 to E20.
- DRI Review amounted to an "intermediate triennial report" with respect to corn ethanol

Major Areas of Agreement Among DRI, NAS, and EPA Reports

- Cellulosic ethanol has failed to materialize. Virtually all fuel ethanol is derived from corn grain.
- Main drivers of environmental impacts are land use and land use change
- Because crops are grown for multiple purposes, it is difficult to accurately define the fraction of adverse impacts that are due to biofuels vs. due to other factors.
- Increased cropland for corn agriculture involves more intensification than extensification
    - This is true in the U.S.; may be different elsewhere
    - Adverse environmental impacts are generally more severe with extensification

- Many adverse environmental impacts can be mitigated by application of effective conservation practices
- New research since 2011 has improved our understanding of the environmental impacts of ethanol production and use, but the overall conclusions have not changed

Specific Environmental Areas Discussed in EPA's Triennial Report

1. ***Emissions and Air Quality***
   - Emissions should be considered on an entire fuel life-cycle basis, not just vehicular emissions
   - Per-gallon of ethanol produced, upstream emissions of most pollutants (SOx, NOx, PM and ammonia) exceed vehicle tailpipe emissions
   - Total life-cycle emissions of most pollutants are higher for ethanol than for gasoline
   - Ethanol provides little (or no) ozone reduction benefit compared to gasoline
   - Industrial pollutants from ethanol production plants are of increasing concern
   - Vehicle tailpipe emissions of NOx are slightly higher when using ethanol fuel. Little data exist from the most modern vehicles (Tier 3), but there is no reason to expect major changes in NOx emissions effects.

2. ***Water Quality***
   - Corn agriculture is a significant contributor to runoff of sediment, nutrients (nitrogen and phosphorous), and pesticides
     - Proximal effects: excessive loadings of N, P, and sediment are harmful to aquatic ecosystems
     - Downstream effects: excessive N and P contribute to eutrophication, harmful algal growth, and hypoxia
   - Fertilizer from corn agriculture contributes to nitrate contamination of drinking water
     - Additional water treatment is necessary to mitigate this problem

3. ***Water Quantity***
   - Water requirements for corn ethanol production plants are modest overall (2.5-3.0 gal water per gal. ethanol produced), but this can still represent a significant resource problem if sited in water-constrained areas.
   - Total water footprint of corn ethanol is dominated by irrigation. Amount of irrigation varies widely geographically – from none to over 1000 gal. water per gal. of ethanol.
   - Volume-weighted water intensity of ethanol is about 100 gal/gal, while that of gasoline is about 5 gal/gal.
   - Expansion of corn agriculture is occurring in relatively dry areas, which require larger than average amounts of irrigation.

4. ***Ecosystem Health and Biodiversity***
    - Increased corn cropping contributes to landscape simplification (mono-culture), which reduces plant and animal biodiversity
    - There is particular concern about expansion into sensitive ecosystems
        - Loss of wetlands affects aquatic life
        - Loss of grasslands diminishes wildlife habitat

5. ***Soil Quality***
    - Conversion of grasslands to corn agriculture negatively affects soil quality, with increases in erosion and loss of soil nutrients
        - Particular concerns with conversion of Conservation Reserve Program (CRP) land
        - Adverse effects can be partially mitigated by proper land management practices

Issues not Covered in EPA Triennial Report

1. ***GHG Emissions***
    - Estimating GHG benefits of biofuels is extremely complex and controversial
        - Requires application of sophisticated life-cycle assessment (LCA) models
        - LCA incorporates agro-economic models and carbon emission factors
        - Results are highly dependent upon specific scenarios and modeling assumptions
    - Regulatory LCA assessments (by EPA and CARB) estimate a modest GHG benefit (~20%) for corn ethanol

2. ***Food vs. Fuel***
    - Fraction of U.S. corn crop used in corn ethanol production has increased from <10% in 2000 to about 40% today
    - Connections between biofuels and global food security are of increasing concern, particularly in areas with high population growth
    - Many individuals and organizations have strong ethical/moral objections to using staple food products in the production of fuels

3. ***Total Sustainability***
    - Assessment of sustainability includes not only resource and environmental considerations, but also social and economic dimensions
    - Sustainability issues involve both technical and ethical questions
    - Producing nationwide E20 fuel from corn ethanol is technically possible, but may not be fully sustainable

Overall Summary/Conclusion

Use of corn ethanol as a fuel provides both benefits and dis-benefits. Benefits include rural economic development, enhanced employment, reduction of non-renewable fossil fuels, production of valuable by-products (e.g., DDGS), and modest reductions of GHGs. Dis-benefits include potential water pollution, water shortages, soil degradation, loss of biodiversity, increased air pollution, greater food insecurity, and diminished sustainability. At today's production level of 15 billion gallons/year, the dis-benefits outweigh the benefits. Any increase beyond 15 bg/y should be undertaken with extreme caution.

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