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**PHOSPHORUS**  
**A Strategic Barrier to the National Biofuels Action Plan for**  
**Energy Independence**

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The National Biofuels Action Plan, drawing on mandates and funding in the Energy Independence and Security Act (EISA) of 2007, the Food, Conservation, and Energy Act (FCEA) of 2008, and other Federal legislation, lays out an ambitious plan for replacing imported oil with biofuels derived from plant matter. Biofuel production from first-generation technology, primarily ethanol from corn and biodiesel from vegetable oils, has increased dramatically in the last few years, now accounting for about 10 billion gallons annually. Federal programs are also aggressively seeking technical and economic innovation for use of crop and forest residues and dedicated energy crops such as switchgrass for cellulosic conversion to ethanol or bio-oil or for direct burning for power generation.

The purpose of this brief is to draw attention to a strategic barrier to energy independence posed by future availability of an essential plant nutrient—phosphorus.<sup>1</sup> Phosphorus is essential for life. Phosphorus removed from fields in plant material must eventually be replaced to avoid plant biomass yield decreases.

World sources of phosphorus are being progressively depleted and production costs are increasing. Most commercially viable reserves are found in only two locations, Morocco/Western Sahara and China. Predictions are that commercially viable reserves of phosphate rock in the United States will be depleted in only 25-30 years at present use rates, and cheap reserves depleted in only about 10-15 years. Depletion of U.S. supplies could occur much sooner with substantial use of plant material for biofuel production.

Dwindling U.S. reserves and political instability in countries where most phosphate rock reserves are held suggest that the U.S. biofuels action plan may be replacing energy dependence with phosphorus dependence. Potential severity of the phosphorus problem led Swedish researchers to proclaim that the global economy could flip from oil- to phosphorus-based in only 10-20 years.

Political instability in countries with large phosphate rock reserves is potentially exacerbated by market control in the U.S. A transnational corporation, Mosaic, Inc., sells 59% of phosphorus fertilizer consumed in the U.S. and 15% worldwide. Cargill, Inc., owns 64% of Mosaic. This level of domestic market share along with control of reserves is sufficiently high to warrant considerable concern about monopoly control over phosphorus fertilizer and, since it is an essential nutrient, to warrant concern about indirect market power effects in domestic food and bioenergy markets.

We maintain that four components need to be added to the national biofuel action plan to insure success in achieving true energy independence. These components are: (a) policy encouraging better distribution of phosphorus in animal, poultry and human waste, (b) expanded research on technology for recycling phosphorus in plant material going into biofuel and food production, (c) expanded research on technical and economic aspects of poly-culture of plants to enhance phosphorus acquisition by plants through mycorrhizal and rhizobial symbiosis, and (d) monitoring and correction, if necessary, of market power imbalances.

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<sup>1</sup> The U.S. increasingly relies on imports of nitrogen and potash, the other two major plant nutrients, but potential domestic availability of them is not as significant a strategic issue as phosphorus.