TRANSITIONING TO RESILIENT LOW CARBON LOCAL ENERGY SOURCES

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Outline

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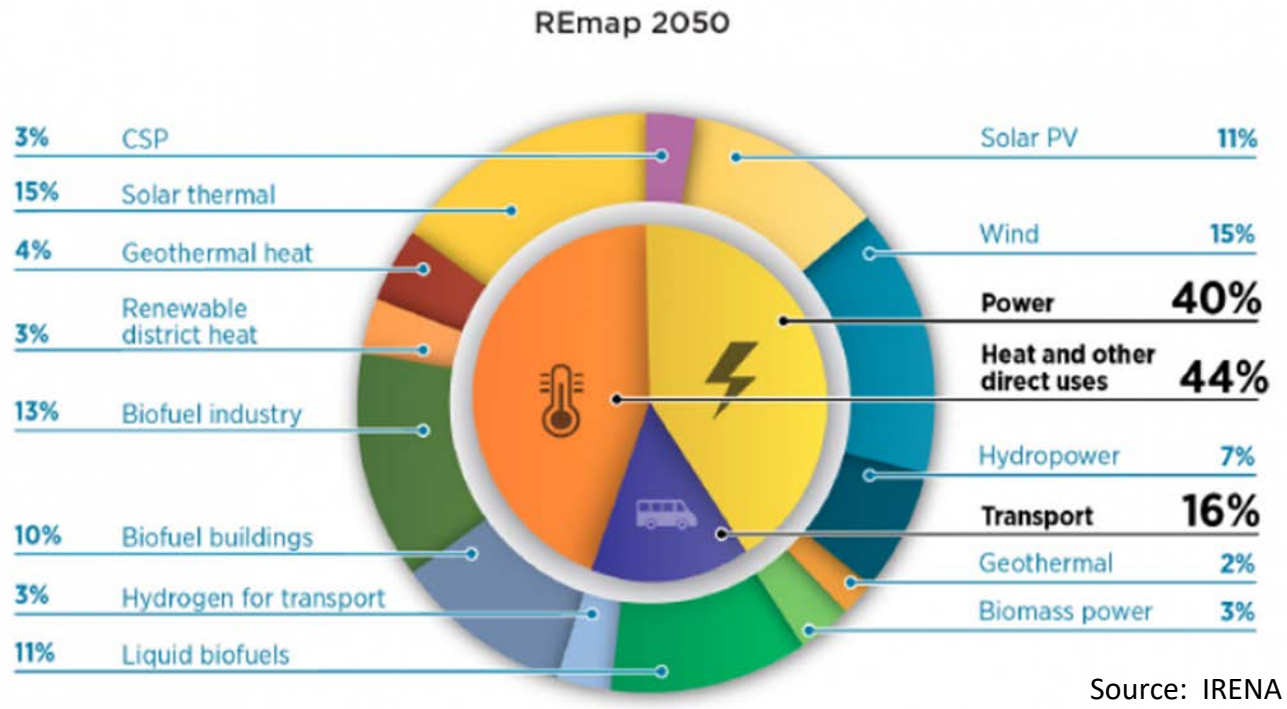
  - Benefits of Local CAAP Development
  - Local Climate Action and Adaptation Planning History and Outlook – California
  - **Local Energy Transitions**
  - Local Decarbonization Pathways
  - Local Energy Security and Resilience Strategies
- Local Gas Fuel CAAP Project
  - Purpose
  - Pathways and Actions
  - General Recommendations and Guidelines



Source: IRENA

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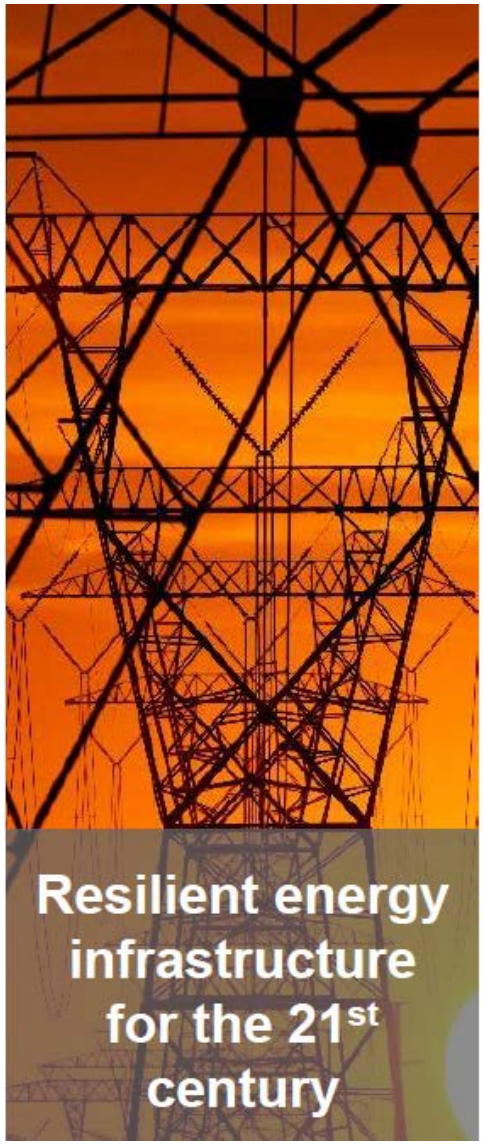
The Energy Transition Both/And

- Tension between economic and other concerns will likely continue, esp. in the energy sector.
- There will be a need for both resilient infrastructure, affordable, sustainable energy for all, and a need for locally resilient infrastructure and locally specific programs focused on affordability.
- Vulnerability has local consequences.



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The Energy Transition Conversation: What's Missing?

- Energy sector change requires incremental substitution. How and where does this happen?
- The cost buildup for delivered energy continues to shift in favor of local production.
- New local vulnerabilities are created as regional and continental energy systems evolve and new threats emerge. How can communities mitigate them?

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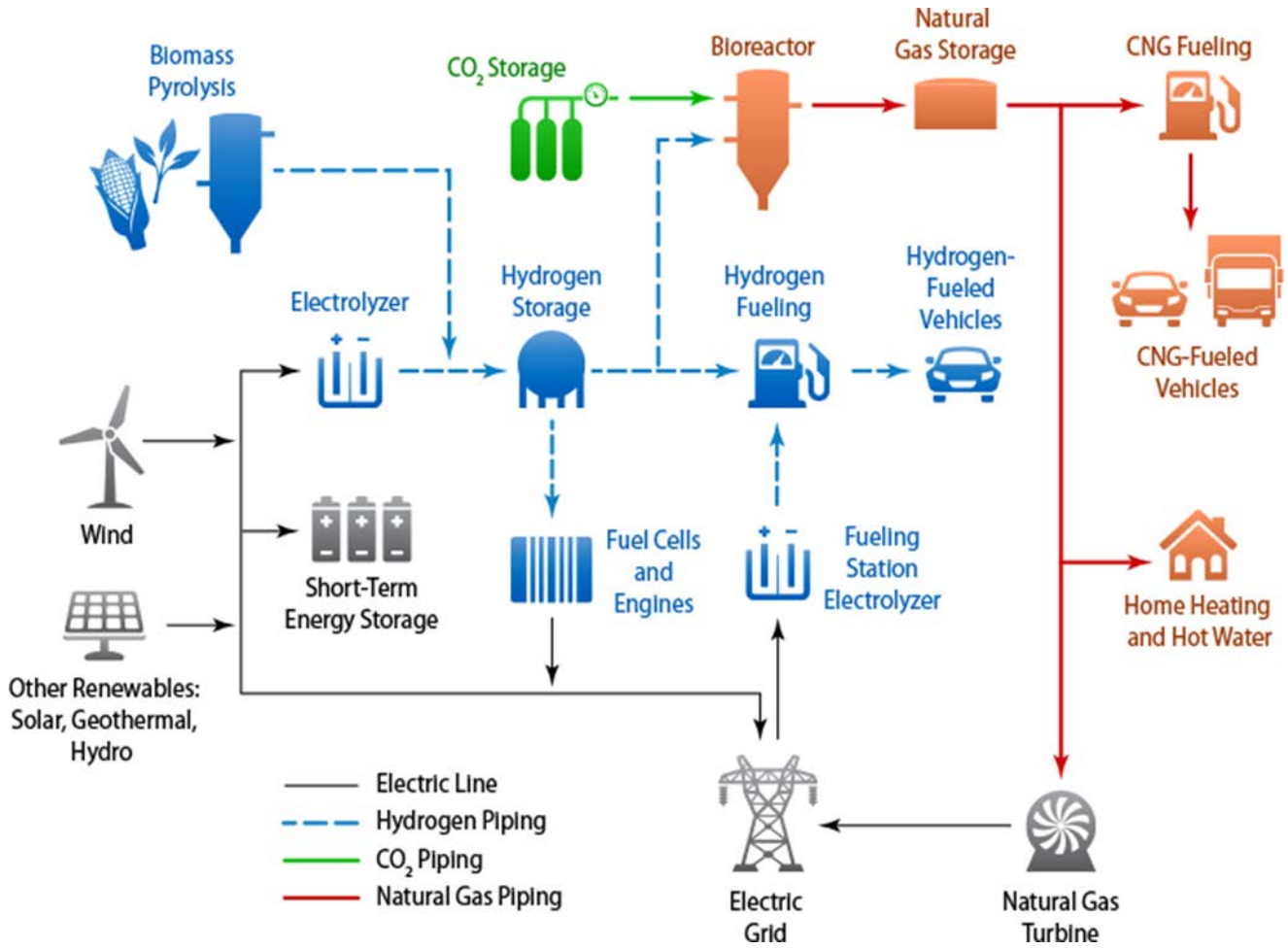
Renewable Hydrogen

- It’s the end game if we get there soon enough.
- Requires mature competencies in transport and handling of gas fuels.
- Natural gas is a bridge fuel, not just to renewable power, but to renewable hydrogen.



https://cleantechnica.com/files/2019/04/renewable-hydrogen.png

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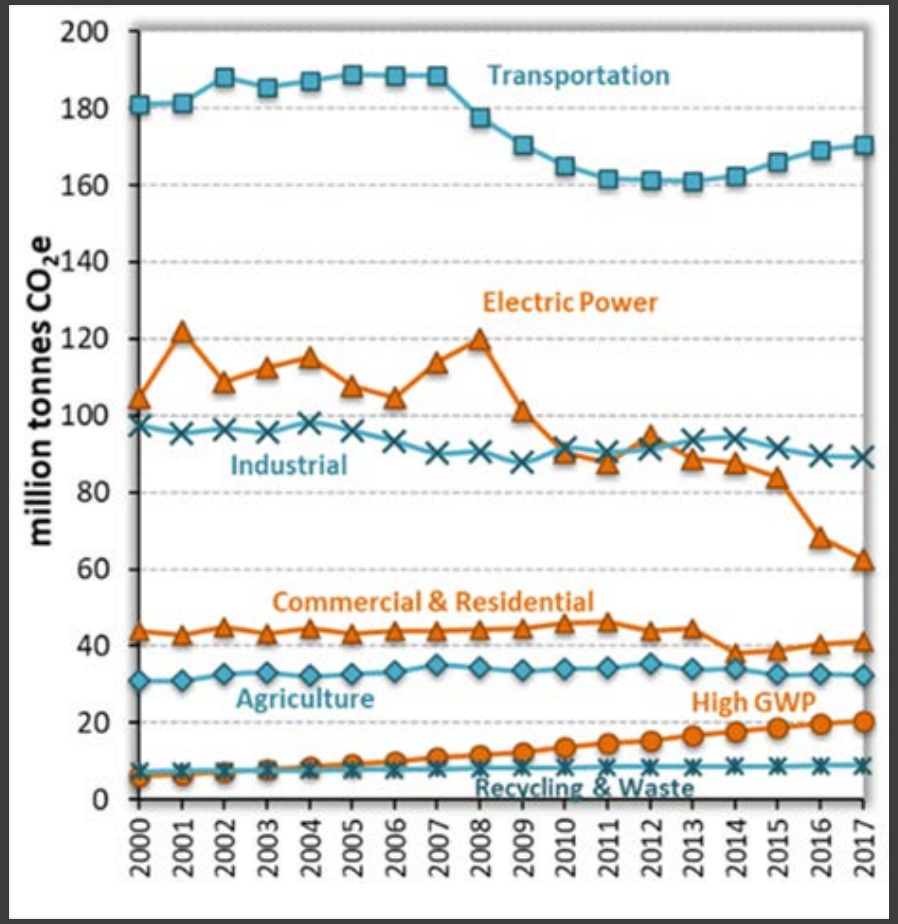
Benefits of Local CAAP Development

- Roughly half of GHG emissions come from local sources.
- Critical local government services, e.g. water supply, waste collection and treatment, use energy and can supply and recover energy.
- Energy users make investments that save them money, create local jobs, accelerate local emissions reductions, and provide a foundation for future local energy resilience.
- Cities and counties can facilitate energy customer investments aligned with these public needs.
- Local economies can be:
  - strengthened by local energy job creation and increased property tax revenues; or
  - harmed if energy services are disrupted and restoration of energy service is too slow



https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf

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Local CAAP History in California

California called on its cities and counties to respond to climate change. Initial local CAAPs aimed for 15% GHG reductions by 2020.

- Founded on studies to determine local inventories
- Had diverse content and structure and included aspirational targets
- More about decarbonization than adaptation, electricity than natural gas
- Typically no reference to emissions reduction pathways

Recent northern California catastrophes and climate emergency declarations raise the bar for planning and implementation.

https://ww3.arb.ca.gov/cc/ab32/ab32-5.png

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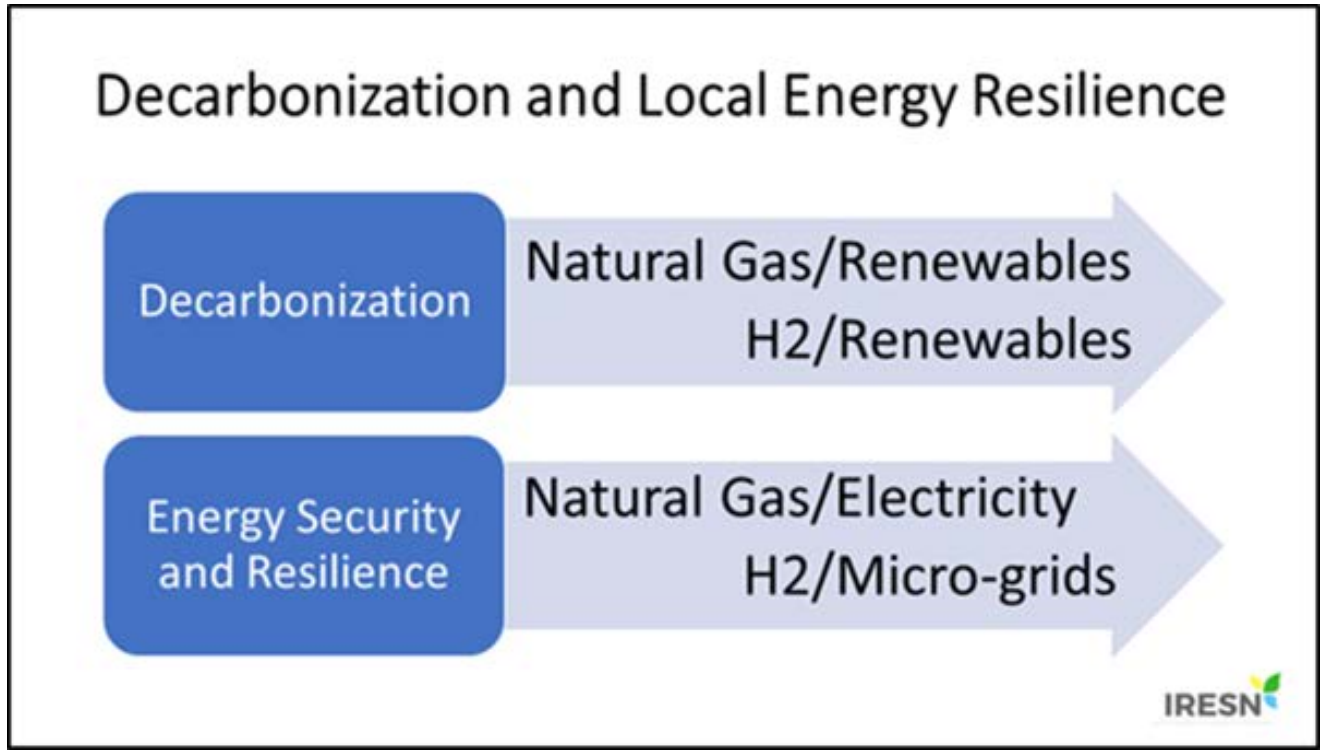
New Outlook for Local CAAPs

- Clearer now that out-sourcing decarbonization to national and sub-national governments doesn't work
- Escalating need for local energy resilience
- Technology and economic tipping points favoring decentralized, low carbon solutions
- Feasible to fully decarbonize fast and without economic disruption or coercive policies
- But no "silver bullets". **Major opportunities in both electricity and gas fuel sectors**
- Fully resilient local energy service requires reserve supplies, redundant delivery pathways, and both daily and seasonal storage.



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Local Energy Transition: Enabling Technologies

On-site and community renewable electricity for electric vehicle (EV) charging

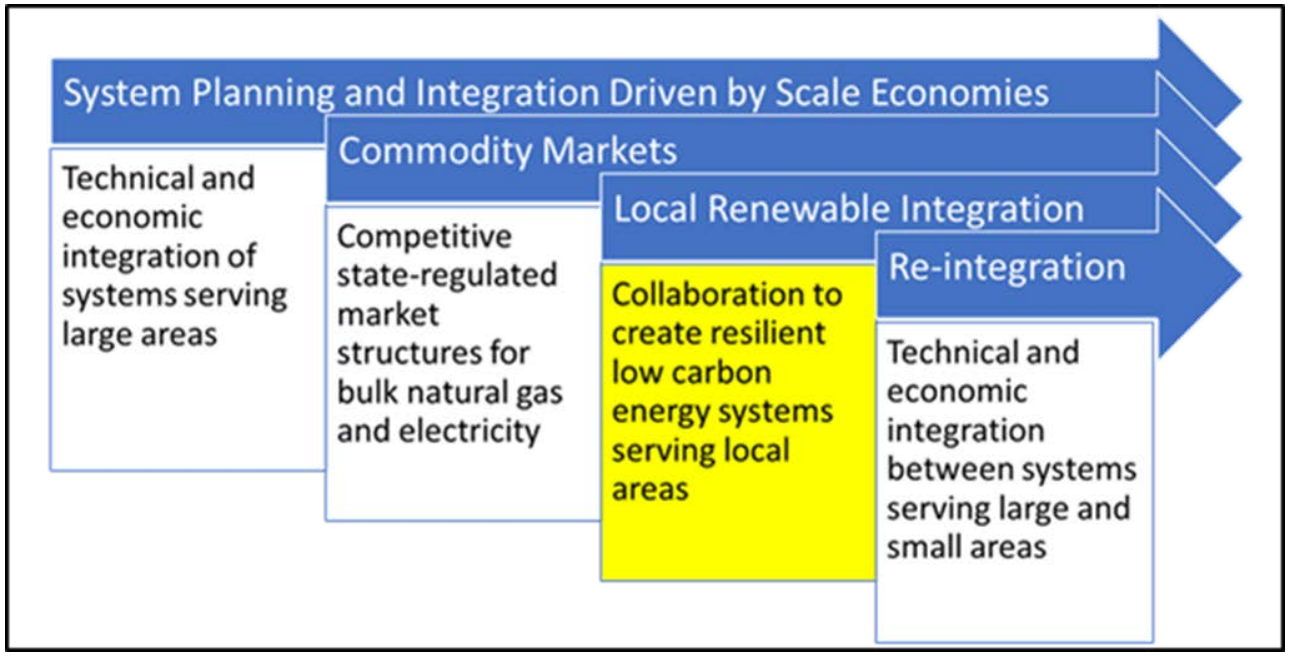
Waste to renewable natural gas (RNG) for vehicles and buildings

Hydrogen (H2) for fuel cell electric vehicles (FCEVs) and blending with natural gas (NG) and RNG. Convert:

- NG to zero carbon H2 - by "reforming" NG and capturing the CO2 byproduct.
- Renewable power to renewable hydrogen (RH2) - by water splitting (electrolysis)

Fully resilient, low carbon local grids and microgrids. Energy exchange with:

- Combined heat and power systems and stationary fuel cells
- Local solar PV, wind and short-term battery storage
- Interconnected EVs and FCEVs



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Decarbonization Strategies

- Layering – each level of government has a role that includes removing barriers at the next lower level.
- Diversity – every region or location has unique energy, demographic, and GHG profiles that differ from every other's, making it necessary to match barrier removal program options to profiles.
- Leverage – Local governments have project permitting and code enforcement authority and access to essential technical and economic advice, legislative and regulatory processes. Thus, local CAAPs must give as much attention to implementation as to goals and targets.

Energy Security and Resilience Strategies

Technically informed scenarios for:

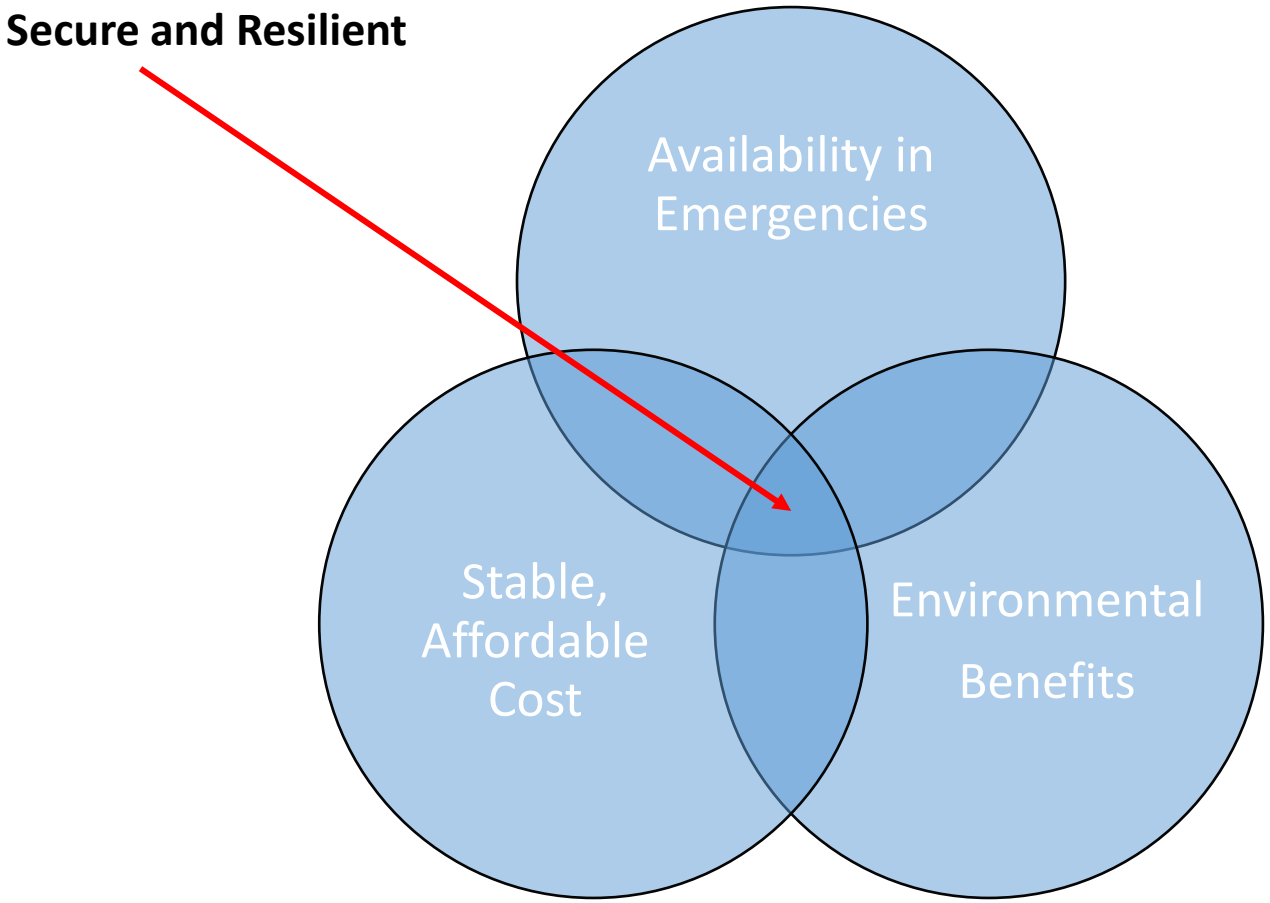
- Failures and disruptions
- Attacks
- Disasters

Redundant systems and inputs:

- Near term: ability to substitute available local supply when imports are disrupted
- Next: local electricity grids and microgrids provide mutual backup

Inter-operability and sufficiency:

- Local electricity and gas fuel production
- Local and regional grids and gas transport networks



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Two (Converging?) Local CAAP Pathways

Electricity		Gas Fuel
On-site solar electricity production	**and**	Renewable gas (RNG) from local waste
Increase renewable electricity imports	**and**	Increase RNG gas imports
Renewable microgrids	**and**	Renewable/gas hybrid microgrids
Heat pump water heaters	**and**	Hybrid solar/gas water heating
Heat pump space heating	**and**	RNG space heating
Battery electric vehicles	**and**	RNG fueled commercial vehicles
Plug in hybrid electric vehicles	**and**	RNG/RH2 fueled personal vehicles
Competitive higher renewable content retail electricity	**and**	Industrial combined heat and power
	and	Reduce methane leakage

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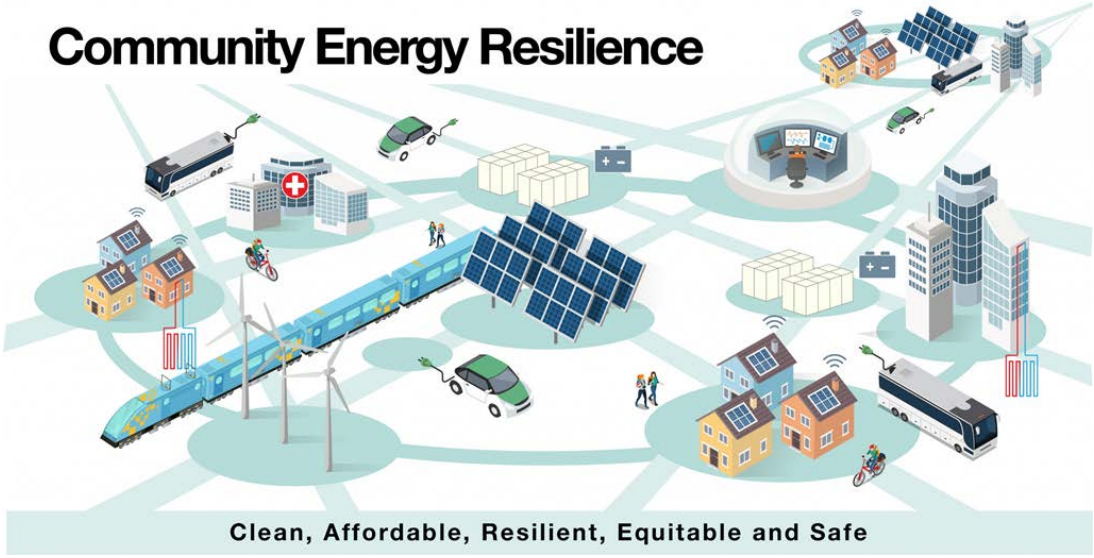
Local Electricity CAAP Emphasis

Modest Success To Date in California

Substitution of renewable electricity for retail grid electricity by:

- Implementing Community Choice to import more wholesale renewable electricity; and
- Promoting adoption of on-site solar PV.

Future Emphasis?



https://cleanpowerexchange.org/advanced-community-energy/

Note: Importing wholesale renewable energy can be a zero sum decarbonization game if it relies on existing renewable sources.

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Local Gas Fuel CAAP Project

- Help cities and counties plan for climate action with fuel sector decarbonization options on the table.
- Identify opportune local pathways and actions for fuel use decarbonization and energy service resilience.

Pathway	Initial Action Elements
Local renewable fuel production from waste	• Inter-jurisdictional organics study informing county and city plans • Initial local RNG production project
Resilient local power	• RNG microgrids for critical public services • RNG fueled community fuel cell and CHP projects • Diesel backup generator retrofits
Low carbon gas water heating	• Hybrid solar thermal/RNG retrofit program • Hybrid solar thermal/NG water heating for low-income housing
Low carbon gas space heating	• Low cost/low carbon NG/electric hybrid heating program • Special attention to building types needing to be fully resilient
Low carbon transportation	• Convert waste collection fleets to compressed RNG • Provide local FCEV fueling capacity consistent with demand
Low carbon industrial energy	• Track/report on industrial/ag user decarbonization investments

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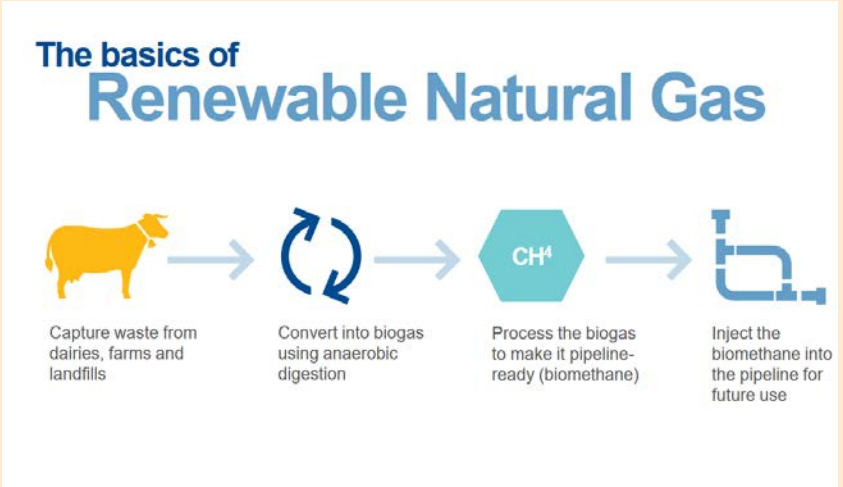
Renewable Natural Gas from Waste

Landfilled organic materials are converted to methane over time, which leaks to the atmosphere. Diverting and substituting food waste and manure to produce RNG can be "carbon negative".

Local governments pay for waste collection using fees paid by residents and businesses. They own landfill sites or pay "tipping fees" and have a stake in climate-beneficial use of renewable gas or electricity produced from waste streams.

They can collaborate with private renewable gas producers and gas utilities to maximize decarbonization benefits and recover life-cycle costs. Gas utilities have fuel clean up expertise and may consider co-investing.



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Substitution – RNG and RH2 for NG

To what extent, how, how soon and at what costs?

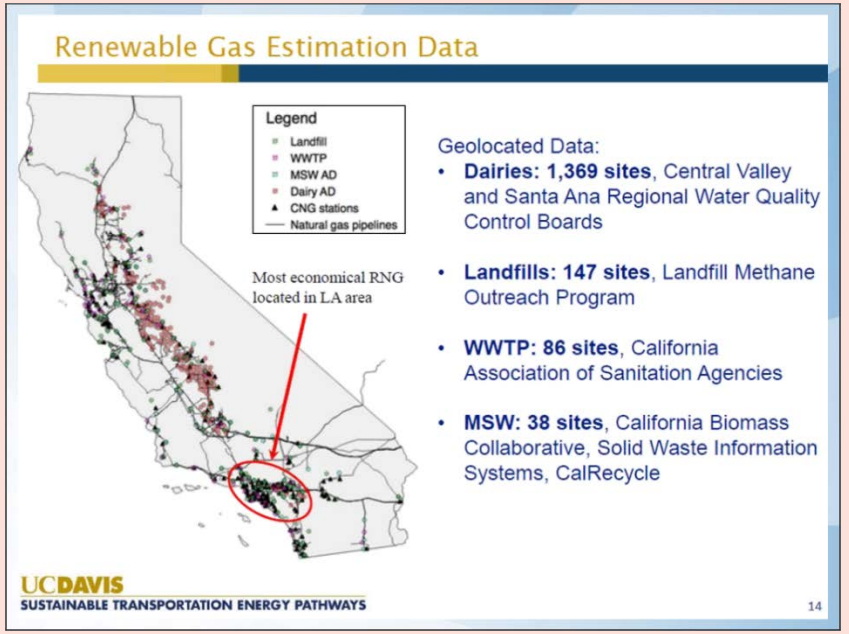
Extent. California has the potential to produce approximately 90.6 billion cubic feet of RNG (750 million gasoline gallon equivalents) per year. RH2 technical potential is unlimited.

How. Capture and upgrading for landfill gas and anaerobic digestion for dairy, landfill, municipal solid waste, and wastewater treatment plant sources.

Timing. Incentives accelerate RNG substitution, e.g.

- Federal - Renewable Fuel Standard
- CA - Low Carbon Fuel Standard

Cost. Building decarbonization (RNG or electric) has combined annual cost ~ $10 billion per year in southern California.



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Transportation Decarbonization Benefits – RNG for NG RNG

Hydrogen and electricity are emerging transportation energy sources. Their use results in reduced GHG emissions.

Substitution of RNG for diesel fuel can have a major decarbonization impact because some RNG sources have lower and even negative carbon intensity.

Substitution impacts vary significantly from project to project.

California assesses GHG impacts on a project basis as well as in generic categories.

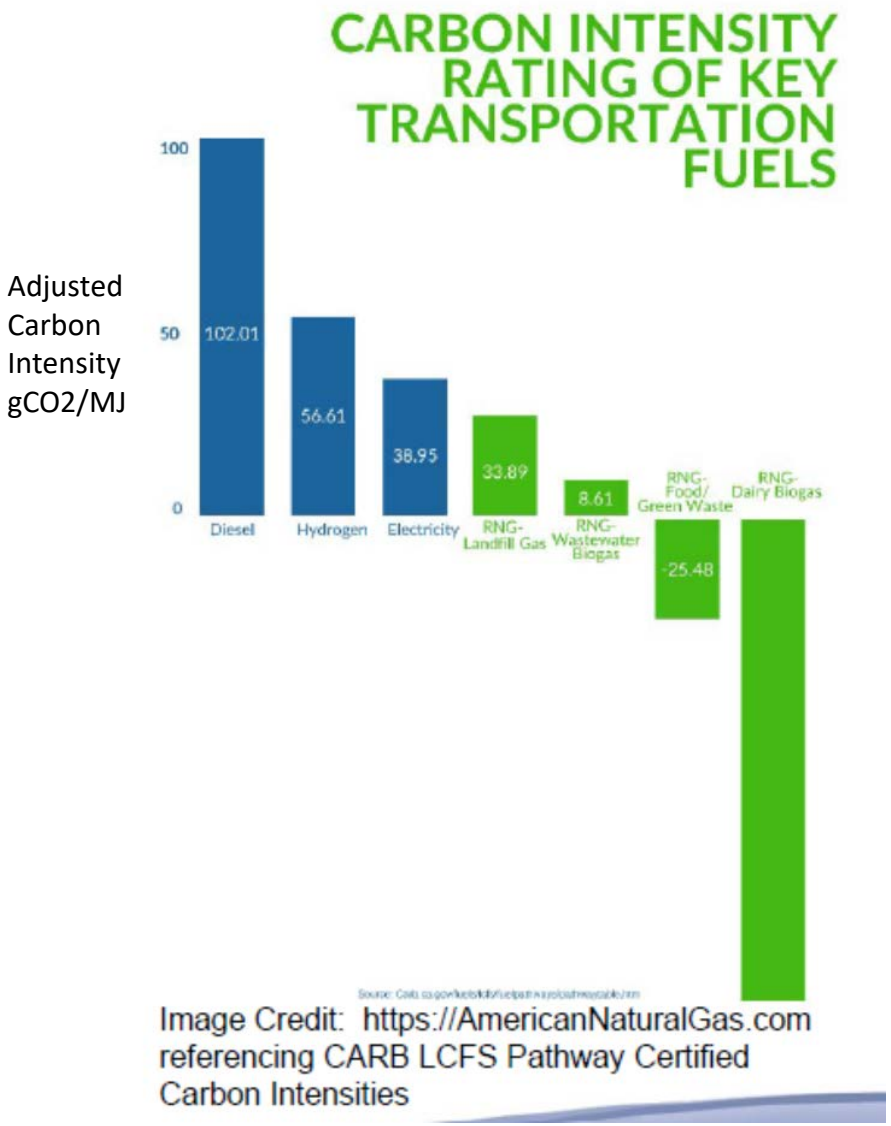

Image Credit: https://AmericanNaturalGas.com referencing CARB LCFS Pathway Certified Carbon Intensities

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Resilient Local Power

Critical local government services depend on energy services provided by gas and electric utilities. How can cities, counties and utilities work together on energy resilience? E.g.:

- Joint local vulnerability assessment and strategic resilience planning?
- Energy delivery infrastructure investments to minimize vulnerabilities and take full advantage of existing customer and community owned supply and storage resources during extended electricity grid outages.
- Increase locally produced RNG and RH2 for **fully resilient** local microgrids and backup power sources.

UC San Diego's microgrid provides a flexible, resilient, reliable, secure energy distribution system that generates more than 85% of the electricity used on campus annually. Power is provided from several sources, including the campus' 30-megawatt cogeneration plant, 2.8-megawatt renewable energy fuel cell, and 2.4 megawatts of solar arrays.

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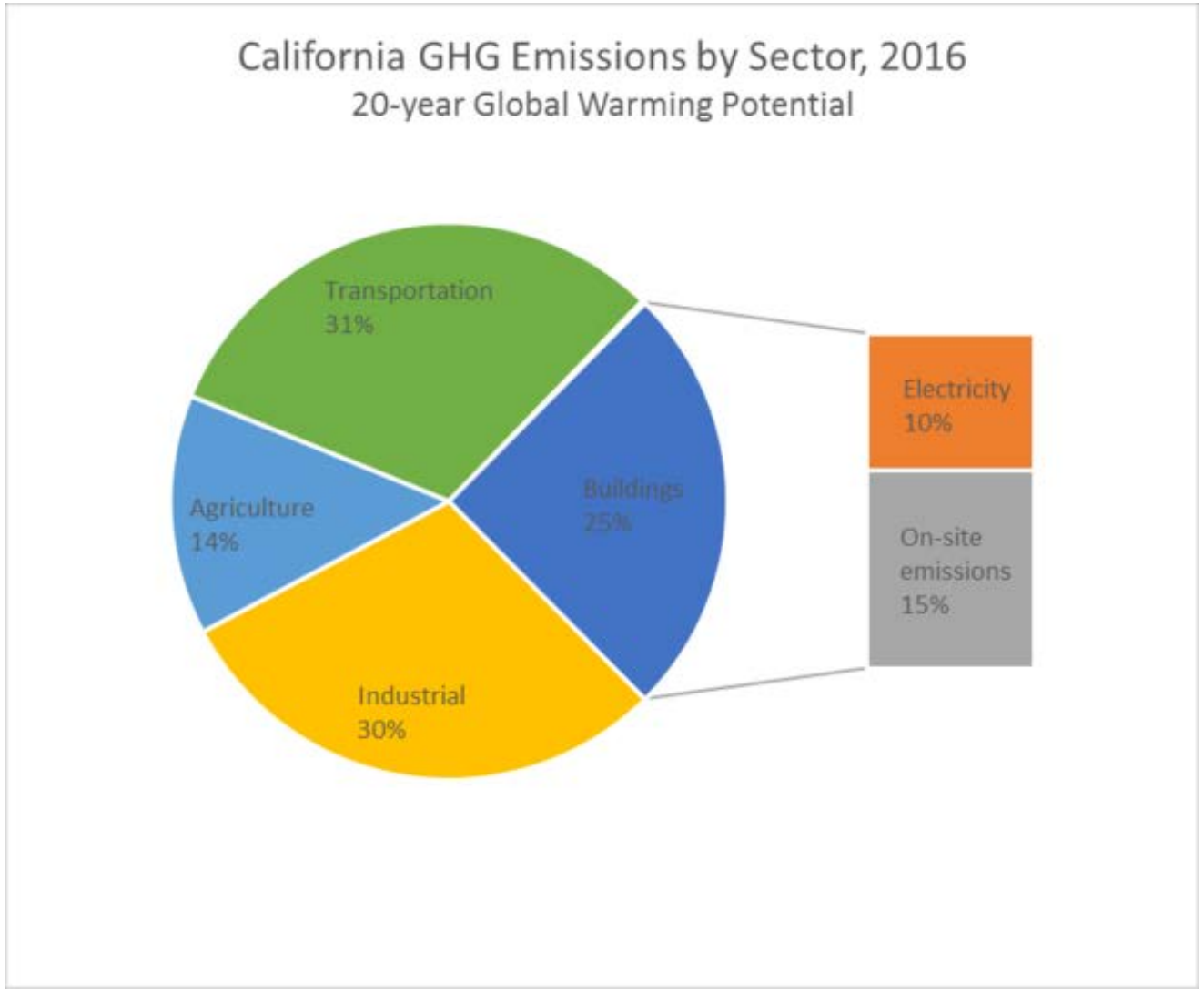
Buildings Share of GHG Emissions

To what extent can local GHG inventories be reduced through local production of heat and electricity?

- Fossil-fuel combustion for residential and commercial building heating and cooling accounts for nearly 30% local GHG emissions inventories in the US.
- Building and community scale solar electricity and solar heat sources are life-cycle cost-competitive with imported energy commodities.
- Substituting locally produced renewable heat, gas and electricity can, over time, result in full decarbonization.



Source: https://www.nrdc.org/experts/joe-vukovich/real-climate-impact-californias-buildings

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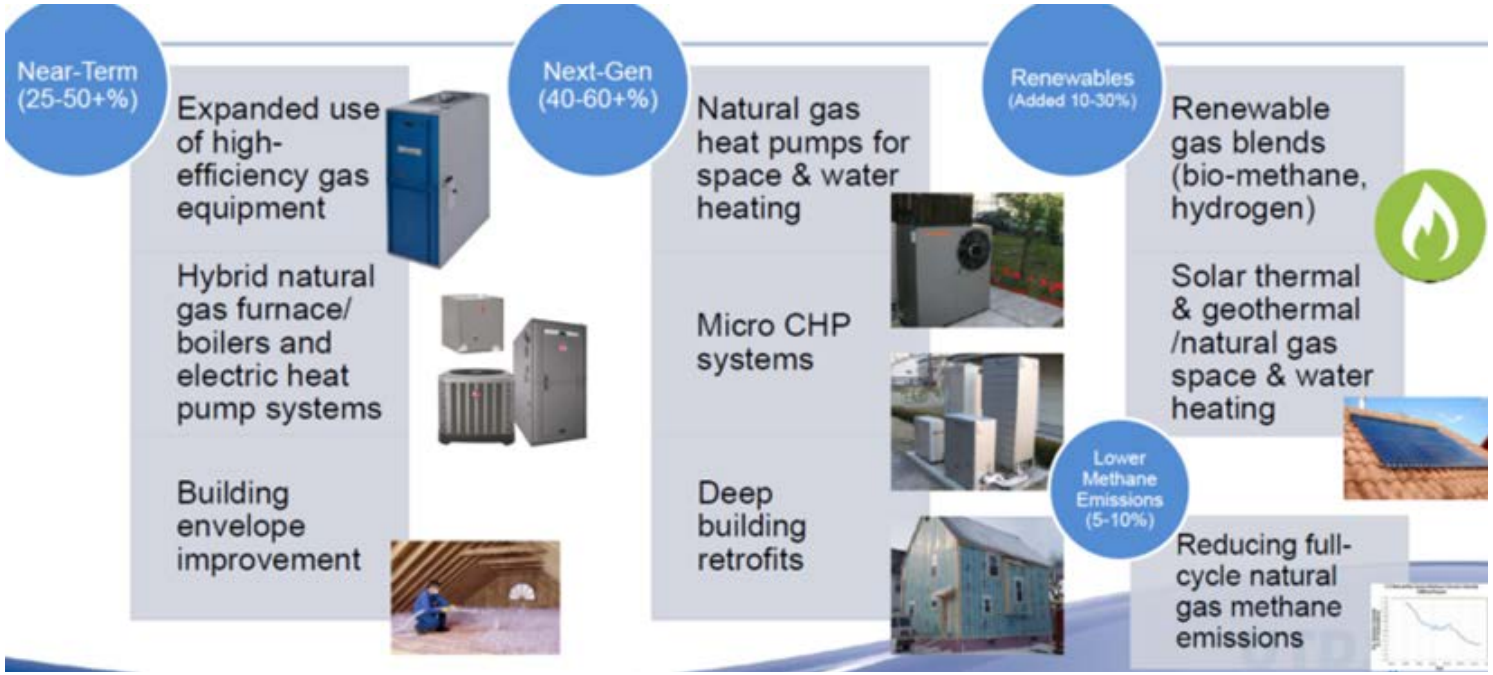

Source: Gas Technology Institute

Residential Pathways

Hybrid (multi-source) systems are in the development and commercialization pipeline that will deliver both affordability and decarbonization, esp. when fueled with RNG blends. The USDOE, California Energy Commission, and utilities around the US are supporting programs to make them commercially available.

Low Carbon Space and Water Heating

Motivation for city and county decarbonization interventions?

- **Life cycle cost savings and resilience benefits for local energy users**
- Local job creation and property tax base expansion

State interventions focus on new buildings.

Local CAAP development can identify:

- Barriers and steps to lower them, e.g. local contractor training
- Strategies to engage local retailers, project developers and contractors

Hybrid systems are comprised of a gas furnace and electric heat pump.

Source: My Air Today

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Low Carbon Transportation

- The table on the right is included and discussed in a recently completed white paper.
- Other such tables cover renewable fuel, resilient power, water heating, space heating and industrial process heat.
- California mandates conversion of public transport buses to electric drive, but allows private vehicles use to use low and zero carbon fuels.

	Years 1-5	Years 5-10	Years 10-15	Totals
CNG Fueled Vehicle Fleets	Convert 50% of private commercial and waste collection fleets to CNG	Complete public fleet conversions and convert 50% of local CNG fleet to RNG or comparably low carbon RH2 blends	Complete public fleet conversions to RNG or RH2	
Local GHG (-%)	<0.1	0.1	0.2	0.3
Fuel Cell Electric Vehicles	Ensure publicly accessible local FCEV fueling capacity to serve 100% of forecast local demand	Locally produce 50% of RH2 needed for FCEV fueling	Locally produce 100% of RH2 for FCEV fueling	
Local GHG (-%)	<0.1	0.5	2	2.5
Collaborations	CNG fueling stations for public fleets and private CNG vehicles	RH2 fueling stations for public and private FCEVs	Local RH2 supply and distribution infrastructure	
Totals	<0.1	0.6	2.2	2.8

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Low Carbon Industrial and Agricultural Energy

Cities and counties have relatively little leverage to drive industrial and agricultural decarbonization and resilience. But gas utilities do. So, collaborative outreach and engagement is possible.

Hybrid solar thermal/natural gas systems offer a significant decarbonization pathway for food processing and craft brewing industries.

Photo credit: Skyven

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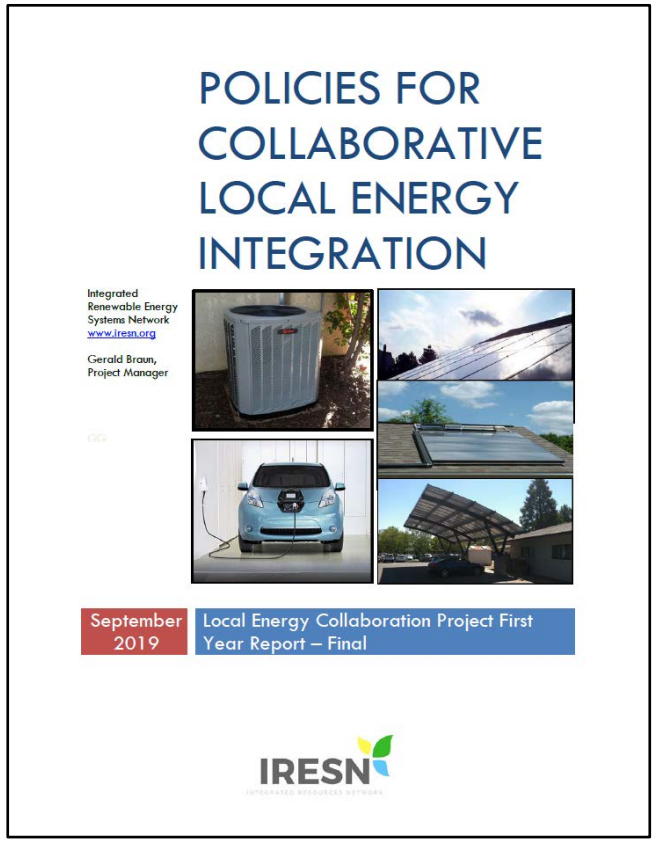

General Recommendations

- Aim to decarbonize fuels and electricity.
- Recognize local fuels CAAP synergies with:
  - other local CAAP elements
  - annual local utility service (water, waste, energy) operating and capital improvement plans
- Recognize that resilience depends on redundancy and diversity.
- Assess local energy sector trends. How can those that are shrinking the local carbon footprint be accelerated?
- Local energy collaboration is the key to timely, effective implementation.

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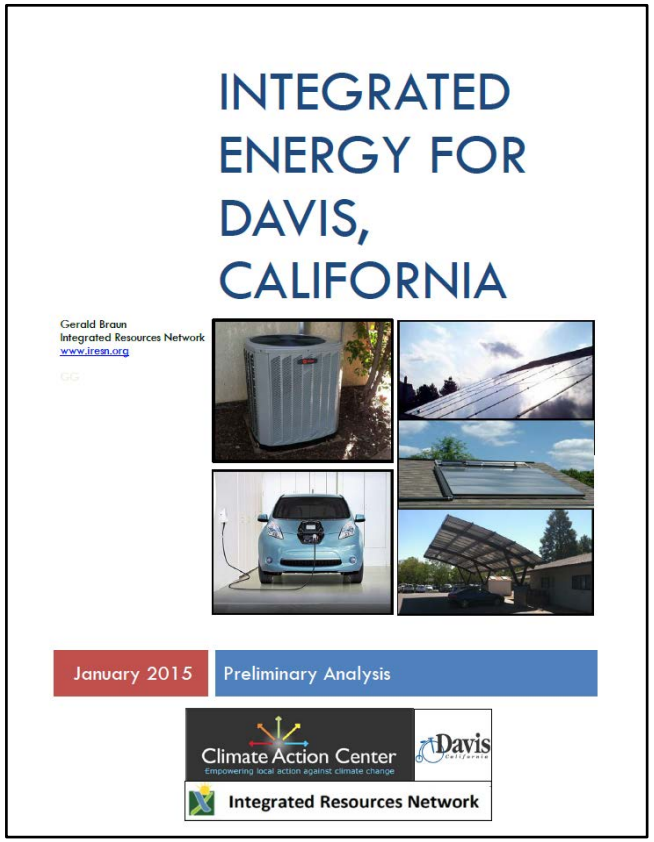

Local CAAP Development Guidelines

Start with integrated energy analysis, which:

- Keys off local trends
- Evaluates multiple scenarios
- Accounts for substitution

- Comport with norms of business planning, e.g. annual and five-year cycles
- Engage collaborators, i.e.:
  - Energy service providers
  - Local energy sector retailers
  - University based teams having energy modeling and technology assessment and forecasting capacity.

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Thanks!

Questions?
Slide deck? Draft White Paper?

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