

Feasibility of Dairy Manure Biogas Projects

Dairy Biogas Programs

Grant Funding

**Capital, Revenue & Operating
Costs**



Dairy Biogas Opportunities

RNG for Transportation

- RNG, Liquid Fuels & Hydrogen

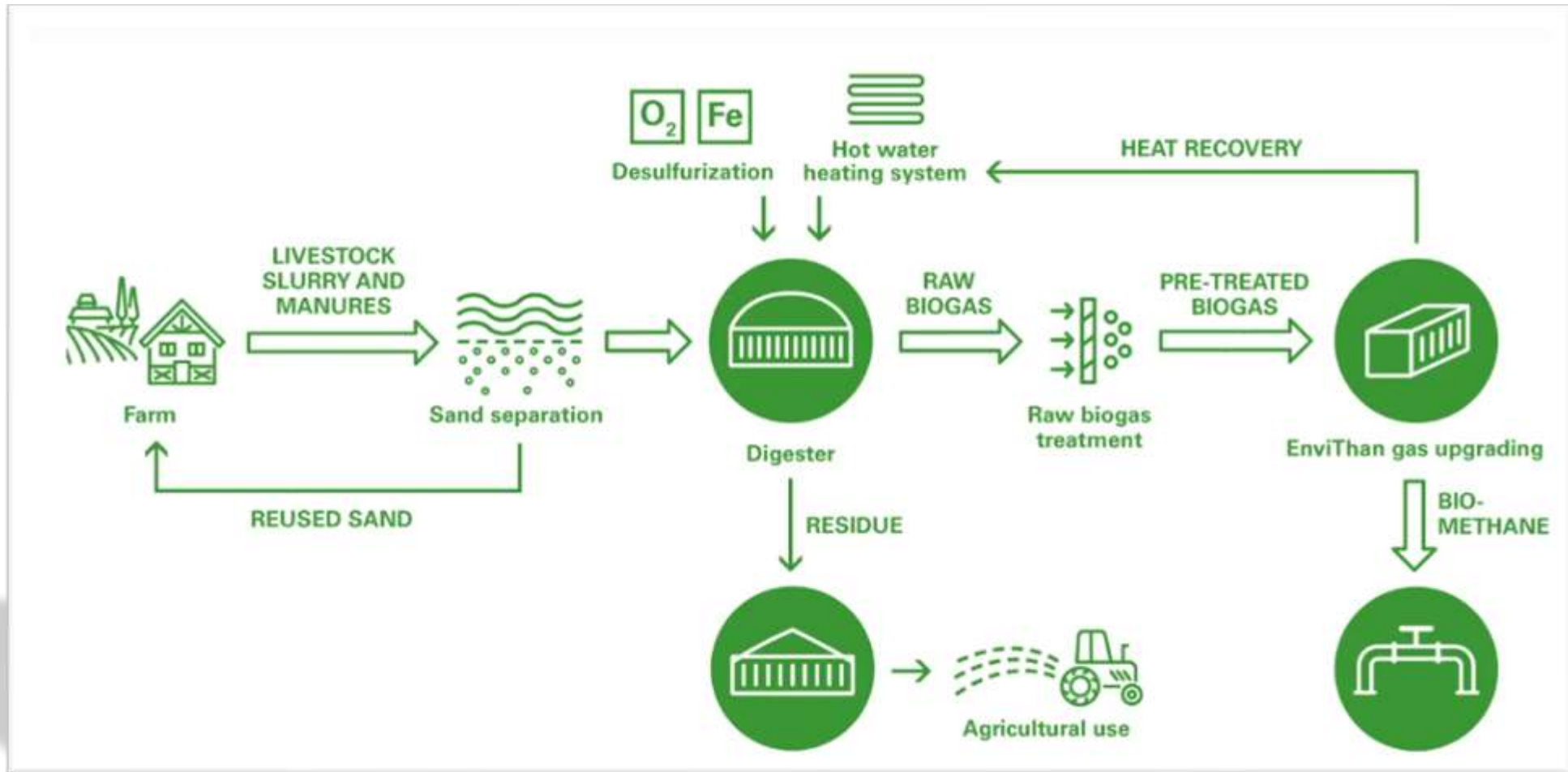
RNG for Voluntary Market

Biogas Destruction

- Biogas to Electricity



Biogas to RNG Schematic



Revenue Streams

RNG for Transportation

Commodity

- MMBtu (MSCF, MCF, Dth) delivered

Renewable ID Numbers (RINs)

- Based on commodity delivered

Low Carbon Fuel Standard (LCFS)

- Carbon intensity & commodity delivered based

Production Tax Credit (PTC)

- Carbon intensity & commodity delivered based

Revenue = Commodity + RINs + LCFS + PTC



Carbon Intensity (CI) Score Calculation

LCFS and Voluntary Market Emission Reduction

- Methane is 25+ times more potent than CO₂
- Post AD Emissions – Pre-AD Emissions

CI Score

- Emission Reduction/Energy Delivered

PTC CI Score

- Post Ad Emissions – Fossil Fuel Emissions



Monetization Process

RNG for Transportation

Marketing Company

- LCFS, RINs, PTC and Commodity
- Generally, Commission Based
- SCADA, Cow Counts, Utility & Fuel Usage
- Calculations, Verification & Reporting



Capital Costs

RNG for Transportation

Minimum Capital (3,000 WCE)

- **Digester**
\$4,500,000
- **Upgrader**
\$2,600,000
- **Balance of Plant**
\$2,900,000



Annual Revenue

RNG for Transportation

- **Commodity**
\$30 - \$110/WCE
- **RINs Credits**
\$280 - \$560/WCE
- **LCFS Credits**
\$310 - \$530/WCE
- **PTC Credits**
\$220 - \$280/WCE
- **Operating Expense**
\$320 - \$420/WCE



Economic Drivers

RNG for Transportation

- Grant Funding & Debt Servicing
- Retention Time
- Pipeline Access
- H₂S Treatment
- Single Farm vs. Community



Grant Funding Opportunities

REAP Energy Efficiency

- Up to 25% and \$250,000

REAP Alternative Fuel Development

- Up to 25% and \$500,000

NRCS EQUIP Program

- Digester/Lagoon Covers and Flare
- Up to \$450,000



Intermission



Voluntary Market

- Relatively New Market
- Credits Sold in Lieu of LCFS and RINs
- Credits Often Sold for Extended Period of Time
- Administrative Requirements



Annual Revenue

RNG for Voluntary Market

- **Commodity**
\$30 - \$110/WCE
- **Voluntary Credit**
\$710 - \$970/WCE
- **Production Tax Credit**
\$0 - \$280/WCE
- **Operating Expense**
\$320 - \$420/WCE



Biogas Destruction

Destruction Carbon Credits (CC)

- Methane is 25+ Times More Potent than CO₂
- Pre-Anaerobic Digester (AD) vs Post-AD based
- Stable Market
- Combined Heat and Power (CHP) Unit is Often Involved
- Administrative Requirements



Capital Costs

Biogas Destruction

Lowest Cost Option

Minimum Capital (1,500 WCE)

- Digester
\$1,600,000
- Combined Heat & Power (CHP)
\$900,000
- Balance of Plant
\$1,500,000



Annual Revenue

Biogas Destruction

Sell Carbon Credits and Produce Electricity

- Credits
\$80 - \$100/WCE
- Electricity Value
\$0 - \$200/WCE
- Operating Expense
\$130 - \$230/WCE
- Challenging Economics Limits Development



Economic Drivers

Biogas Destruction

- Grant Funding & Debt Servicing
- Inclusion of CHP (Electricity Value)
- Bedding Savings
- Outside Factors



Economics



<u>RNG for Transportation</u> <u>(3,000 WCE assumed)</u>	<u>RNG for Voluntary Market</u> <u>(3,000 WCE assumed)</u>	<u>Biogas Destruction</u> <u>(1,500 WCE assumed)</u>
<ul style="list-style-type: none">• CapEx \$10,000,000• Net Revenue (per WCE) \$420/yr – \$1,160/yr• Net Revenue (Annual) \$1,260k - \$3,480k	<ul style="list-style-type: none">• CapEx \$10,000,000• Net Revenue (per WCE) \$320/yr – \$1,040/yr• Net Revenue (Annual) \$960k - \$3,120k	<ul style="list-style-type: none">• CapEx \$4,000,000• Net Revenue (per WCE) \$>0/yr - \$70/yr• Net Revenue (Annual) \$0k - \$105k