

RNG WORKS



Anaerobic Digester Siting, Logistics & Development

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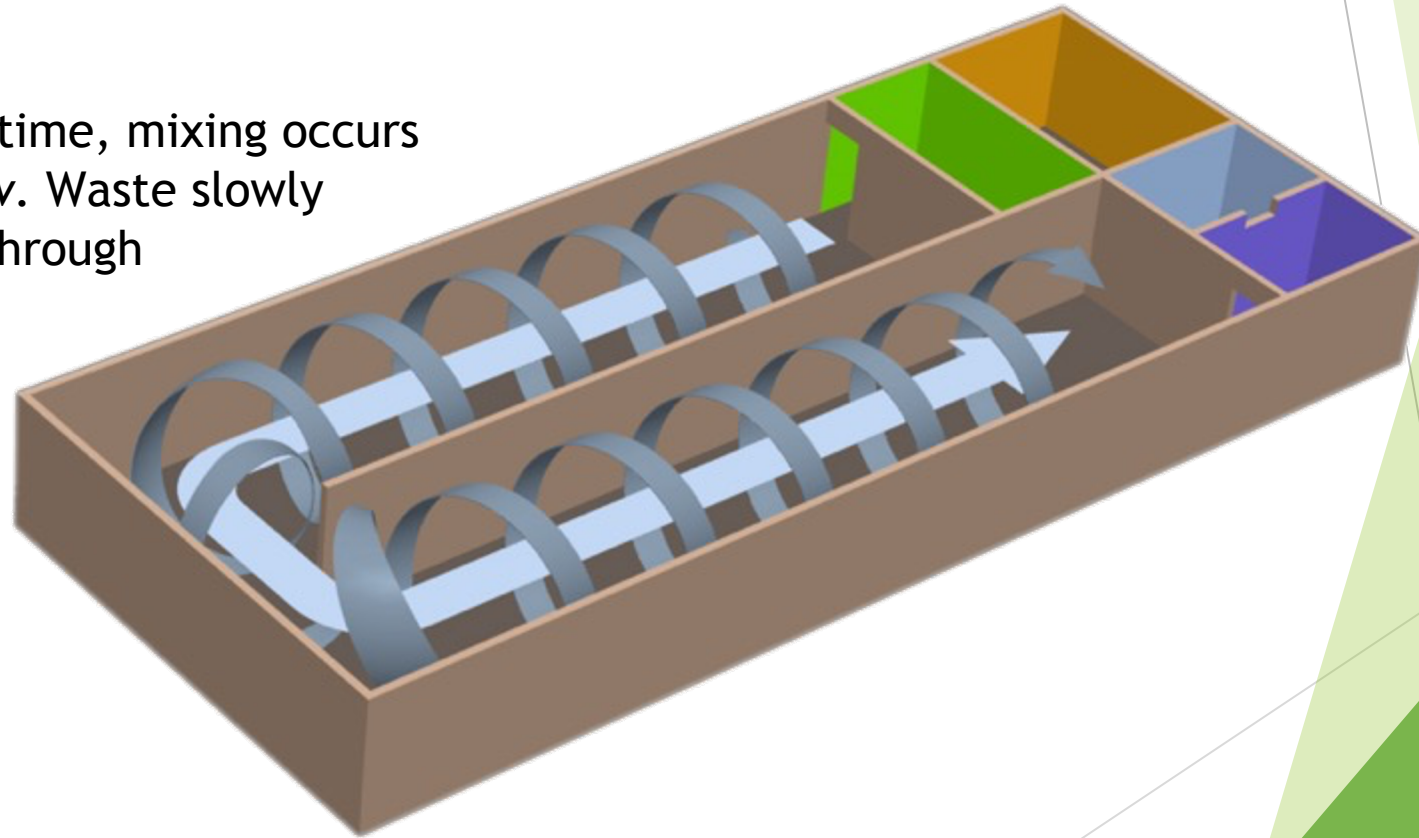


- ▶ Based in Wisconsin, with operations worldwide
- ▶ Founded in 1989 by Steve Dvorak, P.E.
- ▶ Our first mixed plug flow digester (current design)
 - ▶ Gordondale Farms, WI in September 2001
- ▶ DVO is the USA market leader, with 125 digesters operating at 90 sites in 19 U.S. states
- ▶ International operations (Serbia, Canada, Chile, Australia, China, South Korea)
- ▶ The most proven technology in the industry
- ▶ Produces and recovers the highest levels of biomethane in the industry on a consistent, year-round basis

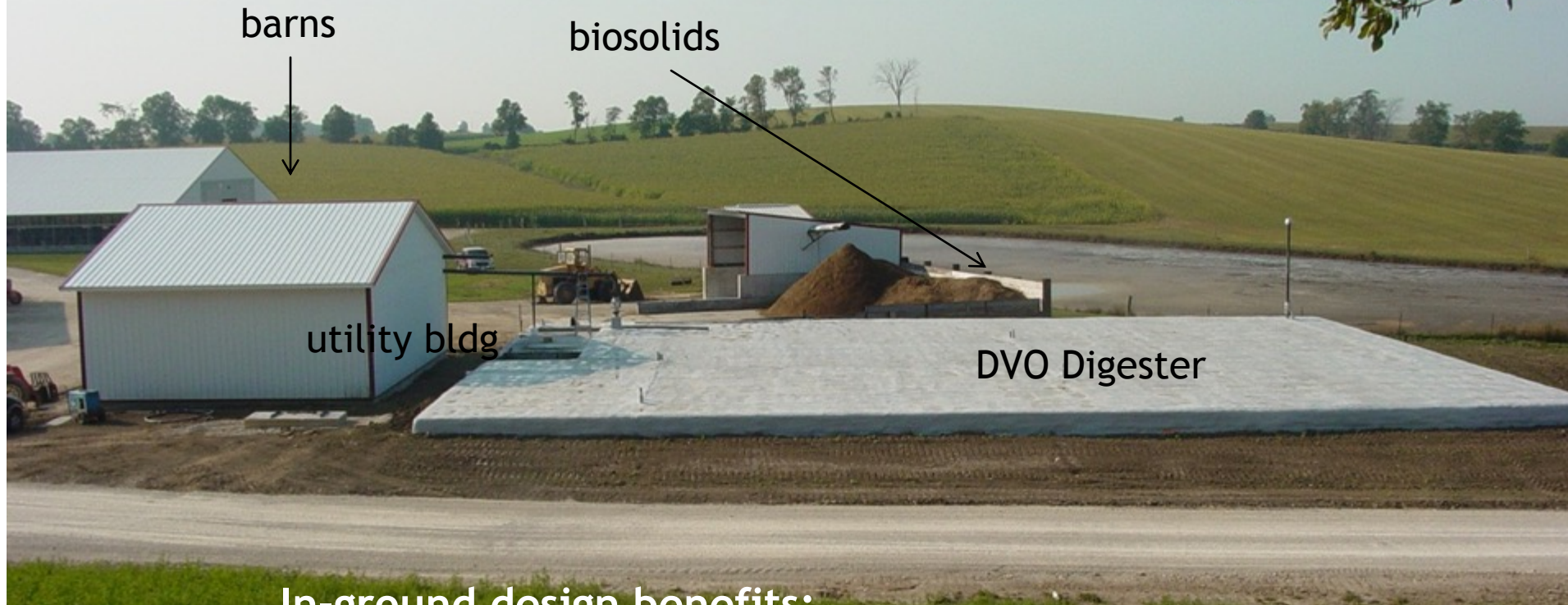
DVO'S MIXED PLUG-FLOW™

Waste flows longitudinally through the channel. As fresh waste enters one end, processed waste is pushed out the other. Typical residence time is 21 days.

To preserve retention time, mixing occurs around the *axis of flow*. Waste slowly “corkscrews” its way through the digester.



A Typical DVO Dairy Installation



In-ground design benefits:

- Thermal insulation - digester not prone to outside air temperature swings = consistent biogas output year-round
- Provides structural integrity
- Not visible to neighbors

Identify the “Right” Opportunity

- ▶ Support Infrastructure:
 - ▶ Onsite utilities/resources
- ▶ Inject directly or go “virtual”
 - ▶ Will there be more than one facility eventually sharing an injection point?
- ▶ Where to place the biogas scrubber in the chain...
 - ▶ Transport H₂S and CO₂ is undesirable



Identify the “Right” Opportunity

- ▶ Supply:
 - ▶ Reliability, consistency, volumes
 - ▶ Stability of supplier
 - ▶ Expectations of supplier (financial, other factors)
- ▶ Regulatory Setting
 - ▶ Ability to manage effluents
 - ▶ Local air district requirements
- ▶ Permitting Requirements/Permit-ability
 - ▶ Local, State, Federal
 - ▶ Will affect timeline to bring to market

Trucked In Wastes

- ▶ Are any existing roads impacted, and/or need to be upgraded?
 - ▶ Have a plan in place to begin with
 - ▶ Get local involvement & support early

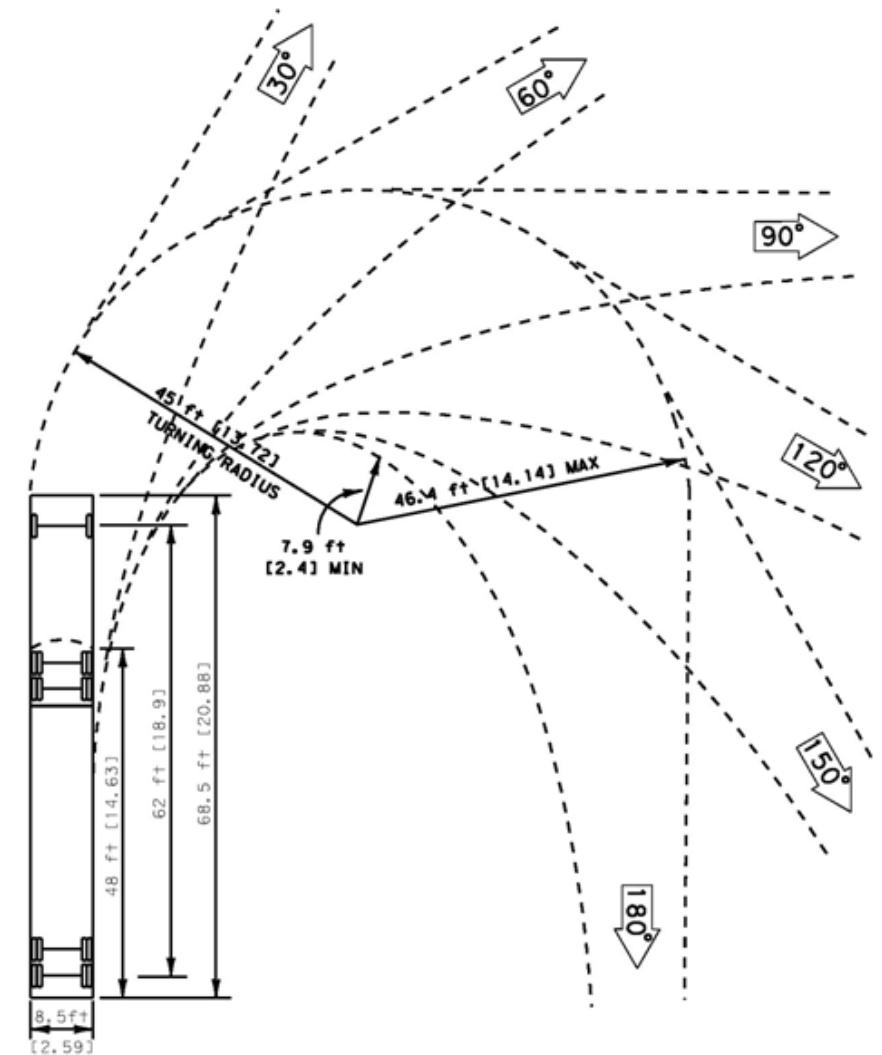


Trucked In Wastes

- ▶ Is the Site large enough for multiple truck access?
 - ▶ Turnarounds (don't use minimum turning radii)
 - ▶ Waiting area - Trucks can arrive “in waves” and stack up!



WB-62 [WB-19] DESIGN VEHICLE
RADIUS = 45 ft [13.72 m]
SCALE = 1:20 [1:200]



Turning Template for Semi-Trailer with 62 ft [18.9 m]
Wheelbase (Radius=45 ft [13.72 m])

Encroachment & Odors

- ▶ **Prevention** = the **key** to odor control
 - ▶ Schedule all arrivals
 - ▶ Contain/enclose dumping area
 - ▶ Do not store wastes unnecessarily... process “as it arrives”
 - ▶ If you must store wastes, do so methodically for easy access & removal
 - ▶ Empty & clean the tipping floor daily
 - ▶ Design facility to handle leachate/floor spills quickly & cleanly



Encroachment & Odors

- ▶ Air handling / odor destruction
 - ▶ Do not assume “best case scenarios” will always apply (ask “What if ‘x’ happens...?”)
 - ▶ Negative air pressure
 - ▶ Air is pulled into dumping facility/ transfer station, & treated before exiting
 - ▶ Can be costly, but effective



Encroachment & Odors

- ▶ Misting systems for odor neutralization
 - ▶ Inside buildings
 - ▶ Along property lines
 - ▶ Air “exit vents”



Development

- ▶ Seek community & regulator/agency support
- ▶ Educate proactively. Be responsive to local concerns
- ▶ Address public perception AND reality



Development

- ▶ AD Technology Selection
 - ▶ Steady performance year-round (non-seasonal)?
 - ▶ Output per cow/pig/chicken/ton VS?
 - ▶ Processes ALL the waste from a farm site? Solids are processed & do not require further composting?
 - ▶ Track record (= “Bankability”)

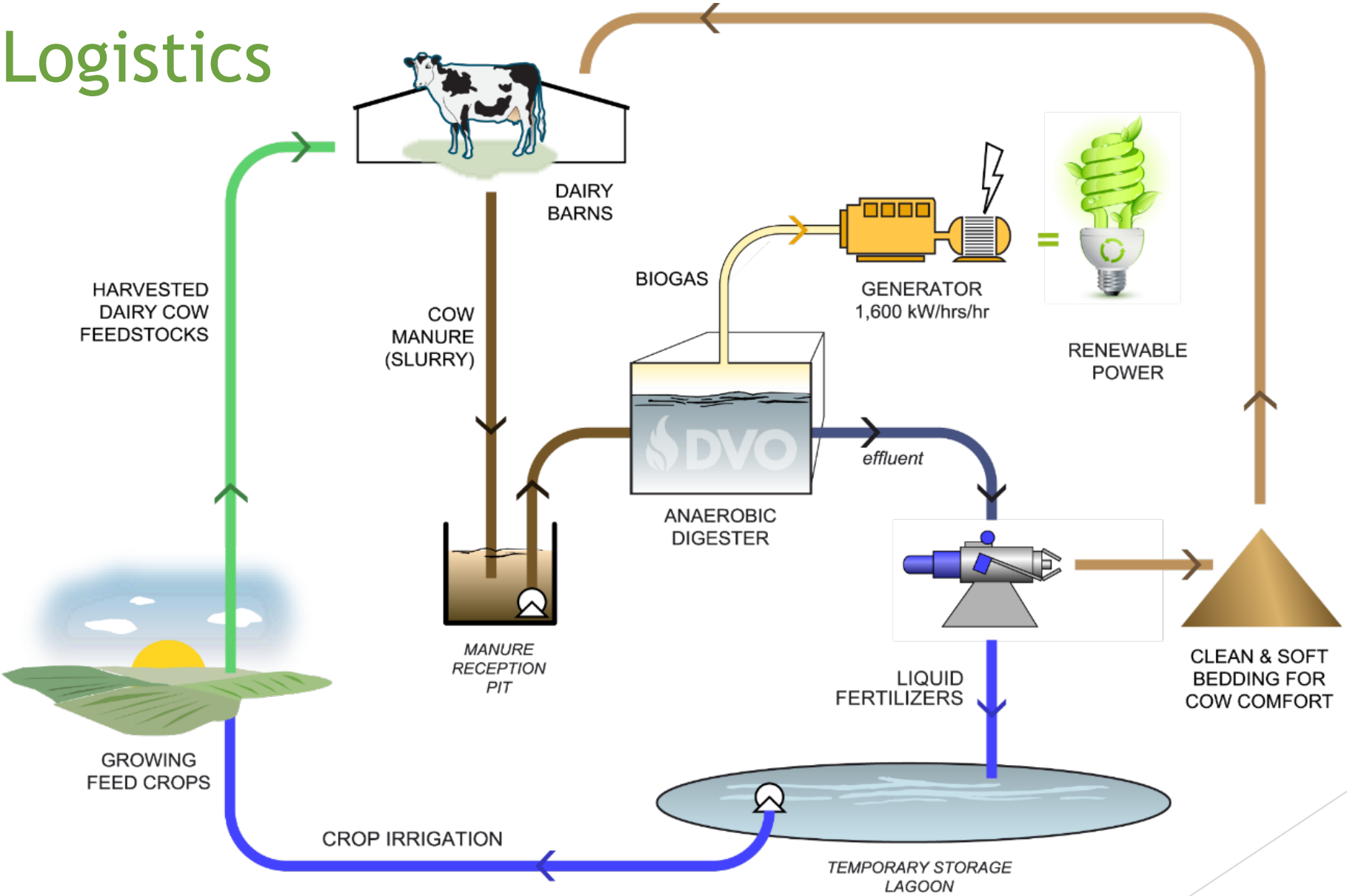


Development

- ▶ Biogas Upgrading
 - ▶ Pay close attention to uptime & performance track record over purity & capture % claims - and even (to a degree) CAPEX/OPEX
 - ▶ Place all upgrading...CO₂ and H₂S removal, moisture & particle removal, pressurization etc... under a **single “umbrella”** of responsibility



Logistics



Logistics

- ▶ Digestate Disposal
 - ▶ AD doesn't make wastewater "go away"
 - ▶ NPK often has real value to farmers
 - ▶ Is there sufficient land nearby to accept these nutrients - and interest?
 - ▶ How will digestate be stored? For how long? Cost of transport?
 - ▶ Can land application be guaranteed/contracted long-term?



Logistics

- ▶ Further treatment onsite needed?
 - ▶ Enhanced COD & BOD removal
 - ▶ Example: Placing “nutrients in separate piles” (AR and PR process)



Logistics

- ▶ Is a local WWTP an option?
- ▶ Max loading requirements?
- ▶ Can these be reliably met ALWAYS?
 - ▶ Ask all the “What if...”s
- ▶ Dedicated pipeline/access to the plant?
 - ▶ There WILL be residual gas generated



Development

- ▶ Have your financial ducks in a row **FIRST**, before approaching waste producers & others
 - ▶ Producers tire of “empty promises” made by some project developers
- ▶ Seek local support for a project *early*
- ▶ Work closely with regulating agencies/authorities *early*



Thank You!

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