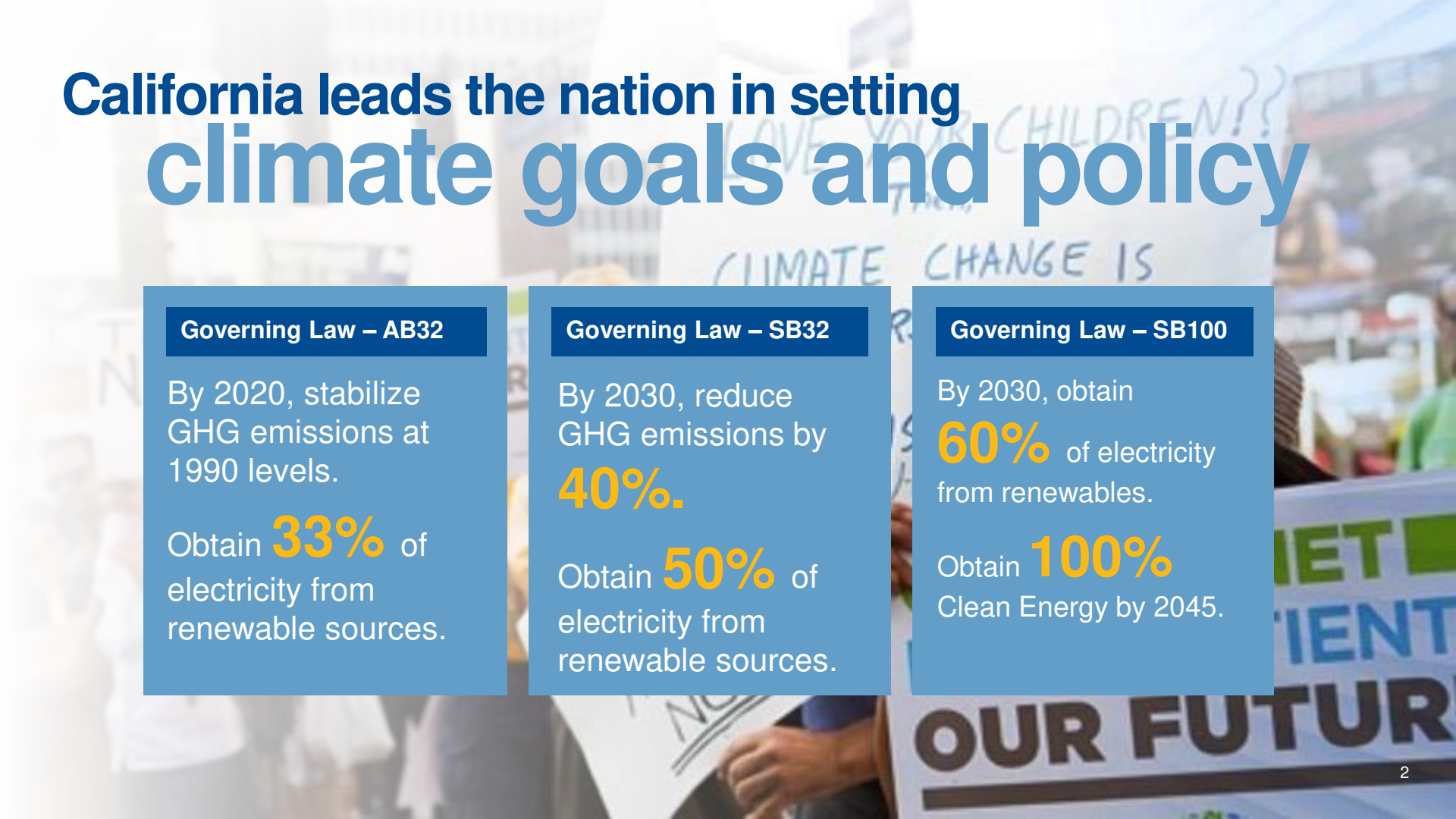
Renewable Energy Solutions

California leads the nation in setting climate goals and policy



Governing Law – AB32

By 2020, stabilize GHG emissions at 1990 levels.

Obtain **33%** of electricity from renewable sources.

Governing Law – SB32

By 2030, reduce GHG emissions by **40%.**

Obtain **50%** of electricity from renewable sources.

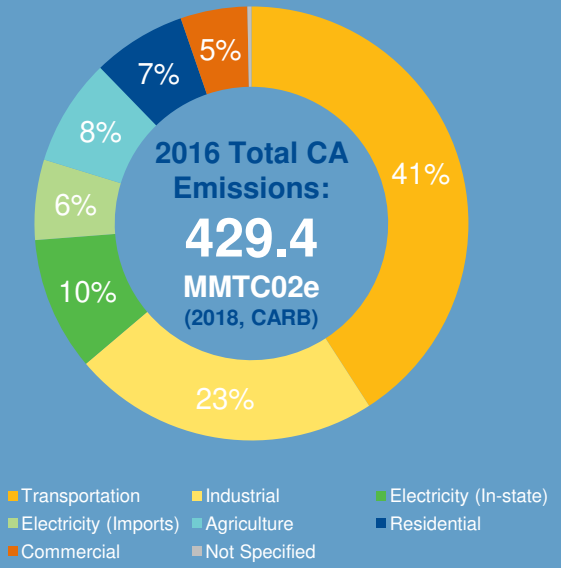
Governing Law – SB100

By 2030, obtain **60%** of electricity from renewables.

Obtain **100%** Clean Energy by 2045.

CA Climate Change Policy

Role for "Net-Zero" end uses and low carbon gas



For some in California, the strategy is to "de-carbonize" electricity and then "electrify everything":

- De-carbonize generation
- Electrify transportation
- Electrify energy end uses

Gas industry focus is on "de-carbonizing" the pipeline, and "electric equivalent" end uses:

- De-carbonize gas supply
- Deploy electric equivalent NGV's
- Deploy net zero gas technologies

It's not either/or,

It's both

Electricity... And Gas

De-carbonizing Transportation

New “net-zero” truck engine ready for primetime

- Heavy Duty truck engine with 90% lower NOx emissions TODAY
- Tailpipe emissions are the same as emissions from generating electricity to run a similar electric truck
- For Goods Movement, this truck will meet California’s ambitious targets long before other technology
- RNG already delivering greatest GHG reductions from diesel **today**!
- Construction, rail and marine **tomorrow**!

De-carbonizing end uses:

Natural Gas Stationary Use Pathways

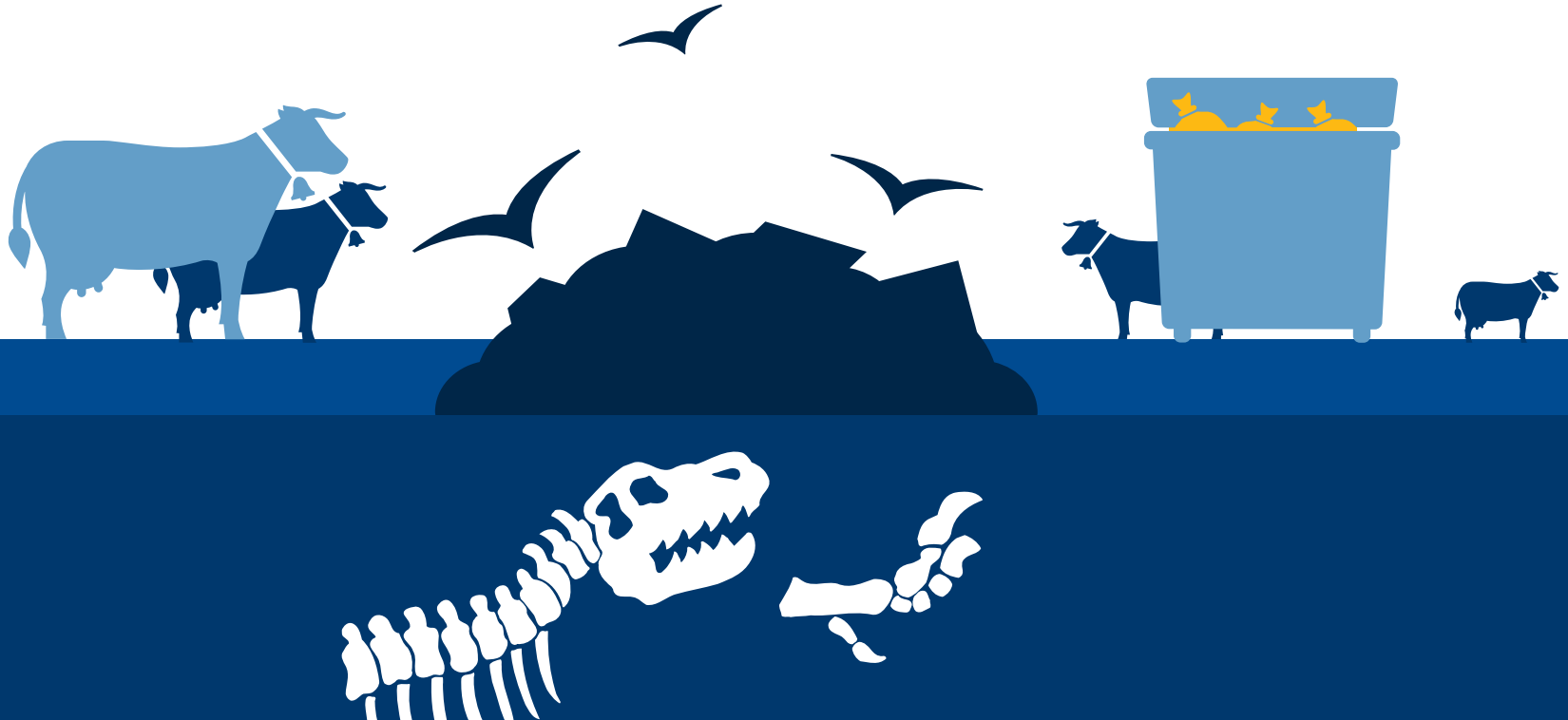
The move toward "net-zero" emission technology focuses also on:

- Distributed Generation
- Small-scale, Fast-ramping Generation Matched with Renewables
- Power Generation with Carbon Capture

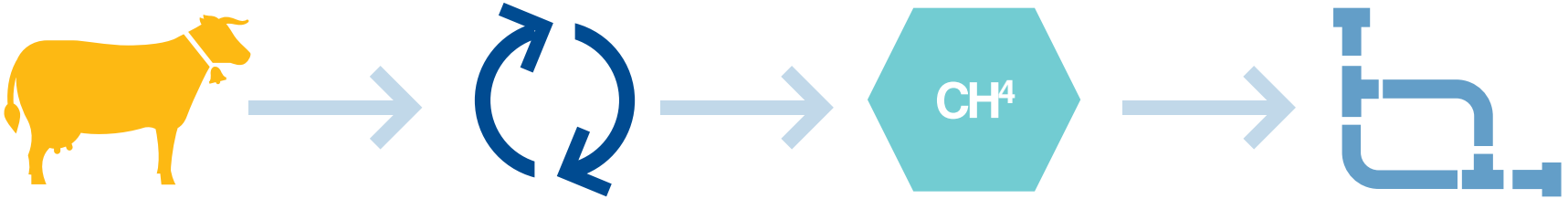
Not just solar and wind:

- Fuel Cells
- Micro-turbines
- Combined Heat & Power

Like electricity, natural gas can come from renewable sources



The basics of Renewable Natural Gas



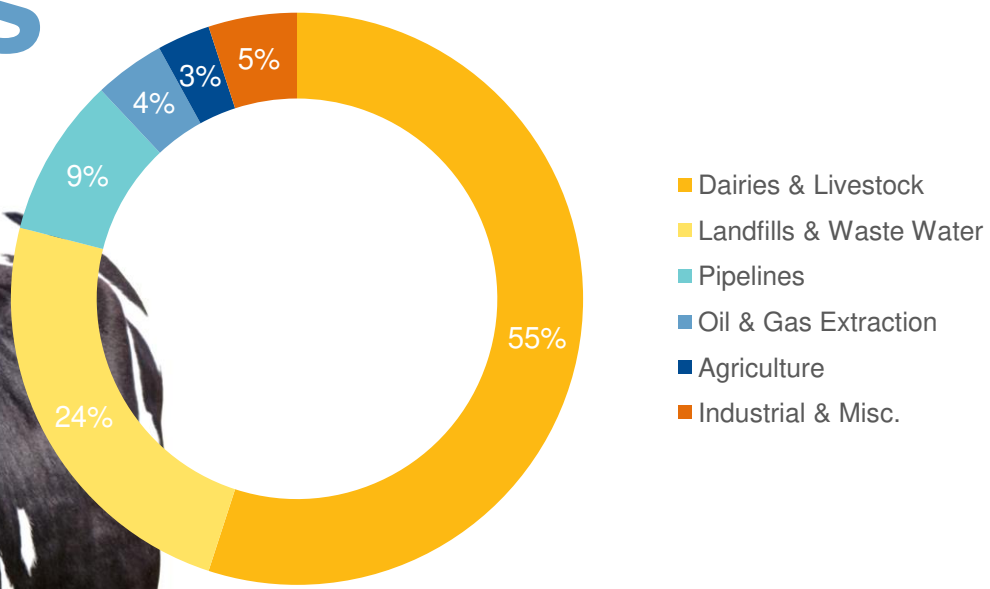
Capture waste from dairies, farms and landfills

Convert into biogas using anaerobic digestion

Process the biogas to make it pipeline-ready (biomethane)

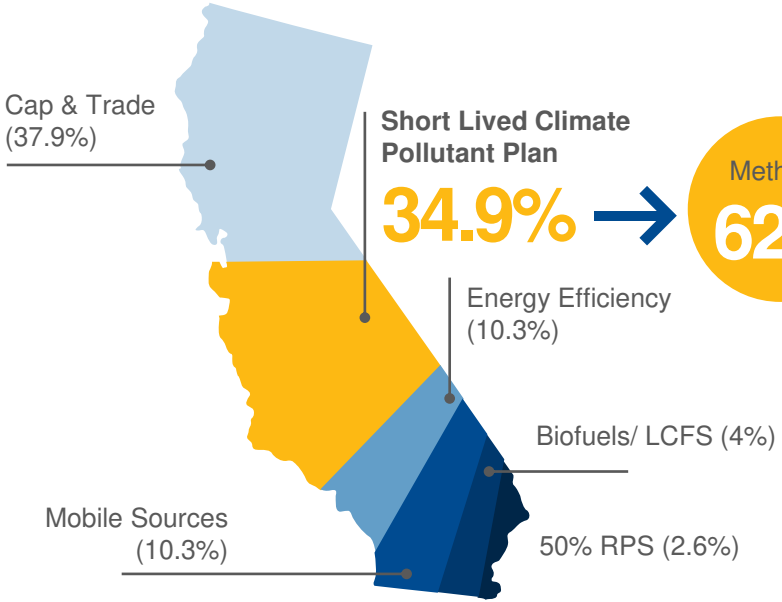
Inject the biomethane into the pipeline for future use

And RNG gives us a clear path to address CA's biggest methane emitters



Source: CARB 2015 Greenhouse Gases Emissions Inventory, 2013 Methane Emissions

CARB's Scoping Plan relies on reducing SLCPs



Methane
62%

Governing Law – SB1383

By 2030, reduce methane emissions

40%

below 1990 levels

Stated Objective:

"Reduce the use of heating fuels while concurrently making what is used cleaner by minimizing fugitive methane leaks, prioritizing natural gas efficiency and demand reduction, and enabling cost-effective access to renewable gas."

Source: Percentages reflect reductions proposed in California Air Resources Board, AB 32 Updated Scoping Plan (2017).

The RNG supply is available (2030):
in-state estimates

94 BCF

UC Davis/ARB Study:
based on current federal and LCFS incentives

100-200 BCF

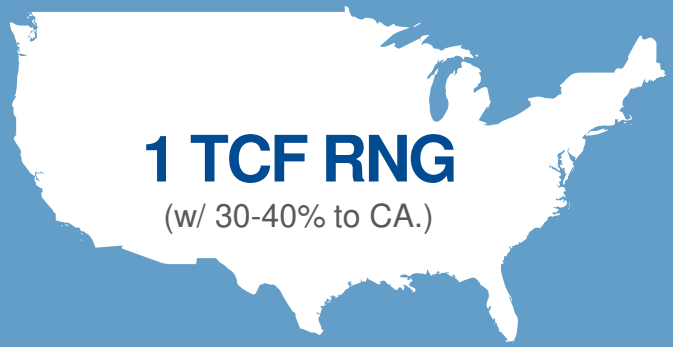
ICF Assessment:
CA with current regulation / incentives; 100 BCF conservative estimate

300 BCF

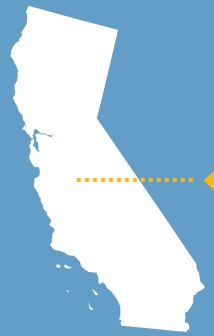
UC Davis/CEC Study

Sources: The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute, Prepared for the California Air Resources Board and the California Environmental Protection Agency by Amy Jaffe, Principal Investigator. STEPS Program, Institute of Transportation Studies, UC Davis

The RNG supply is available (2030):
out-of -state resources

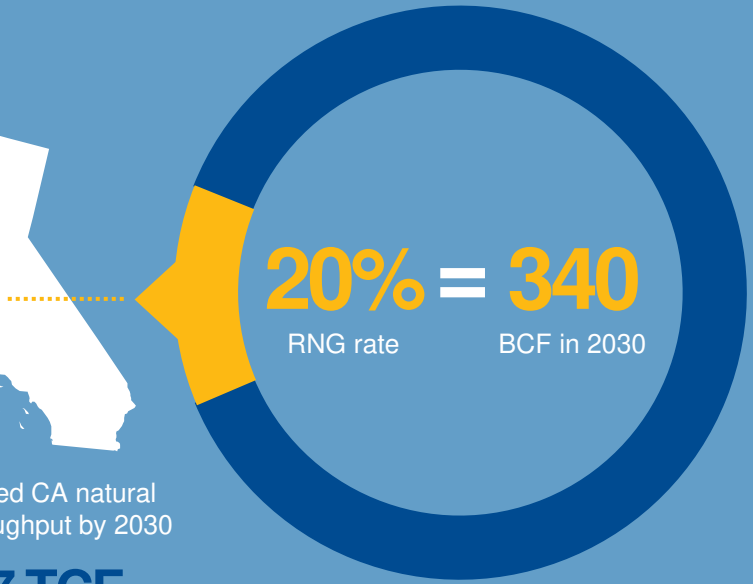


Available in the US today
(and growing to ~ 13 TCF in 2030)



Projected CA natural
gas throughput by 2030

1.7 TCF

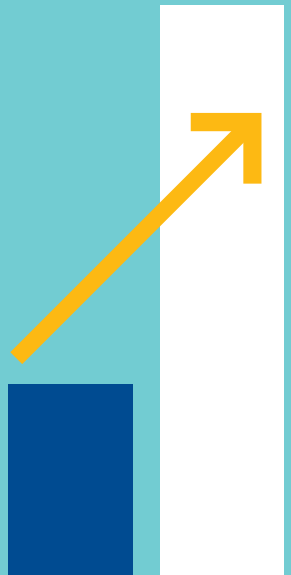


Sources: U.S. Department of Energy. 2016. 2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy, Volume 1: Economic Availability of Feedstocks. M. H. Langholtz, B. J. Stokes, and L. M. Eaton (Leads), ORNL/TM-2016/160. Oak Ridge National Laboratory, Oak Ridge, TN. 448p. doi: 10.2172/1271651.

Decarbonizing energy is easier than switching appliances and equipment

=

100%
Building Electrification



RNG is
2-3x
More cost effective

Sources: Navigant Consulting, “Gas Strategies for a Low-Carbon California Future,” 2018.
California Building Industry Association (CBIA) and Navigant Consulting, “The Cost of Residential Appliance Electrification,” 2018.

We need to decarbonize gas system (2050)

not just electrify end-uses

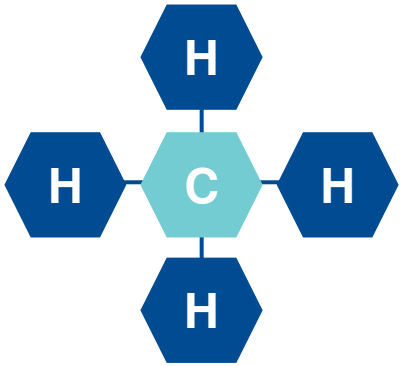
↗ Develop the market for renewable natural gas

↗ Decarbonize the pipeline with renewable natural gas supplies

↗ Harness Power-to-Gas technology to integrate electric and natural gas grids for long-term decarbonized energy supply and storage

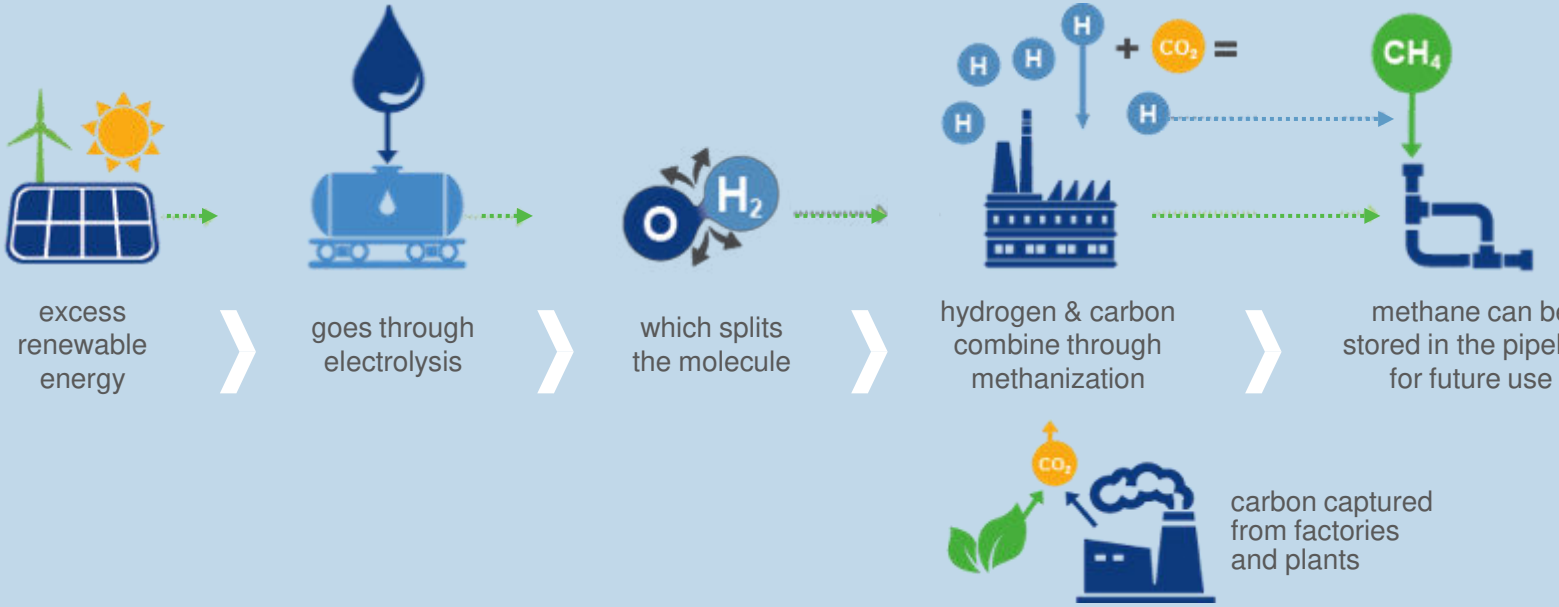
Natural Gas

CH_4 (Methane)



Power-to-gas

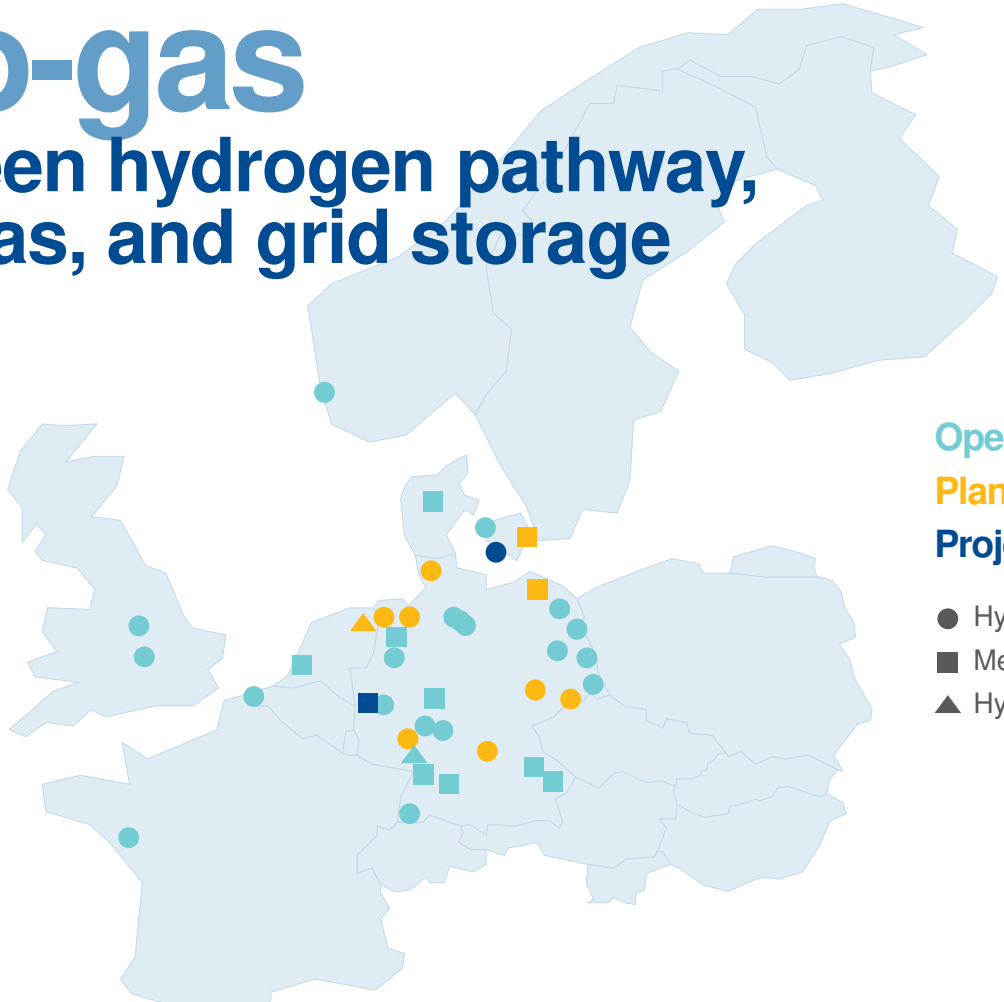
converts excess renewable electricity into renewable gas



Power-to-gas

provides green hydrogen pathway, renewable gas, and grid storage

- 70 Projects Now Launched In Europe
- 40 Projects Launched in Germany, with more in development
- 30 MW of installed capacity



Operational

Planned

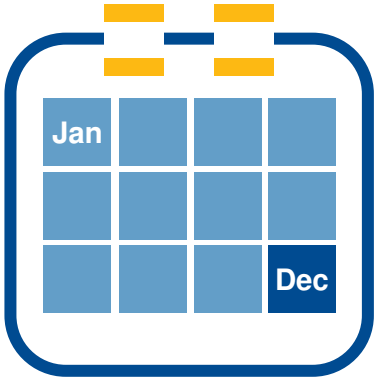
Project Finished

- Hydrogen
- Methane
- Hydrogen/Methane

P2G provides grid scale and seasonal storage

Batteries

P2G H_2



P2G CH_4


Thank
You