SURVEYING THE BECCS LANDSCAPE

ENERGY FUTURES INITIATIVE

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Surveying the BECCS Landscape is the first report in the Energy Futures Initiative's series "BECCS: Sowing the Seeds of a Negative-Carbon Future."

What Is The Report?

The Energy Futures Initiative surveyed literature on **bioenergy with carbon capture and storage** (BECCS) to establish a foundational understanding of BECCS as the first study in a series examining opportunities and challenges related to BECCS.

What Is "BECCS"?

BECCS is one of several **carbon dioxide removal** (CDR) methods. It is made up of a set of systems that produces energy from biological material while also capturing carbon from processes like energy production and either storing it safely in the Earth or repurposing it.

Why Is Any of This Important?

- Studies by climate and energy experts show that removing existing carbon dioxide from the atmosphere is necessary to successfully combat climate change by limiting warming to 1.5 or 2 degrees Celsius at most, a goal outlined by the **Paris Agreement** in 2015 to stave off even worse harm from climate change.
- CDR is important for two reasons:
  - 1. Scientists have shown it's needed to remove **historical emisssions**, emissions accumulated in the atmosphere form hundreds of years of burning fossil fuels
  - 2. It can help offset sectors that are harder to decarbonize, like the industrial sector
- Scaling up BECCS could be a promising avenue for decarbonization when executed properly, but it needs further study.

How BECCS Works

***Biomass* in this context includes forestry and agricultural byproducts, organic waste, animal waste, and purpose-grown crops**

Plants store carbon as they grow. Later, biomass is harvested and transported to a BECCS facility.

Energy conversion occurs through combustion, thermochemical, or biochemical conversion

Biomass is converted to energy.

These steps can happen simultaneously

Energy products, like electricity or ethanol (biofuel) are produced that can be used to do things like fuel transportation and heat buildings. The CO_2 from the ethanol is returned to the atmosphere.

Carbon is captured either during the energy conversion process, from biomass itself, or from the facility's exhaust.

Captured carbon in a gaseous form is stored in geologic formations for thousands of years. In a solid form (biochar), carbon can be used as a soil amendment and can stay in the ground for centuries.

Through carbon removal, BECCS could bring the U.S.

6%-36%

of the way to its net zero by 2050 goal

BECCS ranges from

$20-$400

per metric ton of carbon

Scientists advise that BECCS projects remove

8 Gt

of emissions annually by 2050 to limit warming to 1.5°C

Key Findings

Climate change modeling includes significant CDR from BECCS, but the **actual achievable level is less certain**.

BECCS encompasses a range of technologies; numerous **underexplored BECCS pathways are worthy of consideration**.

Not all BECCS is necessarily carbon-negative, and **emission reductions and environmental impacts are project-specific**.

Current greenhouse gas accounting rules are limited in fully capturing the life cycle emissions and removal from BECCS.

The **BECCS industry is limited today** but has potential for significant growth.

A national BECCS industry would require **expanded biomass supply chains and CO_2 infrastructure.**

BECCS pathways present **opportunities for rural economic development.**

BECCS pathways face opposition; there's a need for approaches to BECCS that address **environmental justice concerns**.

There is an opportunity to **address BECCS through existing programs and policies**.

Next Steps

In the next part of its series, EFI plans to study the following and opportunities and challenges of BECCS in more detail:

1. The opportunities for BECCS to contribute to sustainable and resilient forests in the Western United States
2. An evaluation of the socioeconomic and environmental justice impacts of the BECCS industry
3. An exploration of greenhouse gas accounting issues and ways to ensure BECCS contributes to net-zero or net-negative emissions
4. A deep dive into sustainable sourcing practices of U.S. biomass feedstocks for BECCS projects