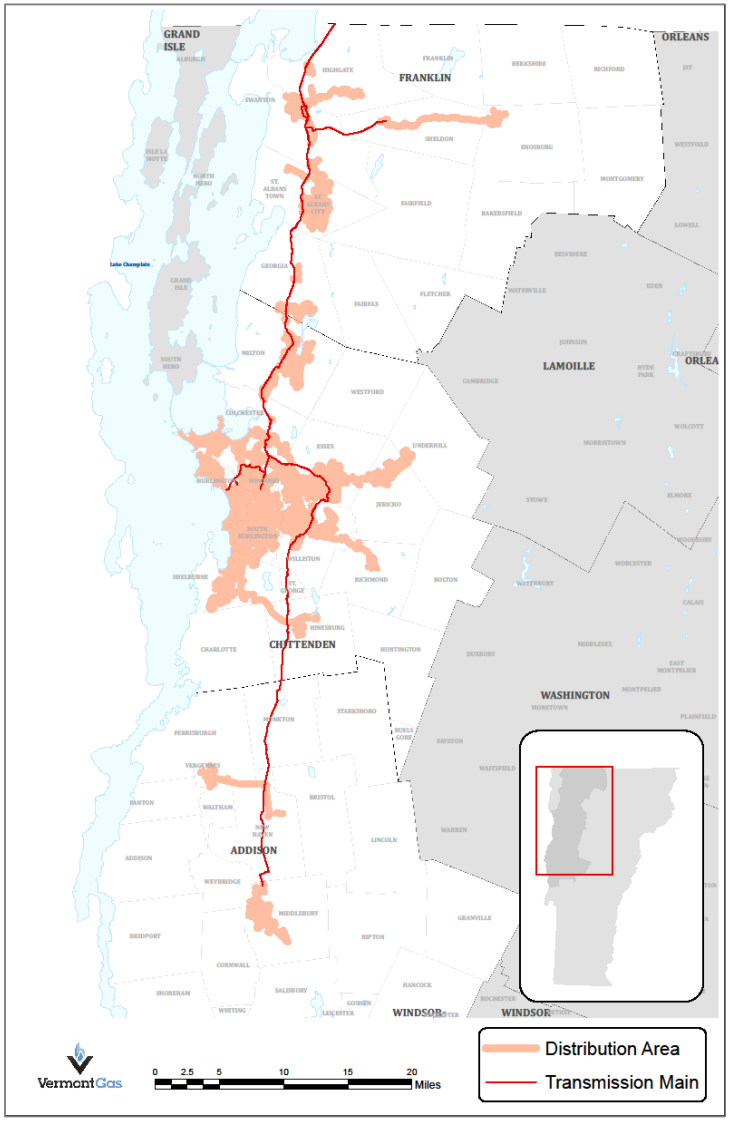
Decarbonizing our Future

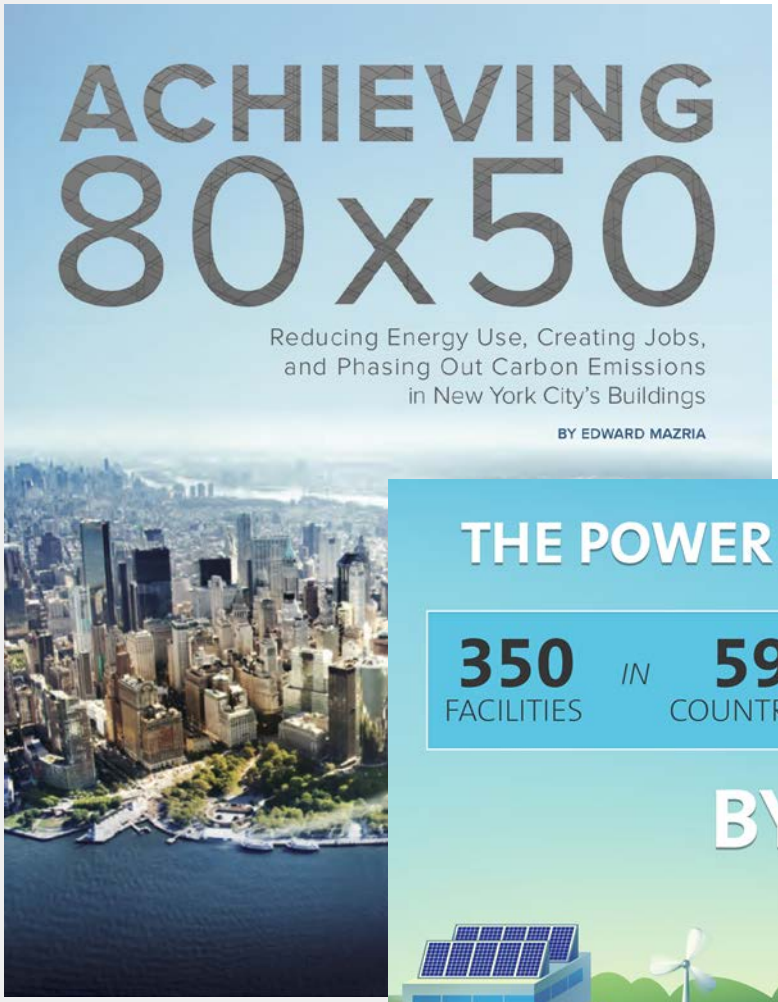
Thomas Murray-Vice President

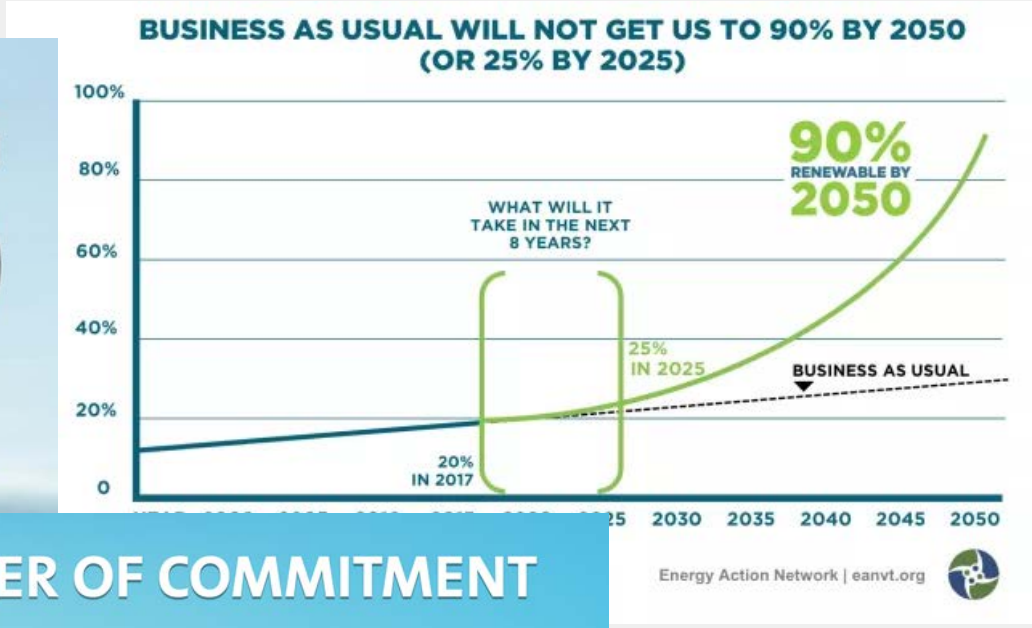
Vermont Gas 101

- **Serving 53,000 Customers in Northwestern Vermont**
- **Modern Pipeline System**
- **Efficiency and Behind the Meter Sevices**
- **95% Customer Satisfaction**
- **2017 Completed 40+ Transmission Expansion**



Drivers for Decarbonization





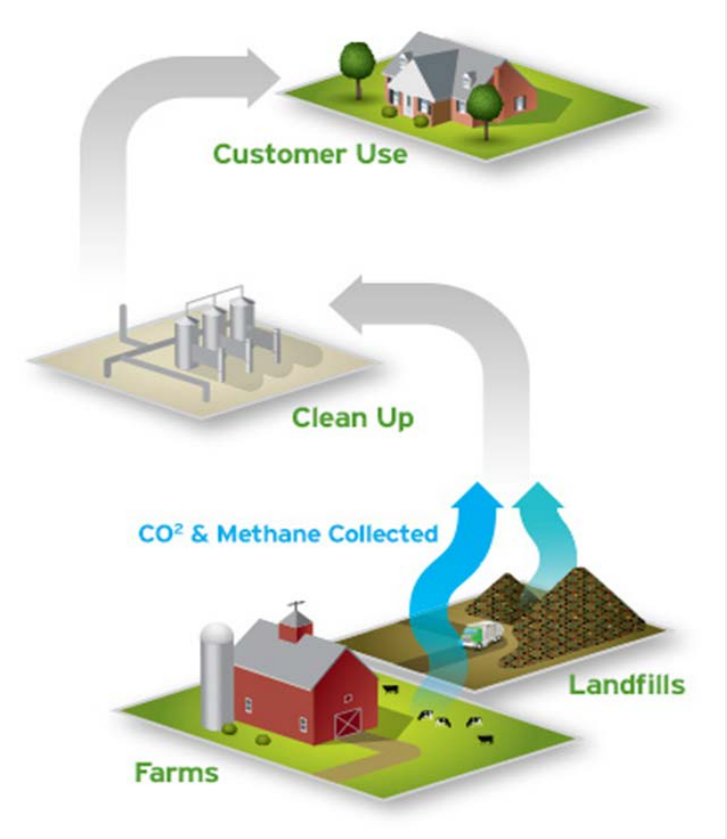
VGS Renewable Gas Program

- Program Launch in April of 2018
- First Retail RNG program in the US

What exactly is VGS' RNG Product?

RNG also known as biomethane or biogas, is produced by the anaerobic digestion of organics at farm digesters, waste treatment plants and landfills.

"VGS Renewable Natural Gas" is an innovative offering that will allow customers to purchase the **renewable attributes** of biogas production.

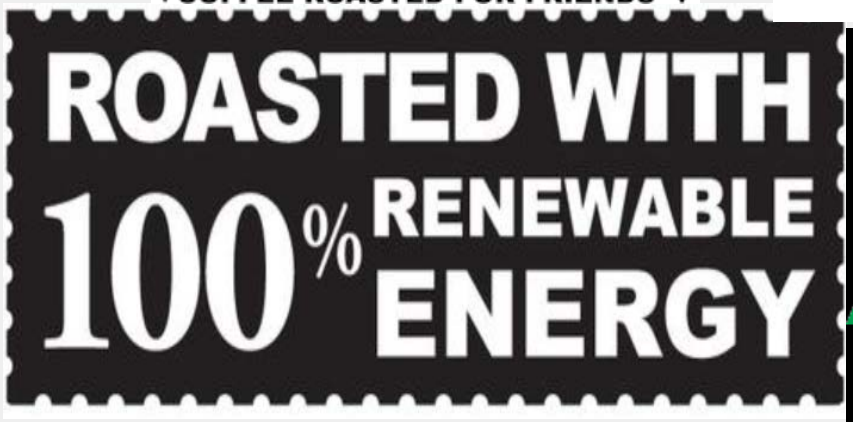


VGS Renewable Gas Program

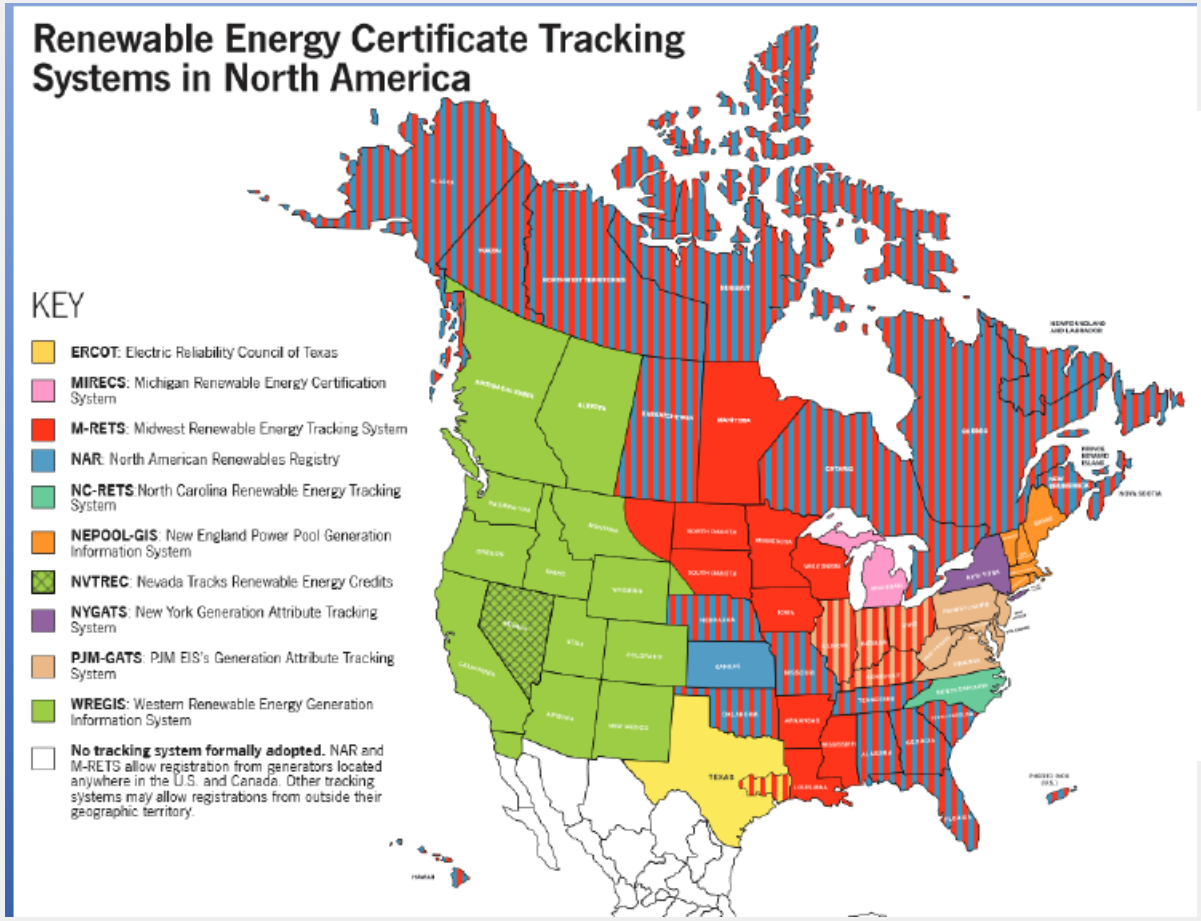
Strategic Approaches

Stakeholders

Customer Focused on Sustainability Goals



RNG Certification and Marketplace

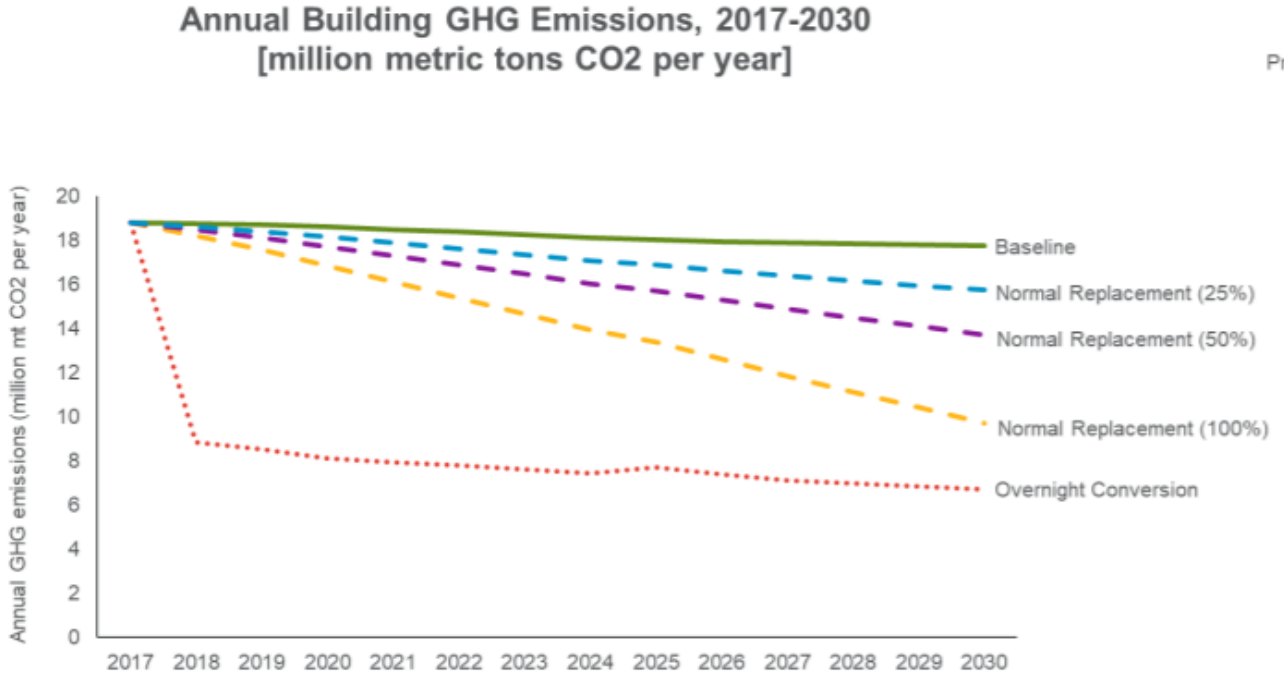


Green-e®

Source: CRS RNG Standards Workplan

RNG Portfolio Standards-SoCalGas Example

Figure ES-1. Annual GHG Emissions Reductions and Required RG Percentage Under Different Electrification Scenarios



Renewable Gas Scenario

Proportion of RG required to achieve the same GHG emissions reductions by 2030

	As a % of buildings gas use	As a % of total gas throughput[1]
Baseline	0%	0%
Normal Replacement (25%)	12%	4%
Normal Replacement (50%)	23%	8%
Normal Replacement (100%)	46%	16%
Overnight Conversion	63%	22%

1. Calculated from % of buildings gas use, assuming that building consumption represents 34% of SoCalGas's total gas throughput in 2030

Source: Navigant analysis

As shown in Table ES-2, if there was a lower conversion rate, a lower volume of RG would be required to maintain GHG emissions equivalency. Normal Replacement 50% would require 23% RG as a percentage of buildings gas use (8% of total system throughput). Normal Replacement 25% would require 12% RG as a percentage of buildings gas use (4% of total system throughput).

Steps to Decarbonization

'Zero Carbon Gas' pathway

The term 'Zero Carbon Gas'

Referring to certain fuels as 'green' appears to cause a significant amount of confusion. For the purposes of this study, we use the term 'zero carbon gas' to refer to all gaseous fuels that can have a zero carbon footprint across their production chain. This includes:

Biogas/Biomethane: Carbon emissions resulting from burning the gas are offset because of the sustainable source of the gas.

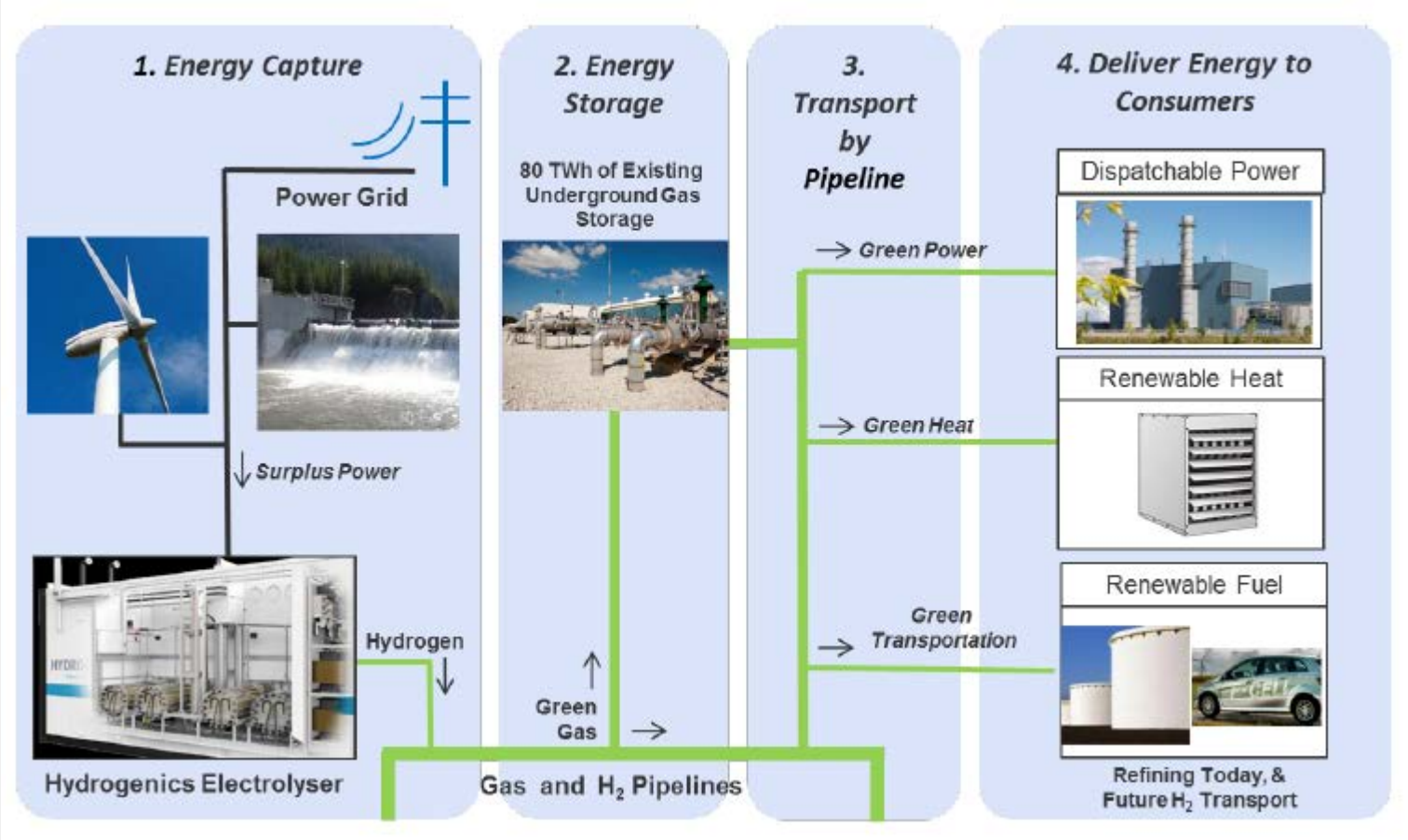
Hydrogen from methane reforming: Carbon content has been removed from methane and then captured and stored.

Hydrogen from electrolysis: No carbon emissions arise in the process.

Carbon capture and storage (CCS): Although it does not fully remove CO_2 from the process, 'negative emissions' can be created if sustainable bioenergy carriers are used in CCS. These 'negative emissions' arise since carbon has already been captured in growing the precursor for the bioenergy carrier.

SOURCE: FULLY DECARBONIZING EUROPE's ENRGY SYSTEM BY 2050
PÖYRY POINT OF VIEW - MAY 2018

Hydrogen Opportunity



Responsible NG Production

Natural Gas Supply Collaborative

Collectively, purchases of natural gas by participants for delivery or electric generation are equivalent to over 13% of U.S. marketed natural gas.

Austin Energy
conEdison, inc.
energir
nationalgrid
HERE WITH YOU. HERE FOR YOU.
CALPINE
cps ENERGY
LA DWP Los Angeles Department of Water & Power
nrg
NW Natural
PG&E Pacific Gas and Electric Company
Xcel Energy
VermontGas

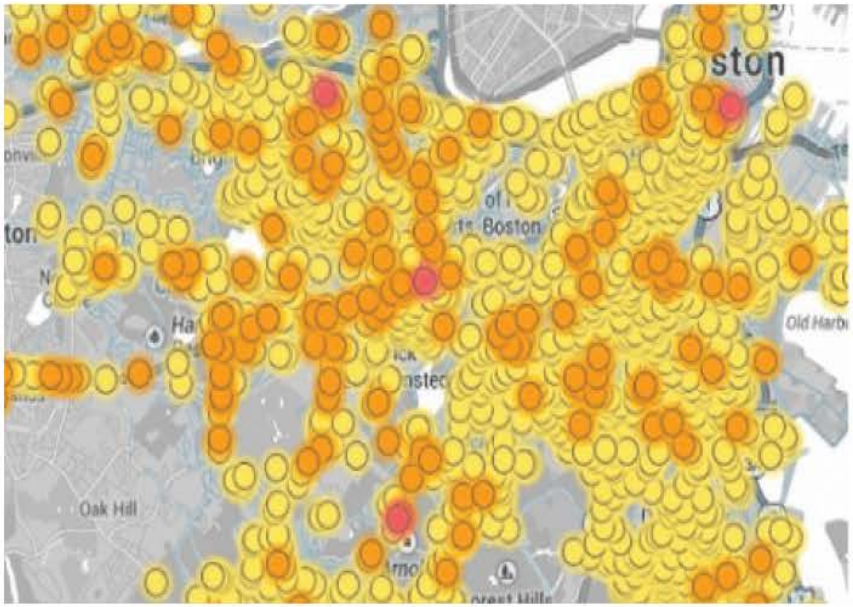
Overview
NGSC is a voluntary collaborative of natural gas purchasers promoting safe and responsible practices for natural gas supply.

Environmental and Social Performance Indicators
NGSC identified 14 key environmental and social (non-financial) performance indicators for natural gas production that reflect the perspectives of natural gas purchasers, are guided by the interests of customers and stakeholders, and highlight leading producer practices.

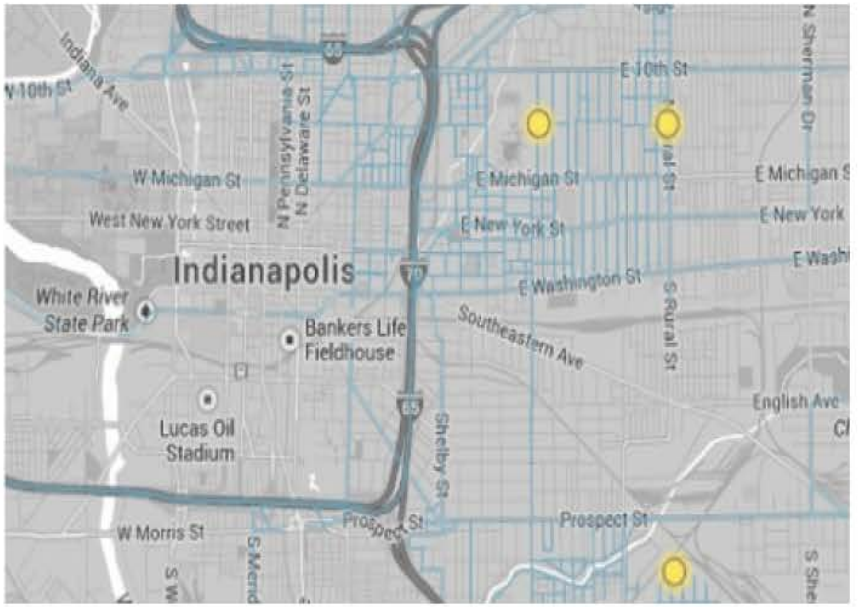
Methane Emmission-Downstream

VGS has a newer system with no cast iron or bare steel and no leak policy

BOSTON:
Older pipes, more leaks



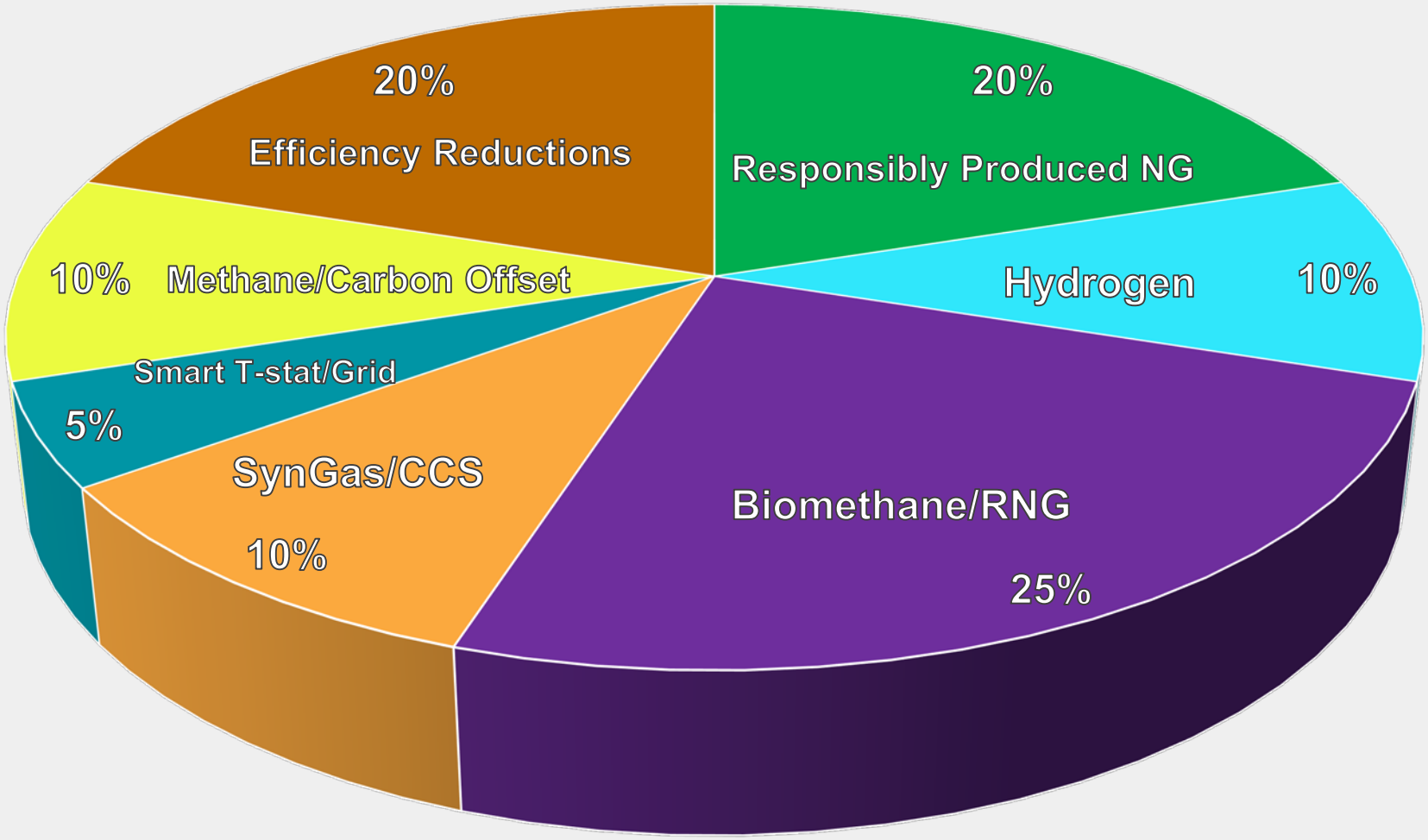
INDIANAPOLIS:
Newer pipes, fewer leaks



Source: EDF

VGS Scenario-90% Decarbonized by 2050

What could VGS' System look like in 2050?



Questions

Social Media Post