



Sustainable Transportation Energy Pathways (STEPS)

Potential for Renewable Natural Gas in Transportation

STEPS Spring 2015 Symposium

Davis, CA

May 12-13, 2015

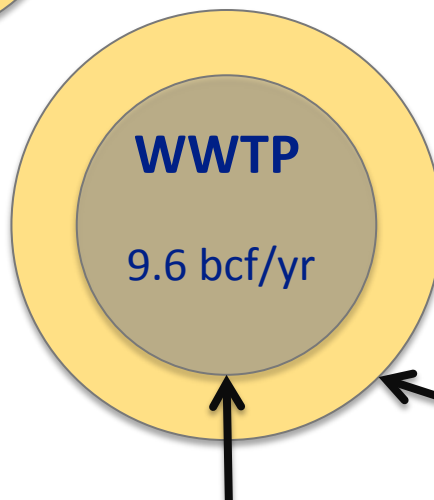
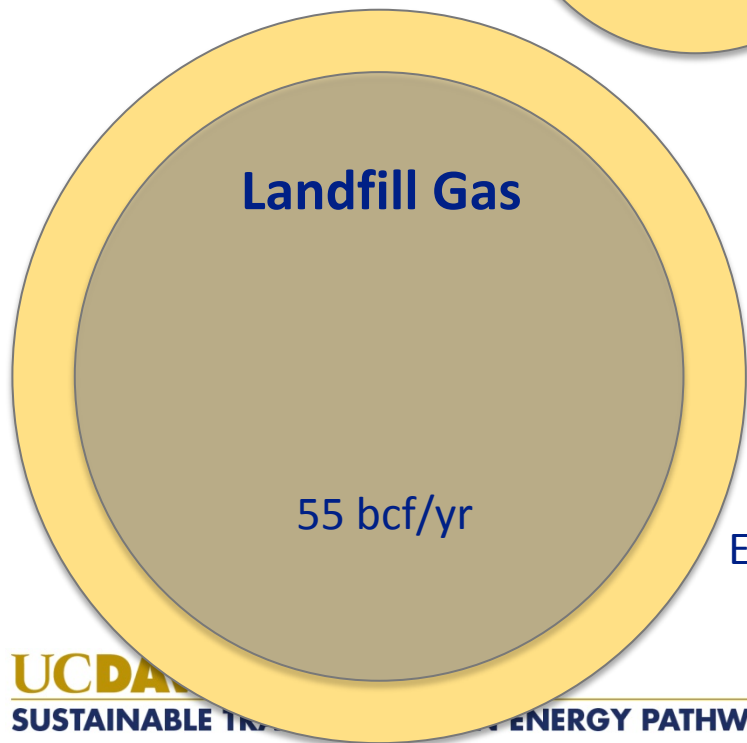
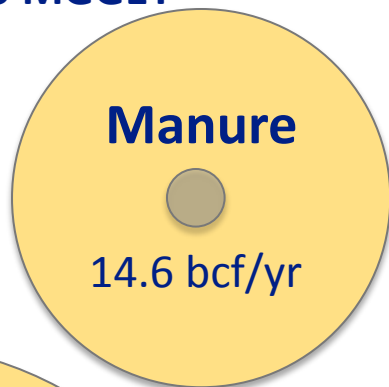
Nathan Parker
Rob Williams
Rosa Dominguez-Faus
Daniel Scheitrum
Marshall Miller

WHAT IS RENEWABLE NATURAL GAS?

Renewable natural gas potential in CA

CA RNG Production Potential

Total: ~725 MGGEY



Existing capacity (all end uses)

Consumption of NG



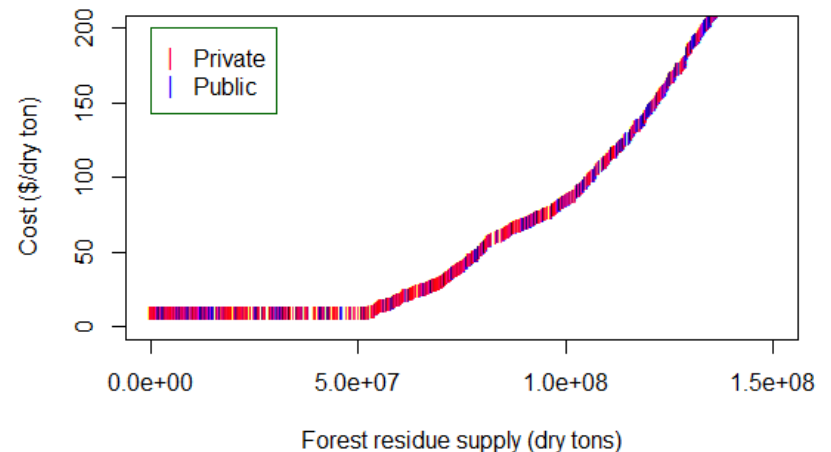
2022 projection

Technical Potential

Feedstock Cost

- Many of the feedstocks of interests are “waste” or residues.
- Expected market prices are difficult to predict.
- We consider the engineering cost of accessing the resource.

Forest Residue Supply Curve by Ownership

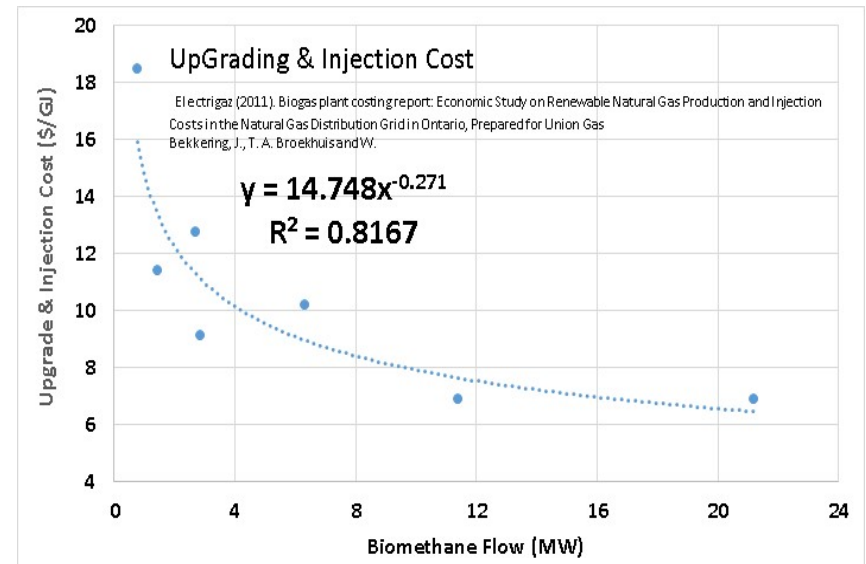


The supply of woody biomass from forest management operations in California as estimated for a BAU scenario by the BioSUM model.

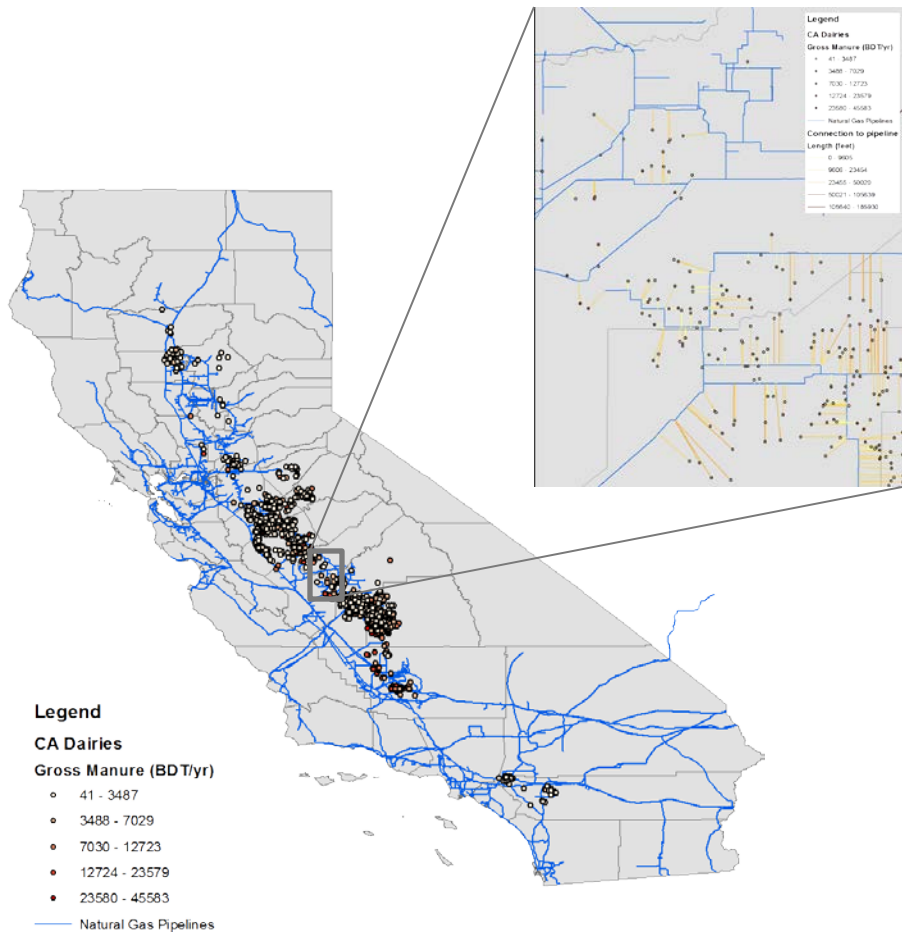
Larger is more economic

- Economies of scale in the production of biogas
- Economies of scale in the upgrading.
- Large economies of scale in interconnect.

Estimated biogas upgrading cost

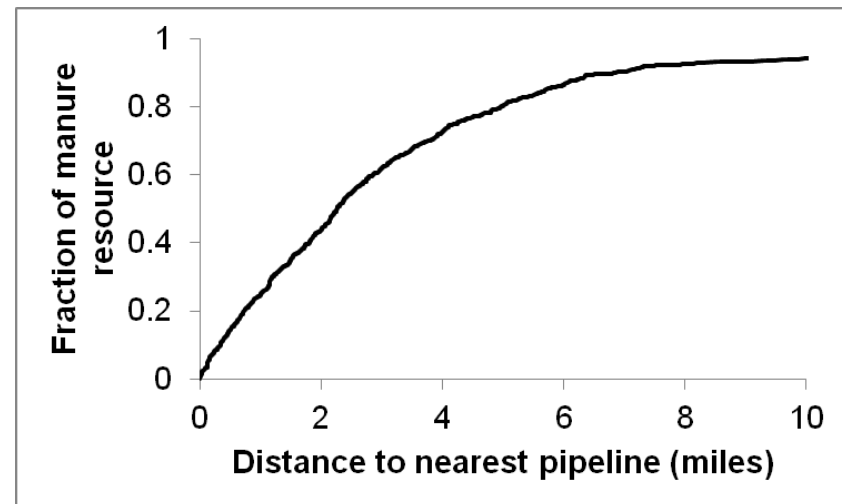


RNG access to pipelines



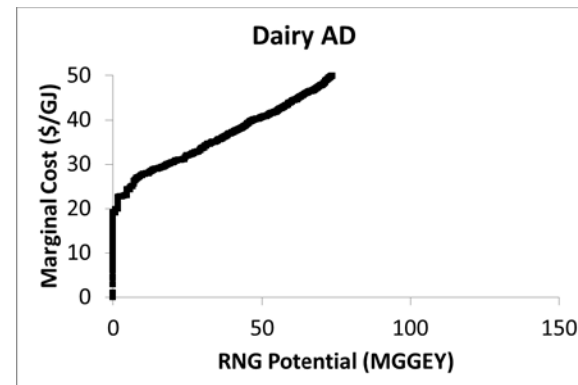
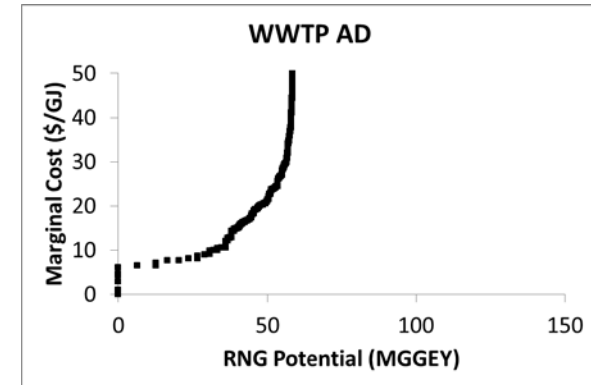
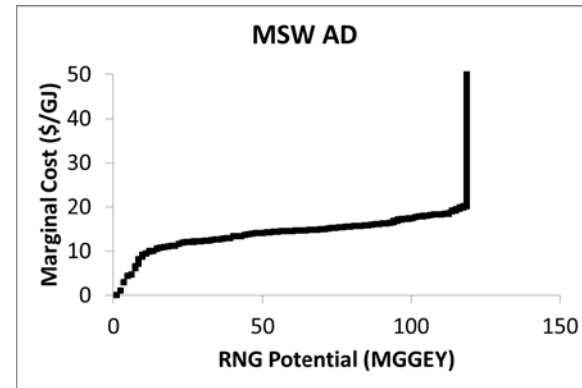
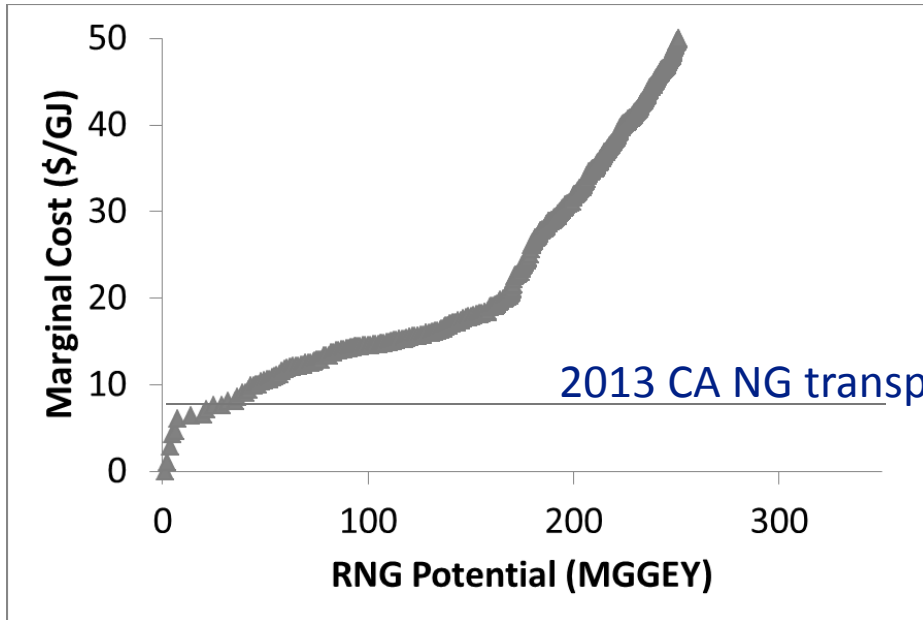
Connecting RNG sources to natural gas transmission pipelines will depend on the location of the source with respect to the pipelines.

Here is an example for the dairies in California.

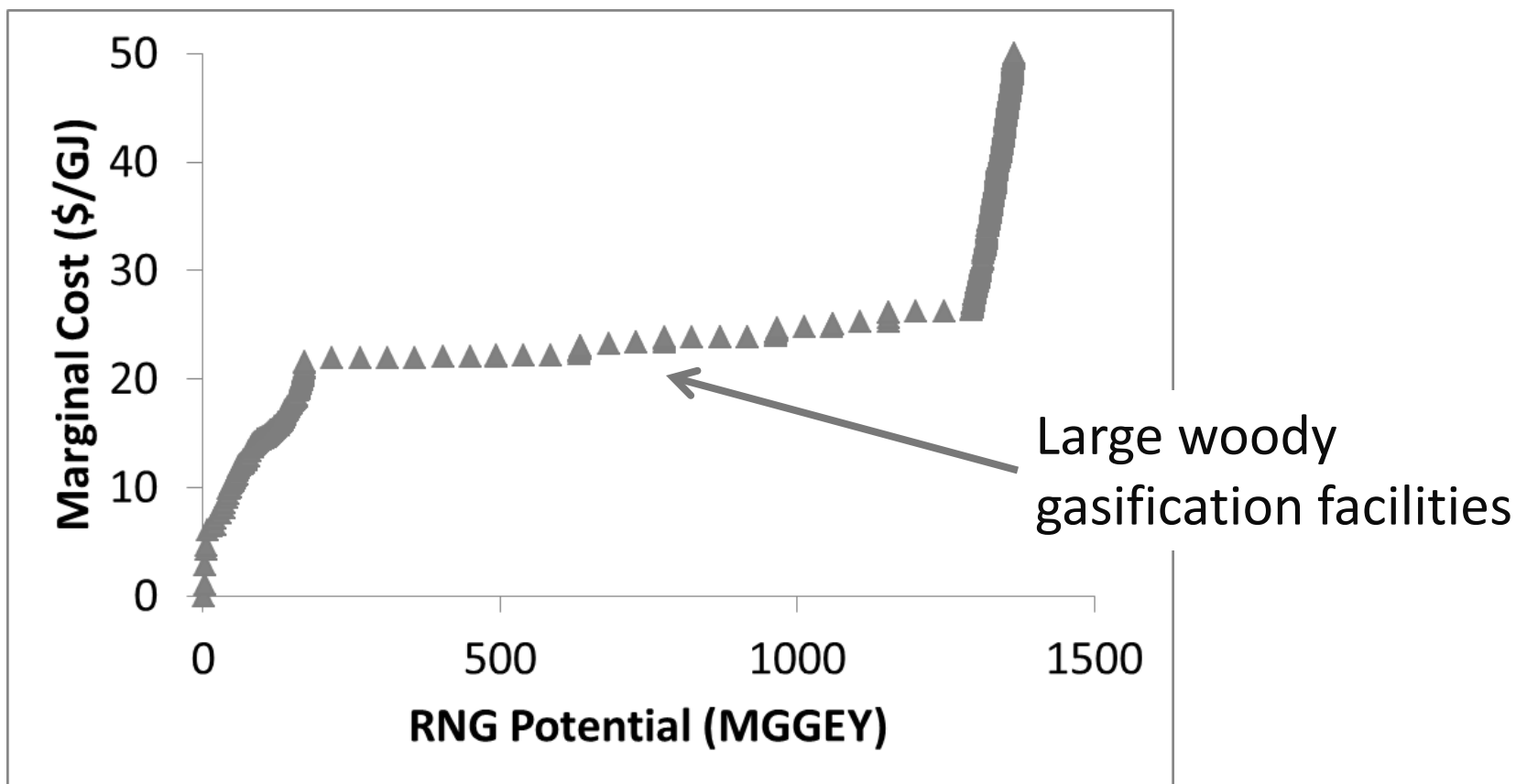


Preliminary RNG Supply Curve for California

Total RNG Supply

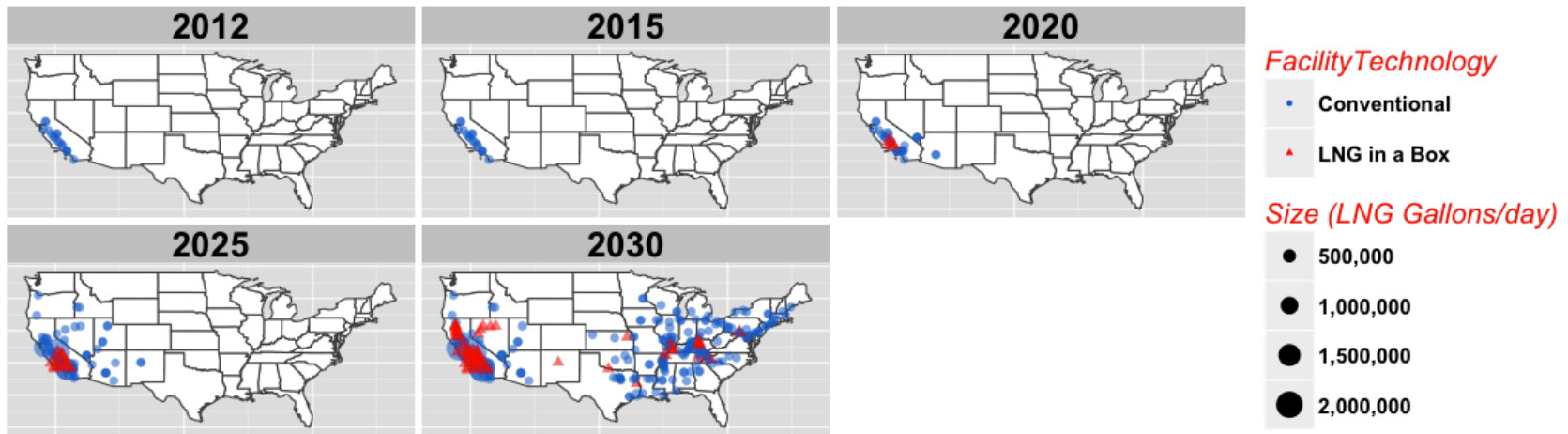


Potential supplies triple if including woody waste materials



Including RNG supplies in NG truck model will allow exploration of policies impacting the price of RNG to influence adoption and carbon intensity of NG in the trucking industry.

Dynamic Station Buildout Scenarios (0.002)



Ongoing and Future Work

- Refining economics
 - Including landfill gas supply curve
 - Validation of cost functions and testing the sensitivity of the results to model parameters
- Including RNG supply in truck model as a separate source of natural gas supply
- Expanding to a national scope

Conclusion

- RNG potential in California outstrips current natural gas consumption for transport in the state.
- Preliminary estimates of RNG production costs are 1.2 to 4 times higher than current natural gas prices.
 - Landfill gas is not included and is likely better performing than supplies assessed thus far.