

Adapting Agricultural Anaerobic Digestion to Human Behavior: Factors of Adoption in Pennsylvania and Beyond

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Introduction

Unmanaged methane emissions from the breakdown of organic material on farms is a significant part of the almost 10% of US emissions generated by agriculture⁴.

What is an Anaerobic Digester (AD)?

An airtight vessel that allows anaerobic bacteria to break down, or “digest” organic material, such as animal, food and crop waste, producing 1) a liquid digestate and 2) a biogas (~ 60% Methane, ~ 40% Carbon Dioxide, < 1% other gases)

How can Anaerobic Digestion (AD) help?

Agricultural AD uses these wastes to reduce carbon emissions by 1) capturing and burning methane into CO₂, with a global warming potential ~ 32 times lower than methane, and 2) upgrading the initial biogas to be burned as Renewable Natural Gas, thereby displacing traditional, GHG-intense fossil fuel use.

Process

To understand the best support system and pathway to AD adoption:

- Review the literature, case studies, and policy surrounding AD, first globally, then in the US, and finally in Pennsylvania (PA).
- Use Stata to analyze data from the Livestock Anaerobic Digester Database and categorize reasons for closure (do-file and complete reference list can be found in the QR code poster website).
- Identify gaps in the literature on farmer investment behavior; begin planning choice study and discussing key factors of AD with farmers, consultants, and industry experts in New England.

Results: Current adoption of Agricultural AD in PA



Freund's Farm Anaerobic Digester
 East Canaan, CT

- 31 digesters; first in 1985
- Biogas Use: Electricity or Combined Heat and Power
- Alternative Energy Portfolio Standards Act: goal 30% renewable energy by 2030¹
- Payback length varies by grant amount, unstable electricity prices, design quality inconsistency

References

- 1) Amendment to Alternative Energy Portfolio Standards Act of 2004, P.A. Gen. Assemb. Bill 600, Reg. Sess. 2019-2020 (2019).
- 2) Bangalore, M., Hochman, G., & Zilberman, D. (2016). Policy incentives and adoption of agricultural anaerobic digestion: A survey of Europe and the United States. *Renewable Energy*, 97, 559-571.
- 3) Edwards, J., Othman, M., & Burn, S. (2015). A review of policy drivers and barriers for the use of anaerobic digestion in Europe, the United States and Australia. *Renewable and Sustainable Energy Reviews*, 52, 815-828.
- 4) United States Environmental Protection Agency. (2019). "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990–2017".

Results: Policy Dictates Adoption

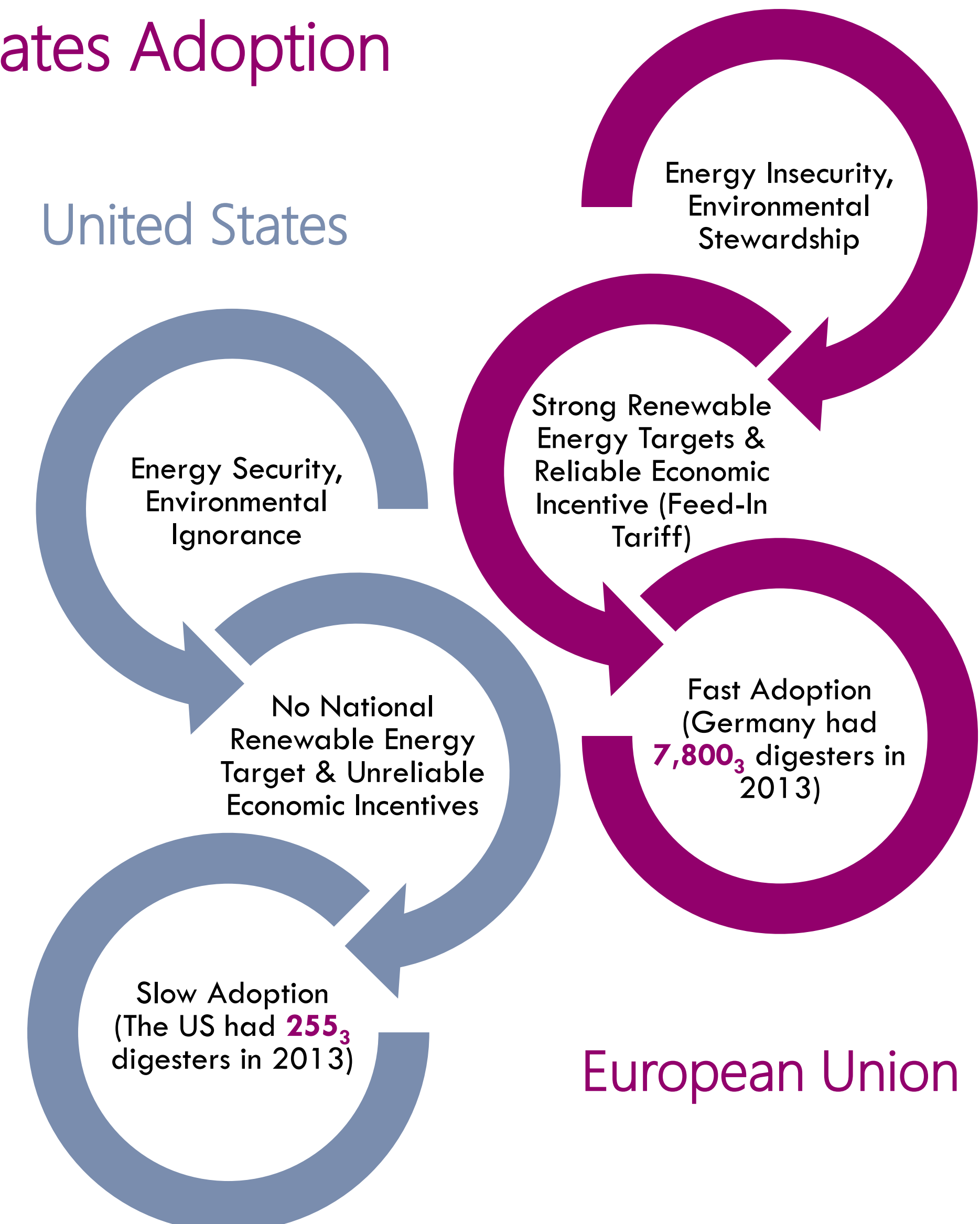


Figure 1.2

Results: Understanding Behavior = Better Policy

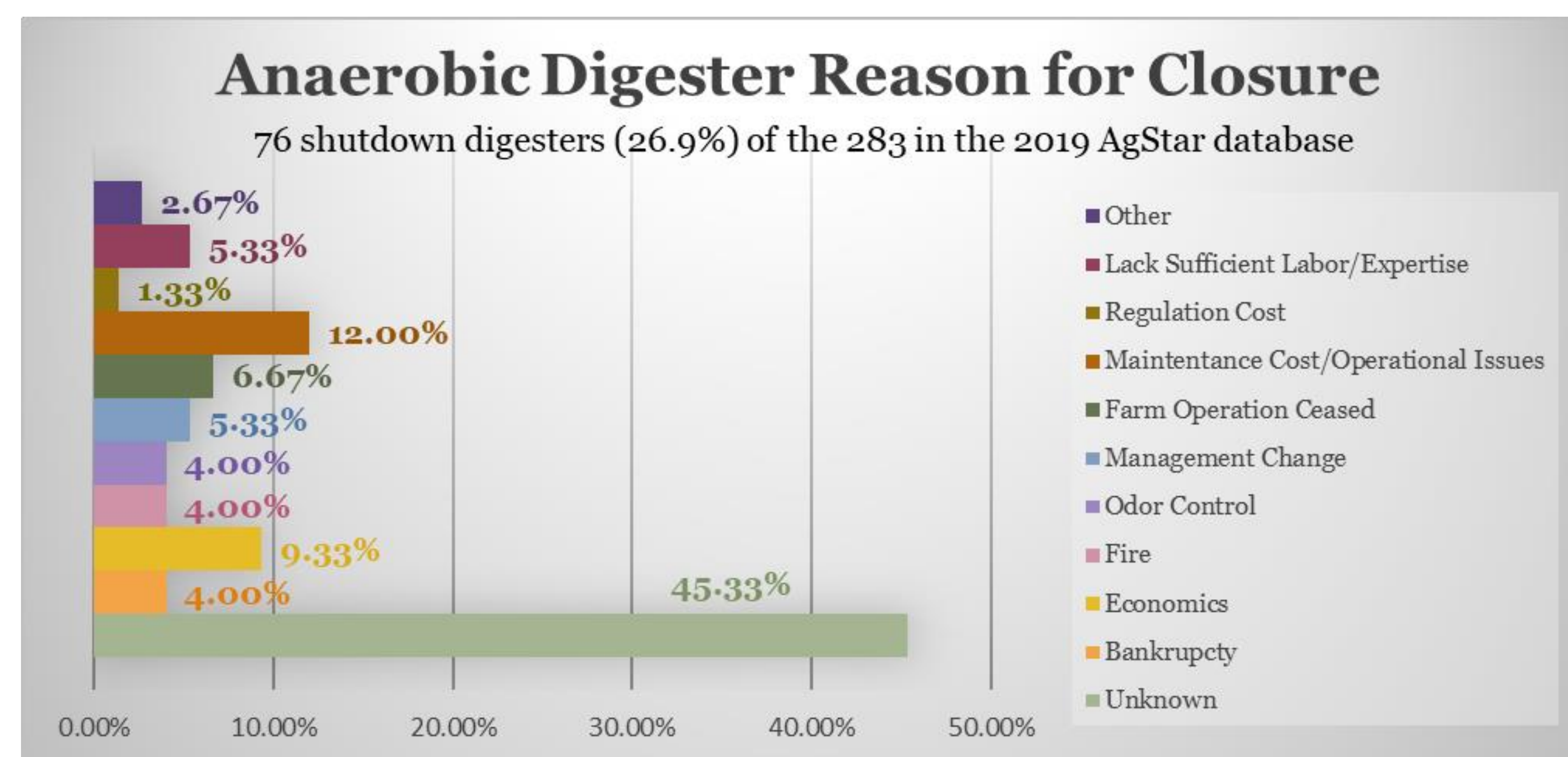


Figure 2. Shutdown Digesters in US, AgStar Livestock Anaerobic Digester Database

Key Factors for Choice Study: AD Policy Recommendations:

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|--------------------------------|--|
| 1. Environmental Stewardship | 1. AD Developer Review Forum |
| 2. Grant Amount | 2. Standardized State Ombudsman Programs |
| 3. Project & Permit Consultant | 3. Streamlined Permitting Processes |
| 4. Return on Investment | 4. Reliable Economic Credit Similar to Germany's Feed-In Tariff |
| 5. Risk Tolerance | 5. State Mediation Programs for Utility Interconnection and Net Metering |
| 6. Odor Control | |



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