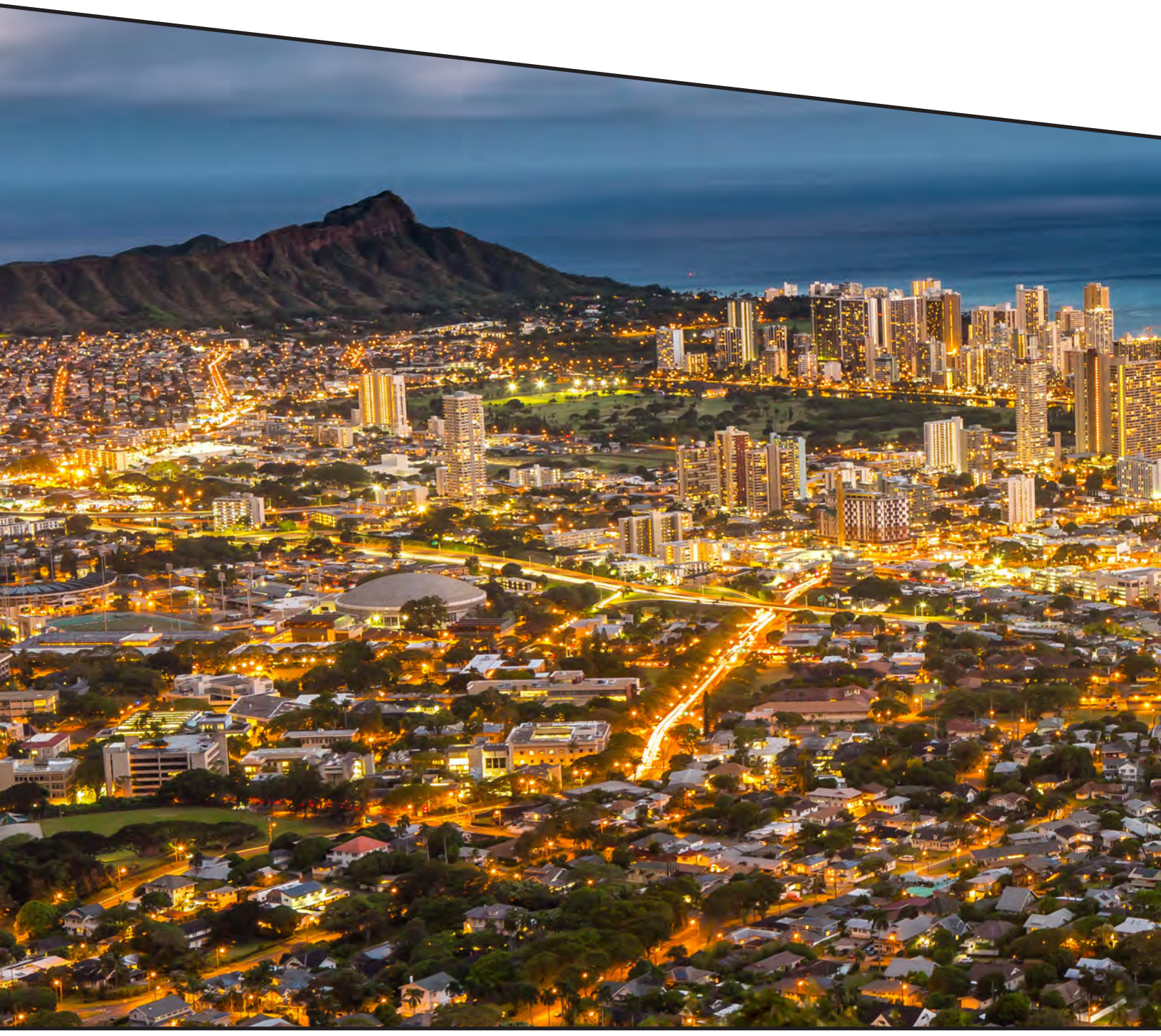
Feasibility and Implications of Establishing a Carbon Offset Program for the State of Hawai'i



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Executive Summary

This report evaluates the feasibility for the Hawai‘i state government to foster additional greenhouse gas reductions through carbon offset credits. The State of Hawai‘i has taken significant steps to reduce greenhouse gases, by setting strong targets and implementing an array of policies focusing on energy efficiency, renewable energy, and greenhouse gas sequestration. This report evaluates how offset projects for a state-administered carbon offset program in Hawai‘i could support further greenhouse gas emissions reductions.

The State of Hawai‘i’s Office of Planning hosted an educational Carbon Offset Symposium on April 10, 2019 for decision-makers, stakeholders, and the public. After providing foundational concepts of offsets, the symposium evaluated the feasibility of creating offset credits through specific Hawai‘i greenhouse gas reduction opportunities. This evaluation used an AECOM-developed tool called an “Offset Gate Key” to walk attendees through the four “gates” that represent the decision criteria for creating offset projects: Quality, Additionality, Financial Viability, and Environmental Justice. Further use of this Offset Gate Key evaluation process can help the State of Hawai‘i or the general public determine whether an offset project will be viable for any greenhouse gas reduction opportunity identified.

An offset credit represents one entity paying another to mitigate greenhouse gas emissions elsewhere. Offset credits are certified by a reputable offset standard and must meet the requirements of being real, quantifiable, permanent, enforceable, verifiable, and additional. Once an offset project has met these requirements, and the resulting credits are verified by a third party, those credits are monetarily tradeable.

Offset credits can bridge the gap between entities with high costs for greenhouse gas reductions on-site, and those with lower costs. Offset credit generation is a rigorous process that is only practicable in a narrow set of circumstances. The primary benefits of offset credits include the credibility that results from the rigor, and the potential for financial opportunities rather than regulatory requirements. The primary challenges of developing greenhouse gas offset projects include the strict criteria required (i.e. reductions must be maintained in perpetuity), the costs of the offset crediting process (that are beyond the cost of achieving the greenhouse gas reductions), and the loss of the greenhouse gas reduction once it is sold.

In the event that offset development is feasible, the next step for the State of Hawai‘i to consider when evaluating its participation in the offset market is its role: program administrator or project developer. An offset program administrator provides the protocols and certifies offset credits as valid according to a

specific protocol, and no revenue is generated for the program administrator from the sale of offset credit. In comparison, an offset project developer owns the offset credits and can generate revenue through the sale of offset credits. There is an inherent conflict of interest between these roles as one role provides credibility to offset credits generated, while the other can generate revenue. Following this feasibility study to fulfill the investigatory requirement of Act 16, Session Laws of Hawai‘i 2018; if the state government intends to continue to establish the proposed Carbon Offset Program, it is necessary for the state government to choose between the roles of offset program administrator or to participate in offset project development and sale.

It is unlikely that the State of Hawai‘i would generate significant revenue through the production of offsets, and any trading of offset credits produced within Hawai‘i would be limited by the state’s laudable Zero Emissions Clean Economy target.

The State of Hawai‘i is already a leader in climate change solutions as the first state in the United States to set statutory targets for a 100% Renewable Portfolio Standard and a Zero Emissions Clean Economy by the year 2045. Offset project development is just one greenhouse gas reduction implementation mechanism that the State of Hawai‘i can use to address climate change. Regardless of the use of offsets, the state government can explore and implement all actions at its disposal, with appropriate financial consideration, to achieve all feasible greenhouse gas reduction and sequestration measures. For those greenhouse gas reduction projects in which offset creation is not a viable or advantageous mechanism, the alternative mechanisms discussed in this report can be considered. The alternative implementation mechanisms discussed include: non-offset program carbon pricing (i.e. carbon tax, cap-and-trade, etc.), greenhouse gas reduction funds, building codes and standards, and integrated greenhouse gas reduction plans.

Each mechanism supporting the reduction of greenhouse gas emissions has advantages and disadvantages, with some mechanisms being better suited toward specific greenhouse gas emission reduction actions. An appropriate mix of implementation mechanisms will be required to effectively reduce greenhouse gas emissions and address climate change. The State of Hawai‘i should build on its existing policies and programs to develop an economically viable comprehensive approach to reach its climate change mitigation goals.

1 Introduction

Hawai‘i’s state government demonstrated leadership on an international stage when it committed to the goals of the Paris climate agreement, and developed its own ambitious statewide Zero Emissions Clean Economy target. The state government is using a multipronged approach to address the issues of climate change including efforts on greenhouse gas reduction planning through its laws, policies, task forces, and committees.

The Office of Planning expanded these efforts by hosting a Carbon Offset Symposium in April of 2019 and soliciting this report to evaluate the feasibility of establishing a state-administered carbon offset program.

This report provides a summary of the Carbon Offset Symposium (Chapter 2 of this report) including all presentations as appendices. This report also describes the fundamentals of greenhouse gas emissions, provides an overview of the State of Hawai‘i’s climate change laws and policies, and describes the key elements of offset concepts, offset development, and offset markets. These key elements are used to establish a feasibility analysis for carbon offset generation and a program framework for the Hawai‘i state government.

The language associated with carbon offsets is complex because the definitions are often loose, interchangeable, and are used differently under different programs. The first step in working through this complexity is by defining key terms, which this report has done both within the body of the report and as a glossary of terms, which is included in the appendices.

This feasibility analysis reviews offsets from the project development perspective and different program outcomes depending on the role the State of Hawai‘i chooses to fulfill. Offsets are a specific implementation mechanism used to foster greenhouse gas reductions and, while valuable, the uses are narrow. For this reason, alternative approaches to offsets are also included in this report. Providing a broader, comparative view best supports the State of Hawai‘i with an initial framework for identifying viable greenhouse gas reduction approaches.

Conclusions and recommendations were derived from information gleaned during the Office of Planning’s Carbon Offset Symposium, as well as from accumulated knowledge, experience, and research with regards to greenhouse gas reduction strategy development, offset markets, feasibility analyses for offset program development, and greenhouse gas policy from the State of Hawai‘i and other leading states.

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2 Carbon Offset Symposium

The State of Hawai‘i’s Office of Planning hosted a Carbon Offset Symposium (Symposium), which was held on April 10, 2019, at the Hawai‘i State Capitol Auditorium. The Symposium was designed as an informational and educational session to provide decision-makers, stakeholders, and the public with the information necessary to evaluate the feasibility of carbon offset projects and programs in Hawai‘i. Information provided on offsets included basic concepts, markets and financials, registries, standards, and protocols. Hawai‘i-specific project examples, as well as alternatives to offsets, were also discussed. Discussions with invited speakers and guests of the Symposium helped to identify data gaps and inform the organization of this feasibility report.

The Symposium’s agenda was broken into three parts:

1. Greenhouse Gas Offsets, Offset Markets, and Feasibility
2. Hawai‘i-based Greenhouse Gas Reduction Project Examples
3. Connecting Greenhouse Gas Reduction Projects to Offset Project Feasibility

The following sections summarize the discussions from each portion of the agenda. The agenda and key concepts and terms are provided as Appendix A of this report. The PowerPoint presentations from the Symposium are provided in Appendix B of this report. The Symposium was also professionally video recorded, the video and the PowerPoint presentations from the Symposium are available online through the State of Hawai‘i, Office of Planning’s website at: https://planning.hawaii.gov/sustainability.

2.1 Greenhouse Gas Offsets, Offset Markets, and Feasibility

AECOM’s Greenhouse Gas Technical Practice Group Leader, Michael Conrardy, began the Symposium by providing an overview of climate change, the connection to greenhouse gas emissions, and the need for emissions reductions. Key concepts were introduced to create a shared level of knowledge and a foundation for the technical information, which was built upon throughout the Symposium. The basics of greenhouse gas inventories were introduced, and invited speaker Mike Madsen, from the State of Hawai‘i’s Department of Health, provided an overview of the state’s greenhouse gas policy, inventories, and anticipated trends.

Mr. Conrardy also provided an overview of offsets including offset registries, standards, and examples of protocols. The quality criteria required to evaluate offset creation were also discussed. NatureBank's Steve Baczko provided an overview of the regulated and voluntary markets, as well as offset transactions, market participants, and the current value for offsets.

The information presented during this portion of the Symposium is discussed in greater detail in Chapters 3, 5, and 6 of this report.

2.2 Hawai'i-based Greenhouse Gas Reduction Project Examples

To assess initial project level feasibility of converting greenhouse gas reduction actions into offsets, representatives from three Hawai'i-based greenhouse gas reduction projects were invited to share information regarding their ongoing work during a panel session. The three Hawai'i-based project examples represent real greenhouse gas emissions reduction projects or actions occurring within the State of Hawai'i. They are as follows:

- **Carbon Sequestration through Forestry**
  Leah Laramee, State of Hawai'i, Department of Land and Natural Resources, Division of Forestry and Wildlife
- **Biogas Capture**
  Aaron Kirk, Hawai'i Gas
- **Electric Vehicle Adoption Encouragement through Charging Systems**
  Jimmy Yao, Hawaiian Electric

Each presentation included a technical explanation of the action or process that reduces greenhouse gas emissions, an approximation of total emissions reduced, and associated costs of the project or action. The presenters also provided unique details of their projects, including co-benefits.

2.3 Connecting Greenhouse Gas Reduction Projects to Offset Project Feasibility

Following the presentations on Hawai'i-based greenhouse gas reduction projects, Dr. Trisha Kehaulani Watson provided a presentation on environmental justice. Dr. Watson provided an overview of environmental justice in the context of greenhouse gas emissions and the impacts of decision-making on indigenous peoples and local communities. Environmental justice was a key component throughout the Symposium due to its importance with respect to the global actions necessary to address climate change and impacts on indigenous peoples. Environmental justice was also discussed within the context of Hawai'i's local communities and Native Hawaiian traditional and customary access rights.

AECOM developed an interactive tool to provide a framework to assess initial project-level feasibility of greenhouse gas reduction actions converting to offsets, called the Greenhouse Gas Offset Gate Key (Offset Gate Key). The Carbon Offset Symposium facilitators used the Offset Gate Key to create an audience participation exercise to walk attendees through the four "gates" that represent the decision criteria for creating offsets.

Physical copies of the Offset Gate Key were distributed to all attendees of the Symposium, and thanks to the contributions of the Hawai'i-based project presenters, their projects were used to help the participants

understand the feasibility of offset creation. A digital version of the Offset Gate Key and a video of the exercise are available online at the Office of Planning's website; they are also attached as Appendix C of this report.

The Offset Gate Key can be used to evaluate the initial feasibility of using offsets to support the implementation of any greenhouse gas reduction project. All of the Hawai'i-based greenhouse gas reduction projects presented at the Carbon Offset Symposium are currently being implemented with funds other than from carbon offset credit generation. The live walk-through of the Offset Gate Key demonstrated that the creation of carbon offsets is unlikely to bolster the implementation of the projects presented, apart from carbon sequestration through forestry. Potential hurdles may exist for the greenhouse gas reduction projects presented, depending on the expectations of a financial return from offset creation. It is rare for the right conditions to be met for converting greenhouse gas reductions into offset credits, but that does not diminish the value of the greenhouse gas emissions reduction projects themselves.

The financial implications of each individual project are varied and detailed, as discussed in Section 6.6 of this report.

The Symposium concluded with a panel session discussing alternative implementation mechanisms to offsets, such as:

- Carbon pricing
- Greenhouse gas reduction funds, financing, and incentives
- Codes and standards
- Integrated greenhouse gas plans

A more detailed discussion related to alternatives to offsets is provided in Chapter 8 of this report.

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3 Overview of Greenhouse Gas Emissions

3.1 Climate Change and Global Action

Climate change is defined by changes in global or regional climate patterns from a rise in average global temperatures due to human emissions of greenhouse gases. Multiple anthropogenic activities, such as fossil fuel combustion and land use changes, emit greenhouse gases. These greenhouse gas emissions contribute to a changing climate and have profound impacts across the globe, including extreme weather, disruption of water and habitats, and an overall risk to society. Scientific data regarding climate change has been collected for over a century with the fundamental understanding of the problem being communicated as far back as the 1970s.

Climate change is a global problem requiring global solutions. Accordingly, cooperation across scientific disciplines and geographic boundaries is necessary to achieve successful mitigation. Governments and industries have committed to act to lower environmental impacts and actively fight climate change. The United Nations' Framework Convention on Climate Change, 21st Conference of the Parties in Paris, marked a historic commitment with nearly 200 countries coming to a consensus on the need to cut greenhouse gas emissions.[1] The Paris Agreement sets the objective of "holding the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels." Many businesses have voluntarily joined in these commitments through initiatives to attain a low carbon, sustainable future through multiple actions and coalitions.[2]

As climate change research continues, the basic conclusions remain consistent with our understanding of the issue regularly refined by building upon our previous knowledge. Figure 1 shows the basic history of climate-based science and demonstrates how far our atmospheric data and understanding of global warming go back in time. The Science Based Targets initiative (SBTi) tracks the latest climate science to determine the levels of greenhouse gas emissions reductions necessary to achieve the Paris Agreement objective.[3] In October 2018, the Intergovernmental Panel on Climate Change (IPCC) released Special Report 15, which defines specific

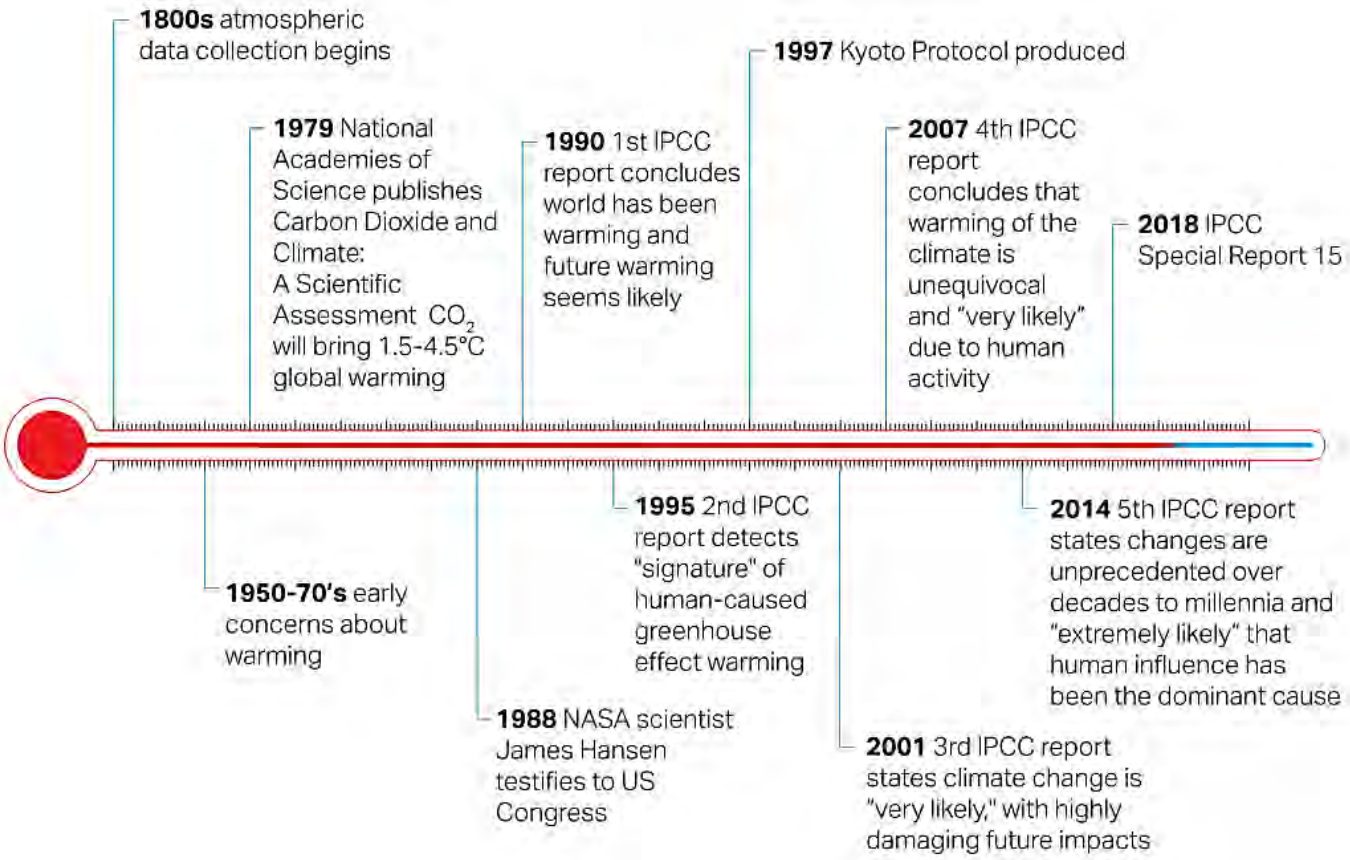
[1] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[2] https://unfccc.int/news/100-global-corporations-commit-to-science-based-targets-aligned-with-paris-agreement

[3] https://sciencebasedtargets.org/about-the-science-based-targets-initiative/

pathways to avoid the dangerous consequences of climate change.[4] Figure 2 is an important summary figure from the IPCC report, describing greenhouse gas reduction pathways to limit warming to 1.5 degrees Celsius, a threshold established in the Paris Agreement.

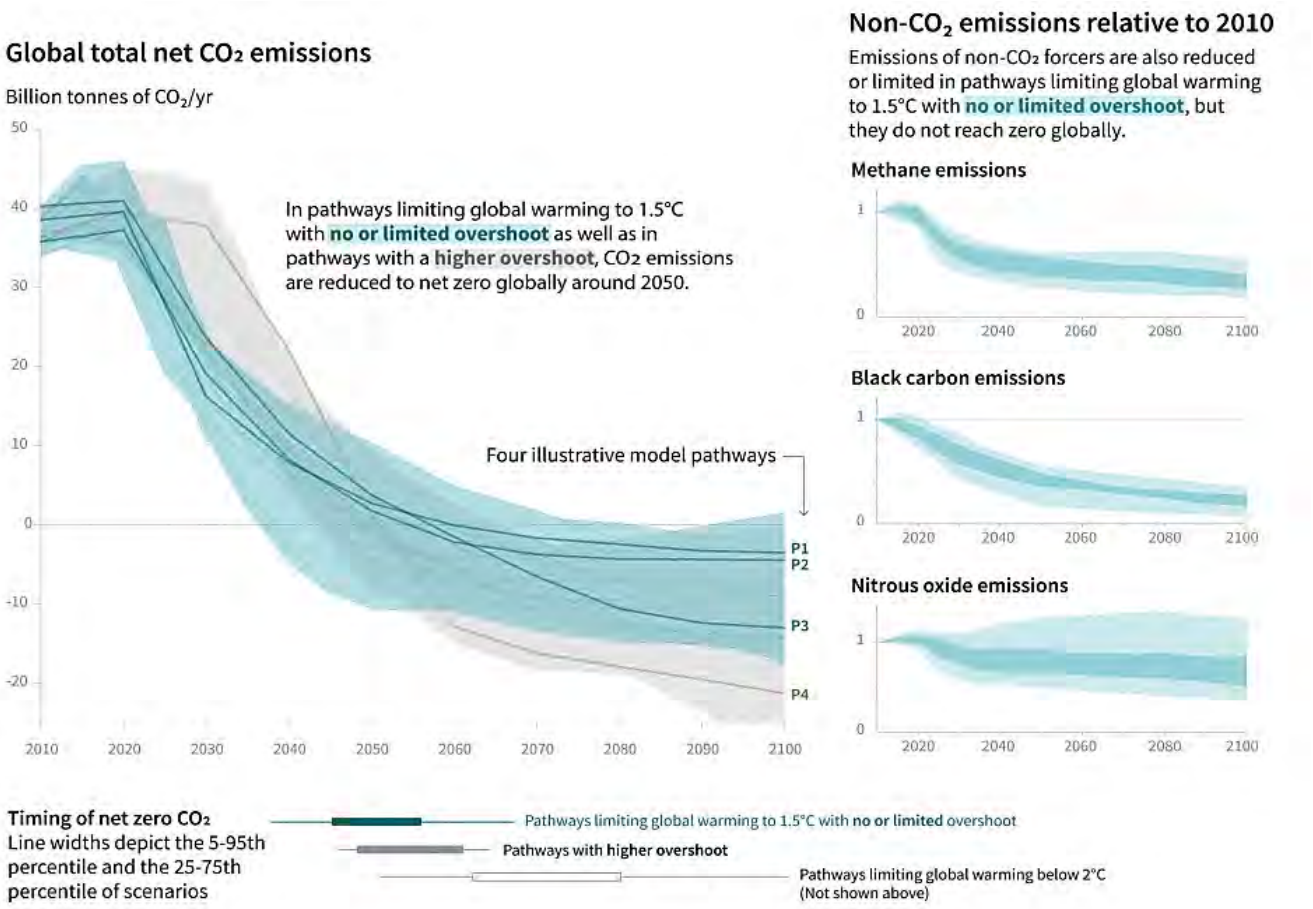
Figure 1 – Basic History of Climate Change Science



Source: Figure developed by AECOM.

[4] https://www.ipcc.ch/sr15/

Figure 2 – Intergovernmental Panel on Climate Greenhouse Gas Emission Reduction Pathways



Source: IPCC Special Report 15 on Global Warming of 1.5° C. October 2018.

States and local governments have been taking significant steps to reduce greenhouse gas emissions within their own jurisdictions. The State of Hawai‘i continues to serve as a leader in addressing climate change, as detailed in Chapter 4 of this report. These types of local and regional actions provide models for others, and collaborative efforts are necessary for innovative solutions that cross state boundaries. As greenhouse gas emissions are the primary cause of climate change, an understanding of greenhouse gas fundamentals is imperative to addressing climate change.

3.2 Fundamental Greenhouse Gas Concepts

The following is an introduction to greenhouse gas terms that are fundamental to understanding the more specific concepts of carbon offsets discussed in this report.

Greenhouse Gas: The term “carbon” is often used interchangeably with or along with greenhouse gas, as most greenhouse gases are carbon-based. The key metric for climate change mitigation is not the carbon itself, but rather total emissions of greenhouse gases. Accordingly, for clarity and consistency, this report prioritizes the use of the term greenhouse gases rather than carbon. The primary exceptions are references to established entities like carbon neutrality plans, as the term “carbon neutrality” is sometimes used as a shorthand for full mitigation of an entity’s greenhouse gas emissions.

Metric Ton of Carbon Dioxide (CO_2) Equivalent: CO_2 equivalent is the internationally accepted term for describing different greenhouse gases in a common unit. CO_2 is the most commonly emitted greenhouse gas, but all other primarily regulated greenhouse gases have higher climate change impacts per metric ton than CO_2. For any quantity and type of greenhouse gas, one metric ton of CO_2 equivalent signifies the amount of CO_2 that would have the equivalent climate change impact. For the purposes of greenhouse gas accounting and carbon neutrality calculations, the unit of metric ton CO_2 equivalent is used to consistently quantify all greenhouse gas emissions or reductions.

Primarily Regulated Greenhouse Gases: Although many greenhouse gases exist, the United States' greenhouse gas regulatory and voluntary programs primarily include gases from this list of more commonly emitted greenhouse gases including:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Fluorinated gases Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur Hexafluoride (SF_6)
- Nitrogen Trifluoride (NF_3)

Scopes: For consistency of reporting and management, greenhouse gas emissions are frequently categorized as follows:

- **Direct greenhouse gas emissions** are from sources owned or controlled by the reporting entity (e.g. company owned vehicles).
- **Indirect greenhouse gas emissions** are a consequence of the reporting entity's activities but occur at sources owned or controlled by another entity (e.g. shipping for goods and services purchased).

Honolulu traffic at night

Direct and indirect emissions can be further be categorized into three broad scopes:

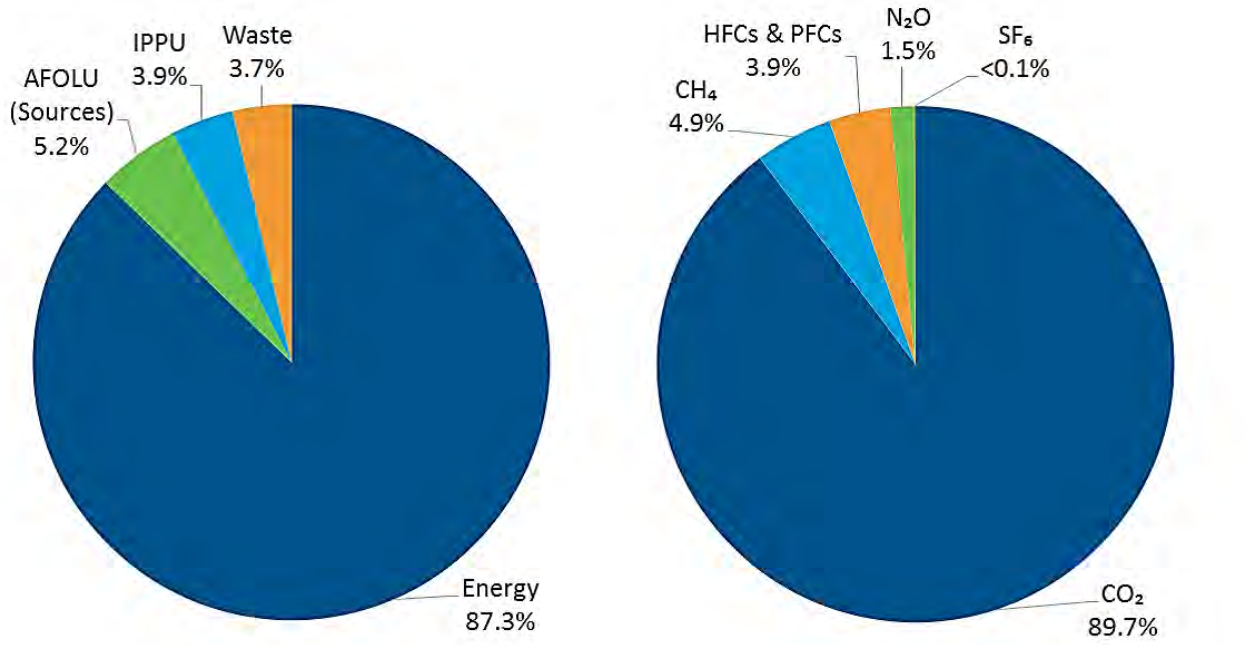
- **Scope 1:** All direct greenhouse gas emissions.
- **Scope 2:** Indirect greenhouse gas emissions from consumption of purchased electricity, heat, or steam.
- **Scope 3:** Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in Scope 2, outsourced activities, and off-site waste disposal.

Scopes are generally used by cities, corporations, or smaller agencies for greenhouse gas accounting. Division by scopes is typically not used for state or national level greenhouse gas inventories, and therefore, the State of Hawai‘i’s greenhouse gas inventory is not delineated by scope.

3.3 State of Hawai‘i’s Greenhouse Gas Emissions Inventory Summary

The State of Hawai‘i’s Department of Health Clean Air Branch tracks the state’s annual greenhouse gas emissions inventory in accordance with part VI of Chapter 342B, Hawai‘i Revised Statutes.[5,6] The most recent 2015 total statewide carbon dioxide equivalent emissions equaled 21.28 million metric tons CO_2 equivalent, excluding emissions from sinks & international bunker fuel.[7] Energy represents the sector with the greatest emissions, and this state inventory includes sources such as power generation and transportation in the energy sector category. Figure 3 shows the distribution of these totals by sector and gas from the report with further details provided in the Department of Health Clean Air Branch’s Hawai‘i Greenhouse Gas Emissions Report for 2015.

Figure 3 – State of Hawai‘i 2015 Greenhouse Gas Emissions Inventory



Notes: AFOLU = Agriculture, Forestry and Other Land Uses, IPPU = Industrial Processes and Product Use, HFCs = hydrofluorocarbons, PFCs = perfluorocarbons.

Source: State of Hawai‘i Department of Health. Hawai‘i Greenhouse Gas Emissions Report for 2015. January 2019.

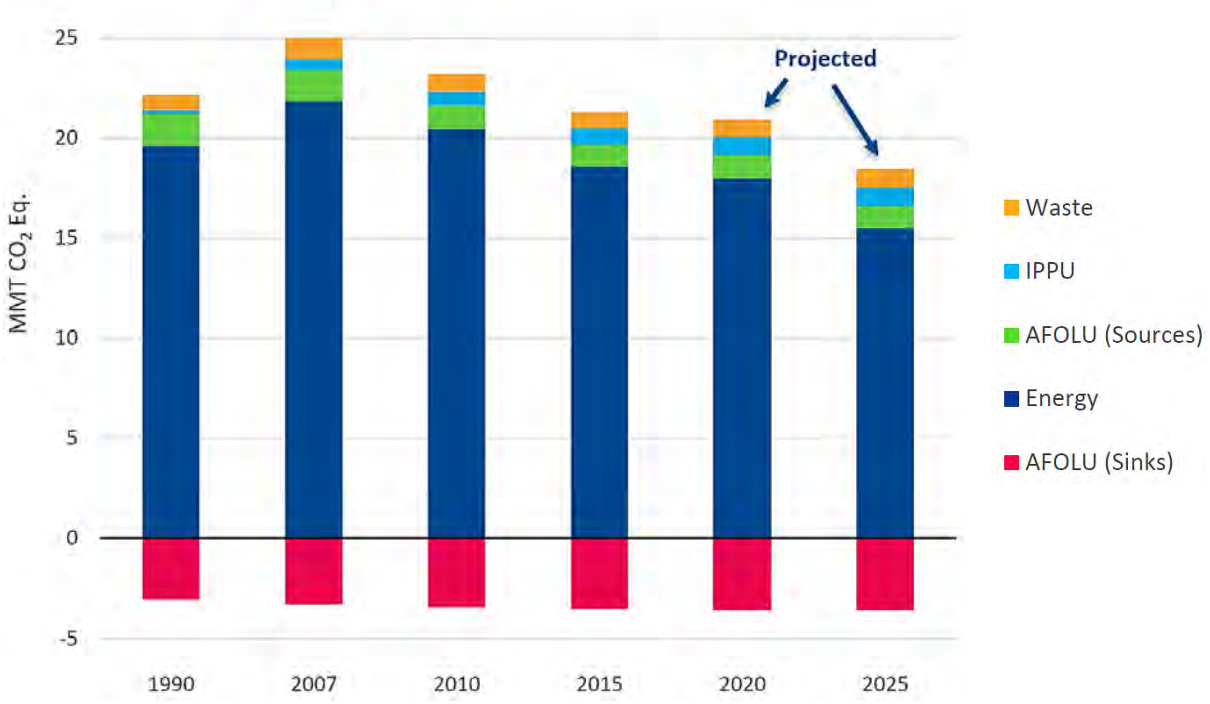
The State of Hawai‘i’s Department of Health Clean Air Branch also tracks the state’s progress toward this statutory emissions target; the state is currently on track to meet the 2020 target statewide. Figure 4 shows the state’s progress reducing greenhouse gas emissions over time.

[5] https://health.hawaii.gov/cab/hawaii-greenhouse-gas-program/

[6] http://www.capitol.hawaii.gov/hrscurrent/Vol06_Ch0321-0344/HRS0342B/HRS_0342B-.htm

[7] https://health.hawaii.gov/cab/files/2019/02/2015-inventory_final-report_january-2019-004-1.pdf

Figure 4 – State of Hawai‘i Greenhouse Gas Emissions Over Time



Notes: AFOLU = Agriculture, Forestry and Other Land Uses, IPPU = Industrial Processes and Product Use

Source: State of Hawai‘i Department of Health. Hawai‘i Greenhouse Gas Emissions Report for 2015. January 2019.

The State of Hawai‘i conducted its statewide inventory using the following protocols:

- The 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories.[8]
- The United States Environmental Protection Agency’s (U.S. EPA) Greenhouse Gas Reporting Program.[9]
- The United States Environmental Protection Agency’s (U.S. EPA) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015, and U.S. EPA’s State Inventory Tool.[10]

Other prominent methods and protocols exist for greenhouse gas inventories of various entities, including the World Resources Institute and the World Business Council for Sustainable Development, Greenhouse Gas Protocol, and International Organization for Standardization 14064.[11,12]

3.4 Reducing Greenhouse Gas Emissions

With a comprehensive greenhouse gas inventory an entity such as the State of Hawai‘i can identify the major sources of emissions and the most viable opportunities for reductions. Individual greenhouse gas

[8] https://www.ipcc-nggip.iges.or.jp/public/2006gl/
[9] https://www.epa.gov/ghgreporting
[10] https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool
[11] https://ghgprotocol.org/
[12] https://www.iso.org/standard/66453.html

reduction actions can impact multiple greenhouse gas inventory sectors. Those reductions can be based entirely on the State of Hawai'i's own priorities, such as the extent of greenhouse gas reductions, costs, political viability, and co-benefits (such as air quality improvement, climate resilience, or job creation). The benefit of this approach is that it puts the least amount of restrictions on which emissions can be reduced.

Challenges to reducing greenhouse gas emissions include costly solutions, and the need for a clear understanding of the interconnection between greenhouse gas emissions sources in order to identify solutions that account for these connections. Greenhouse gas reduction options are not always effective in every scenario. Determining effectiveness of each greenhouse gas reduction or solution requires evaluating specific localized conditions. For this reason, it is valuable to identify solutions with an understanding of all greenhouse gas sources as well as the various policy and voluntary mechanisms to reduce greenhouse gas emissions. Types of greenhouse gas reduction project examples are summarized in Table 1.

Table 1 – Types of Greenhouse Gas Reductions and Examples

Greenhouse Gas Reduction Project Types	Greenhouse Gas Reduction Project Examples
Energy Distribution, Demand, or Efficiency	• Energy efficiency • Electric vehicle charging infrastructure • Landfill methane capture • Wastewater methane capture • Hydrogen fueling infrastructure
Transportation	• Modal shift • Public transit expansion • Fuel switching • Zero emission vehicles
Industrial Process and Fugitive Emissions	• Methane and high-global warming potential gas capture and destruction • High-global warming potential gas replacement • Efficiency measures • Feedstock substitution
Water Sustainability	• Water infrastructure efficiencies that lead to energy savings • Carbon sequestration through aquatic reef restoration

Greenhouse Gas Reduction Project Types	Greenhouse Gas Reduction Project Examples
The Urban and Built Environment	• Urban forestry • Green infrastructure • Energy reduction measures for buildings
Waste Handling and Disposal	• Landfill and wastewater process efficiencies • Recovery and diversion • Composting
Land Management: Agriculture, Forestry, Grassland or other Land Use	• Regenerative agriculture and pasture • Afforestation • Reforestation
Livestock and Manure Management	• Collection and central treatment • Methane recovery and avoidance • Strategic feed supplementation
Carbon Capture and Storage	• Chemical Sequestration • Industrial sequestration • Physical Sequestration
Renewable Energy Generation	• Wind • On-site or utility-scale solar • Biomass and biofuel • Waste-to-energy • Marine energy • Hydropower • Geothermal energy projects

Each of the greenhouse gas reduction project types listed in Table 1 can be readily linked to greenhouse gas sources. The viability of any climate change mitigation strategy depends on factors such as operational impact, ease of implementation, cost effectiveness, regulatory impact, political and social acceptance, and other concerns specific to each strategy. State policies have various implications on a robust climate change strategy, and the next chapter of this report summarizes the State of Hawai‘i’s current laws and policies.

4 State of Hawai‘i Climate Change Laws and Policies

The State of Hawai‘i has taken important steps toward managing and reducing greenhouse gas emissions. This chapter summarizes the State of Hawai‘i’s major laws and policies related to climate change. The foundational targets of these laws include:

- Reducing the State of Hawai‘i’s greenhouse gas emissions to 1990 levels by the year 2020.[13]
- Achieving 100% renewable energy in electricity sales by the year 2045.[14]
- Achieving the Zero Emissions Clean Economy target by the year 2045.[15]

The following summary provides details of these targets and relevant context for the consideration of greenhouse gas offsets or alternative implementation mechanisms to further reduce greenhouse gas emissions in the State of Hawai‘i.

4.1 Statewide Greenhouse Gas Emissions Reductions

Act 234, Session Laws of Hawai‘i 2007

Act 234, Session Laws of Hawai‘i 2007, established a state policy framework for cost effective reductions of the State of Hawai‘i’s greenhouse gas emissions to 1990 levels, by January 1, 2020, excluding the greenhouse gas emissions from airplanes.[16] Key outcomes of Act 234, Session Laws of Hawai‘i 2007, included the following statutes and resulting programs.

Hawai‘i is currently on track to meet the 2020 greenhouse gas emissions reduction target.

Hawai‘i Revised Statutes, § 342B-71

This statute established a statewide greenhouse gas emissions limit to be achieved by the year 2020 that is equal to or below 1990 statewide greenhouse gas emissions, excluding the greenhouse gas emissions from airplanes.[17]

[13] https://www.capitol.hawaii.gov/hrscurrent/Vol06_Ch0321-0344/HRS0342B/HRS_0342B-0071.htm

[14] http://www.capitol.hawaii.gov/hrscurrent/Vol05_Ch0261-0319/HRS0269/HRS_0269-0091.htm

[15] https://www.capitol.hawaii.gov/hrscurrent/Vol04_Ch0201-0257/HRS0225P/HRS_0225P-0005.htm

[16] https://www.capitol.hawaii.gov/session2007/bills/gm1005_.pdf

[17] https://www.capitol.hawaii.gov/hrscurrent/vol06_ch0321-0344/hrs0342b/hrs_0342b-0071.htm

Hawai‘i Revised Statutes, § 342B-72

This statute required the following measures in furtherance of achieving the statewide 2020 greenhouse gas emissions limit:

- Establishing source category-specific greenhouse gas limits, supported by measures to achieve the maximum practically and technically feasible and cost-effective reductions;
- Conducting statewide greenhouse gas inventories, verification, and reporting to track progress toward the 2020 limit;
- Adopting rules, to the extent feasible, to achieve real, permanent, quantifiable, and verifiable greenhouse gas reductions; and
- Reviewing and updating the State of Hawai‘i greenhouse gas reporting requirements periodically to align them with international, federal, and other states’ greenhouse gas emission reporting programs, as necessary.[18,19]

Hawai‘i Revised Statutes, § 342B-73

This statute empowered the State of Hawai‘i’s Department of Health to establish a schedule of fees to be paid by the sources of greenhouse gas emissions regulated under these statutes.[20] All revenues collected are to be deposited into the clean air special fund. This fund was established under Hawai‘i Revised Statutes, § 342B-32, solely for developing, supporting, and administering the permit program requirements.[21]

Amendments to Hawai‘i Administrative Rules, Chapter 11-60.1

Based on Hawai‘i Revised Statutes, §§ 342B-72 and -73, the Department of Health amended its Air Pollution Control rules to include the following requirements for permitted stationary sources with potential CO_2 equivalent emissions of at least 100,000 short tons per year:[22,23]

- Reducing facility-wide greenhouse gas emissions 16% from a 2010 baseline by 2020;
- Submitting a greenhouse gas reduction plan establishing measures to meet the target;[24]
- Flexibility is provided in meeting the greenhouse gas cap. Facilities may seek approval for an alternate target and may partner with each other so as to achieve the total required emissions from this large stationary source emissions sector; and
- Starting in 2015, greenhouse gas emissions are included along with criteria pollutants in determining those sources’ annual fees.[25] As specified in Chapter 11-60.1-114(i), the greenhouse gas fees total $0.12 per ton of CO_2 equivalent.[26]

[18] https://www.capitol.hawaii.gov/hrscurrent/vol06_ch0321-0344/hrs0342b/hrs_0342b-0072.htm

[19] The 2015 results summarized in Section 3.3 of this report demonstrate that the state is on track to achieve the 2020 target.

[20] https://www.capitol.hawaii.gov/hrscurrent/vol06_ch0321-0344/hrs0342b/hrs_0342b-0073.htm

[21] https://www.capitol.hawaii.gov/hrscurrent/vol06_ch0321-0344/hrs0342b/hrs_0342b-0032.htm

[22] http://health.hawaii.gov/opppd/files/2015/06/11-60.1.pdf

[23] https://health.hawaii.gov/epo/files/2015/08/2014-6-19-ghg-talking-points.pdf

[24] Municipal waste combustion operations are exempted from the greenhouse gas emission reduction plan. https://health.hawaii.gov/cab/files/2014/07/responsetocomments4.pdf

[25] http://health.hawaii.gov/cab/hawaii-greenhouse-gas-program/

[26] This $0.12 per ton total is made up of $0.07 per ton made payable to the Clean Air Special Fund-COV, and $0.05 per ton made payable to the Clean Air Special Fund-NON.

Work Plan for Greenhouse Gas Emissions Reductions

As required by Act 234, Session Laws of Hawai'i 2007, a task force made up of state government leaders and other experts developed Hawai'is Greenhouse Gas Emission Reduction Work Plan (2009).[27] This work plan focused on implementing the maximum practically, technically feasible, and cost-effective reductions in the State of Hawai'i's major greenhouse gas emissions sectors to achieve the 2020 statewide limit.[28,29]

Key conclusions and recommendations from the work plan included the following:

- The Hawai'i Clean Energy Initiative (discussed in Section 4.2 of this report) was identified as the primary driver of emissions reductions measures recommended in the work plan.
- Along with accounting for emission reductions through the Hawai'i Clean Energy Initiative measures, the State of Hawai'i should consider additional measures to reduce emissions in the buildings and transportations sectors.
- The cost of achieving those measures should be more explicitly defined.
- Additional assurances, incentives, and policy mechanisms should be developed.
- Carbon pricing mechanisms should be considered. The work plan evaluated both a carbon tax and cap-and-trade system and concluded that either policy would only result in incremental greenhouse gas reductions beyond those projected from the Hawai'i Clean Energy Initiative. Specific conclusions about these two types of carbon pricing mechanisms include the following:
    - A statewide greenhouse gas cap-and-trade system was deemed infeasible for the size of Hawai'i's economy.[30] The work plan was written while the federal cap-and-trade legislation was under consideration, and the work plan assumed that the legislation would pass, which did not occur. Based on these factors at the time, the work plan did not recommend further consideration of a statewide greenhouse gas cap-and-trade system.
    - Further research was recommended for the implementation of a carbon tax, the optimal price of the tax, and the use of tax revenue. The recommendation included the need to ensure compatibility with federal cap-and-trade legislation expected at the time of the 2009 work plan.

Climate Change Adaptation Priority Guidelines

Along with focusing on reducing greenhouse gas emissions, the State of Hawai'i set priority guidelines to prepare for adapting to statewide impacts to climate change in the Hawai'i State Planning Act codified as § 226-109, Hawai'i Revised Statutes.[31] This statute included a focus on impacts to natural resources as

[27] The full work plan can be found at: http://files.hawaii.gov/dbedt/annuals/2009/2009-sid-ghgrtf.pdf

[28] The 2015 update to the work plan can be found online at: https://energy.hawaii.gov/wp-content/uploads/2016/03/2015-greenhouse-gas-program.pdf

[29] Act 15, SLH 2017, amended a portion of Act 234, SLH 2007 by deleting the work plan's five-year review and reporting requirement to be performed by the Greenhouse Gas Emissions Reduction Task Force, the task force was dissolved in 2010: https://www.capitol.hawaii.gov/session2017/bills/GM1115_.PDF

[30] This conclusion was stated in Section 3 of the work plan.

[31] https://www.capitol.hawaii.gov/hrscurrent/Vol04_Ch0201-0257/HRS0226/HRS_0226-0109.htm

well as human-made infrastructure and land uses. Although this statute is primarily focused on increasing Hawai‘i’s resiliency through climate change adaptation, it included a directive to preserve and restore natural landscape features, which can also provide climate change mitigation through carbon sequestration.

Hawai‘i Climate Change Mitigation and Adaptation Initiative

The State of Hawai‘i built on Act 234, Session Laws of Hawai‘i 2007, ten years later through Act 32, Session Laws of Hawai‘i 2017, to align with the principles of the United Nations’ Paris Agreement and contribute to its goals.[32] The purpose of Act 32, Session Laws of Hawai‘i 2017, was to combat climate change by reducing greenhouse gas emissions as well as improving the state’s resiliency to climate change. Act 32, Session Laws of Hawai‘i 2017, directed the State of Hawai‘i to expand strategies and mechanisms to reduce statewide greenhouse gas emissions through reduction of energy use, adoption of renewable energy, and control of air pollution among all agencies, departments, industries, and sectors, including transportation. Such strategies and mechanisms are required to:

- Utilize the best available science, technologies, and policies to reduce greenhouse gas emissions; and
- Align closely with the climate change principles and goals adopted in the Paris Agreement and Hawai‘i’s share of obligations within the expectations apportioned to the United States, regardless of federal action.

Act 32, Session Laws of Hawai‘i 2017, also added a greenhouse gas reduction focus to the newly created Hawai‘i Climate Change Mitigation and Adaptation Commission, which is administratively attached to the Department of Land and Natural Resources. Coordination of this advisory commission is headed jointly by two co-chairs: the Chairperson of the Board of Land and Natural Resources and the Director of the State of Hawai‘i’s Office of Planning, or their designees. This new focus was established by amending Hawai‘i Revised Statutes, Chapter 225P to:

- Rename the Interagency Climate Adaptation Committee the Hawai‘i Climate Change Mitigation and Adaptation Commission; and
- Direct this advisory commission to develop strategies and make recommendations based on the best available information, to further climate mitigation as well as adaptation.

4.2 Renewable Energy and Energy Efficiency

Hawai‘i Clean Energy Initiative

The cornerstone of the State of Hawai‘i’s reduction of fossil fuel-derived energy is the Hawai‘i Clean Energy Initiative**.** This initiative was launched through a 2008 Memorandum of Understanding between the United States Department of Energy and the State of Hawai‘i to collaborate on reducing the State of Hawai‘i’s heavy dependence on imported fossil fuels. This agreement established overall goals for the State of Hawai‘i to significantly increase its clean energy production capabilities and to transition to renewable energy sources. The Hawai‘i Clean Energy Initiative resulted in a total of 82 laws enacted between 2008 and

[32] https://www.capitol.hawaii.gov/session2017/bills/GM1132_.PDF

2017, and legislative activity continues.[33,34] Policies derived from Hawai'i Clean Energy Initiative address topics such as regulatory reform, tax policy, and clean energy financing. Two of the primary regulatory drivers of fossil fuel reductions are the Renewable Portfolio Standard and the Energy Efficiency Portfolio Standard, along with building codes and standards.

Renewable Portfolio Standard

Hawai'i Revised Statutes, § 269-92, required all electric utilities that sell electricity for consumption in Hawai'i to establish a Renewable Portfolio Standard that meets the following targets for renewable energy generation:

- 30% by 12/31/2020;
- 40% by 12/31/2030;
- 70% by 12/31/2040; and
- 100% by 12/31/2045.[35]

Hawai'i's Renewable Portfolio Standard has been a longstanding policy pre-dating the Hawai'i Clean Energy Initiative. After initially establishing a renewable portfolio goal in 2001, the State of Hawai'i codified an enforceable Renewable Portfolio Standard through Act 95, Session Laws of Hawai'i 2004.[36] Since that initial adoption, Hawai'i's Renewable Portfolio Standard was amended multiple times to expand and align with Hawai'i's energy policies and with the goals established by the Hawai'i Clean Energy Initiative.

The most recent expansion of Hawai'i's Renewable Portfolio Standard was enacted through Act 97, Session Laws of Hawai'i 2015, which made Hawai'i the first state in the nation with a statutory target of a 100% Renewable Portfolio Standard.

Energy Efficiency Portfolio Standard

Along with the Renewable Portfolio Standard, Act 155, Session Laws of Hawai'i 2009, added other energy initiatives including the Energy Efficiency Portfolio Standard codified as Hawai'i Revised Statutes, § 269-96.[37]

The State of Hawai'i's Public Utilities Commission is required to establish the Energy Efficiency Portfolio Standard to maximize cost-effective energy-efficiency programs and technologies and foster electricity use reduction through the following provisions:

- Mandates a statewide annual electricity reduction of 4,300 gigawatt-hours by the year 2030;
- Directs the establishment of interim goals and potential adjustment of the 2030 target;
- Allows for establishment of performance-based incentives and penalties;

[33] A summary of primary policy initiatives by year is available at: http://www.hawaiicleanenergyinitiative.org/policy/
[34] 2019 legislative measures are available at: http://www.hawaiicleanenergyinitiative.org/2019-measures/
[35] https://www.capitol.hawaii.gov/hrscurrent/vol05_ch0261-0319/hrs0269/hrs_0269-0092.htm
[36] https://www.capitol.hawaii.gov/session2004/bills/sb2474_hd1_.htm
[37] https://www.capitol.hawaii.gov/hrscurrent/vol05_ch0261-0319/hrs0269/hrs_0269-0096.htm

- Mandates re-evaluation of the standard every five years; and
- Allows for electricity savings from customer-sited, non-grid-connected renewable energy to count toward electricity savings under the standard.

Building Codes and Standards

Building codes that reduce the consumption of fossil fuels help to minimize greenhouse gas emissions. The following summarizes the State of Hawai'i's primary energy-related building code-related initiatives to date.

One of the State of Hawai'i's building code rules is the State Energy Conservation Code, which sets minimum energy usage effectiveness requirements for design and construction of commercial and residential buildings in the State of Hawai'i.[38,39] This code, most recently updated in 2017, adopted the 2015 International Energy Conservation Code, and primarily focuses on energy efficiency and conservation. Renewable energy is addressed through a few requirements for residential buildings.

The Hawai'i Clean Energy Initiative has addressed building codes and other requirements that support fossil fuel energy usage reduction. Notable legislative initiatives to date include:

- **Act 204, Session Laws of Hawai'i 2008:** Supported residential solar water heating, which is also addressed in the State Energy Conservation Code.[40]
- **Act 192, Session Laws of Hawai'i 2009:** Prohibited real estate contracts, agreements, and rules from precluding or rendering ineffective the use of clotheslines on the premises of single-family dwellings or townhouses. Although not a building code, this act supports Hawai'i residents' ability to use clotheslines as an alternative to electric dryers.[41]
- **Act 53, Session Laws of Hawai'i 2010:** Gave board of directors the authority to install or allow the installation of solar energy or wind energy devices on the common elements of condominiums.[42]
- **Act 186, Session Laws of Hawai'i 2010:** Allowed the installation of an electric vehicle charging station on or near the parking stall of any multi-family residence or townhouse.[43]
- **Act 201, Session Laws of Hawai'i 2010:** Required private homeowners associations to revise their rules so as not to impose conditions or restrictions that render a solar energy device less effective; increase the cost of installation, maintenance, and removal of a solar energy device; or require an encumbrance on title because of the placement of the solar energy device.[44]

[38] https://ags.hawaii.gov/bcc/building-code-rules/
[39] https://ags.hawaii.gov/wp-content/uploads/2012/09/stateenergyconservationcode-20170331.pdf
[40] https://www.capitol.hawaii.gov/session2008/bills/gm847_.pdf
[41] https://www.capitol.hawaii.gov/session2009/bills/gm863_.pdf
[42] https://www.capitol.hawaii.gov/session2010/bills/gm515_.pdf
[43] https://www.capitol.hawaii.gov/session2010/bills/gm647_.pdf
[44] https://www.capitol.hawaii.gov/session2010/bills/gm693_.pdf

- **Act 261, Session Laws of Hawai‘i 2013:** Exempted landlords and lessors who install renewable energy systems on their property and provide, sell, or transmit electricity generated from those renewable energy systems to tenants or lessees on the premises from the definition of public utility, under certain conditions.[45]
- **Act 106, Session Laws of Hawai‘i 2014:** Provided consumer protection related to solar energy installation.[46]
- **Act 164, Session Laws of Hawai‘i 2014:** Updated, funded, and staffed the state Building Code Council, which was created in 2007 to review and adopt current, nationally recognized building codes and standards for the State of Hawai‘i. [47]
- **Act 99, Session Laws of Hawai‘i 2015:** Required that the University of Hawai‘i become net-zero with respect to energy use, producing as much energy as the University system consumes across all campuses, by January 1, 2035.[48]
- **Act 164, Session Laws of Hawai‘i 2015:** Established a working group to address the installation of electric vehicle charging systems at apartments, condominiums, cooperative housing corporations, and planned community associations.[49]
- **Act 176, Session Laws of Hawai‘i 2016:** Required that the state Department of Education become net-zero with respect to energy use, producing as much renewable energy as the department consumes across all public-school facilities by January 1, 2035.[50]
- **Act 141, Session Laws of Hawai‘i 2017:** Required the state Building Code Council to adopt codes or standards within two years of official publication; otherwise, automatic adoption into the Hawai‘i State Building Code will occur.[51]
- **Act 142, Session Laws of Hawai‘i 2019:** Established a rebate program within the state Public Utilities Commission that incentivizes the installation or upgrade of an electric vehicle charging system.[52]

4.3 Greenhouse Gas Sequestration, Zero Emissions, Carbon Offsetting, and Carbon Pricing

Act 15 and Act 16, Session Laws of Hawai‘i 2018, were established in parallel to increase a focus on greenhouse gas sequestration as well as offsetting, and provided fiscal year 2018-19 funding for the initial efforts required by the respective statutes.

[45] https://www.capitol.hawaii.gov/session2013/bills/gm1364_.pdf
[46] https://www.capitol.hawaii.gov/session2014/bills/gm1207_.pdf
[47] https://www.capitol.hawaii.gov/session2014/bills/gm1267_.pdf
[48] https://www.capitol.hawaii.gov/session2015/bills/GM1199_.pdf
[49] https://www.capitol.hawaii.gov/session2015/bills/gm1265_.pdf
[50] https://www.capitol.hawaii.gov/session2016/bills/gm1278_.pdf
[51] https://www.capitol.hawaii.gov/session2017/bills/gm1242_.pdf
[52] https://www.capitol.hawaii.gov/session2019/bills/HB1585_CD1_.pdf

Greenhouse Gas Sequestration Task Force

Act 15, Session Laws of Hawai‘i 2018, built upon Act 32, Session Laws of Hawai‘i 2017, to emphasize greenhouse gas sequestration by taking specific steps to increase sequestration in Hawai‘i.[53] Act 15, codified as Hawai‘i Revised Statutes, § 225P-4, established the Greenhouse Gas Sequestration Task Force.[54] This task force was charged with a number of statutory objectives, which among other responsibilities, include: identifying the potential to improve soil health, and increasing greenhouse gas sequestration in the agricultural, aquacultural, urban, and natural environments. The Greenhouse Gas Sequestration Task Force was also directed to consider developing incentives and funding mechanisms to achieve its statutory objectives. The task force is required to submit a preliminary report of its findings and recommendations, including any proposed legislation to the Hawai‘i State Legislature and the Hawai‘i Climate Change Mitigation and Adaptation Commission. This preliminary report is due prior to the regular legislative session of 2023, followed by annual reports beginning with the regular legislative session of 2024.

Zero Emissions Clean Economy Target

A portion of Act 15, Session Laws of Hawai‘i 2018, was codified separately as Hawai‘i Revised Statutes, § 225P-5, which commits Hawai‘i to a Zero Emissions Clean Economy target:[55, 56]

> *Considering both atmospheric carbon and greenhouse gas emissions as well as offsets from the local sequestration of atmospheric carbon and greenhouse gases through long-term sinks and reservoirs, a statewide target is hereby established to sequester more atmospheric carbon and greenhouse gases than emitted within the State as quickly as practicable, but no later than 2045.*

In the context of this statute, this target focuses on the sequestration side of the greenhouse gas commitment. Achieving this statutory target will be eased through greenhouse gas emissions reductions, which can be supported by policies such as the Hawai‘i Clean Energy Initiative.

The statute further requires that “after January 1, 2020, all agency plans, decisions, and strategies shall be given consideration to the impact of those plans, decisions, and strategies on the State’s ability to achieve the goals in this section, weighed appropriately against their primary purpose.”

Act 15, Session Laws of Hawai‘i 2018, focused on realizing greenhouse gas benefits from agricultural and aquacultural operations and touches on achieving economic benefits for these operations. As such, the state’s greenhouse gas sequestration law informally relates to the state’s important agricultural lands law codified in Hawai‘i Revised Statutes, §§ 205-41 through -52, which describes the State of Hawai‘i’s compelling interest to conserve the state’s agricultural land resource base and assure the long-term availability of agricultural lands for agricultural use in Hawai‘i.[57] Though these important agricultural lands statutes are not directly tied to the legislative intent of Act 15, Session Laws of Hawai‘i 2018, they can be potentially supported by any economic benefits derived through Act 15, Session Laws of Hawai‘i 2018.

[53] https://www.capitol.hawaii.gov/session2018/bills/GM1115_.PDF
[54] https://www.capitol.hawaii.gov/hrscurrent/vol04_ch0201-0257/hrs0225p/hrs_0225p-0004.htm
[55] https://www.capitol.hawaii.gov/session2018/bills/GM1115_.PDF
[56] https://www.capitol.hawaii.gov/hrscurrent/vol04_ch0201-0257/hrs0225p/hrs_0225p-0005.htm
[57] https://www.capitol.hawaii.gov/hrscurrent/vol04_ch0201-0257/hrs0205/

Carbon Offset Program

Act 16, Session Laws of Hawai‘i 2018, codified as Hawai‘i Revised Statutes, § 225P-6, directed the Office of Planning in partnership with the Greenhouse Gas Sequestration Task Force to:[58,59]

- Investigate the establishment of a Hawai‘i carbon offset program.
- Submit a preliminary report of its findings and recommendations, including any proposed legislation, to the Hawai‘i State Legislature and the Hawai‘i Climate Change Mitigation and Adaptation Commission.

This report serves as the feasibility study pursuant to Act 16, Session Laws of Hawai‘i 2018, to investigate the framework necessary for the establishment of an offset program. Act 16, Session Laws of Hawai‘i 2018, is the primary legal foundation for this report and included as Appendix D of this report.

State of Hawai‘i Public Utilities Commission Memorandum of Understanding

The March 27, 2019 Memorandum of Understanding between the State of Hawai‘i’s Public Utilities Commission with the State of California’s Public Utilities Commission built on the State of Hawai‘i’s greenhouse gas commitments and the Hawai‘i Clean Energy Initiative.[60] Key objectives specified in the State of Hawai‘i’s Public Utilities Commission’s Memorandum of Understanding include: the advancement of infrastructure to reduce emissions in the energy and transportation sectors; the examination of opportunities to electrify transportation, energy, and building sectors; and the promotion of carbon offset programs.

Carbon Pricing Study

Act 122, Session Laws of Hawai‘i 2019, formally established the Hawai‘i State Energy Office, which among having other responsibilities, will conduct a study of carbon pricing, including whether and how a carbon pricing policy shall be implemented in Hawai‘i.[61]

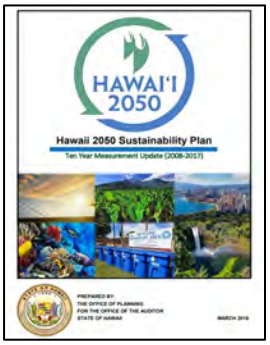
4.4 Hawai‘i 2050 Sustainability Plan

Hawai‘i 2050 Sustainability Plan Ten Year Measurement Update

The Hawai‘i 2050 Task Force was established by Act 8 of the 2005 Special Session of the Hawai‘i State Legislature to review the Hawai‘i State Plan and the state’s comprehensive planning system, to develop a statewide sustainability plan for the 21st century.[62] Based on the recommendations in the task force’s report, the Office of the Auditor developed the Hawai‘i 2050 Sustainability Plan to define and implement state goals, objectives, policies, and priority deadlines by incorporating the task force’s recommendations. The initial Hawai‘i 2050 Sustainability Plan was submitted in 2008.[63]

[58] https://www.capitol.hawaii.gov/session2018/bills/GM1116_.PDF
[59] https://www.capitol.hawaii.gov/hrscurrent/vol04_ch0201-0257/hrs0225p/hrs_0225p-0006.htm
[60] https://www.cpuc.ca.gov/uploadedfiles/cpuc_public_website/content/safety/mou%20ca%20and%20hi%20march%2027,%202019.pdf
[61] https://www.capitol.hawaii.gov/session2019/bills/GM1224_.PDF
[62] https://www.capitol.hawaii.gov/splsession2005/bills/sb1592_cd1_.htm
[63] http://files.hawaii.gov/dbedt/op/sustainability/hawaii_2050_plan_final.pdf

In 2018, the Hawai‘i State Auditor, with the assistance of the Office of Planning, conducted an informal update of the Hawai‘i 2050 Sustainability Plan.[64] To measure the State of Hawai‘i’s progress toward the sustainability goals established in the 2008 plan, the update reviewed data collected between 2008 and 2017. The plan’s benchmark of reducing reliance on fossil fuels, and thereby reducing the associated greenhouse gas emissions, was shown to be an area of relatively strong performance for the state. Based on policies including those discussed here, the plan update showed that the State of Hawai‘i has made measurable progress toward reducing fossil fuel reliance.



Hawai‘i 2050 Sustainability Plan Codified within the Hawai‘i State Planning Act

Act 146, Session Laws of Hawai‘i 2019, built on Act 8, Special Session Laws of Hawai‘i 2005, and transitioned the execution and future updates of the Hawai‘i 2050 Sustainability Plan from the Hawai‘i State Auditor to the State of Hawai‘i’s Office of Planning.[65]

Act 146, Session Laws of Hawai‘i 2019, further codified in the Hawai‘i Revised Statutes as § 226-65 within the Hawai‘i State Planning Act that the Hawai‘i 2050 Sustainability Plan shall serve as the state’s climate and sustainability action plan. This revised version of the plan is directed to determine the future actions guiding the coordination and implementation of the State of Hawai‘i’s sustainability and climate adaptation goals, principles, policies, and priority guidelines using the Hawai‘i State Planning Act and the Hawai‘i Climate Change Mitigation and Adaptation Initiative as its guiding principles.

The Office of Planning is required to submit the update of the Hawai‘i 2050 Sustainability Plan to the Hawai‘i State Legislature, prior to the regular session of 2021, followed by decennial updates of the plan thereafter.

With this foundation of the State of Hawai‘i’s major climate change laws and policies, the following chapters of this report provide an overview of greenhouse gas offsets, offset markets, and the transaction process, and provide a framework with which to evaluate offset feasibility for the State of Hawai‘i. Alternative implementation mechanisms to carbon offsets are also provided to assist the Hawai‘i state government evaluate the best mechanisms to foster greenhouse gas emissions reductions.

[64] http://files.hawaii.gov/dbedt/op/sustainability/2018_hawaii_2050_measurment_update.pdf
[65] https://www.capitol.hawaii.gov/session2019/bills/GM1248_.PDF

5 Overview of Greenhouse Gas Offsets

The following is an introduction to key concepts related to offset credits, followed by a summary of the advantages and disadvantages of creating them. There is much confusion regarding carbon (greenhouse gas) offsets, which may be partially due to their name. Many refer to “offsetting” their greenhouse gas emissions by planting a tree or performing another action to use or sequester carbon. In the context of an offset market, offsets are an implementation mechanism to support greenhouse gas reduction actions; they are not the greenhouse gas emissions reductions.

It is possible for voluntary greenhouse gas reductions to be turned into offset credits, but it is rare for the right conditions to be met. More importantly, greenhouse gas reductions and offsets are not synonymous. Offsets were originally intended to bridge the gap between high and low-cost greenhouse gas reductions. For example, if a regulated entity (e.g. production facility) is emitting greenhouse gases and needs to lower their volume of emissions, they have two choices: 1) invest in technologies or solutions to produce fewer emissions, or 2) purchase carbon offsets. Purchasing offset credits is a lower cost alternative to changing their manufacturing process, for example, while still lowering their regulated emissions. A scale is often used to visually demonstrate this principle; however, it oversimplifies the process and does not consider other crucial considerations, such as environmental justice. There are numerous complexities involved in the creation and transfer of offset credits; these complexities are discussed at length in this report.

5.1 Offsets vs. Allowances

Offset: An offset or offset credit, sometimes referred to as “greenhouse gas emissions reductions credit,” “offset certificate,” “offset instrument,” “carbon offset,” or “greenhouse gas offset,” is a credit for mitigating 1 metric ton carbon dioxide (CO_2) equivalent by paying someone else to avoid 1 metric ton CO_2 equivalent. Offset credits are monetarily tradeable and must be evaluated and certified by an offset standard, which provides an established set of rules to ensure that offsets meet stringent requirements to ensure transparency and credibility.

Allowance: An emissions credit or permit in a carbon market that is generated by a regulatory agency to allow for the emissions of greenhouse gases, generally as part of a limit on emissions.

In summary, an offset is a price for greenhouse gas emissions reduced, and an allowance is a price for greenhouse emissions emitted.

5.2 Quality Criteria, Standards, and Protocols for Offsets

Quality Criteria

Greenhouse gas reductions from an offset project are independently verified to a specific protocol and then assigned to a third-party registry, certifying that the offset credits meet the following requirements:

1. **Real/Actual:** Quantified through technically and scientifically sound accounting practices that represent actual emissions reductions beyond a baseline.
2. **Quantifiable/Quantification:** The ability to consistently manage, measure, and calculate the total quantity of offsets produced.
3. **Permanent/Permanence:** The greenhouse gas emissions reductions will last in perpetuity without reversal.[66]
4. **Enforceable/Enforceability:** Assurance that the offset credits are trackable and supported by regulatory or third-party framework that defines their creation, provides transparency, and guarantees exclusive ownership.
5. **Verifiable/Verification:** An auditing process performed by an approved party according to the offset project's program, whereby the project's offset credits are calculated according to the approved protocol.
6. **Additional/Additionality:** The requirement that a greenhouse gas reduction project not be implemented in a baseline or "business-as-usual" scenario (i.e. the emissions reduction project must be additional or new. If it was already planned for, then it is not a new or additional reduction.

   The primary tests for determining additionality are as follows:

   - *Legal Requirement Test:* The greenhouse gas reduction is not required by any federal, state, or local law, statute, rule, regulation, ordinance, court order, or other legally binding mandate.
   - *Performance Test:* The project achieves greater greenhouse gas reductions or removals than the standard performance threshold for the given project type, demonstrating the emissions reduction would only occur through the development of the offset credit.

Standards and Registries

The key to demonstrating the validity of greenhouse gas offset credits is meeting an internationally recognized offset standard. Examples of offset standards include the following:

- Climate Action Reserve [67]
- American Carbon Registry [68]
- Verified Carbon Standard [69]
- Gold Standard [70]

[66] Permanence is primarily a concern for offset projects that are related to land use due to ownership requirements and numerous unknowns related to climate change.

[67] https://www.climateactionreserve.org/

[68] https://americancarbonregistry.org/

[69] https://verra.org/project/vcs-program/

[70] https://www.goldstandard.org/

Each standard uses a registry to ensure that no offset is double counted. Registries track offset production and purchases and guarantee that offset credits are only counted once. APX and IHS Markit are examples of registries that standards use to ensure transparency.[71,72] In some programs or markets, the standards act as and are referred to as a registry. Whenever a standard acts as a registry, that standard still retains its typical registry (e.g. APX or IHS Markit) as part of the process assurance process. For clarity, this report retains the use of the term "standards" to refer to these entities.

Other standards exist for international offset projects, including the United Nations Clean Development Mechanism. Offset projects under this standard exist solely in developing countries to identify the most cost-effective global greenhouse gas reductions and at the same time provide opportunities for local economies to benefit from the projects.

Protocols

Each of the standards assure that the quality criteria are met through the development and subsequent adherence to protocols. Protocols exist for numerous greenhouse gas reduction projects. A comprehensive list of existing protocols under the standards is included in Appendix E of this report. This list of protocols can be used for understanding offset development and for identifying greenhouse gas reductions actions.

5.3 Risk and Additionality

While creating and trading offsets continues to be a strategy through credible institutions, there are major criticisms as to the effectiveness of offsets in supporting global greenhouse gas reductions.[73,74] Each varying offset program only has minor differences in structure, with the quality of offset credits being produced under each remaining fairly constant. The majority of offset risk is inherent in offset credits themselves. One such risk is the economic concept of "leakage," which is an undesirable situation in which the reduction of one entity's greenhouse gas emissions leads to an increase in greenhouse gas emissions elsewhere in the world. Greenhouse gases are a pollutant with global consequences; therefore, the ultimate goal must be an overall reduction in emissions, and not simply to transfer the emissions to another region. The potential for leakage can be reduced by including as many actors as possible in a trading scheme, as well as through policy and economic research in the proposed greenhouse gas reduction actions.

There is evidence that some offset programs and offset credits already produced do not meet the rigorous standards placed upon them, including the requirements of being real, quantifiable, and additional.[75,76,77] Alternatively, some offset programs, including those associated with California's Cap-and-Trade Program, have learned lessons from the past and do achieve real emissions reductions.[78]

To alleviate further environmental risk, some programs that allow offset purchases, including California's Cap-and-Trade Program, have a provision to invalidate purchased offset credits if they are found not to

[71] https://apx.com/apx-services/carbon-registries/
[72] https://ihsmarkit.com/products/environmental-registry.html
[73] http://unfccc.int/2860.php
[74] https://www.arb.ca.gov/cc/capandtrade/offsets/offsets.htm
[75] https://ec.europa.eu/clima/sites/clima/files/ets/docs/clean_dev_mechanism_en.pdf
[76] https://www.sei-international.org/publications?pid=2803
[77] http://www.npr.org/2017/02/24/515379885/environmental-groups-say-californias-climate-program-has-not-helped-them
[78] https://www.sciencedirect.com/science/article/pii/S0301479717304309

meet the necessary standards.[79] Two such instances have arisen in California's program, only one of which ultimately resulted in invalidation.[80] Potential invalidation represents a financial risk to offset credit purchasers. Conversely, programs that choose not to invalidate credits create more environmental integrity risk.[81]

Due in some part to the criticism of offset programs, the European Union decided to disallow the use of international Clean Development Mechanism offset credits starting in 2021 to meet its 2030 regional greenhouse gas reduction goals.[82] This decision does not disqualify the use of Clean Development Mechanism credits for voluntary purposes, but rather points to the need for moderate caution with offset credits.

5.4 Environmental Justice

Since offsets (voluntary or compliance) are a form of emissions trading, there is a possibility that one party may be disadvantaged in a trade. For this reason, consideration of environmental justice is important when establishing any emissions trading mechanism. The following series of questions regarding environmental justice is recommended for consideration when evaluating any offset project:

- Is there an interest in claiming the emissions reduction produced by the project? If yes, then re-evaluate offset creation.
- Is it acceptable for the buyer to claim the reduction? If no, then re-evaluate offset creation.
- Has climate change been considered as a global issue where the solutions require an interconnected approach between global communities? If no, then re-evaluate offset creation.
- Will the greenhouse gas reduction project adversely affect the community in which it is developed? If yes, then re-evaluate offset creation.
- Will the greenhouse gas reduction project adversely affect developing communities around the world through shifts in supply, demand, or resources? If yes, then re-evaluate offset creation.

Due to environmental justice and other concerns, offset creation and purchase are among the most contentious parts of regulated greenhouse gas emissions reduction programs. To date, offsets remain a contentious part of California's Cap-and-Trade due to environmental justice concerns.[83,84,85] A cap-and-trade program can be politically challenging and can generate great concern for environmental and social justice, but it can also generate revenue for the state. Gaining the benefits from offsets in a responsible way requires technical knowledge, policy understanding, and public education.[86,87,88]

[79] https://www.arb.ca.gov/cc/capandtrade/offsets/arboc_guide_regul_conform_invalidation.pdf
[80] https://www.arb.ca.gov/cc/capandtrade/offsets/ods_final_determination.pdf
[81] Every regulatory program has invalidation measures, though some voluntary programs do not.
[82] https://ec.europa.eu/clima/policies/ets/credits_en
[83] https://www.ghgpolicy.org/blog/2017/6/27/hot-air-and-offsets-in-californias-post-2020-carbon-market
[84] https://www.washingtonpost.com/news/energy-environment/wp/2017/08/21/a-controversial-california-effort-to-fight-climate-change-just-got-some-good-news/
[85] https://www.sandiegouniontribune.com/news/environment/sd-me-carbon-credits-20180917-story.html
[86] https://www.foodandwaterwatch.org/insight/california-cap-and-trade-environmental-injustice
[87] https://news.berkeley.edu/2018/07/10/californias-cap-and-trade-air-quality-benefits-go-mostly-out-of-state/
[88] https://www.npr.org/2017/02/24/515379885/environmental-groups-say-californias-climate-program-has-not-helped-them

The U.S. Environmental Protection Agency defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." [89] Therefore, the local community should be considered and respected through robust community engagement during offset project development planning. The terms and conditions established during offset project development can be used to ensure local community coordination.

Protection for Native Hawaiian Traditional and Customary Rights

Article XII, Section 7, of the Hawai'i State Constitution, protects land access for traditional and customary uses to Native Hawaiians.[90,91,92]

During the Carbon Offset Symposium, a question was raised from the audience as to whether offset projects could exclude access to land. The Carbon Offset Symposium facilitators emphasized that it is not necessary for offset projects to exclude access to offset project lands. Native Hawaiian rights for access to lands for traditional and customary use was affirmed.

5.5 Advantages and Disadvantages of Offsets

Entities with high on-site greenhouse gas reduction costs can purchase greenhouse gas offsets as one strategy to meet their greenhouse gas reduction targets. Greenhouse gas offsets offer the ability to bridge the gap in costs between entities with high costs for greenhouse gas reductions on-site and those with low costs for greenhouse gas reductions on-site.

The primary benefits of offsets are:

- Offsets represent actual greenhouse gas emission reductions, while providing co-benefits.
- Offset credits can be sold on a voluntary or regulatory offset market, as appropriate.
- Under the right conditions, an offset program provides economic opportunities, rather than regulatory or financial requirements.
- An offset developer receives money from the offset credits generated per the terms of the offset purchase agreements.
- Offsets are created through a rigorous process to ensure trust in the greenhouse gas reduction markets. The benefit of this rigor is that a purchasing entity will have confidence that the greenhouse gas reductions being purchased within those markets are verifiable and real.

[89] https://www.epa.gov/environmentaljustice

[90] https://dlnr.hawaii.gov/mk/files/2016/10/b.02d-hoohana-aku.pdf

[91] https://www.capitol.hawaii.gov/hrscurrent/vol01_ch0001-0042f/05-const/const_0012-0007.htm

[92] http://lrbhawaii.org/con/conart1.html

The primary challenges of offsets are:

- The rigor required in the process greatly reduces the flexibility in greenhouse gas reduction project selection. Only greenhouse gas reductions that fit into one of the very specific offset protocols can potentially be turned into offset credits.
- In addition to the costs of enacting the greenhouse gas reductions, the offset developer has potentially significant upfront and ongoing costs associated with the offset process. These fixed costs combined with regulatory and market risks can make it difficult for offset projects to be commercially viable.
- Once an offset is created and sold, the greenhouse gas reduction is no longer owned by its creator.[93] This can create an issue with meeting organizational goals, such as Hawai‘i’s Zero Emissions Clean Economy target. If the offset credit is sold outside of Hawai‘i, then the offset cannot count toward the state’s Zero Emissions Clean Economy target (see Section 7.3 of this report for further details).

The benefits of offsets differ depending on the role an entity plays within an offset market or program. The various offset roles, markets, and transaction process are described in Chapter 6 of this report. The exact role the State of Hawai‘i decides to pursue will have an impact on feasibility and is discussed further in Section 7.2 of this report.

[93] https://www.ftc.gov/sites/default/files/attachments/press-releases/ftc-issues-revised-green-guides/greenguides.pdf

6 Offset Markets and Transaction Process

This chapter provides a general overview of carbon markets, which are the overarching mechanism behind developing and commercializing carbon offsets. Carbon markets exist where there is pricing and trading of two products:

1. Allowances
2. Offsets

A price on greenhouse gas emissions can incentivize companies or government organizations to reduce and limit their greenhouse gas emissions through the lowest cost option while driving investment, innovation, and technology transfer. There are both “voluntary” and “regulated/compliance” carbon markets that exist worldwide. Both markets are driven by supply and demand, while compliance markets have the largest market size due to regulated demand, liquidity, and forecasted pricing.

Compliance markets operate under government-regulated programs that institute a price on greenhouse gas emissions based on mandated emission reduction targets through either a market-based approach (cap-and-trade) or a carbon tax structure. Offsets are used as a compliance alleviation method for regulated entities in a regulated carbon market. Offsets are most often used in a cap-and-trade system, as opposed to a carbon tax model, and offsets generally represent a very low fraction of the total compliance market share. Government administered offset programs require a program that prices greenhouse gas emissions, such as cap-and-trade or a carbon tax. In a compliance market, the price on greenhouse gas emissions establishes a demand and incentive for the purchase of offsets. Without this established demand through carbon pricing, a compliance offset market cannot exist.

Government administered offset programs require a program that prices greenhouse gas emissions such as cap-and-trade or a carbon tax.

In voluntary markets, organizations or individuals purchase and trade offset credits to meet voluntary commitments without any official requirement to pay for emissions. Unlike compliance programs, there is no overarching regulation or cost of noncompliance to organizations, which has the effect of decreasing

demand and price; however, there are several corporate initiatives and greenhouse gas reduction programs that support the voluntary market, ranging from carbon neutrality to internal carbon pricing. Voluntary markets co-exist with compliance markets and oftentimes operate as an incubator for offset protocols in addition to early action or pre-compliance initiatives. One of the other main differentiators is that voluntary markets offer more flexibility and fewer invalidation risks but carry a lower market size/price and overall demand.

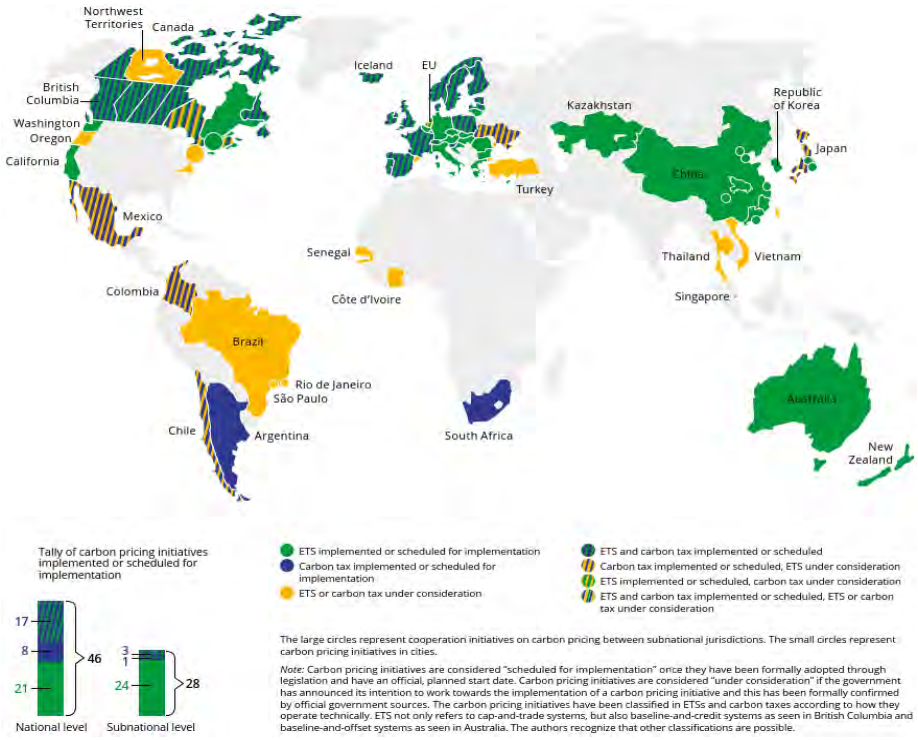
6.1 Current Carbon Markets

Carbon (greenhouse gas) markets are comprised of tradable carbon pricing credits including allowances and offsets with offsets making up a small fraction of overall market totals. See Section 5.1 of this report for clarification between allowances and offsets.

The demand for greenhouse gas reduction solutions has increased based on new regulatory requirements and public pressure. The allure of greenhouse gas offsets has ensured a continued interest from active participants in both regulatory/compliance and voluntary markets.

Carbon markets, for which offsets represent a small percentage, continue to grow and serve as a model that many jurisdictions are adopting in their efforts to fight climate change. Of equal relevance is that many of these programs are also being implemented in response to Article 6 of the Paris Agreement, where countries are looking toward market systems to meet their respective targets.[94] Figure 5 provides a global overview of the current carbon market and carbon pricing initiatives that have been, or are planned to be, implemented.

Figure 5 – Summary Map of Regional, National and Subnational Carbon Pricing Initiatives



Source: World Bank Group State and Trends of Carbon Pricing 2019 Washington DC, June 2019.

[94] Paris Agreement Article 6 begins on page 4:
https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf

Most recently, the COP 25, the 25th meeting of the Conference of the Parties to the United Nations Framework Convention on Climate Change, ended without an agreement on the rules related to Article 6 of the Paris Agreement.[95, 96,97] From a policy perspective, it is also important to note that due to minimal federal action and withdrawal from the Paris Agreement, states are now addressing the impacts of climate change by implementing carbon pricing and market solutions at the state-level while also linking to other jurisdictions. This swing from federal policy is most noticeable in the expansion of the Regional Greenhouse Gas Initiative (commonly known as RGGI) and the Western Climate Initiative. Within North America, there exist several different carbon market programs including California's landmark economy-wide cap-and-trade program.

Current North American Carbon Markets include:

- Western Climate Initiative, including:
  - California's Cap-and-Trade Program – (based on Assembly Bill 32/Senate Bill 32 – Global Warming Solutions Act).[98]
  - Quebec's Cap-and-Trade Program.[99]
  - Nova Scotia's Cap-and-Trade Program.[100]
- RGGI – (a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont).[101]
- British Columbia; Greenhouse Gas Industrial Reporting and Control Act, carbon tax.[102]
- Alberta; Carbon Competitiveness Incentive Regulation, hybrid carbon tax and cap-and-trade.[103]
- Canadian Federal Program; Pan-Canadian Framework on Clean Growth and Climate Change.[104]
  - The Canadian Federal Program outlines a framework for pricing carbon, which each province and territory can follow.

According to Forest Trend's Ecosystem Marketplace, voluntary greenhouse gas offset buyers transacted a total of 84.1 million metric tons CO_2 equivalent in 2015, which was a 10% increase over 2014. Over 90% of these 2015 results were repeat buyers.[105] In 2016, 63.4 million metric tons CO_2 equivalent were transacted with a total offset market value of $191.3 million.[106] According to the World Bank's 2019 carbon

[95] https://apnews.com/aca79ab4956f370b8892ba574fe56834

[96] https://news.un.org/en/story/2019/12/1053561

[97] https://www.wsj.com/articles/u-n-climate-talks-end-without-accord-on-carbon-markets-11576424025

[98] https://ww3.arb.ca.gov/cc/capandtrade/capandtrade.htm

[99] http://www.environnement.gouv.qc.ca/changements/carbone/inscription-spede-en.htm

[100] https://climatechange.novascotia.ca/nova-scotias-cap-trade-program

[101] https://www.rggi.org/

[102] http://www.bclaws.ca/civix/document/id/complete/statreg/14029_01

[103] Current program: https://www.alberta.ca/carbon-competitiveness-incentive-regulation.aspx Proposed program to replace it: https://www.alberta.ca/technology-innovation-and-emissions-reduction-engagement.aspx

[104] https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework.html

[105] EcoSystem MarketPlace, State of the Voluntary Carbon Markets 2016, https://www.forest-trends.org/publications/raising-ambition/

[106] EcoSystem MarketPlace, State of the Voluntary Carbon Markets 2017, https://www.forest-trends.org/publications/unlocking-potential/

market reports, both compliance and voluntary carbon markets exist in 57 jurisdictions around the world with $44 billion in revenue raised in 2018.[107] In comparing the information from Ecosystem Marketplace and the World Bank, offsets represent less than 1% of the total carbon market with direct regulated pricing on greenhouse gas emissions comprising the majority of carbon markets.

Not all compliance markets contain an offset option, and each compliance carbon market has varying degrees of offset market shares. Two examples in the United States can be used as a general reference: California's Cap-and-Trade Program and the RGGI. California's Cap-and-Trade Program offsets account for just over 6% of required compliance from 2015-2017.[108] Alternatively, less than 1% of the RGGI's compliance carbon market consists of offsets, with a single offset project registered in the program.[109]

Offsets represent less than 1% of the total carbon market.

For the purposes of this report, the key points about compliance markets is that within such a market; offset credits:

- Serve as a component to carbon markets but represent only a small percent of the overall market size and value;
- Provide a lower cost solution to regulated entities for their compliance liability;
- Carry a discounted value against allowances/permits due to invalidation risk;
- Are heavily impacted by supply and demand, policy changes, and protocols;
- Provide actual greenhouse gas reductions that occur outside of cap sectors;
- Provide potential co-benefits (environmental, socioeconomic, sustainable development goals);
- Enable linkage and trading between entities and other jurisdictions;
- Provide alternative revenue streams and access to private capital for offset developers; and
- Provide little to no revenue for offset programs.

6.2 Types of Offset Markets

Similar to carbon markets and carbon pricing programs, there are different types of offset markets that exist within the broader framework of carbon markets. The main offset markets are summarized in Table 2.

[107] World Bank Group State and Trends of Carbon Pricing 2019, Washington DC, June 2019, https://openknowledge.worldbank.org/handle/10986/31755?stream=top

[108] California Air Resources Board, Cap-and-Trade Program, Publicly Available Market Information, 2015-2017 Compliance Report, https://www.arb.ca.gov/cc/capandtrade/capandtrade.htm

[109] RGGI CO_2 Allowance Tracking System, Public: Offset Projects, https://rggi-coats.org/eats/rggi/index.cfm?fuseaction=search.project_offset&clearfuseattribs=true

Table 2 – Carbon Offset Market Summary

Offset Market Type	Description	Program Examples	Offset Buyers
Compliance	Government-regulated programs where offsets are legally eligible for a percentage of compliance obligation.	• Western Climate Initiative[110] • RGGI[111] • European Union Emissions Trading System[112]	• Oil and Gas Industry • Utilities • Independent Power Producers • Industrial Emitters • Trading Firms
Pre-compliance[113]	Early action participation based on carbon pricing policy speculation.	• Carbon Offsetting and Reduction Scheme for International Aviation (commonly known as CORSIA)[114] • REDD+[115]	• Aviation Sector • World Bank • Nation-States • Corporate Foundations • REDD+ funds
Voluntary (Corporate)	Non-regulated programs driven by corporate mandates to reduce specific scopes of greenhouse gas emissions.	• Carbon neutrality pledges including: Climate Neutral Now and Airport Carbon Accreditation[116,117] • Internal carbon pricing • Greenhouse gas reporting; often formalized through organizations such as CDP[118]	• Airlines • Airports • Fortune 500 companies including: Disney, Walmart, Google, Microsoft, DOW, GM, Barclays, Allianz, Lyft, BP
Voluntary (Retail)	Market for small quantity offset purchases for small companies, event organizers and individuals.	• BEF[119] • Carbon Fund[120] • Green-e[121] • Jet Set[122] • Native Energy[123] • Offsetters[124] • The Climate Trust[125] • Terrapass[126] • The Good Traveler[127] • Ucapture[128]	• Personal travel • Private events • Consumer purchases

[110] http://www.wci-inc.org/

[111] https://www.rggi.org/allowance-tracking/offsets

[112] https://ec.europa.eu/clima/policies/ets_en

[113] Pre-compliance refers to markets that are anticipated to be included in future compliance markets, but this inclusion is not a guarantee and therefore pre-compliance could be simply considered under voluntary market.

[114] https://www.icao.int/environmental-protection/corsia/pages/default.aspx

[115] https://www.un-redd.org/

[116] https://unfccc.int/climate-action/climate-neutral-now

[117] https://www.airportcarbonaccreditation.org/

All the offset market types summarized in Table 2 use the same primary offset standards but vary in which standards and specific protocols are allowed.

6.3 Greenhouse Gas Offset Roles

There are a multitude of participants involved in the development and transaction process of offsets. The primary greenhouse gas offset roles include:

- **Project Owner/Developer:** An entity that produces an offset project, either through physically creating the greenhouse gas reduction project, or an outside investor interested in the offset.
- **Verifier:** An accredited entity that ensures that an offset project meets all the necessary criteria, based on the applicable standards.
- **Standard:** An entity that provides an established set of rules to ensure that offsets meet the stringent requirements to ensure transparency and credibility. Projects follow a comprehensive set of validation and verification procedures to demonstrate that they are generating emission reductions, and projects are monitored on a regular basis through independent third parties under a standard.
- **Registry:** (Note: some standards act as registries) An independent entity that guarantees a greenhouse gas offset credit is counted only once through tracking offset production and purchases, to guarantee singular ownership. APX and IHS Markit are the two most prominent registries.
- **Program Administrator:** An entity that administers the offset program and certifies that offset projects and the resulting credits are valid for use within the program. In voluntary offset markets, the offset standard typically fulfills this role; the role of Program Administrator is specific to compliance markets.
- **Intermediaries/Brokers:** Entities that provide valid offset credits for sale to a buyer.
- **End Buyer:** An entity that purchases offset credits.

To understand the feasibility of an offset program within the State of Hawai‘i, the state government will need to determine which role to play. The state government may either act as a Project Owner/Developer or as the Program Administrator; but is conflicted from acting in both of these roles (see Section 7.2 of this report).

[118] https://www.cdp.net/en
[119] https://store.b-e-f.org/products/carbon-offsets-blend/
[120] https://carbonfund.org/about-us/
[121] https://www.green-e.org/certified-resources/carbon-offsets
[122] https://jetsetoffset.com
[123] https://nativeenergy.com/
[124] https://www.offsetters.ca/
[125] https://climatetrust.org/
[126] https://www.terrapass.com/
[127] https://thegoodtraveler.org/
[128] https://www.ucapture.com/

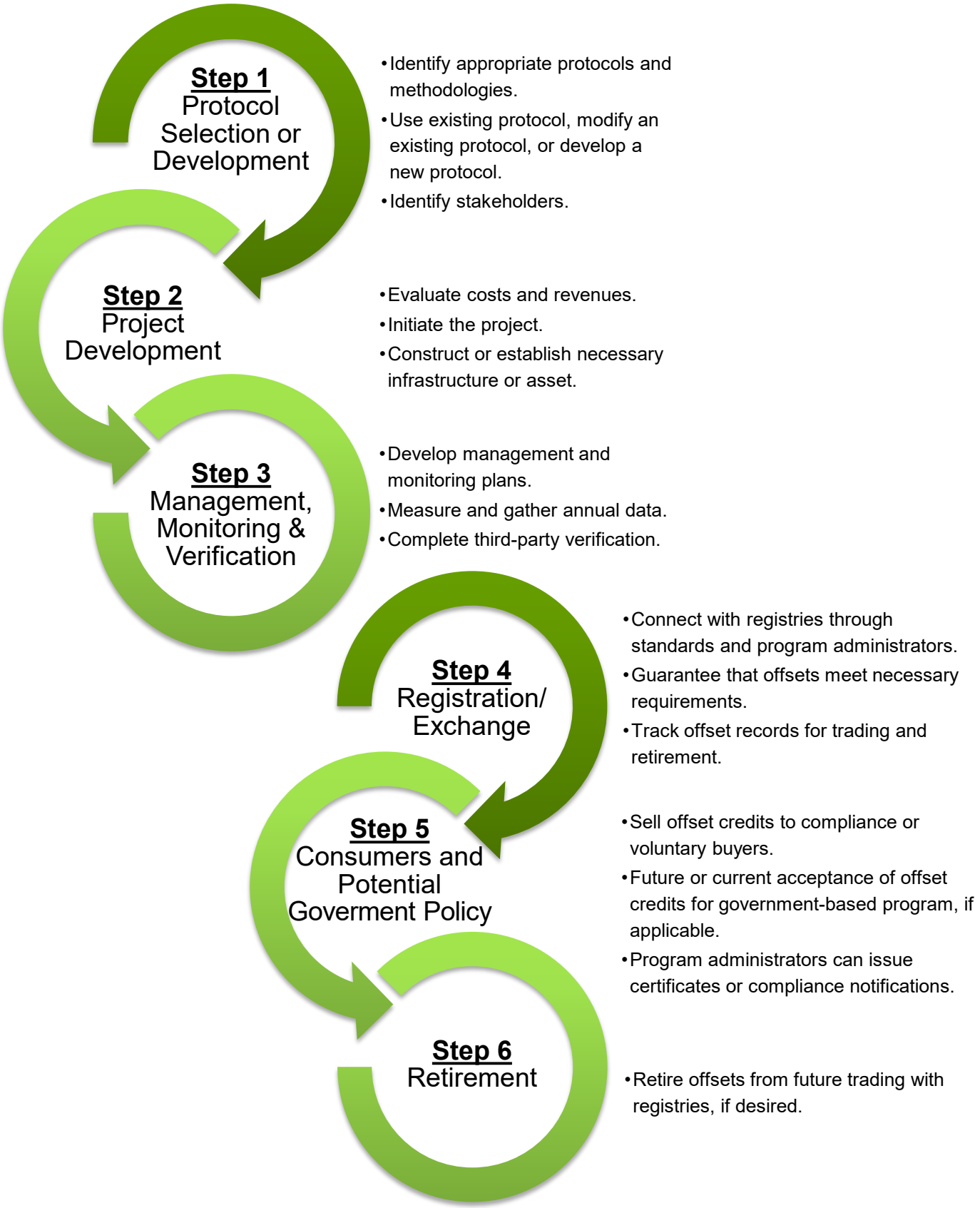
6.4 Development Process

The typical development and transaction process of a voluntary carbon offset project includes: project origination, implementation, verification, and commercialization. Development of an offset project consists of the following steps:

1. Identify the greenhouse gas reduction opportunity on-site.
2. Match that reduction opportunity to a methodology or protocol approved by a standard.
3. Plan, design, and build required infrastructure to produce the greenhouse gas reduction as defined by the methodology or protocol.
4. Manage the greenhouse gas offset project through annually monitoring, measuring, and calculating the greenhouse gas reductions.
5. Verify and certify the greenhouse gas offset credits, typically on an annual basis through third-party verification and certification with a registry.
6. Trade and retire credits through a program administrator and intermediary for end buyers.

The six steps for offset project creation are also displayed in Figure 6.

Figure 6 – Basic Offset Development Process



Creating Offset Credits

Using an existing protocol is the easiest and most feasible path to becoming an offset project developer. There can be opportunities to create offset credits from a wider range of greenhouse gas reduction activities by modifying an existing protocol or creating a new protocol. The significant difference between using an existing offset protocol and creating a new protocol is that protocol creation entails significant time and money. These protocol development expenditures depend greatly on the complexity of the protocol but are often $100,000 or more, and the process can take a year or more.[129] These pursuits are intensive in both time and money but could be cost effective if multiple stakeholders pooled or aggregated resources.

Credits approved under any of the offset standards are then listed and guaranteed by a registry. The projects are monitored on a regular basis through the independent third parties under a recognized standard/program. Each of the offset programs have minor differences in structure, but the quality of offset credits being produced under each remain constant. Much of the offset risk is inherent in offsets themselves, and these risks are outlined further in Section 5.3 of this report. To demonstrate quality, offset credits must adhere to the strict and globally recognized requirements summarized in Section 5.2 of this report. Once these criteria have been met, the credits can be sold through reputable markets.

Offset Development Cost Assumptions

Typical offset project development tasks and associated cost assumptions are provided in Table 3. These costs vary based on the project's type, the standard/protocol used, and the carbon market. Development costs can range from $250,000 - $500,000 depending on the project type, location, and standard.

Table 3 – Typical Fixed Costs in Developing a Carbon Offset Project

Development task	**Description**	**Estimated costs (varies based on market program)**
Project Feasibility assessment	Initial project screening for eligibility and credit generation	$15,000 - $30,000
Protocol/methodology development	This is a necessary step if no protocol or methodology exists	Approximately $100,000
Project Development	Implementation through verification	Approximately $300,000 (varies based on project type and protocol)
Legal	Contracting with buyers, third parties, verifiers	Approximately $50,000
Initial Verification	Third-party verifier site visit, desk review and verification report	$75,000
Annual Verification	Based on protocol and market	$40,000
Registry fees	Fees based on issued volume	20 cents/ton (varies based on program)
Program annual fees	Based on specific program	$500
Listing fees	Based on specific program	$750

Note: Estimates based on Nature Bank's experience in offset development including multiple projects which are individually confidential. While values in the table depict a reasonably expect costs, values can range widely base on market and project type.

[129] Information based on interviews with the Policy Director at Climate Action Reserve, and Program Director at Verified Carbon Standard.

The primary means for selling offset credits include the use of relationships between developers and end buyers, as well as brokers or online exchanges. A broker can provide cost quotations for offset projects meeting a defined set of criteria, or for specific offset projects identified through research by the offset purchaser. An online exchange, on the other hand, provides access to instant information on prices and the availability of offset credits. This information is often only accessible to companies that pay for a membership with the online exchange.

In addition to the voluntary market, greenhouse gas offset credits can potentially be sold through regulatory programs such as California's Cap-and-Trade Program.[130] In this case, the end buyers are regulated entities that need to satisfy greenhouse gas compliance obligations. Regardless of the specific voluntary or compliance program, offset projects must follow a comprehensive set of strict validation and verification procedures to demonstrate that they are meeting all the requirements for valid offset credits.

Offset credits are retired through third-party registries. Offset standards must use an approved independent registry to track offset projects under their programs and ensure transparency. Registries, such as APX or IHS Markit, track offset production and purchases and guarantee that offset credits are counted only once.

An offset credit that has gone through the procedures previously summarized can be considered valid. All offset credits carry some amount of risk, regardless of whether they are listed on the voluntary market or within a compliance program like the California Cap-and-Trade system. Prices for validated offsets can vary substantially between the different offset project types and the projects region, based on the supply, demand, and other economic factors influencing the need to offset greenhouse gas emissions.

Accordingly, a financial viability assessment needs to be conducted for the specific conditions. The following section provides a framework for conducting such an assessment of a given offset project opportunity.

Current Offset Market Price

Offset prices vary widely based on market type, project type, standard, and vintage. Common pricing assumptions for offsets include:

- Pricing is based on a per ton basis, specifically per metric ton of CO_2 equivalent.
- Typical volume thresholds for buyers are based on the market.
- Large volume transactions are often priced in tranches or bundled products.
- Compliance pricing is often indexed and discounted to allowance prices.
- There is an ability to pre-purchase/finance with a discount to the market.
- The prices are driven by supply and demand.
- Co-benefits can carry added market value.
- There are fixed costs and variable costs involved with the creation of the greenhouse gas offsets.
- Policy uncertainty can impact price.

[130] The only offset credits acceptable for this program are created under specific California Air Resources Board protocols.

Table 4 –Sample Offset Pricing

Market	Product Name *	Standard	Price ($ per 1 metric ton of CO_2 equivalent)
California (Western Climate Initiative)	CCO	California Air Resources Board	$12 - $13.63
Alberta	EPC	Alberta	$24
European Union Emissions Trading System	CER	Clean Development Mechanism	$0.25
Voluntary	VER	Verified Carbon Standard	$0.50 - $12 Average $3
Voluntary	REDD+	Verified Carbon Standard Climate, Community and Biodiversity Standards	$3 - $7
Voluntary	VER	Gold Standard	$3 - $15

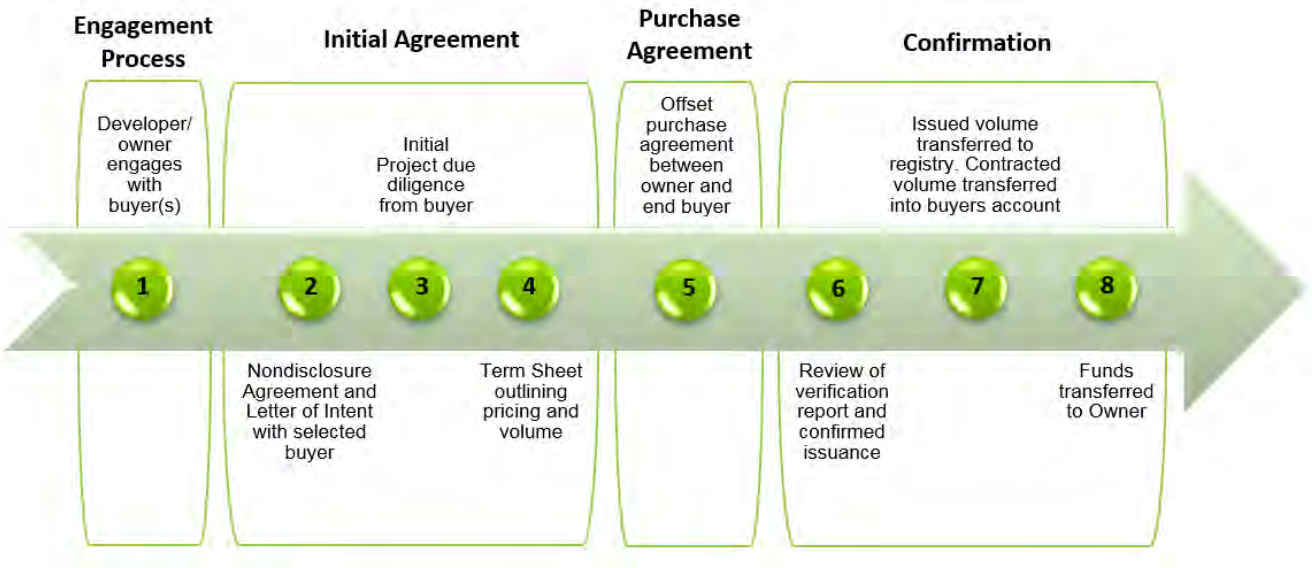
Note: Estimates are based on actual transactions as well as broker quotes during the first quarter of 2019 through Nature Bank, including multiple projects that are individually confidential.

* These are the official names of the offset credit products sold in these markets.

6.5 Offset Transaction Process

Similar to the offset development process, the selling or transaction process includes a number of steps. There are also several different transaction structures that can occur, ranging from set volume or unit contingent to multi-year purchase agreements. Figure 7 illustrates the phases of the compliance offset transaction process and the steps therein.

Figure 7 – Offset Transaction Process



Notes: Adapted from Nature Bank

Engagement Process

1. Engage with buyer: The first step in the transaction process entails the project owner collaborating with the project developer to identify a target market and set of buyers to which to market the project. This evaluation is driven by the protocol and standard under which the project was developed. The target market is identified through the project origination process. Most developers have relationships with end buyers and the professional market brokers, so the developer will often advise the project owner on how to yield the best market and commercial returns.

It is important to note that a direct transaction with an end buyer will often result in better pricing and a higher margin than can be obtained through using a broker or reseller market. An ideal developer will have established relationships with buyers and be financially incentivized to originate and finalize a transaction. The engagement process with the end buyer is a very important step and preferably occurs during the development stage to mitigate market and development risk. Entering into an agreement with a buyer during the offset development process can be beneficial if there is a need for capital through a pre-purchase agreement.

Initial Agreement

2. Nondisclosure Agreement: Once the buyer is identified and both parties have agreed in principle to move forward, they enter into a nondisclosure agreement and/or letter of intent. These agreements are standard and non-binding but provide further assurance and commitment from both parties.

3. Due Diligence: Following the initial engagement process, the buyer will typically conduct a review and due diligence assessment of the project developer and project owner. This is sometimes called the “know your customer” process depending on the level of detail in the agreement process. The level of due diligence will depend on the buyer and market and can be an extensive financial and legal review process. Compliance buyers will conduct a thorough “know your customer” process prior to any purchase agreement.

4. Term Sheet: Either before or after the due diligence process, a term sheet is often drafted that references the main components of the deal. These components include but are not limited to price, volume, vintage, delivery, and issuances. The term sheet is also a good tool for both parties to negotiate the parameters of the deal prior to engaging with attorneys.

Purchase Agreement

5. Purchase Agreement: The next step following the term sheet and due diligence process is the drafting of the Offset Purchase Agreement or sales contract. Depending on the identified market and conditions of the buyer, the purchase agreement can be a very detailed document that expands upon the term sheet. This purchase agreement will include several legal provisions and terms and conditions for the transaction. The buyer will be accountable for drafting the agreement, and both parties will need to have their respective attorneys involved to manage any legal risk. Depending on the complexity of the deal, the purchase agreement can go through multiple iterations before being finalized. During this process, the project development and verification is being finalized, and offset credit issuance might be reserved in the project owner’s registry account.

Confirmation

6. Confirmed Issuance: Once the purchase agreement has been finalized and executed by both parties, the buyer will review the verification reports and confirm the issuance volume with the registry. The registry will not transfer any credits until they have received written authorization from the project developer or project owner.

7. Transfer of Credits: Upon approval, the registry will then transfer the agreed volume from the project owner's account to the buyer's account.

8. Funds Transfer: This transfer of credits will then initiate the payment through a bank wire to the project owner's account based on the agreed pricing and terms. If the transaction is a multi-year deal with set transfers, then the registry will facilitate the same process based on agreed volumes and annual issuance.

6.6 Financial Viability Assessment Framework

To determine the financial feasibility of selling offsets, it is necessary to understand the funding to develop a greenhouse gas offset project. By using an existing greenhouse gas offset protocol, the upfront costs would be limited to:

- Calculating the baseline annual greenhouse gas emissions within the scope of the given protocol.
- Creating the infrastructure (e.g. energy efficiency upgrades) to reduce those emissions.

Financial viability can be evaluated as:

1. Annual gross revenue will be generated from selling all the offsets at the price that the market will bear.
2. Annual costs will include: turning the greenhouse gas reductions into sellable offsets, managing or maintaining any necessary infrastructure, hiring a third-party verifier for the calculated greenhouse gas reductions, and the transaction costs for selling the offsets through a registry.
3. The annual net revenue will be the gross revenue, minus the annual costs. If that calculation indicates positive cash flow, the offset creation is potentially viable.
4. The payback period consists of the number of years it will take to recoup the investment, calculated as shown in Equation 1.

Equation 1 - Payback Period Evaluation

$$Payback\ Period = T\ when: \quad Capital\ Cost - \sum_{t=0}^{T} \frac{B_t - C_t}{(1+r)^t} \leq 0$$

Notes: T = time frame (i.e. 5, 10, 40 years), t = year, B_t = annual benefits, C_t = annual costs, r = discount rate

In summary, the payback period is the number of years before the revenue from the greenhouse gas offset project pays back the upfront cost to create the carbon offset credits.

If the project's calculation indicates financial viability, the offset creation will help the project developer reduce greenhouse gas emissions in a more cost effective and potentially profitable way. Becoming a project developer for offsets is only viable under specific sets of circumstances in which the project developer can efficiently create and deliver those offsets. Profitability is the main driver for most developers. Selling an offset is financially viable or profitable if the revenue received from selling the offset is higher than the costs to generate it. The costs and revenue depend on several factors, which vary widely. Since this is an initial feasibility assessment rather than an evaluation of a specific offset project opportunity, the following is an overview of the types of costs and reasonably expected revenue.

Table 5 provides a high-level evaluation of two hypothetical scenarios to demonstrate the types of conditions under which selling an offset can be viable. These scenarios assume that the infrastructure for greenhouse gas reductions were created, as this table does not include the costs to actually reduce the greenhouse gases. The scenarios also assume that those reductions fit into an existing offset protocol. The financial details of each carbon offset project are detailed, nuanced, and unique.

Table 5 only includes the offset process costs and doesn't account for all the costs or financial savings associated with the actual greenhouse gas reduction. A thorough financial analysis for a specific greenhouse gas reduction project should also include costs to actually reduce the costs to achieve the specific greenhouse gas reductions, any operating expenses that have been decreased due to the project, and the payback period based on those key factors. For example, implementing an energy efficiency project entails costs and result in annual financial savings from reduced energy consumption.

Table 5 – Two Hypothetical Simplified Offset Revenue Scenarios

Scenario	**A**	**B**
Annual greenhouse gases reduced (metric tons CO_2 equivalent)	50,000	200,000
Annual cost to turn greenhouse gas reductions into offsets	$60,000	$60,000
Annual cost for third-party verification	$50,000	$50,000
Selling offsets through a registry: $0.06 metric tons CO_2 equivalent	$3,000	$12,000
Total Annual Costs	$113,000	$122,000
Offset Price per metric tons CO_2 equivalent	$2	$4
Annual Gross Revenue	$100,000	$800,000
Annual Net Revenue or Loss	**-$13,000**	**$678,000**

Note 1: This is a low and simplified estimate of the costs to calculate the greenhouse gas emission reductions that can be sold as offsets under the given protocol and registering them with the applicable registry. See Table 3 for typical costs.

Note 2: Approximate range is $0.06 to $0.10 per metric tons CO_2 equivalent, depending on the registry.

Scenario A

In Scenario A, becoming an offset project developer would not be viable. There would be no payback period because the offset project is generating an annual loss instead of an annual profit. Specifically, the entity would be spending $13,000 more each year to create the offsets than the revenue from selling them. Based on these numbers, the entity could have achieved those same greenhouse gas reductions at less cost by not turning them into offsets. Furthermore, by not turning those reductions into offsets, the entity would be able to claim the reductions. In this case, being an offset developer is unequivocally not worth the expenditures of time and money.

Scenario B

In Scenario B, becoming an offset project developer could potentially be viable. The calculations assume that the annual costs are essentially the same as in Scenario A, as these costs are somewhat fixed. The key differences from Scenario A are associated with the gross revenue, based on two key conditions:

- **A greater amount of greenhouse gas reductions:** This amount depends on what greenhouse gases can be achieved that are covered under a given offset protocol, and what level of reduction can be achieved with currently available resources. This assessment would need to be conducted specifically for each greenhouse gas reduction project being considered.
- **A higher price per metric tons CO_2 equivalent received in the offset market for those reductions:** This price depends on what the market will bear. Small scale offset projects, such as an individual facility generating less than 30,000 metric tons CO_2 equivalent in annual reductions, usually need high per metric tons CO_2 equivalent prices for viability. A more complete assessment of the market would help in determining the best price for the offsets.

Based on these hypothetical parameters, Scenario B is projected to generate $678,000 in annual net revenue to pay back the costs of creating the offsets.

These factors can be utilized to estimate an entity's costs and revenues for a given offset project. Assuming that the result of this calculation indicates financial viability, the offset creation will help the entity reduce greenhouse gas emissions in a more cost effective (and potentially profitable) way. This financial benefit is the advantage of being an offset developer.

In summary, the offset market enables an entity that can cost effectively reduce greenhouse gases to monetize those reductions as offset credits and sell them to another entity whose greenhouse gas reduction costs are more expensive. Therefore, it is feasible to create offset credits when there is an opportunity to do to it cost effectively, and for sale at a price that the market will bear. Process and funding capabilities of becoming an offset developer entail risks that need to be considered. Accordingly, the next chapter provides an overall framework to help the Hawai‘i state government evaluate the feasibility of participating in the offset market.

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7 Offset Feasibility Evaluation

In consideration of the key points this report has discussed regarding greenhouse gas reductions and offset markets, this chapter provides an overall framework for the State of Hawai‘i to evaluate the feasibility of participating in the offset market. Each component of this feasibility evaluation considers the key foundations and frameworks that would be required for an offset program in the State of Hawai‘i.

7.1 Offset Project Feasibility Assessment Framework

Offsets are a commoditized and tradable reduction in greenhouse gas emissions supporting the implementation of emission reduction actions. If the right conditions are met, then any greenhouse gas reduction action could be converted to an offset. While offsets can be a useful greenhouse gas reduction project implementation mechanism, it is rare for the right conditions to be met to convert greenhouse gas reductions into offset credits, and therefore, most greenhouse gas reductions are not offsets.

Once the criteria of offset creation and feasibility are identified and basic information pertaining to an individual greenhouse gas reduction project is gathered, the Offset Gate Key can be used to determine the feasibility of offset generation for that greenhouse gas reduction project. The Offset Gate Key can be used to assess the initial feasibility of the usefulness of offset generation for any greenhouse gas reduction project. Details of offset criteria and concepts are found in Chapters 5 and 6 of this report. Determinations of feasibility at the project level will support the overall feasibility determination of an offset market in Hawai‘i. Without availability of offset credit creation at the project level, no offset program could exist in Hawai‘i, regardless of whether the state government chooses to be a program administrator or project developer.

While offsets can be a useful greenhouse gas reduction project implementation mechanism, it is rare for the right conditions to be met to convert greenhouse gas reductions into offset credits. Most greenhouse gas reductions are not offsets.

A summary of the four Offset Gate Key steps can be used to determine the initial feasibility of converting a greenhouse gas reduction action to offset credits. The Offset Gate Key is provided as Appendix C of this report. The Symposium included an interactive process to explore the following feasibility steps using Hawai‘i-based greenhouse gas reduction opportunities:

Offset Gate Key Steps:

1. **Quality Criteria:** If the greenhouse gas reduction project fits into an existing protocol, then it is feasible to meet quality criteria and the interested party can move to the next gate. If no protocol exists for the project, then one should review the subparts for feasibility to pass this gate. If the greenhouse gas reduction action can meet these criteria (defined in Section 5.2 of this report), then move to the next gate.
    a. **Enforceable/Enforceability**
    b. **Permanent/Permanence**
    c. **Quantifiable/Quantification**
    d. **Real/Actual**
    e. **Verifiable/Verification**
2. **Additional:** Is the greenhouse gas reduction above and beyond applicable regulatory requirements as well as industry standard practices? If no, then offset creation is not feasible. If yes, then move to the next gate.
3. **Financial Viability:**
    a. What are the expected costs per metric tons of CO_2 equivalent?
    b. What is the expected market value of the offset credit created?[131]
    c. Does the expected value of the offset outweigh the cost? If yes, then proceed. If no, then re-evaluate offset creation.
4. **Environmental Justice:**
    a. Is there an interest in claiming the emissions reduction produced by the project? If yes, then re-evaluate offset creation.
    b. Is it acceptable for the buyer to claim the reduction? If no, then re-evaluate offset creation.
    c. Has climate change been considered as a global issue where the solutions require an interconnected approach between global communities? If no, then re-evaluate offset creation.
    d. Will the greenhouse gas reduction project adversely affect the community in which it is developed? If yes, then re-evaluate offset creation.
    e. Will the greenhouse gas reduction project adversely affect developing communities around the world through shifts in supply, demand, or resources? If yes, then re-evaluate offset creation.

Each step of the Offset Gate Key is designed to move from the most objective criteria toward the most subjective criteria. If the greenhouse gas reduction action can pass each step, then a project developer can review the process to create an offset and begin offset generation, if desired. If offset creation is determined not to be the appropriate path for the greenhouse gas reduction action, then the interested party can consider one of the alternative approaches to support the implementation of the greenhouse gas reduction.

[131] Typical greenhouse gas offset credit prices can range from ~$2-15; however, there are market outliers. Recent values are found in Table 4.

7.2 Hawai‘i State Government’s Role: Program Administrator vs. Project Developer

In the event that greenhouse gas offset project development is feasible, the next step for the State of Hawai‘i to consider when evaluating the state government’s participation in the offset market is its role: program administrator or project developer.

Program Administrator

Established and respected greenhouse gas offset standards or regulatory agencies, such as the California Air Resources Board or RGGI, fulfill the role of a program administrator. In this capacity, they develop or adopt protocols that define the requirements for specific project types and certify offset credits as valid according to a specific protocol. An offset project developer lists the certified credits on a reputable standard. Those credits are not sold through the standards but can be sold to interested buyers through market channels such as brokers or online exchanges.

The preamble written in Act 16, Session Laws of Hawai‘i 2018, the enabling legislation for this report references billions of dollars raised by the State of California from carbon offset credits. The State of California’s carbon offset program is attached through its cap-and-trade regulation administered by the California Air Resources Board. The revenue generated is not from the offset program but rather from the Cap-and-Trade Program, which is one way that the State of California chose to regulate greenhouse gas emissions from its large stationary sources.[132] The State of California gains its revenue through quarterly auctions of cap-and-trade allowances, which are sold to regulated entities. Separately, the State of California administers an offset program to set the standards and limits by which carbon offset credits can be used to provide regulated entities alternatives to meet a portion of the compliance obligations for their greenhouse gas emissions. The State of California’s program serves as the primary model by which a state government administers an offset program, and no revenue is generated by the State of California through the carbon offset program.

Project Developer

In contrast with administering an offset program, an offset developer or owner is an entity that reduces greenhouse gases according to a specific offset protocol and participates in the offset market by selling offset credits. The offset project developer or owner can be a single entity or a partnership. Some government agencies are involved in offset project development and sale, occasionally through public/private partnerships. Some current examples include:

The intent of an aggregator is to take less profitable offset projects and increase profitability through bulk management of offset development administration.

- A public/private partnership called Connecticut Green Bank, which helped develop the Verified Carbon Standard’s Methodology for Electric Vehicle Charging Systems, intends to serve as an aggregator to support generation of offset credits within the state.[133,134]

[132] Although the California Cap-and-Trade Program is not an offset program, offsets are used as one instrument within the program that regulated entities can purchase and then use for compliance.

[133] https://verra.org/methodology/vm0038-methodology-for-electric-vehicle-charging-systems-v1-0/

[134] https://ctgreenbank.com/evccc/

- Municipalities in the Pacific Northwest are developing forestry offset projects, through public/private partnerships. One such municipality is King County, Washington.[135,136] The county has:
    - Generated and listed urban forest offset credits according to a protocol created by an entity called "City Forest Credits."[137,138]
    - Developed the King County Rural Forest Carbon Project, which is currently undergoing the validation process for listing with the Verified Carbon Standard.[139]

In these partnerships, both parties can share the project costs as well as the revenue. Once revenue is derived, profit sharing would occur according to the agreements established between the public and private partners. Use of any revenue could be potentially reinvested in further greenhouse gas reductions.

In considering these roles, it is necessary to address the reasons why an offset program administrator cannot also serve as a project developer. The fundamental concern is upholding the credibility of offset programs and credits. The International Organization for Standards' 14064 Standard underlies the principles for the major offset programs, which are designed to ensure the integrity of an offset program and the certification of the credits.[140] If an offset program administrator developed or owned offset credits, a conflict of interest would exist that would undermine this program's integrity and the credibility of the offset credits. The primary conflicts include the following:

- An offset program administrator cannot be in competition with offset developers listing credits on their platform, as they need to remain a neutral certifier of valid credits from multiple parties.
- If an offset program administrator was developing offset credits through a project, that entity would have a financial incentive to have its credits listed on a registry. This incentive would diminish the credibility of the entity, as the entity would be certifying its own offset credits. Beyond developing and approving the offset protocols, program administrators are involved in the project-specific verification process by:
    - Approving the third-party verifier, after reviewing the verifier's conflict of interest assessment;
    - Reviewing the eligibility and verification documents to make sure that the verification is done per the program's standards; and
    - Approving a deviation to an offset methodology, on a case-by-case basis, when requested by a project developer for a legitimate reason.

Because of this conflict of this interest, credits listed by a governmental entity that dually serves as the program administrator and the project developer would not have strong value in the carbon offset market. The demand in the carbon offset market consists of savvy buyers who require fully valid and legitimate carbon offset credits. There would be little interest in carbon offset credits if there were a perceived conflict

[135] https://www.kingcounty.gov/elected/executive/constantine/news/release/2019/May/09-forest-carbon-program.aspx

[136] https://kingcounty.gov/services/environment/water-and-land/land-conservation/forest-carbon.aspx

[137] https://www.cityforestcredits.org/

[138] City Forest Credits follow a similar structure to other reputable offset standards and protocols; however, they serve as their own registry rather than using a third party and their credits are currently not directly comparable to other recognized offset standards.

[139] https://www.vcsprojectdatabase.org/#/pipeline_details/PL1911

[140] https://www.iso.org/ics/13.020.40/x/

of interest with any of the parties involved in the offset process. These key validity principles of the carbon offset program and carbon offset project need to be followed and documented to ensure successful participation and revenue generation from the carbon offset market.

If the state were to decide to serve in the role of a program administrator, such as the California Air Resources Board or the RGGI, offsets produced by the state government could have a conflict with the potential state-administered carbon offset program and may need to exist outside of the program and remain within the voluntary market.

Being an offset program administrator is not necessary for deriving revenue from the offset market. Offset programs are intentionally separate from the offset market financial transactions. The current major offset programs/certification bodies are government entities or non-profit organizations that are funded through means other than the sales of offset credits. The establishment of a credible offset certification body is a considerable endeavor, separate from offset project development. The key elements of an offset program are discussed in Section 7.4 of this report.

Standards and offset certification bodies that develop offset protocols, as well as list credits, are intentionally kept separate from offset market financial transactions, including project developers. Act 16, Session Laws of Hawai‘i 2018, and the resulting § 225P-6 of the Hawai‘i Revised Statutes, mentions certification of offset credits, as well as generation and marketing of those credits; however, the rest of § 225P-6 of the Hawai‘i Revised Statutes, focuses on financial transactions. Within this context, the state government will need to decide whether it will fulfill the role of a program administrator or project developer. If a state agency begins actions as a project developer, then it could be challenging for offset credits developed under the project to be included in a state-administered program.

7.3 Relationship of Carbon Offsets to the State’s Zero Emissions Clean Economy Target

Regardless of the role that Hawai‘i’s state government opts to take within an offset program, the development and selling of any offsets generated is limited by the state’s Zero Emissions Clean Economy target. This commitment is codified in Hawai‘i Revised Statutes, § 225P-5, inset below:[141]

> *Considering both atmospheric carbon and greenhouse gas emissions as well as offsets from the local sequestration of atmospheric carbon and greenhouse gases through long-term sinks and reservoirs, a statewide target is hereby established to sequester more atmospheric carbon and greenhouse gases than emitted within the State as quickly as practicable, but no later than 2045.*

When a greenhouse gas reduction action is converted into an offset credit and then traded, the ownership rights of the emissions reduction are transferred to the buyer of the offset.

[141] https://www.capitol.hawaii.gov/hrscurrent/vol04_ch0201-0257/hrs0225p/hrs_0225p-0005.htm

When a greenhouse gas reduction action is converted into an offset credit and then traded, the ownership rights of the emission reduction are transferred to the buyer of the offset. Exclusive ownership is an inherent attribute of an offset credit and is guaranteed as part of the Enforceability Quality Criteria defined in Section 5.2 of this report. Therefore, to support the statewide Zero Emissions Clean Economy target, any offset generated within Hawai‘i should only be sold to individuals or entities within the Hawaiian Islands. Further, the Zero Emissions Clean Economy target requires that local carbon sequestration exceeds Hawai‘i’s greenhouse gas emissions, and as such, no offsets from outside of Hawai‘i should be used to meet this goal.[142]

If the state government decides to take on the role of offset project developer or project owner, the state could potentially ensure that any buyer resides within Hawai‘i as a precondition of selling the credit. If the State of Hawai‘i decided to take on the role of an offset program administrator, then the state should consider limiting both the sale and purchase of offsets to exclusively transact within the Hawaiian Islands by program participants.

7.4 Overall Offset Program Framework Requirements

The overall framework required to establish an offset program depends on the role that the State of Hawai‘i would like to fill within an offset program. To this end, a separate list of framework requirements is provided for each of the two roles under current consideration.

State of Hawai‘i as the Program Administrator

If the state government were to take on the role of a program administrator and establish an offset program similar to one of the major standards or greenhouse gas compliance market managers, then the following would need to be investigated and established.

1. A mechanism to create the demand for offsets. Without a requirement for individuals or entities to purchase offset credits, the value of offset credits is simply dictated by the willingness to pay, which may or may not be sufficient for appropriately reducing greenhouse gas emissions to address climate change. Mechanisms to create demand for offset credit purchase typically take the form of carbon pricing. Setting up carbon pricing mechanisms would require an evaluation of the appropriate carbon price and pricing mechanism, as discussed in Chapter 6 of this report.
2. The creation or adoption of robust greenhouse gas inventory protocols or methodologies for regulated entities. To create a pricing mechanism on emissions such as an allocation or permit, a robust and verifiable emissions inventory must be created to ensure consistency in the measurement of metric tons CO_2 equivalent and to avoid market manipulation.
3. Creation or adoption of specific standards or protocols for offsets. As a program administrator, the state government could create its own offset standards or protocols for use within the state. Alternatively, the state government could selectively adopt or allow for the use of existing protocols or entire standards.
4. Depending on the selection of protocols for both allowances and offsets, the State of Hawai‘i would need to train and provide a credential to verifiers or delegate this practice to an alternative entity such as an existing standard.

[142] This does not serve as a legal interpretation, but an interpretation that ownership of emissions or emissions reductions are retained exclusively by one party.

5. Establish or partner with a registry such as IHS Markit or APX, or with an existing standard, to act as the registry.
6. To meet the State of Hawai‘i’s Zero Emissions Clean Economy target by 2045, all offsets generated and traded within this program should originate and remain in Hawai‘i (see Section 7.3 of this report for further details).[143]
7. The establishment of an offset program may or may not create the need for securities registration depending on the development of the program. Issues of securities were discussed with personnel from the State of Hawai‘i’s Department of Commerce and Consumer Affairs Securities Branch (Securities Branch) for this report. The Securities Branch does not give legal advice and only provides registration services for securities. Securities law is fluid and largely dependent on current case law. Consult with the state Attorney General’s office and/or qualified securities attorneys.

State of Hawai‘i as the Offset Project Developer or Project Owner

If the state government were to take on the role of offset project developer or project owner, then the following actions would need to be investigated and established on a per project basis:

1. Ownership, insurance, county zoning, and other relevant information.
2. Procurement of initial funding for project development. Each project’s financial details differ depending on numerous variables. In general terms, projects that produce less than 30,000 metric tons of greenhouse gas reductions and cost more than the market value of offsets will not make a return on investment. See Section 6.4 of this report for the current market value of offsets.
3. Select a specific standard or protocols for offsets. During the use of the protocol and the development of offsets, each project will need to be individually evaluated to determine insurance needs as well as zoning requirements to ensure all compliance with all state and county laws. Further, actions toward offset development will need to take appropriate precautions to ensure permanence according to the protocol, and stipulations of these actions should be reviewed in context to regional zoning and other requirements.
4. To meet the State of Hawai‘i’s Zero Emissions Clean Economy target by 2045, all offsets generated and traded within this program should originate and remain in Hawai‘i (see Section 7.3 of this report for further details).[144]
5. The establishment of an offset program may or may not create the need for securities registration depending on the development of the program. Issues of securities were discussed with personnel from the State of Hawai‘i’s Department of Commerce and Consumer Affairs Securities Branch (Securities Branch) for this report. The Securities Branch does not give legal advice and only provides registration services for securities. Securities law is fluid and largely dependent on current case law. Consult with the state Attorney General’s office and/or qualified securities attorneys.

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8 Alternative Mechanisms to Support Greenhouse Gas Reductions

Greenhouse gas offsets are a specific and unique mechanism to support the implementation of greenhouse gas emission reduction efforts; however, most greenhouse gas emissions reduction actions are not converted to offsets. Very specific criteria must be met to realize the true benefits of offset projects, as detailed within this report. The state government can pursue alternative implementation mechanisms to support greenhouse gas emissions reductions. Each of these mechanisms has its own advantages and disadvantages. All mechanisms used to facilitate greenhouse gas emissions reductions should be considered within the context of what sector is being addressed as well as what specific greenhouse gas reduction action is being undertaken. The following sections provide an overview of some mechanisms that the state government can consider.

8.1 Carbon Pricing

Carbon pricing is a mechanism that has been advocated by economists and implemented to encourage actions to reduce greenhouse gas emissions. The most common examples of carbon pricing are a carbon tax and cap-and-trade. The World Bank's 2019 carbon pricing evaluation estimated that the appropriate price on emissions to meet international goals on climate change ranges from $40 to $80 per metric ton of greenhouse gases by the year 2020, and $50 to $100 per metric ton of greenhouse gases by the year 2030.[145,146] Along with incentivizing emissions reductions, pricing is intended to help account for the social cost of carbon, which has been estimated in numerous studies to be in an even higher range than the World Bank's carbon pricing recommendations.[147,148] Before a government agency sets pricing for greenhouse gas emissions under its jurisdiction, studies should be conducted to identify a price range that can be effective in reducing emissions in line with applicable goals.

As discussed in Sections 6.1 and 6.2 of this report, some states have enacted regulations that establish carbon markets through entities such as the Western Climate Initiative and the RGGI. These regulatory markets require specific entities to reduce greenhouse gas emissions or pay for those emissions through

[145] https://openknowledge.worldbank.org/handle/10986/31755

[146] https://static1.squarespace.com/static/54ff9c5ce4b0a53decccfb4c/t/59b7f2409f8dce5316811916/1505227332748/carbonpricing_fullreport.pdf

[147] https://www.nature.com/articles/s41558-018-0282-y

[148] https://www.carbonbrief.org/qa-social-cost-carbon

taxes, fees, or market-based cap-and-trade programs. Both the Western Climate Initiative and the RGGI programs focus on stationary source emissions, with RGGI focusing exclusively on the power sector.

Large stationary sources comprise a significant portion of the State of Hawai'i's net total inventoried greenhouse gas emissions.[149] Accordingly, they represent a significant opportunity for emissions reductions and potential to raise revenue to support other greenhouse gas reductions throughout the state, similar to the goals attributed to offset generation established in the preamble of Act 16, Session Laws of Hawai'i 2018. Therefore, it is valuable to look at the results achieved by the state government's current mechanism for regulating greenhouse gas emissions from large stationary sources and to consider other mechanisms that could be employed.

Hawai'i Revised Statutes, Chapter 342B, Part VI, and Hawai'i Administrative Rules, Chapter 11-60.1, establish one carbon pricing mechanism for the State of Hawai'i's large stationary sources subject to its air emissions permitting program, used for compliance with Title V of the Federal Clean Air Act. As established by the United States Environmental Protection Agency, states and air agencies have the discretion to set and change their fee schedules under Title V permitting programs, and there is no requirement to revise both the greenhouse gas fee adjustment and fees for actual emissions of each regulated air pollutant simultaneously. The purpose of this pricing is to ensure that all Part 70 permit program costs are covered. The United States Environmental Protection Agency explicitly requires that any Title V permitting fee must be used solely for permitting program costs.[150]

Some key attributes of the State of Hawai'i's current approach to regulating greenhouse gas emissions from Title V sources are as follows:

- The Hawai'i state government created a greenhouse gas emissions cap for the stationary sources covered in its program; these are stationary sources with maximum potential greenhouse gas emissions greater than or equal to 100,000 short tons CO_2 equivalent per year. Each affected facility must be in compliance with the applicable greenhouse gas limit on and after 2020.[151]
- Emissions trading is allowed between the covered facilities.[152]
- The state's Title V air emissions permitting program is used to collect payments. The state set a price of $0.12 per ton of CO_2 equivalent.[153] This pricing is part of the schedule of fees solely to cover the air permitting program costs, as consistent with United States Environmental Protection Agency requirements.

This program has achieved valuable results. The emissions cap has resulted in required emissions reductions. The carbon pricing through the permitting program provides a type of incentive for reducing emissions to a level lower than the cap; however, the $0.12 per ton of CO_2 equivalent fees are nominal and well outside of the World Bank 2019 recommendation. Further, the United States Environmental Protection

[149] Refer to https://health.hawaii.gov/epo/files/2015/08/2014-6-19-ghg-talking-points.pdf, and Table 2.1 of Hawai'i's 2015 greenhouse gas inventory: https://health.hawaii.gov/cab/files/2019/02/2015-Inventory_Final-Report_January-2019-004-1.pdf.

[150] https://www.epa.gov/sites/production/files/2018-03/documents/title_v_fee_eval_strat_guid_03_27_18.pdf

[151] https://health.hawaii.gov/cab/files/2014/07/HAR_11-60_1-typed.pdf

[152] Hawai'i Revised Statutes, § 11-60.1-204 (6)(A) allows covered facilities to partner with each other for a combined emissions cap.

[153] http://health.hawaii.gov/opppd/files/2015/06/11-60.1.pdf

Agency's restriction of using the fees solely to cover the permitting program costs means that this pricing does not generate revenue to fund other actions that reduce greenhouse gases within the State of Hawai'i.

Other state-level carbon pricing programs such as cap-and-trade programs within the Western Climate Initiative have price ranges that are orders of magnitude higher, and therefore are better able to account for the social cost of carbon and significantly incentivize greenhouse gas emissions reductions.[154] The State of Hawai'i could consider developing a different carbon pricing mechanism for large stationary sources in conjunction with the current permitting program. Table 6 identifies greenhouse gas reduction project examples that might benefit from carbon pricing and other alternative implementation mechanisms. Such a carbon pricing mechanism could contain a higher price per ton of CO_2 equivalent if the aim of pricing is to reduce emissions and support funding of further greenhouse gas emissions reductions throughout the state. The State of Hawai'i's current stationary source emission reduction requirement is associated with the achievement and maintenance of statewide greenhouse gas emissions at 1990 levels by the year 2020. If further reductions are desired from this sector, they could be achieved through use of mechanisms such as:

- Requiring emissions reductions by setting a more stringent post-2020 sector-wide cap; and/or
- Incentivizing emissions reductions by using a different mechanism than the current permitting program to set a higher price per ton for the emissions generated in the sector.

It is beyond the scope of this report and its enabling legislation to recommend what emissions pricing or mechanism could be economically or politically feasible for the State of Hawai'i's large stationary sources. The stationary source permitting program is simply one avenue by which carbon pricing can be used. Carbon pricing could be set up as a tax, fee, or cap-and-trade program among different sectors. Many economic and policy analyses have been conducted to evaluate these different policy mechanisms.[155] The State of Hawai'is Tax Review Commission addressed the topic of a carbon tax in its 2018 review of the State of Hawai'i tax system and recommendations for change.[156] In Appendix A of the Hawai'i Tax Review Commission report, a conclusion was presented that a carbon tax would make Hawai'i's tax system more regressive. The state's consideration of carbon pricing mechanisms should account for this conclusion.

8.2 Greenhouse Gas Reduction Funds, Financing, and Incentives

While greenhouse gases can be reduced through regulatory requirements, governments can also provide financial benefits for specific actions that reduce greenhouse gas emissions. This implementation mechanism for greenhouse gas emissions reductions may be available to the State of Hawai'i. Specifically, a voluntary greenhouse gas reduction fund could be implemented to provide direct financial commitments or financing incentives. The principle concept behind a greenhouse gas reduction fund or a financing incentive program, is an organization sets up a means for donations or grants to contribute to a fund with the sole purpose of financing local greenhouse gas reduction projects. Funding could be derived from a variety of sources, such as greenhouse gas emissions payments, contributions from a financial institution, or utility customer revenue. Any funding or financing could be used for any Hawai'i greenhouse gas

[154] Note that the Hawai'i pricing is per short ton and is at a set level; whereas California's Cap-and-Trade pricing is per metric ton and increases over time. California's Cap-and-Trade information, including current auction price information, is available at https://www.arb.ca.gov/cc/capandtrade/capandtrade.htm

[155] https://link.springer.com/article/10.1007/s10584-018-2162-x

[156] http://files.hawaii.gov/tax/stats/trc/docs2017/trc_rpt_2017.pdf

reduction projects that meet criteria established for the fund, such as cost effectiveness, or value as a pilot project for advancing innovative greenhouse gas reduction approaches.

This potential strategy could capitalize on the modern trends of social media and crowdfunding, as well as keen public interest in contributing to sustainability initiatives. It can also help foster community involvement, buy-in, and voluntary climate change mitigation action.

A greenhouse gas reduction fund or financing incentive program can have more flexibility and less rigor than a carbon offset program, meaning that that this type of implementation mechanism has a distinct set of advantages and disadvantages.

Advantages include:

- Public and local business participation and marketing;
- Guarantee of greenhouse gas reductions occurring locally;
- Flexibility in the greenhouse gas reduction projects implemented;
- Reduced or eliminated future management of the reduction project; and
- Ownership of the greenhouse gas reductions.

Disadvantages include:

- Less scrutiny and certainty in the total quantity of the greenhouse gas reduction; and
- A potentially higher cost per unit of greenhouse gases reduced.

Such a fund or financing incentives program can also provide more flexibility with the possible drawback that it might not carry the official weight of a greenhouse gas offset project that has undergone third-party verification and been accepted into a standard or registry. Due to this flexibility, there are a range of ways to finance a greenhouse gas fund, as well as a range of ways that it can be used to facilitate greenhouse gas reductions. The following examples are not a comprehensive list, but they are provided to highlight this range of approaches. These examples serve to demonstrate some of the ways the other governments have created greenhouse gas funds that work for the constraints and resources of their jurisdictions. The State of Hawai‘i may be able to expand existing programs to a similar type of greenhouse gas fund.

- **The San Francisco Carbon Fund** derives revenue from carbon pricing on municipal airline travel and uses that revenue to award grants for local greenhouse gas reductions projects.[157] This is an example of a municipality using greenhouse gas payments from one sector to fund greenhouse gas reductions in other sectors.
- **The California Solar Initiative** derives funding from utility ratepayer revenue and provide rebates to electricity customers that use solar panels on their buildings.[158] Through these rebates, the program incentivizes the displacement of fossil fuel-derived electricity consumption and the associated reduction of greenhouse gases. This is an example of incentivizing funding from a

[157] http://sfenvironment.org/policy/resolution-approving-san-francisco-carbon-fund-grant-awards

[158] https://www.gosolarcalifornia.ca.gov/about/csi.php

source other than greenhouse gas emissions payments and using it to fund actions that lead to greenhouse gas reductions.

- **The Bay Area Air Quality Management District** finances established partnerships with a bank to offer subsidized financing to early adopters of emerging technologies that reduce greenhouse gas emissions.[159]
- **The United States Internal Revenue Service** offers a federal tax credit for carbon capture projects that securely store carbon dioxide in geologic formations or use it as a production feedstock in a way that results in greenhouse gas emission reductions.[160,161]

A particularly relevant example is the California Climate Investments program.[162] Act 16, Session Laws of Hawai'i 2018, the enabling legislation for this offset feasibility study, references that California used greenhouse gas payments to raise billions of dollars for investment into further greenhouse gas reductions. The program being referenced is the California Climate Investments program. The specific mechanism generates revenue from the sale of cap-and-trade allowances in California, and then reinvested into greenhouse gas reduction projects throughout the state. This program is an example of regulatory requirements being used in conjunction with incentives. Cap-and-trade policies generate revenue through required greenhouse gas emissions payments from large stationary sources. This revenue is then reinvested as incentive funding for further greenhouse gas reductions outside of the cap-and-trade regulation.

8.3 Building Codes and Standards

Fossil fuel-based energy used in buildings comprises a significant portion of statewide and global greenhouse gas emissions. Accordingly, building-related policies can play an important role in helping to reduce a state or municipality's greenhouse gas emissions. As discussed in Section 4.2 of this report, the state government has facilitated reductions of fossil fuel-based energy used in buildings through updated building codes and improved standards that encourage energy efficiency or the use of renewable energy. The following discussion provides examples of leading international, national, and state standards for building energy.

The Leadership in Energy and Environmental Design (commonly known as LEED®) green building program is a well-established program of the United States Green Building Council (commonly known as USBGC), with standards for new and existing buildings.[163] Hawai'i has achieved multiple building certification projects according to this nationally recognized standard and has been recognized by the USGBC as one of the states recently adding the most LEED®-certified buildings.[164,165] The Green Globes certification is another prominent standard through the Green Building Initiative.[166] Presently, Hawai'i Revised Statutes, § 196-9,

[159] http://www.baaqmd.gov/funding-and-incentives/businesses-and-fleets/climate-tech-finance
[160] https://www.betterenergy.org/blog/primer-section-45q-tax-credit-for-carbon-capture-projects/
[161] https://www.irs.gov/pub/irs-access/f8933_accessible.pdf
[162] http://www.caclimateinvestments.ca.gov/
[163] https://new.usgbc.org/
[164] https://www.usgbc.org/usgbc-hawaii?view=projects
[165] https://www.bizjournals.com/pacific/news/2019/02/05/hawaii-in-top-10-for-greenest-buildings-says-u-s.html
[166] https://www.thegbi.org/green-globes-certification/

encourages all state agencies to design and construct buildings to meet the LEED® silver rating of the USGBC or a two Green Globes rating.[167] Meeting these standards supports energy efficiency and environmental standards for state facilities, motor vehicles, and transportation fuel.

The rating system is made up of specified performance areas. LEED® building design encourages greenhouse gas reduction through the following performance areas:

- Vehicles (parking, electric vehicles)
- Energy efficiency
- Renewable energy

Greenhouse gas reductions can also be indirectly achieved from the following LEED® performance areas:

- Materials and resources
- Water efficiency

The associated greenhouse gas reductions from those sources are not currently tracked in the State of Hawai'i's greenhouse gas emissions inventory. Specifically, when a building uses fewer resource-intensive materials, less greenhouse gas emissions are generated in the material production process. When a building is designed to use water more efficiently, greenhouse gas emissions reductions result from the reduced amount of energy required to convey water to the building.[168]

The International Energy Conservation Code sets minimum standards for energy efficient commercial and residential buildings.[169] Many states reference this code as a basis for establishing their state-level codes. Hawai'i's State Energy Conservation Code is built largely on the International Energy Conservation Code with specific modifications and additions to fit the State of Hawai'i while retaining the minimum standards required.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) "Standard 90.1–Energy Standard for Buildings Except Low-Rise Residential Buildings" provides a benchmark specifically for commercial building energy codes.[170] As with the International Energy Conservation Code, states and municipalities often adopt Standard 90.1 and potentially make their own modifications. The State of Hawai'i adopted the 2013 version of Standard 90.1 for its commercial buildings. These energy efficiency requirements lead to greenhouse gas reductions.

The United States Department of Energy's Building Codes program provides a snapshot and summary of energy-related building codes and energy efficiency performance levels by each state.[171] Commercial buildings are compared to the energy efficiency benchmarks of Standard 90.1-2013 and/or the 2015

[167] http://www.capitol.hawaii.gov/hrscurrent/Vol03_Ch0121-0200D/HRS0196/HRS_0196-0009.htm

[168] The Hawai'i Water Plan, codified in Hawai'i Revised Statutes, § 174C-31, requires requires the utilization of reclaimed water for uses other than drinking and for potable water needs in 100% of all state and county facilities within Hawai'i by 2045. This statute is available at: http://www.capitol.hawaii.gov/hrscurrent/Vol03_Ch0121-0200D/HRS0174C/HRS_0174C-0031.htm

[169] https://www.iccsafe.org/products-and-services/i-codes/2018-i-codes/iecc/

[170] https://www.ashrae.org/technical-resources/bookstore/standard-90-1

[171] https://www.energycodes.gov/status-state-energy-code-adoption

International Energy Conservation Code. Residential buildings are compared to the International Energy Conservation Code. The State of Hawai'i's commercial and residential building standards are noted as equivalent to the International Energy Conservation Code, with amendments to fit the State of Hawai'i. Other states are noted as having standards that are more energy efficient than one or both of these standards.

The following are a few examples of the states and municipalities that have set especially strong building energy codes and standards that reduce greenhouse gas emissions:[172]

- **California's Building Energy Efficiency Standards** are updated every three years by the California Energy Commission, and set California's energy benchmark for residential and non-residential buildings.[173] These standards, comprising Title 24, Parts 1 and 6, of the California Code of Regulations, are mandatory statewide and are noted to exceed the energy efficiency standards of the International Energy Conservation Code as well as Standard 90.1.[174]
- **Florida Building Code 6th Edition** is noted as more energy efficient than the International Energy Conservation Code for commercial and residential standards. Florida has a similar climate to Hawai'i's and has similar heating and cooling needs. Some notable recent amendments to Florida's codes include sizing limitations for residential heating and cooling equipment, and specific provisions for insulation.[175]
- **New York City's Climate Mobilization Act** focuses on reducing greenhouse gas emissions from buildings by increasing renewable energy along with improving city's energy efficiency standards.[176] Some key provisions from the Act include:
  - A proposal to establish greenhouse gas emissions caps for buildings over 25,000 square feet;[177]
  - Provisions to support the requirement to utilize wind energy in the city; and [178]
  - A requirement that the roofs of certain buildings be partially covered in green roof or solar photovoltaic electricity generating systems.[179,180]

Building energy codes and standards can provide key components of the state's overall approach to reducing greenhouse gas emissions. While the State of Hawai'i's current building codes and standards facilitate reductions of fossil fuel energy and the associated greenhouse gas reductions, the state government can evaluate the previously discussed examples to identify potentially valuable next steps.

[172] https://www.c2es.org/category/policy-hub/
[173] https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards
[174] https://www.energycodes.gov/adoption/states/california
[175] https://www.energycodes.gov/adoption/states/florida
[176] https://council.nyc.gov/data/green/#green-bills
[177] https://legistar.council.nyc.gov/legislationdetail.aspx?id=3761078&guid=b938f26c-e9b9-4b9f-b981-1bb2bb52a486
[178] https://legistar.council.nyc.gov/legislationdetail.aspx?id=3830889&guid=d5499519-6afa-4c23-a1a4-10eaa8048a67&options=&search
[179] https://legistar.council.nyc.gov/legislationdetail.aspx?id=3332071&guid=a2326db7-ebe2-4cf3-ac1d-50834b9bddc9
[180] https://legistar.council.nyc.gov/legislationdetail.aspx?id=3557657&guid=b4c3a822-2fbb-45fd-8a74-c59dd95246c1

8.4 Development of Integrated Greenhouse Gas Plans

Climate change mitigation solutions benefit from a comprehensive view of the specific region taking action and that region's relationship to the rest of the world. The State of California, for example, compile these higher-level aims within plans through California's Climate Change Scoping Plan.[181] This scoping plan provides summary actions with a comprehensive and integrated view of all sectors, these summary actions ultimately become specific regulatory or policy actions. The State of Hawai'i has many plans relating to greenhouse gas emissions, including the Greenhouse Gas Emission Reduction Work Plan initially published in 2009 to recommend methods to achieve the 2020 greenhouse gas emissions reduction target. The State of Hawai'i is currently on track to meet the 2020 greenhouse gas emissions reduction target, as indicated by the state's greenhouse gas emissions inventory report, and now must meet the 100% renewable portfolio standard and Zero Emissions Clean Economy target requirements by the year 2045.

Future comprehensive planning and strategic greenhouse gas mitigation plan updates conducted by the State of Hawai'i should be used to refine the state government's comprehensive climate change solutions strategy. Hawai'i Revised Statutes, § 225P-5, requires that "after January 1, 2020, agency plans, decisions, and strategies shall give consideration to the impact of those plans, decisions, and strategies on the state's ability to achieve the [Zero Emissions Clean Economy target] goals" by 2045. As well as taking inspiration from other state actors, the State of Hawai'i can utilize the resources from the Science Based Targets initiative and the Intergovernmental Panel on Climate Change Special Report 15 to understand necessary pathways for reduction necessary for each industry or sector.[182]

8.5 Greenhouse Gas Reduction Opportunities in Hawai'i

While offsets are a mechanism to support the implementation of greenhouse gas reduction actions, it is important to reflect on the possible greenhouse gas reduction actions available to understand whether offsets or another implementation mechanism are appropriate to use.

Throughout this report and the Symposium, the evaluation of greenhouse gas reduction project examples includes initial conclusions about whether a given project can be supported by offsetting or if alternative approaches are likely more viable. In most cases, an alternative approach to support greenhouse gas reduction implementation is more feasible. For greenhouse gas reductions to become offset credits, they need to meet the feasibility evaluation discussed in Section 7.1 of this report. Table 6 provides a summary of the primary types of greenhouse gas reduction opportunities. The current offset project viability listed for each greenhouse gas reduction type is based on the Offset Gate Key. The designations of high, medium, low, or zero feasibility are initial, qualitative assessments, and the state can evaluate specific opportunities in more detail.

[181] https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm

[182] https://sciencebasedtargets.org/

Table 6 – Greenhouse Gas Reduction and Sequestration Opportunities and Potential Implementation Mechanisms

Greenhouse Gas Reduction Project Type	Examples	Initial Assessment of Offset Project Feasibility in Hawai'i (High, Medium Low, Zero)	Potential Alternative Implementation Mechanisms
Energy Distribution, Demand, or Efficiency	• Energy efficiency • Electric vehicle charging infrastructure • Landfill methane capture • Wastewater methane capture • Hydrogen fueling infrastructure	Zero to Low[1,2]	Building Codes and Standards, Funds, Financing and Incentives, Integrated Plans
Transportation	• Modal shift • Public transit expansion • Fuel switching • Zero emission vehicles	Low[1,2,3]	Carbon Pricing, Funds, Financing and Incentives, Building Codes and Standards, Integrated Plans
Industrial Process and Fugitive Emissions	• Methane and High-global warming potential gas capture and destruction • High-global warming potential gas replacement • Efficiency measures • Feedstock substitution	Medium[3,4]	Carbon Pricing, Funds, Financing and Incentives, Integrated Plans
Water Sustainability	• Water infrastructure efficiencies that lead to energy savings • Carbon sequestration through aquatic reef restoration	Low[1,2,3]	Funds, Financing and Incentives, Building Codes and Standards, Integrated Plans
The Urban and Built Environment	• Urban forestry • Green infrastructure • Energy reduction measures for buildings.	Low[1,2]	Funds, Financing and Incentives, Building Codes and Standards, Integrated Plans
Waste Handling and Disposal	• Landfill and wastewater process efficiencies • Recovery and diversion • Composting	Low[1,2]	Carbon Pricing, Funds, Financing and Incentives, Integrated Plans
Land Management: Agriculture, Forestry, Grassland, or other Land Use	• Regenerative agriculture and pasture • Afforestation • Reforestation	Medium-High[3,4]	Funds, Financing and Incentives, Integrated Plans

Greenhouse Gas Reduction Project Type	Examples	Initial Assessment of Offset Project Feasibility in Hawai‘i (High, Medium Low, Zero)	Potential Alternative Implementation Mechanisms
Livestock and Manure Management	• Collection and central treatment • Methane recovery and avoidance • Strategic feed supplementation	Medium[3,4]	Funds, Financing and Incentives, Integrated Plans
Carbon Capture and Storage	• Chemical sequestration • Industrial sequestration • Physical sequestration	High[3,4]	Carbon Pricing, Funds, Financing and Incentives, Integrated Plans
Renewable Energy Generation	• Wind • On-site or utility-scale solar • Biomass and biofuel • Waste-to-energy • Marine energy • Hydropower • Geothermal energy projects	Zero[2]	Carbon Pricing, Funds, Financing and Incentives, Building Codes and Standards, Integrated Plans

Notes: Offset Project Feasibility was assessed using the foundation established in the Offset Gate Key provided as part of this study. The numbers correspond to the gate it becomes infeasible or challenging to create offset credits given the greenhouse gas reduction project type. The gates are as follows: 1=Quality 2=Additionality 3=Financial Viability 4=Environmental Justice

There are many opportunities for continued greenhouse gas reduction in Hawai‘i. This section does not provide a comprehensive list or recommendations of specific opportunities to pursue; however, some current actions are provided below as examples of greenhouse gas reduction opportunities within the State of Hawai‘i.

Reduction of Fossil Fuel-Derived Energy and Transportation

- The City and County of Honolulu’s Department of Environmental Services’ contract with Hawai‘i Gas for the sale of biogas produced from the Honouliuli Wastewater Treatment Facility.[183]
- The increase use of electric vehicles and the charging infrastructure to support them.[184,185]
- The adoption of alternative fuels in transportation,[186] including hydrogen fuel-cell vehicles and hydrogen fueling stations.[187,188]
- The transition to renewable energy and energy efficiency.[189,190,191]

[183] http://oeqc2.doh.hawaii.gov/ea_eis_library/2018-05-23-oa-fea-honouliuli-wwtp-biogas-project.pdf

[184] https://afdc.energy.gov/vehicles/electric_emissions.html

[185] https://www.hawaiianelectric.com/clean-energy-hawaii/electrification-of-transportation

[186] https://www.biodiesel.com/

[187] https://www.hnei.hawaii.edu/projects#EET

[188] https://ushybrid.com/us-hybrid-powering-hawaii-zero-emission-hydrogen-bus/

[189] https://energy.hawaii.gov/renewable-energy

[190] https://www.hawaiianelectric.com/clean-energy-hawaii/our-clean-energy-portfolio/renewable-energy-sources

[191] https://energy.hawaii.gov/energy-efficiency

Greenhouse Gas Sequestration

- State of Hawai'i's Department of Transportation's test project sequestering CO_2 in concrete.[192,193]
- State of Hawai'i Department of Land and Natural Resources' forestry pilot projects:[194]
  - Pu'u Mali Forest Carbon Project (Island of Hawai'i)[195]
  - Kahikinui/Nakula Forest Carbon Project (Island of Maui)[196]
- The Hawaiian Legacy Reforestation Initiative.[197]
- Sequestration in agricultural land and rangelands.[198,199]

State of Hawai'i Department of Transportation using CarbonCure Technology (2019). Source: CarbonCure.com

Many sources and publications have explored potential greenhouse gas reduction opportunities including those from the State of Hawai'i.[200,201,202] Nearly all greenhouse gas reduction opportunities center around reducing the use and combustion of fossil fuels to achieve the pathways established by the Intergovernmental Panel on Climate Change. It is beyond the scope of this report and its enabling legislation to identify all greenhouse gas reduction options, yet identifying those options always entails the same process by:

- Evaluating the greenhouse gas emissions source through an inventory.
- Setting a target for reduction and re-evaluate after each of the subsequent steps.
- Identifying efficiencies to reduce greenhouse gas emissions from the source.
- Finding alternative technologies to replace the process producing greenhouse emissions.
- Changing or removing the demand for the process producing greenhouse gas emissions.

Appendix E of this report presents comprehensive offset protocols, which can be used beyond the creation of offsets. This list can also be used to identify actions to reduce greenhouse gas emissions. These actions can be taken and still retain their environmental benefit even if no offset credit was generated.

[192] https://www.iea.org/publications/freepublications/publication/technologyroadmaplowcarbontransitioninthecementindustry.pdf
[193] https://www.carboncure.com/
[194] http://files.hawaii.gov/dbedt/op/carbon_farming_task_force/forest_arbon_dofaw_presentation.pdf
[195] http://dlnr.hawaii.gov/forestry/frs/initiatives/forestcarbon/pmra/
[196] http://dlnr.hawaii.gov/forestry/frs/initiatives/forestcarbon/kahikinui-nakula-forest-carbon-project/
[197] https://legacytrees.org/index.html
[198] http://files.hawaii.gov/dbedt/op/carbon_farming_task_force/agendas/hawaiicenterforfoodsafety_regeneratingparadise.pdf
[199] http://files.hawaii.gov/dbedt/op/carbon_farming_task_force/soil_carbon_hawaiian_rangelands.pdf
[200] https://www.drawdown.org/
[201] http://www.baaqmd.gov/~/media/files/strategic-incentives/climate-tech-finance/baaqmd-climate-technology-review-20181011-pdf.pdf?la=en
[202] https://health.hawaii.gov/epo/strategic/greenhouse/

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9 Conclusions and Recommendations

The State of Hawai‘i is already a leader in climate change solutions as the first state in the United States to adopt a 100% Renewable Portfolio Standard and a Zero Emissions Clean Economy target. Setting these targets and taking other actions through Hawai‘i’s various climate change and sustainability laws and policies are productive first steps. Offset project development is just one greenhouse gas reduction implementation mechanism that the State of Hawai‘i can use to address climate change. As explained in the feasibility analysis provided in this report, it is unlikely that the State of Hawai‘i would generate significant revenue through the production of offsets, and any trading of offset credits produced within Hawai‘i would be limited by the state’s Zero Emissions Clean Economy target.

If the state government chooses to act as an offset program administrator, the state would not receive revenue from the sale of offset credits. The offset credit revenue would go to entities that reduce greenhouse gas emissions and develop offset projects for those reductions. An offset program administrator simply facilitates these transactions. Offset credit generation is not the same as an allowance within a cap-and-trade program, in which entities that emit regulated greenhouse gas emissions make required payments for those emissions.

In contrast, if the state government chooses to act as an offset project developer or project owner, then there is minimal possibility of revenue generation for the state. It is unlikely that significant profits would be produced from offset generation within the state, considering the costs for enacting greenhouse gas reductions, the administrative costs of offset credit generation, the limitations of total potential offset credits that could be generated within the state, and the current offset market value. The financial case to be made is project dependent.

Regardless of the use of offsets, the state government should take all actions at its disposal, with appropriate financial consideration, to explore and implement all feasible greenhouse gas reduction and sequestration measures.

As mechanisms to help accomplish these types of reductions, the following future actions are recommended:

- Build on the state government's success in achieving greenhouse gas reductions to date.
  - The greenhouse gas reduction requirements established through Act 234, Session Laws of Hawai'i 2007, conclude with the achievement and maintenance of the 2020 statewide greenhouse gas reduction target. The 2045 Zero Emissions Clean Economy target provides a basis for developing updated regulatory requirements and incentives to achieve further reductions.
  - The State of Hawai'i's current stationary source emission reduction requirement is associated with the achievement and maintenance of statewide greenhouse gas emissions at 1990 levels by the year 2020. If further reductions are desired from these stationary sources, they could be achieved through the use of mechanisms such as:
    - Requiring emissions reductions by setting a more stringent post-2020 sector-wide cap; and/or
    - Incentivizing emissions reductions by establishing a mechanism to set a higher price per ton for the emissions generated in the sector. This topic is addressed in the carbon pricing recommendations that follow.
  - Include a complete, integrated, and comprehensive approach to sectoral greenhouse gas emissions reductions actions using Science Based Targets and the Intergovernmental Panel on Climate Change Special Report 15 (among others) as a guide toward action. Regardless of the plan format chosen, consider integrating strategies from the recommendations in this report.
  - After January 1, 2020, begin incorporating the requirements set forth in Hawai'i Revised Statutes, § 225P-5, to ensure agency plans, decisions, and strategies give consideration to the impact of these plans, decisions, and strategies on the state's ability to achieve the Zero Emissions Clean Economy target by 2045.
- In accordance with Act 122, Session Laws of Hawai'i 2019, conduct a study on carbon pricing, including whether and how a carbon pricing policy shall be implemented in Hawai'i. Any potential carbon pricing mechanism should align with the current goals of the State of Hawai'i, now that the state is on track to meet its 2020 greenhouse gas emissions reduction target and has a more ambitious Zero Emissions Clean Economy target for 2045. Potential carbon pricing could generate revenue that could be used for achieving other greenhouse gas reductions within the state.
  - A new mechanism could be established to collect significantly higher payments from large stationary sources in the state.
  - Carbon pricing could be set for other sectors, such as transportation emission sources.

- Update the Hawai‘i 2050 Sustainability Plan in accordance with Hawai‘i Revised Statutes § 226-65, to serve as the state’s climate and sustainability action plan to determine future comprehensive actions to guide the coordination and implementation of the State of Hawai‘i’s sustainability goals by using the goals and priority guidelines of the Hawai‘i State Planning Act and the Hawai‘i Climate Change Mitigation and Adaptation Initiative as guiding principles.
- Explore the further use of building codes and standards to improve and direct efficiencies among the existing and new infrastructure of the State of Hawai‘i. Utilize and strengthen standards such as LEED® codified within Hawai‘i Revised Statutes § 196-9, and examples from other state governments, to the extent that they support increased efficiency of buildings within the state.
- Along with regulatory requirements, develop valuable incentives for reducing greenhouse gas emissions throughout the state. Investigate the possibility of establishing a fund to support voluntary greenhouse gas reduction measures and set funding criteria that will make the most sense for the Hawai‘i state government. Revenue for this funding could come from sources such as:
    - Greenhouse gas emissions payments from regulated entities for which the state government establishes carbon pricing;
    - Financial institutions;
    - Voluntary contributions from individuals or organizations;
    - Utility ratepayer revenue; and
    - Tax revenue
- Identify and develop partnerships with entities to provide funding or financing in support of these mechanisms to sustain widespread greenhouse gas emissions reductions. Such partnerships could include entities such as national or international organizations devoted to greenhouse gas reductions, state agencies such as the Department of Health, or utility companies within the state.

The State of Hawai‘i has established a strong foundation of greenhouse gas reduction achievements. Consideration of the mechanisms discussed in this report will help the state government to identify the most feasible steps for facilitating further greenhouse gas reductions. Offsets are a specific implementation mechanism used to foster greenhouse gas reductions and, while valuable, the uses are narrow. The State of Hawai‘i should build on its existing policies and programs to develop the most economically viable mechanisms to facilitate reaching the Zero Emissions Clean Economy target by the year 2045.

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a Symposium Handout Package

Carbon Offset Symposium

Hawaii State Capitol Auditorium

April 10, 2019

Office of Planning
State of Hawaii

9:00 **Welcoming Remarks, Safety Moment, and Symposium Overview**
Erin Dunable, AECOM

Greenhouse Gas Offsets, Offset Markets and Feasibility

9:25 **Greenhouse Gases 101**
Michael Conrardy, AECOM

Mr. Conrardy will provide a brief overview of climate change, the connection to greenhouse gas emissions, and the need for emissions reductions. Information will also be provided regarding global warming potential and greenhouse gas inventory basics.

9:50 **State of Hawaii Greenhouse Gas Policy and Inventory**
Mike Madsen, PE, State of Hawaii, Department of Health

Mr. Madsen will provide a brief overview of the State of Hawaii's greenhouse gas policy, the results of recent greenhouse gas inventories, and anticipated future trends.

10:00 **Greenhouse Gas Offsets, Protocols, Standards, and Registries**
Michael Conrardy, AECOM

Mr. Conrardy will introduce terms and definitions related to offsets for use during the remainder of the symposium. He will provide an overview of offsets including information on existing greenhouse gas offset registries, standards, and examples of protocols. Mr. Conrardy will also review the quality criteria required to evaluate offset creation.

10:30 - 10:40 **Break**

10:45 **Greenhouse Gas Offset Markets and Financials**
Steve Baczko, NatureBank

Mr. Baczko will provide an overview of current offset markets including both regulated and voluntary markets. This section will also include information on offset transactions, market participants, and the current market value for offsets.

11:30 **Q&A**

11:45-12:45 **Adjourn for Lunch Break**

Hawaii-Based Greenhouse Gas Reduction Project Examples

Each presentation will include a technical explanation of the action or process that reduces greenhouse gas emissions as well as an approximation of total emissions reduced and associated costs of the project or action. Each presenter will also provide any unique details of their projects, including co-benefits.

1:00 **Carbon Sequestration through Forestry**
Leah Laramee, State of Hawaii, Department of Land and Natural Resources, Division of Forestry and Wildlife

1:20 **Biogas Capture**
Aaron Kirk, Hawaii Gas

1:40 **Electric Vehicle Adoption Encouragement through Charging Systems**
Jimmy Yao, Hawaiian Electric

2:00 - 2:10 **Break**

Connecting Greenhouse Gas Reduction Projects to Offset Project Feasibility and Beyond

2:15 **Environmental Justice**
Trisha Kehaulani Watson, JD, PhD, Honua Consulting

Dr. Watson will provide an overview of environmental justice in the context of greenhouse gas emissions and the impacts of decision making on indigenous peoples and local communities.

2:30 **Hawaii-based Projects in the Context of Offset Creation Feasibility**
Michael Conrardy, AECOM and Steve Baczko, NatureBank

This portion of the symposium will consist of an audience participation exercise using the AECOM developed “Offset Gate Key” tool. The Offset Gate Key will walk attendees through the four “gates” that represent the decision criteria for creating offsets:

1. Quality
2. Additional
3. Financial Viability
4. Environmental Justice

The facilitators will use the information presented on Hawaii-based greenhouse gas emission reduction projects and the Offset Gate Key to help the audience better understand how to evaluate the feasibility of offset creation.

3:30 **Additional Market-based Tools**
Michael Conrardy, AECOM and Steve Baczko, NatureBank

The team will discuss alternatives to offsets, such as impact investment, voluntary action funds, and other governmental tools. The discussion will include audience participation and will carry into the Final Q&A and the Parking Lot.

4:20 **Next Steps**
Danielle Bass, State of Hawaii, Office of Planning

4:25 **Closing Remarks, Adjourn**
Erin Dunable, AECOM

Key Concepts for Offset Credits

The language of the greenhouse gas (GHG) offset landscape is complex because the definitions are often loose, interchangeable, and are used differently under different programs. The first step in working through this complexity is defining key terms. As such, the following summarizes how relevant concepts will be defined for the purposes of this symposium. [1]

Offset Credit: An offset credit, sometimes referred to as "GHG emissions reductions credit," "offset certificate," "offset instrument," "carbon offset," "GHG offset," or simply "offset," is a credit for mitigating 1 metric ton (MT) carbon dioxide equivalent (CO_2e) by paying someone else to avoid 1 MT CO_2e elsewhere. Offset credits are monetarily tradeable as well as evaluated, certified, and guaranteed by a standard or program.

GHG reductions from an offset credited project are independently verified to a specific protocol and then assigned to a third party registry, certifying that the offset credits meet the following requirements:

1. **Real / Actual:** Quantified through technically and scientifically sound accounting practices that represent actual emissions reductions beyond a baseline.
2. **Quantifiable / Quantification:** The ability to consistently manage, measure, and calculate the total quantity of offsets produced.
3. **Permanent / Permanence:** The GHG emissions reductions will last in perpetuity without reversal.
4. **Enforceable / Enforceability:** Assurance that the offset credits are trackable and supported by regulatory or third-party framework that defines their creation, provides transparency, and guarantees exclusive ownership.
5. **Verifiable / Verification:** An auditing process performed by an approved party according to the offset project's program, whereby the project's offset credits are calculated according to the approved protocol.
6. **Additional / Additionality:** The requirement that a GHG reduction project that would not have been implemented in a baseline or "business-as-usual" scenario.

   The primary tests for determining additionality include:

   - Legal Requirement Test: The GHG reduction is not required by any federal, state, or local law, statute, rule, regulation, ordinance, court order, or other legally binding mandate.
   - Performance Test: The project achieves greater GHG reductions or removals than the standard performance threshold for the given project type, demonstrating the emissions reduction would only occur through development of the offset credit.

With those fundamental concepts defined, the following is a summary of key supporting concepts for offset implementation.

Aggregator: An organization or an independent company that combines individual offset projects into larger bundles that are easier to trade and sell. An aggregator functions as an intermediary between a GHG reduction creator and the end use in the GHG offset market. The intent of an aggregator is to take less profitable offset projects and increase profitability through bulk management of offset development administration.

Allowance: An emissions credit or permit in a carbon market that is generated by a regulatory agency to allow for the emissions of GHGs, generally as part of a limit on emissions.

Cap-and-Trade: A regulatory carbon market through which:

1. An upper limit (or "cap") is set on the total applicable GHG emissions for a specified set of entities.
2. The entities subject to the cap are required to pay for each applicable MT CO_2e of GHGs emitted, by purchasing and surrendering emissions compliance instruments.

[1] This list aggregates definitional aspects from multiple recognized organizations in the offset credit industry, including the California Air Resources Board, Climate Action Reserve, Carbon Fund, Carbon Offset Research and Education (CORE) Initiative, Green-e, the Nature Conservancy, and the World Resources Institute (WRI)

Cap-and-Trade is not an offset program. However, some Cap-and-Trade programs allow offset credits as one type of instrument that regulated entities can purchase and use for compliance. There are typically specific regional and / or other restrictions on the offset credits that can be used within a given Cap-and-Trade program.

Carbon Market: A market backed by a regulatory or voluntary authority that provides the systems, procedures, and infrastructure necessary to commoditize and trade GHG emissions credits in the form of allowances and/or offsets. Examples of carbon markets include:

- Regulatory Markets such as the European Union Emissions Trading Scheme, Western Climate Initiative (WCI), Regional Greenhouse Gas Initiative (RGGI). The credits traded in these markets are overwhelmingly comprised of allowances, and a small percentage of credits traded are offsets.
- The Voluntary Offset Market, through which individuals, businesses or other entities can voluntarily sell or purchase offset credits through offset providers certified through reputable programs or standards.

Carbon Sequestration: Also known as "sequestration," is a process to capture carbon from the atmosphere for long-term or permanent storage. Sequestration can occur through biological, chemical or physical processes. Reforestation is a popular form of sequestration. Sequestration is not synonymous with offsets, though GHG reductions due to sequestration can be converted to offsets given the appropriate criteria.

Crediting Period: A period of time in which a GHG reduction project can generate offset credits.

Leakage: An undesirable situation in which reduction of one entity's GHG emissions leads to an increase in GHG emissions elsewhere in the world.

Offset Project: The infrastructure or assets created and managed to produce a GHG reduction project to be certified as an offset credit**.**

Offset Provider: An entity selling offset credits; these include brokers, marketers, exchanges, and owners.

Ownership: The rights to own the emission reductions that a GHG offset credit represents, to avoid more than one individual or organization claiming the benefit of the reduction.

Standard: An entity that provides an established set of rules to ensure that offsets meet the stringent requirements to ensure transparency and credibility. Some prominent examples include Clean Development Mechanism (CDM), American Carbon Registry (ACR), California Air Resources Board (CARB), Climate Action Reserve (CAR), Gold Standard, Verified Carbon Standard (VCS), and Climate, Community and Biodiversity (CCB) REDD+ (Reducing Emissions from Deforestation and Forest Degradation, as well as conservation, sustainable management of forests and enhancement of forest carbon stocks). Projects follow a comprehensive set of validation and verification procedures to demonstrate that they are generating emission reductions, and are monitored on a regular basis through independent third parties under a standard.

Project Developer: An entity that produces an offset project, either through physically creating the GHG reduction project, or an outside investor interested in the offset.

Protocol / Methodology: The procedures established by standards and used to execute an offset project and create an offset credit. These procedures cover accounting and monitoring, reporting, verification and certification rules. As such, they provide an outline of processes to determine project eligibility, additionality, baseline, and offset project emissions for the applicable project type.

Registry: An independent entity that guarantees a GHG offset credit is counted only once through tracking offset production and purchases, to guarantee singular ownership. Offset credits are retired through registries. APX and IHS Markit are the two most prominent registries.

Retirement: The action of taking an offset out of the market so that it is no longer traded on a public registry.

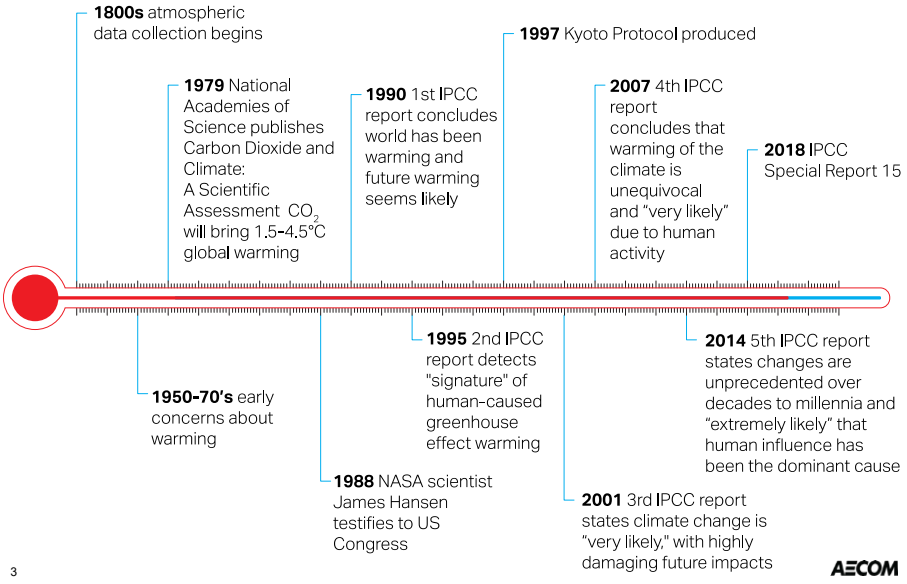
b Symposium PowerPoint Slides

Greenhouse Gases 101

What is Climate Change?

Changes in global or regional climate patterns from a rise in average global temperatures **due to increase from human emissions** of greenhouse gases

Climate Change Science Timeline



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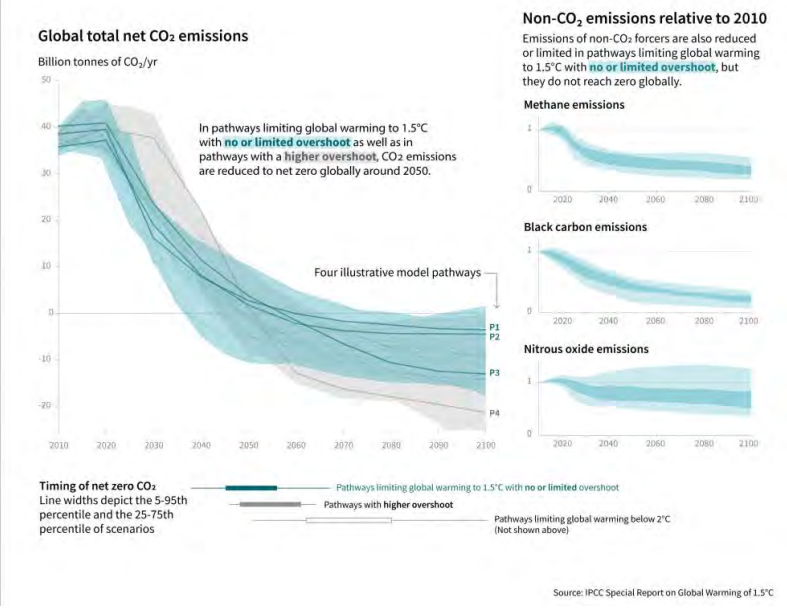
Intergovernmental Panel on Climate Change (IPCC)

Special Report - 15 Released October 2018
GHG Emissions Reduction Pathway

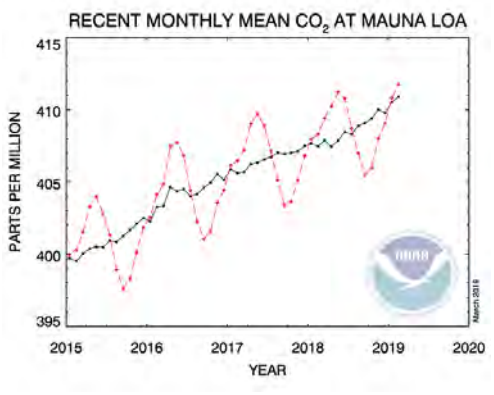


Source: IPCC Special Report on Global Warming of 1.5°C

Climate Change Impacts

You Can't Manage What You Can't Measure

Measuring Parts Per Million (PPM)



- Safe levels of atmosphere concentrations of CO_2 is 350 ppm
- Current CO_2 records from Mauna Loa ~411 ppm
  - The last time CO_2 levels were this high, humans did not exist.
- PPM requirements can be converted to "carbon budgets"

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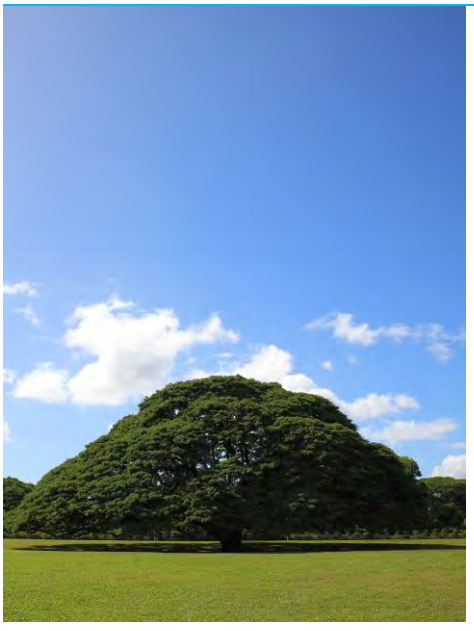
Carbon Budgets



- How much carbon can be emitted for a 66% chance of remaining below 1.5 °C of warming?
- Estimates range:
  - -192 to 779 gigatons CO_2

    Source: Carbon Brief Analysis: "How much 'carbon budget' is left to limit global warming to 1.5C?"
- Per person is maximum (assuming equal distribution):
  - 101 metric tons CO_2 total
- Hawaii per capita emissions currently:
  - ~15 metric tons CO_2 annually

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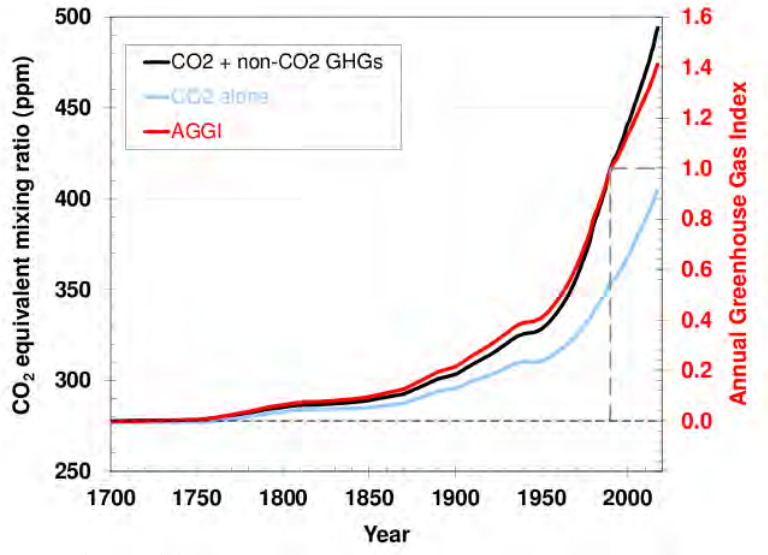
Other Greenhouse Gases



Source: NOAA Earth System Research Laboratory, ANNUAL GREENHOUSE GAS INDEX, Keeling et al., 1958, Machida et al., 1995, Battle et al., 1996, Etheridge, et al., 1996; Butler, et al., 1999

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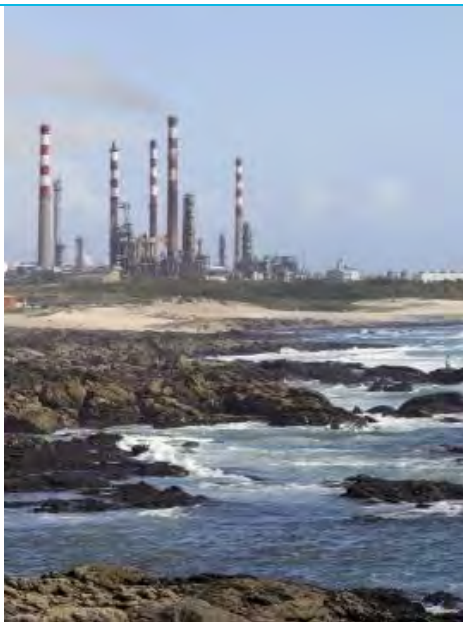
Regularly Regulated/Inventoried Greenhouse Gases

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulfur hexafluoride (SF_6)



Global Warming Potential (GWP) and CO_2 equivalent

Greenhouse Gas	20 yr GWP	100 yr GWP	500 yr GWP
carbon dioxide (CO_2)	1	1	1
methane (CH_4)	56	21	6.5
nitrous oxide (N_2O)	280	310	170
hydrofluorocarbons (HFCs)	460-9,000	140-11,700	42-9,800
perfluorocarbons (PFCs)	4,400-6,200	6,500-9,200	10,000-10,100
sulfur hexafluoride (SF_6)	16,300	23,900	34,900

Source: UNFCCC *Climate Change 1995, The Science of Climate Change: Summary for Policymakers and Technical Summary of the Working Group I Report*

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Greenhouse Gas Sources

Energy

- Stationary Combustion
- Transportation
- Incineration of Waste
- Oil and Natural Gas Systems
- International Bunker Fuels
- CO_2 from Wood Biomass and Biofuel Consumption

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Greenhouse Gas Sources

Industrial Processes and Product Use

- Cement Production
- Electrical Transmission and Distribution
- Substitution of Ozone Depleting Substances

Greenhouse Gas Sources

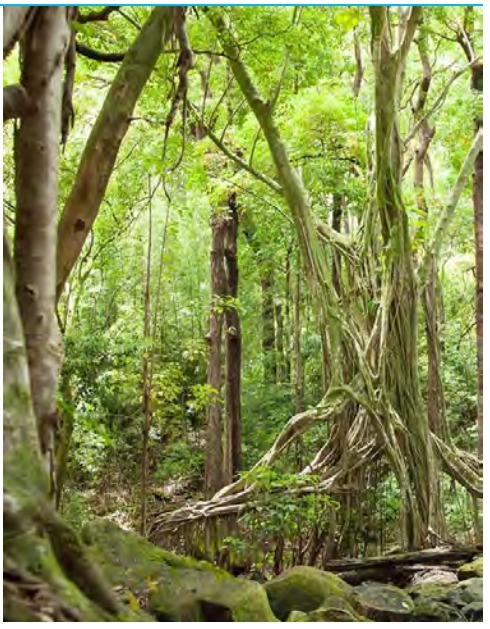
Agriculture, Forestry, and Other Land Use (Sources)

- Enteric Fermentation
- Manure Management
- Agricultural Soil Management
- Field Burning of Agricultural Residues
- Agricultural Soil Carbon
- Forest Fires

Greenhouse Gas Sources

Agriculture, Forestry, and Other Land Use (Sinks)

- Landfilled Yard Trimmings and Food Scraps
- Urban Trees and Forest Carbon



Greenhouse Gas Sources

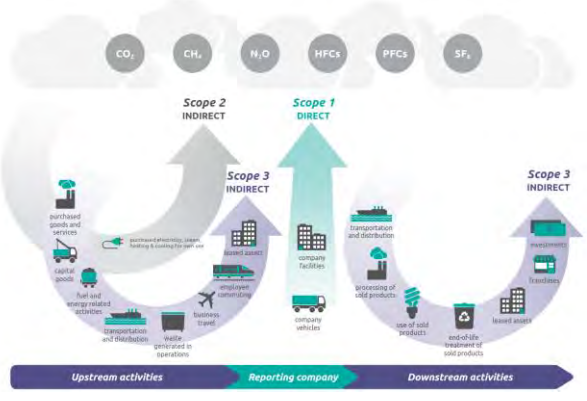
Waste

- Landfills
- Composting
- Wastewater Treatment

GHG Inventory Methods and Protocols

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories,
- U.S. Environmental Protection Agency's (EPA) Greenhouse Gas Reporting Program (GHGRP),
- U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015, and EPA's State Inventory Tool (SIT), and
- World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), GHG Protocol

Inventory Scopes



Source: World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), GHG Protocol

- Division by Scopes is typically not used for state or national level GHG inventories
- Scopes are generally used by cities, corporations, or smaller agencies for GHG accounting.

GHG Rules & Statewide GHG Emission Inventories

April 10, 2019

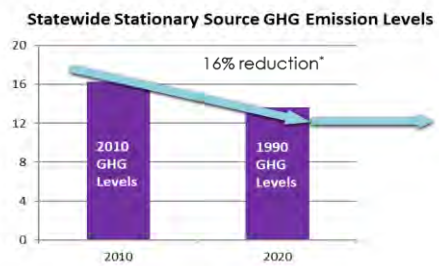
Clean Air Branch

Healthy Communities, Healthy Islands, Healthy People

Greenhouse Gas Offset Symposium

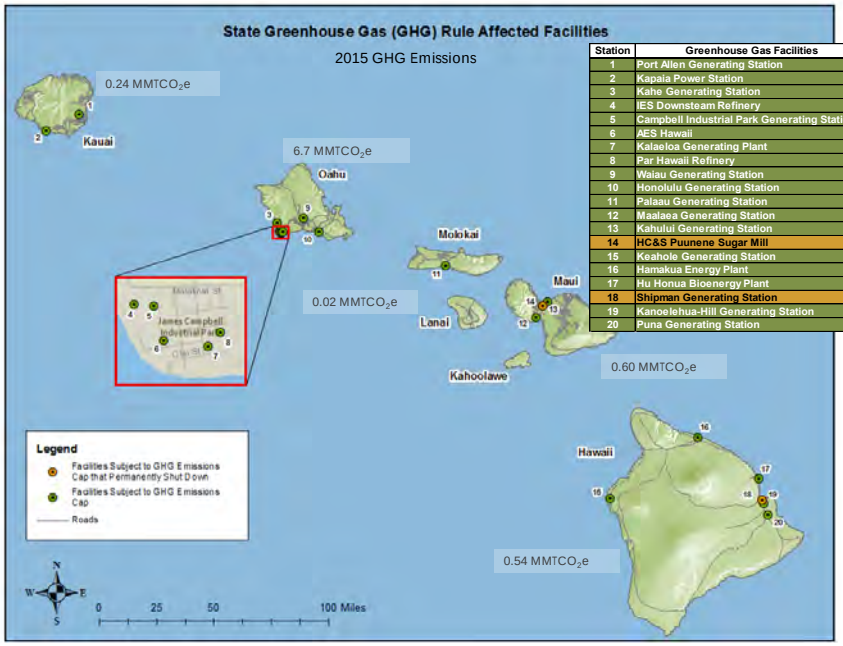
Introduction

- Hawaii Act 234, 2007 – GHG Rules.
- GHG Rules set a statewide greenhouse gas emissions limit to equal or below 1990 levels by 2020 (CO_2e emission limit excludes aviation and international bunker fuel emissions and includes carbon sinks).
- To help meet goal - GHG emission cap is specified for large stationary sources as backstop to State Energy Office – Renewable Portfolio Standards (RPS) and Energy Efficiency Portfolio Standards (EEPS).
- Potential CO_2e threshold of 100,000 tons per year.



* 13.2% + Factor of Safety = 16% Reduction

Stationary Sources



Station	Greenhouse Gas Facilities
1	Port Allen Generating Station
2	Kapaia Power Station
3	Kahe Generating Station
4	IES Downsteam Refinery
5	Campbell Industrial Park Generating Station
6	AES Hawaii
7	Kalaeloa Generating Plant
8	Par Hawaii Refinery
9	Waiau Generating Station
10	Honolulu Generating Station
11	Palaau Generating Station
12	Maalaea Generating Station
13	Kahului Generating Station
14	HC&S Puunene Sugar Mill
15	Keahole Generating Station
16	Hamakua Energy Plant
17	Hu Honua Bioenergy Plant
18	Shipman Generating Station
19	Kanoelehua-Hill Generating Station
20	Puna Generating Station

GHG Rules

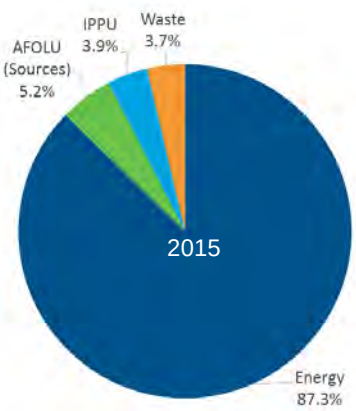
HAR 11-60.1-204(k)

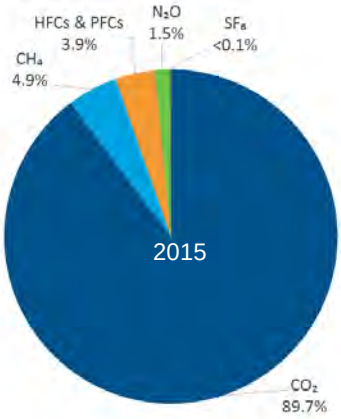
- DOH must conduct annual evaluations to determine progress in achieving the statewide GHG emissions limit.
- Contracted ICF to provide three annual reports.
- First 2015 annual report was recently released and is posted on the Clean Air Branch website.

http://health.hawaii.gov/cab/

2015 Annual Report

- Distribution of 2015 statewide GHG emissions.



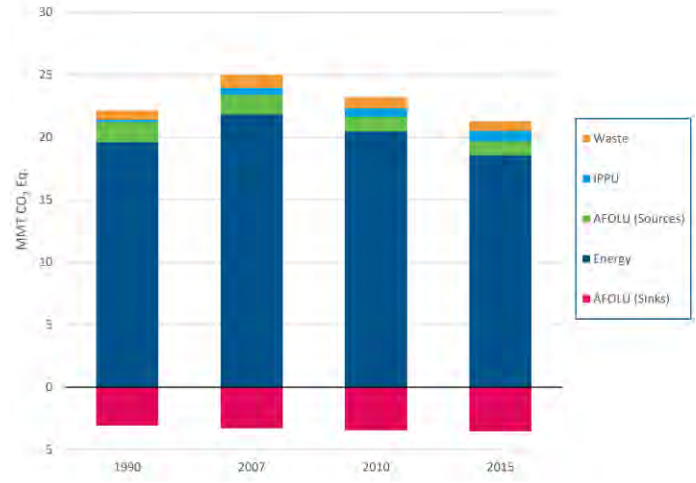


21.28 MMT Statewide CO_2e Emissions , Excluding Emissions from Sinks & International Bunker Fuel

Statewide GHG Inventories

2015 Annual Report

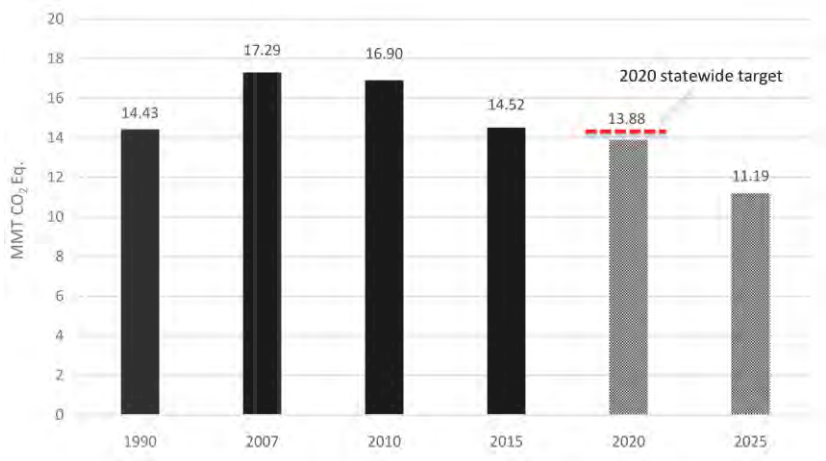
- Statewide GHG emission trends.



Statewide GHG Inventories

2015 Annual Report

- Statewide GHG emission projections.



Conclusion

Thank You

- Mike Madsen
- Clean Air Branch
- 586-4200
- 2827 Waimano Home Road, #130
- michael.madsen@doh.Hawaii.gov

Greenhouse Gas Offset Overview

Additional Hawai'i GHG Reductions Initiatives

- **Hawaii Clean Energy Initiative (HCEI):**

  The State of Hawai'i launched the HCEI partnership in 2008 with the US Department of Energy to collaborate on the reduction of Hawai'i's heavy dependence on imported fossil fuels.
  The HCEI resulted in a total of 82 laws enacted between 2008-2017:

- **Renewable Portfolio Standard (RPS)** (Hawaii Revised Statutes §269-92)

  Requires all electric utilities in Hawai'i to establish an RPS of:
  - 30% by 12/31/2020,
  - 40% by 12/31/2030,
  - 70% by 12/31/2040, and
  - 100% by 12/31/2045.

- **Energy Efficiency Portfolio Standard (EEPS)**(Hawaii Revised Statutes §269-96)

  Establishes energy-efficient portfolio standards, and mandates 30% (4,300 GW) energy reduction goal by 2030.

AECOM

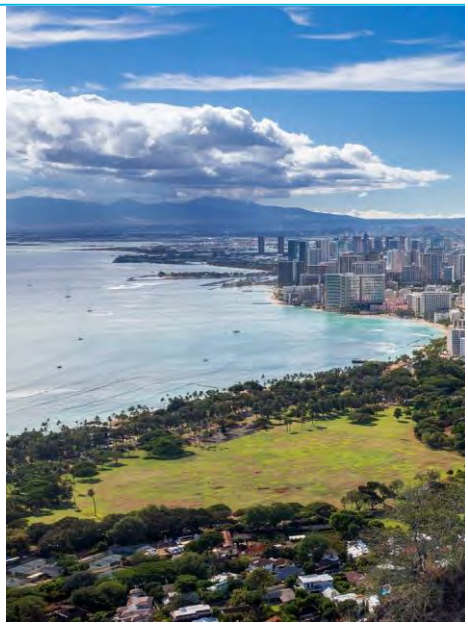
Definition of Terms

Offset Verb - Offsetting

- Reduce GHG emissions offsite
- Reductions not officially certified

Offset Noun - GHG Offset Credit

- Officially certified credit representing reductions
- The focus of this symposium



Approved by the Governor
on JUN 04 2018

HOUSE OF REPRESENTATIVES
TWENTY-NINTH LEGISLATURE, 2018
STATE OF HAWAII

ORIGINAL

ACT 016

H.B. NO. 1986 H.D. 2 S.D. 2 C.D. 1

A BILL FOR AN ACT

RELATING TO THE ENVIRONMENT.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF HAWAII:

SECTION 1. The legislature finds that the State's natural environment and ecosystems are in a fragile state due to the amount of greenhouse gases released through human activities and

other states and private industries have established these types of credits for purchase by polluters to offset their carbon

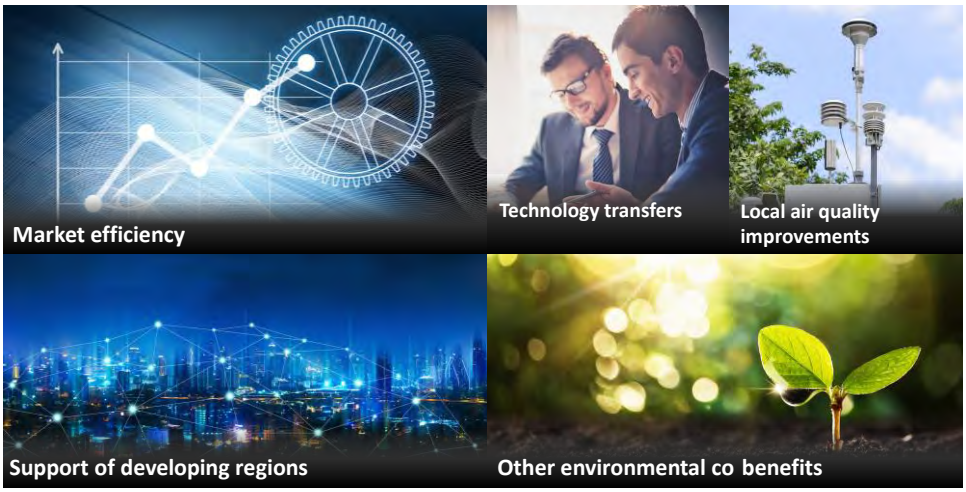
Definition of Terms

Offset:
An offset credit, sometimes referred to as “GHG emissions reductions credit,” “offset certificate,” “offset instrument,” “carbon offset”, “GHG offset” or simply “offset,” is a credit for mitigating 1 metric ton (MT) carbon dioxide equivalent (CO_2e) by paying someone else to avoid 1 MT CO_2e elsewhere. Offset credits are monetarily tradeable as well as evaluated, certified, and guaranteed by a standard or program.

Important Note: GHG emissions reductions, including sequestration, are *not* necessarily offsets.

Offsets’ primary purpose is to mitigate climate change by bridging the gap between high and low cost GHG reductions

Benefits of Offsets



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Distinguishing Between Related Credits

Emissions Reduction Credits (ERC)

- A credit earned by an entity in a regional air quality jurisdiction based on the reduction in air emissions beyond what is required by rules or permits. ERCs are based on non-carbon related pollutants including NOx, SOx and VOCs

Renewable Energy Credits (REC)

- The generation of one megawatt hour (MWh) of electricity from an eligible source of renewable power and is tradable for voluntary and compliance requirements

Important Note: Offsets, ERCs, and RECs are three distinct types of credits. There are numerous other types of environmental credits, and these distinct types of credits are not directly interchangeable. The remainder of the symposium will focus on offsets specifically.

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Offset Program Feasibility through Offset Project Understanding

Offset Project Feasibility

Feasibility of a GHG reduction project converting to an offset can be assessed through:

- Quality Criteria - current presentation
- Additional / Additionality - current presentation
- Financial Viability - Steve Baczko
- Environmental Justice - Trisha Kehaulani Watson

Important Note: Most GHG reductions are *not* converted to offsets.

Quality Criteria for Offsets

- Real
- Quantifiable
- Permanent
- Enforceable
- Verifiable

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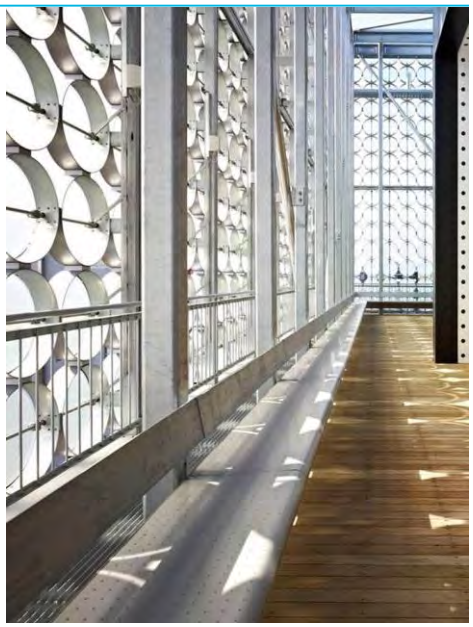
Quality Criteria for Offsets

Real/Actual:

Quantified through technically and scientifically sound accounting practices that represent actual emissions reductions beyond a baseline.

- Initial question: What is the GHG reduction associated with the action?



Quality Criteria for Offsets

Quantifiable / Quantification:

The ability to consistently manage, measure, and calculate the total quantity of offsets produced.

- Deceptively challenging, particularly paired with other quality criteria.

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Quality Criteria for Offsets

Permanent / Permanence:

The GHG emissions reductions will last in perpetuity without reversal.

- Relatively straight forward for GHG reductions involving destruction of High-Global Warming Potential (GWP) GHG.
- More challenging for land use change efforts involving sequestration.

Quality Criteria for Offsets

Enforceable/Enforceability:

Assurance that the offset credits are trackable and supported by regulatory or third-party framework that defines their creation, provides transparency, and guarantees exclusive ownership.

- Compliance programs can satisfy requirement.
- Insurance and other financial mechanisms can also provide assurance.

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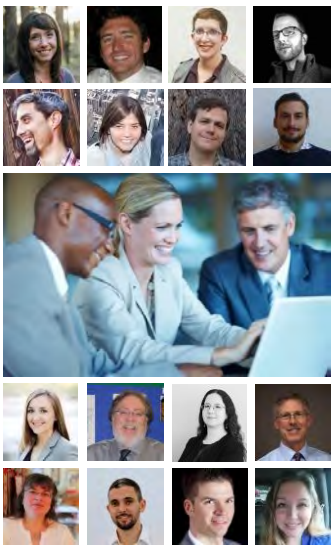
Quality Criteria for Offsets

Verifiable/Verification:

An annual auditing process performed by an approved party according to the offset project's program, whereby the project's offset credits are calculated according to the approved protocol.

- Requires performance by a third party with no conflict of interest.



Additional/Additionality

The GHG reduction project must be an additional project, not one that would have been created in a baseline scenario. The primary tests for determining additionality include:

- Legal Requirement Test:
  The GHG reduction is not required by any federal, state, or local law, statute, rule, regulation, ordinance, court order, or other binding mandate.

- Performance Test:
  The project achieves greater GHG reductions or removals than the standard performance threshold for the given project type, demonstrating the emissions reduction would only occur through development of the offset credit.

Additionality Related to Leakage

Leakage: An undesirable situation in which reduction of one entity's GHG emissions leads to an increase in GHG emissions elsewhere in the world.

As GHGs are a pollutant with global consequences, regardless of the location of emissions.

Standards, Protocols and Registries

Who sets Quality Criteria and determines Additionality?

Standards or Programs

International

- Clean Development Mechanism (CDM)
- Reduction in Emissions through Deforestation and forest Degradation (REDD+) (*note: not always market based/offset generating*)
- Joint Implementation (JI) (*note: Kyoto Protocol trading only*)

State Level

- California Air Resources Board (CARB) Compliance Offset Program
- Regional Greenhouse Gas Initiative (RGGI) Offset Program

Voluntary

- American Carbon Registry (ACR),
- Climate Action Reserve (CAR),
- Verified Carbon Standard (VCS), and
- Gold Standard

How are Quality Criteria determined?

Existing Protocols under Programs or Standards

Offset Protocol Category	Examples of Current Project Protocol Options	Current Project Locations
Renewable Energy Generation	Wind and solar projects	Developing countries
	Biomass energy projects	Developing countries
	Hydropower projects	Developing countries
Energy Distribution, Demand, or Efficiency	Multiple project types	Multiple countries, including US
Transport	Multiple project types	Multiple countries, including US
Industrial Process and Fugitive Emissions	Multiple project types	Multiple countries, including US
Waste Handling and Disposal	Landfill and wastewater projects	Multiple countries, including US
Land Management: Agriculture, Forestry, Grassland or other	Multiple project types	Multiple countries, including US
Livestock and Manure Management	Multiple project types	Multiple countries, including US

How are Quality Criteria accounted for?

Tracking Offsets Through Registries

- Offset programs must use registries such as APX and IHS Markit to track offset projects.
- A registry is an independent entity that guarantees a GHG offset credit is counted only once through tracking offset production and purchases, to guarantee singular ownership.
- GHG offsets are retired through these third-party registries.

APX

IHS Markit

GHG Offset Project Development BASICS

Step1 Protocol Selection or Development	• Identify appropriate protocols and methodologies • Use existing protocol, modify an existing protocol, or develop a new protocol • Identify stakeholders
Step 2 Project Development	• Evaluate costs and revenues • Initiate the project • Construct or establish necessary
Step 3 Management, Monitoring and Verification	• Develop management and monitoring plans • Measure and gather annual data • Complete third party verification
Step 4 Registration/Exchange	• Connect with registries through standards and programs • Guarantee that offsets meet necessary requirements • Track offset records for trading and retirement
Step 5 Consumers and Potential Government Policy	• Sell offset credits to compliance or voluntary buyers • Future acceptance of offset credits for government-based program, if applicable • Retire offsets from future trading

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NatureBank Asset Management Inc. has been involved in carbon markets since 2005.

We provide carbon offset project origination, development and commercialization services for voluntary and compliance carbon markets.

We offer advisory services for corporate GHG management, sustainable agroforestry and land use management.

We have developed projects all over the world, working with private and public companies, land owners, governments, NGO's, Native American Tribes, First Nations and Indigenous communities.

What are Carbon Markets?

"Carbon Markets" exist where there is trading of carbon emission allowances and/or offsets, which incentivizes companies or countries to limit their GHG emissions through the lowest cost option while driving investment and innovation.

There are both "Voluntary" and "Regulated/Compliance" carbon markets worldwide.

Carbon Markets exist in 45 jurisdictions and 25 subnationals around the world with a reported market value of $82 Billion in 2018 ***(World Bank 2018 report)***

Compliance and Voluntary Markets

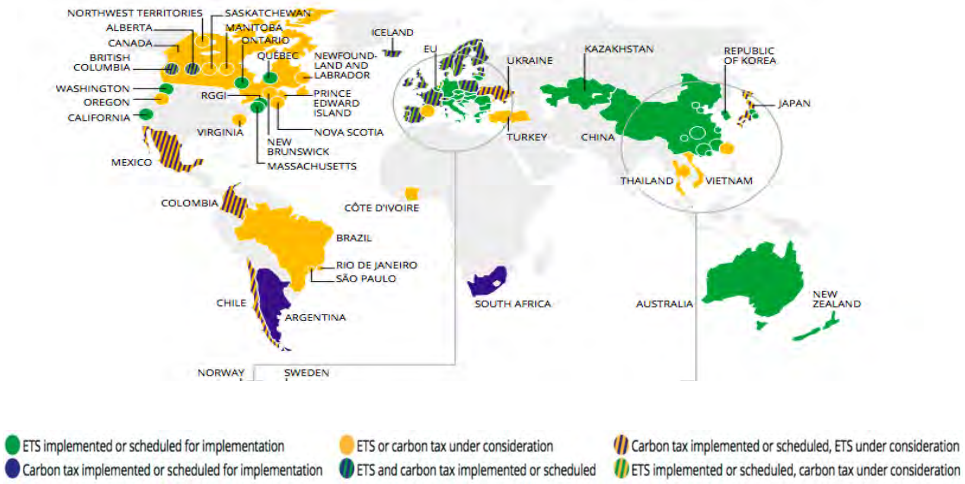
Compliance Markets – government regulated programs that institute a price on emissions based on mandated reduction targets through a market based approach (cap-and-trade) or a carbon tax.

Voluntary Markets – offset based market where organizations purchase and trade offset projects to meet voluntary commitments.

Voluntary markets co-exist with compliance markets and offer more flexibility but lower market size/price and demand.

Where do Carbon Markets Exist

Figure 1 / Summary map of regional, national and subnational carbon pricing initiatives implemented, scheduled for implementation and under consideration (ETS and carbon tax)



North American Carbon Markets

- **California -** ("AB32" – Global Warming Solutions Act)
- **RGGI -** Regional Greenhouse Gas Initiative
- **Quebec -** (Linked to California under cap and trade program - WCI)
- **British Columbia -** ("GGIRCA" – Greenhouse Gas Industrial Reporting and Control Act)
- **Alberta –** ("CCIR" Carbon Competiveness Incentive Regulation)
- **Canadian Federal Program** – (Pan Canadian Framework on Clean Growth and Climate Change)

- ***Lack of federal action is driving US states to address climate change and implement carbon pricing/market solutions at the state level.***
- ***Currently 10 states with Cap-and-Trade programs***
- ***Oregon poised to be next and first state to link to California***

Allowance vs. Offset

Within compliance carbon markets there exist allowances/permits and offsets

Allowance – government issued permit based on a specific allocation of emissions that are distributed for free or auctioned to regulated entities under a cap-and-trade program.

Offsets – represent an actual GHG reduction that is purchased at a lower cost to allowances as a means of managing GHG compliance obligation.

Role of Offsets in Carbon Markets

An offset represents the reduction, removal or avoidance of greenhouse gas emissions, measured in metric ton of CO_2 equivalent ($MTCO_2$)

- Offsets serve as a key component to carbon markets but represent only a small % of the overall market
- In a compliance market, offsets provide a lower cost solution to regulated entities for their compliance liability
- Discounted value applied against allowances/permits due to invalidation risk profile
- Heavily impacted by supply and demand, policy changes
- Actual GHG reduction outside cap sectors
- Provide Non-program revenue

Offset Value Add to Market

- Achieve real emission reductions
- Lower cost and efficient option for managing GHG reduction programs
- Promote innovation and technology transfer
- Alleviate compliance costs
- Provide co-benefits – (environmental, socioeconomic, SDG)
- Enable linkage and trading between entities and other jurisdictions
- Alternative revenue streams and access to private capital

Types of Offset Markets

Compliance	• Government regulated programs where offsets are legally eligible for a % of compliance obligation • Examples: Western Climate Initiative, EU ETS
Pre Compliance	• Early action participation based on carbon pricing policy speculation • Examples: CORSIA, WCI
Corporate Voluntary	• Non-regulated programs driven by corporate mandates to reduce specific scopes of GHG emissions. • Examples: Carbon neutrality, internal carbon pricing, GHG reporting
Retail	• Small companies, individuals • Examples: Travel, weddings, consumer purchases

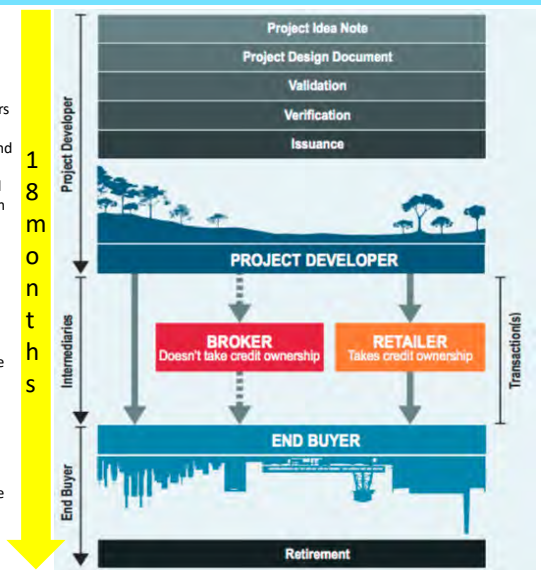
Offset Market Participants

Project Developers contract with project owners and manage the development and commercialization process

18 months

Most large transactions avoid intermediaries due to added cost and role of developer

End buyer often engages early in the process for due diligence and price negotiations.



Third party services and agreements often applied in development process

Legal contracting - offset purchase agreements with owner intermediary and/or end buyer Compliance contracts require KYC

Registry manages issuance and retirement of offset volume

Carbon Market Drivers

Buyer Profiles

Compliance	Government Funds/Foundations	Corporate Voluntary	Retail/Consumer
• Oil and Gas - BP, Shell, Chevron • Utilities • IPPs • EITEs • Trading firms • Aviation (pre-compliance)	• World Bank Fund • Norway • Corporate Foundations • REDD+ funds	• Airlines • ACA – 237 airports • Fortune 500 • Disney, Walmart, Google, Microsoft, DOW, GM, Barclays, Allianz, Lyft, BP Target Neutral	• Travel • Lifestyle • Consumer purchases • Carbonfund, Offsetters, Terrrapass

Pricing

Offset prices vary widely based on market type, policy risk, project type, standard and vintage.

Common pricing assumptions

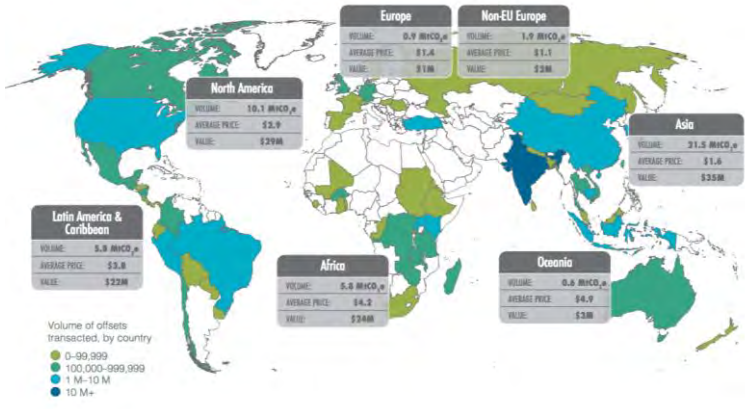
- Pricing is based on per ton basis, i.e. $/ton of $MTCO_2$
- Typical volume thresholds for buyers based on market
- Large volume transaction often priced in tranches
- Compliance pricing is often indexed and discounted to allowances prices
- Ability to pre-purchase/finance with discount to market
- Supply and Demand driven
- Co-benefits can carry added market value
- Fixed costs and variable costs

Sample Offset Pricing

Market	Product	Standard	Price
California (WCI)	CCO	CARB	$12 - $13.63
Alberta		Alberta	$24
EUETS	CER	CDM	$.25
Voluntary	VER	VCS	$.50 -$12 Average $3
Voluntary	REDD+	VCS CCBA	$3 - $7
Voluntary	VER	Gold Standard	$3 - $15

Global Voluntary Market Value

Figure 8: Market Size by Project Region and Country, 2016



Notes: Based on 769 transactions representing 46.5 $MtCO_2e$ in 2016.

California Cap and Trade Program

- The "Global Warming Solutions Act – Assembly Bill 32" began operating in Jan 1, 2013, linked with Quebec 2014.
- Reduce GHG emissions to 1990 levels by 2020, and then 40% below 1990 levels by 2030
- Program extended to 2030
- Economy wide, Covers 350 businesses, 600 facilities, full Cap-and-Trade system that includes allowance allocations, allowance auctions, banking, trading and offsets.
- **Offsets are eligible up to a maximum of 8% of the compliance obligation until 2020 and then 4% from 2020 rising to 6% in 2025**
- The California Air Resource Board (CARB) adopted and adapted offset protocols from the Climate Action Reserve (CAR) for use under the regulated system.

California Offset Market

Currently the largest offset market

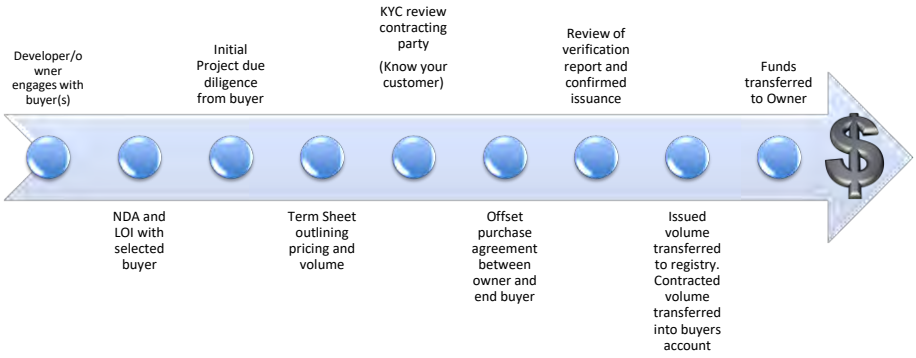
Allocation: 8% compliance obligation until 2020 changing 4% from 2020 rising to 6% in 2025. 2% in state requirement

Protocols: California Air Resources Board (CARB)

Project types: Forestry, Ozone Depleting Substances (ODS), Livestock, Mine Methane Capture, Rice Cultivation

Estimated volume for first phase (2020): ~ 200 MT CO_2
Market Size: ~$2.4 Billion
Issued ARBOC volume to date: 151,945,993

Offset Project Transaction



Fixed Costs Development Assumptions

Development task	Description	Estimated costs (varies based on market program)
Project feasibility assessment	Initial project screening for eligibility and credit generation	$15K - $30K
Protocol/methodology development	Needed if no methodology exists	~$100K
Project development	Implementation thru verification	~$300K (varies based on project type and protocol)
Legal	Contracting with buyers, third parties, verifiers	~$50K
Initial verification	Third party verifier site visit, desk review and verification report	$75K
Annual verification	Based on protocol and market	$40K
Registry fees	Fees based on issued volume	20 cents/ton (varies based on program)
Program annual fees	Based on specific program	$500
Listing fees	Based on specific program	$750

Development costs can range from $250K to $500K depending on project type, location and standard

Sample pro forma
California Air Resources Board (CARB) Compliance Market
Improved Forest Management (IFM) Offset Project

Project Assumptions	
Acres	50,000
Carbon density per acre (tCO2e)	67
Common Practice Value (CPV) per acre (tCO2e)	48
Tones per acre (tC02e)	19
Gross volume first year delivery (tCO2e	950,000
Regulatory Risk Buffer	21%
Net tones	750,500
Annual Growth rate	1.50%
Estimated Annual Carbon (tones)	320,000

Cost Estimate Assumptions*	
Inventory Costs per Plot	$350
# of Plots (depends on project area)	400
Initial Site Visit Verification	$75,000
Ongoing Annual Verification	$40,000
Project Development	$300,000
Legal	TBD
$/CCO8	$13
Rate of Price Increase	7.16%
Registration Fees/CCO	$0.20
Listing fees	$750
Annual Account	$500
Discount rate	5%

	Site Verification						Site Verification					Site Verification
Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
REVENUE	$0	$9,756,500.00	$5,120,000	$5,484,800	$5,878,400	$6,300,800	$6,748,800	$7,235,200	$7,750,400	$8,307,200	$8,902,400	$9,539,200
COST Estimates												
Project Development	$300,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Registry fees		$150,100	$64,000	$64,000	$64,000	$64,000	$64,000	$64,000	$64,000	$64,000	$64,000	$64,000
AB32 Program Fees	$1,250	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500
Inventory	$140,000	$0	$0	$0	$0	$0	$100,000	$0	$0	$0	$0	$100,000
Ongoing Forest Management	$0	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Verification	$75,000	$15,000	$15,000	$15,000	$15,000	$15,000	$40,000	$15,000	$15,000	$15,000	$15,000	$40,000
TOTAL COSTS	$516,250	$175,600	$89,500	$89,500	$89,500	$89,500	$214,500	$89,500	$89,500	$89,500	$89,500	$214,500
NET REVENUE	-$516,250	$9,580,900	$5,030,500	$5,395,300	$5,788,900	$6,211,300	$6,534,300	$7,145,700	$7,660,900	$8,217,700	$8,812,900	$9,324,700

NPV GROSS REVENUE	$57,398,298
NPV COST	$1,436,225
NPV NET REVENUE	$55,962,073

Key takeaways . . .

- Developing an offset project can be a very complicated, expensive and multilayered process
- Development costs can vary widely based on project type and standard
  - Forestry projects often carry higher fixed and variable costs
- Verification costs will always be higher then expected
- Compliance projects carry higher costs and layers of approvals
- Most buyers base engagement process on eligibility and credit generation.
  - Minimum volume threshold of ~ 30,000 MT CO_2
- Early stage feasibility assessment is essential to determine project eligibility and financial returns

Trends and looking forward . . .

Compliance

- WCI expansion
- CORSIA
- Latin America
- Regional Programs

Voluntary

- Science Based Target initiatives
- Corporate disclosure initiatives
- Deforestation pledges

Mahalo

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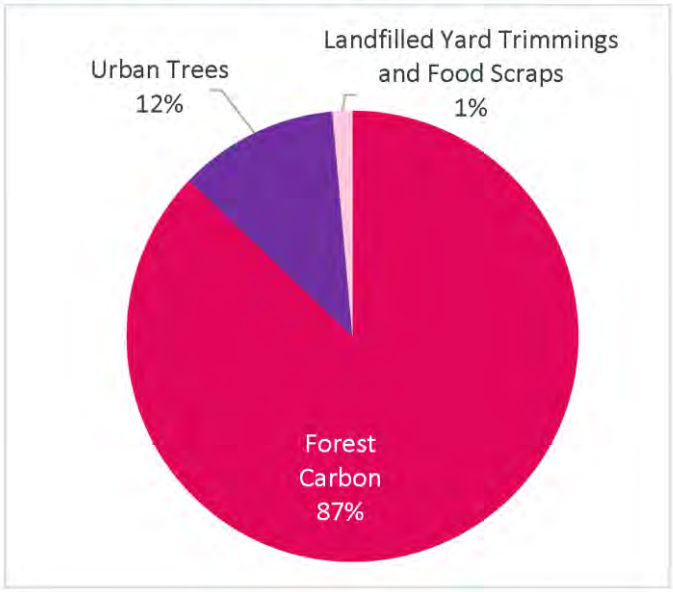
NATUREBANK

Carbon Sequestration through Forestry

Leah Laramee
Natural Resource Planner

State of Hawai'i
Department of Land and Natural Resources
Division of Forestry and Wildlife

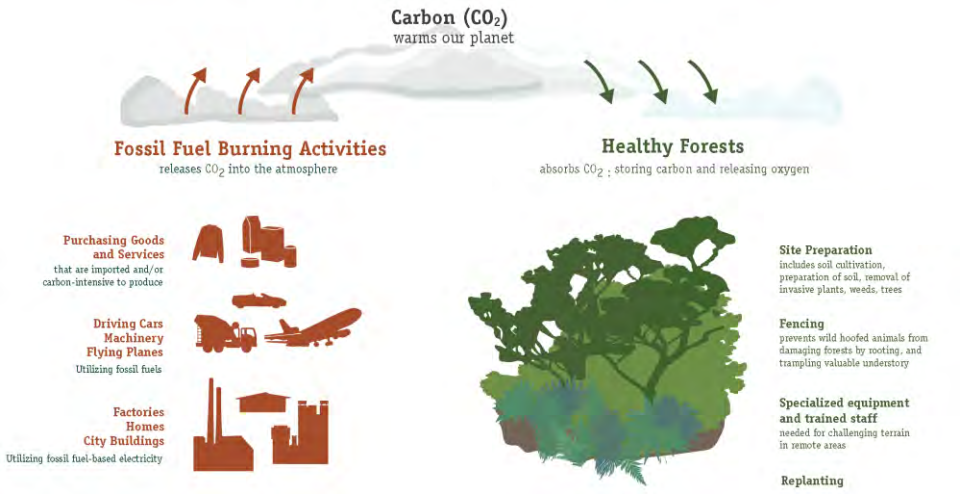
Figure 5-3: 2015 AFOLU Removals by Carbon Sink

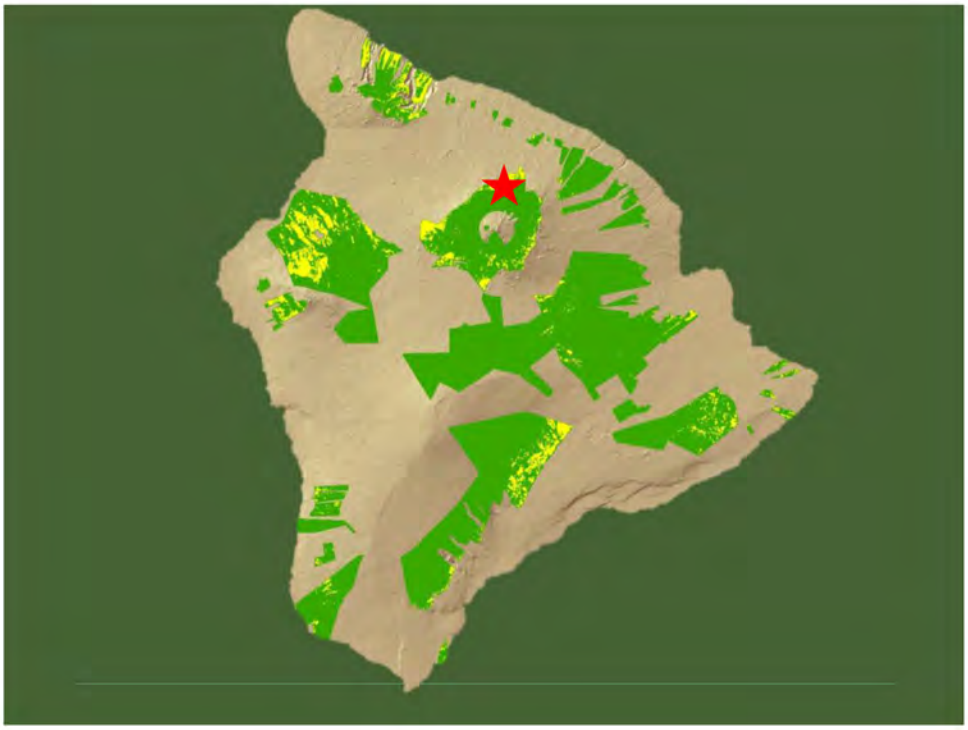


Source: Hawaii Greenhouse Gas Emissions Report for 2015

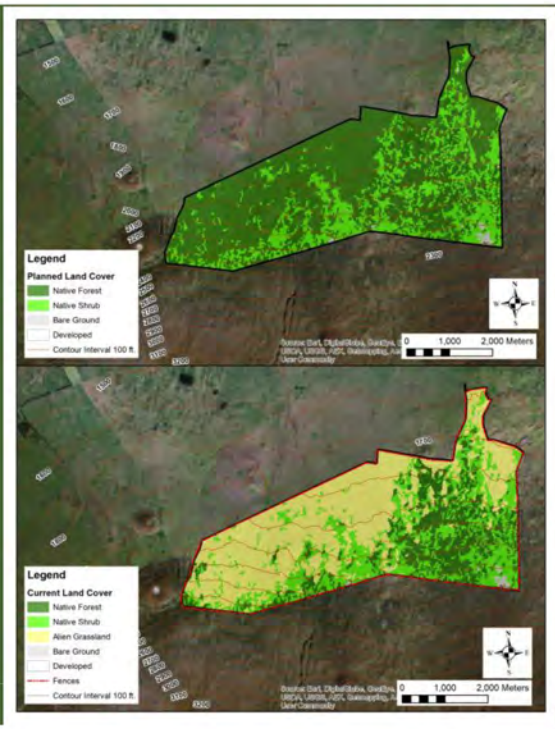
HAWAI'I DOFAW FORESTRY PROJECTS

COOLS OUR PLANET AND SUPPORTS FOREST LIFE





Pu‘u Mali Forest Carbon Project


Legend
Planned Land Cover
Native Forest
Native Shrub
Bare Ground
Developed
Contour Interval 100 ft
0 1,000 2,000 Meters
Legend
Current Land Cover
Native Forest
Native Shrub
Alien Grassland
Bare Ground
Developed
Fences
Contour Interval 100 ft
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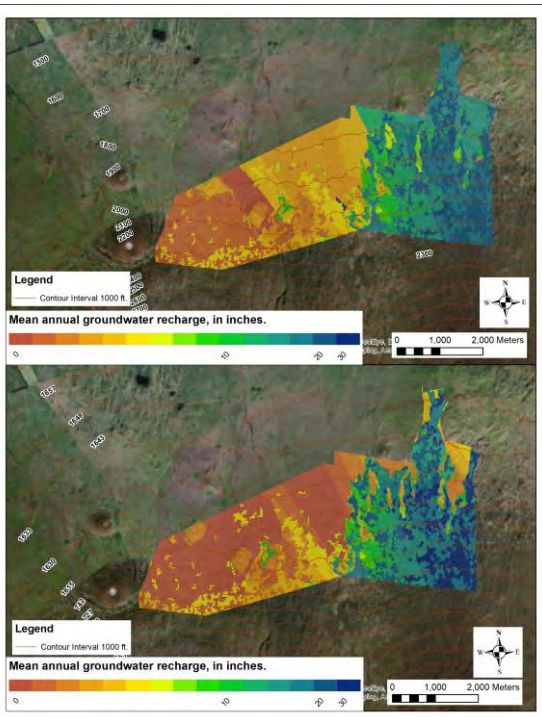
Legend
Contour Interval 1000 ft
Mean annual groundwater recharge, in inches.
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0 1,000 2,000 Meters
Legend
Contour Interval 1000 ft
Mean annual groundwater recharge, in inches.
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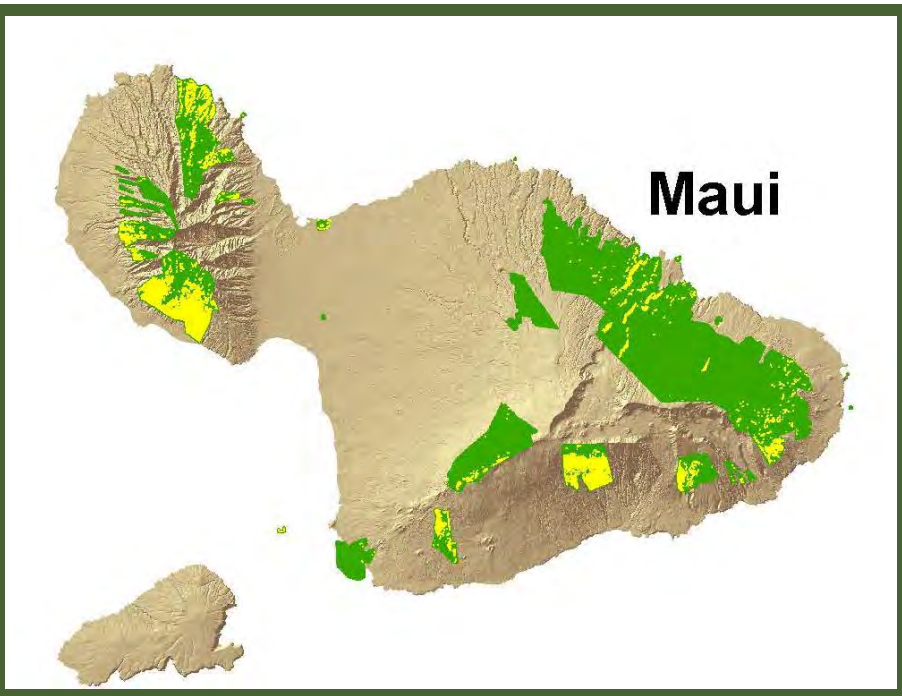
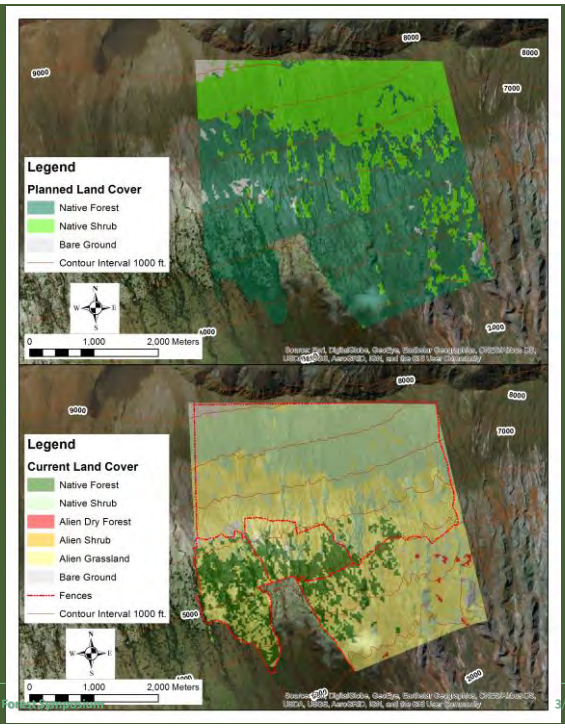

Maui

Kahikinui/Nakula Forest Carbon Project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Legend
Current Land Cover
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Native Shrub
Alien Dry Forest
Alien Shrub
Alien Grassland
Bare Ground
Fences
Contour Interval 1000 ft.
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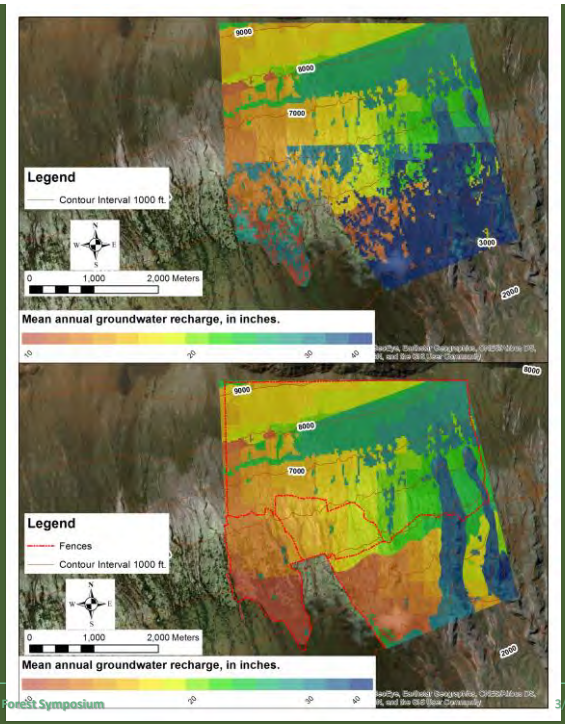
1,000
2,000 Meters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Mean annual groundwater recharge, in inches.
Legend
Fences
Contour Interval 1000 ft.
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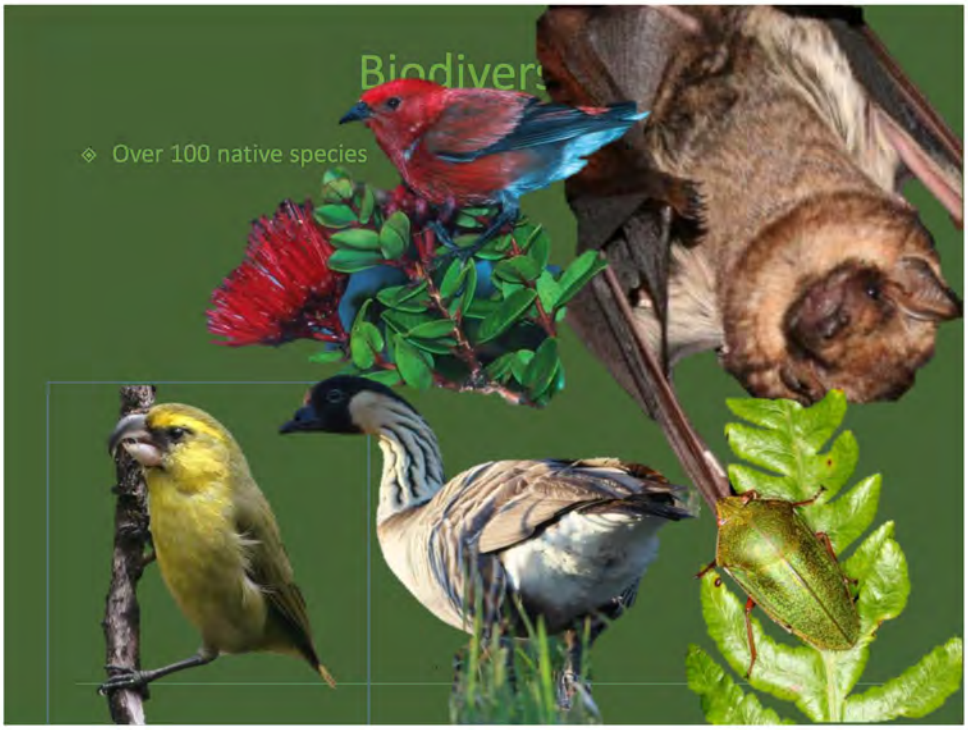
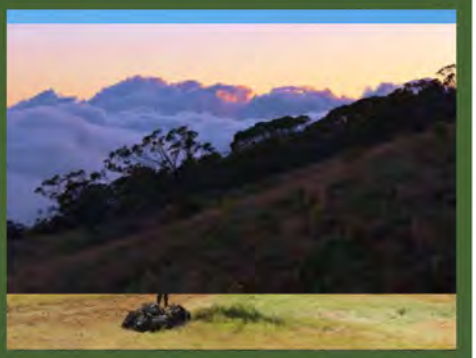
1,000
2,000 Meters
Mean annual groundwater recharge, in inches.



Green Jobs

Project Specifics

- USGS: Total of about 94,000 tons of carbon
- Project includes
  - Fencing
  - Site preparation
  - Invasive species removal
  - Planting
  - Certification
- Total budget: about $10.5 million over the 50 years of the Project



Mahalo!

FORESTS FOR LIFE

Leah. J.Laramee@hawaii.gov

HAWAIʻIGAS

THE CLEAN ENERGY COMPANY

GOOD ENERGY WITH HAWAIʻI GAS

BIOGAS FOR CARBON OFFSET SYMPOSIUM

Aaron Kirk

VP of Marketing & Business Development

About Hawaii Gas

- Founded in 1904
- Hawaii's only gas utility
- ~325 employees
- ~70,000 customers
- Supply gas to all islands

Largest propane supply company in Hawaii

Bulk propane storage on all islands

Produce synthetic natural gas (SNG) and distribute through 1,100 mile pipeline system on Oahu

Diverse Fuel Supply Stabilizes Prices and Improves Reliability

SNG
(Primary Fuel)

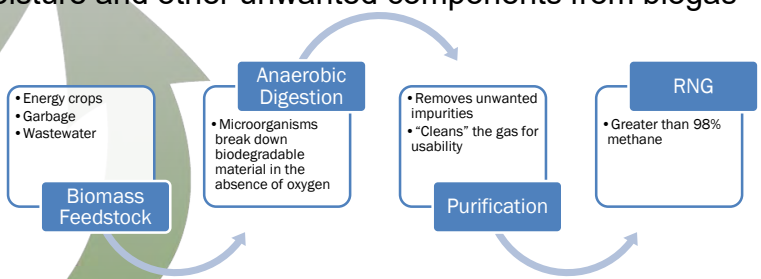
Propane / Air
(SNG Backup)

Containerized LNG
(Up to 30%)

Renewable Natural Gas
(Honouliuli WWTP)

What is Renewable Natural Gas?

- Renewable Natural Gas (RNG) is the term that is used to describe pipeline-quality biomethane produced from biomass
- It is interchangeable with natural gas and fully compatible with existing natural gas pipeline infrastructure
- RNG is produced by removing the carbon dioxide (CO_2), moisture and other unwanted components from biogas



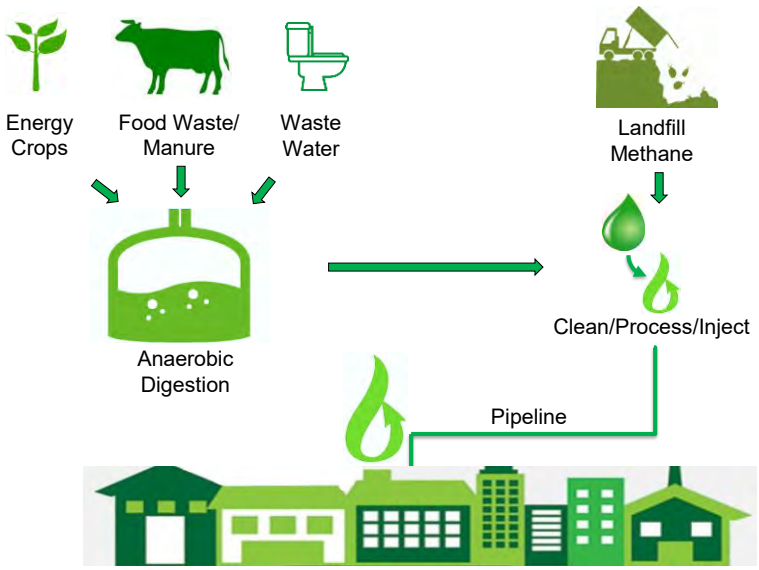
RNG Comes from 3 Local Sources, and Can Be Carbon Negative

Waste Water Treatment Plants: Predictable and consistent supply of feedstock

Landfills: Biogas can be expensive to process/clean due to contaminants. Supply is local and available

Agricultural Crops: Provides a scalable pathway to larger-scale biogas use in Hawaii today. Highly attractive but land use challenges exist

How RNG is Made



Overhead View

Water Removal System

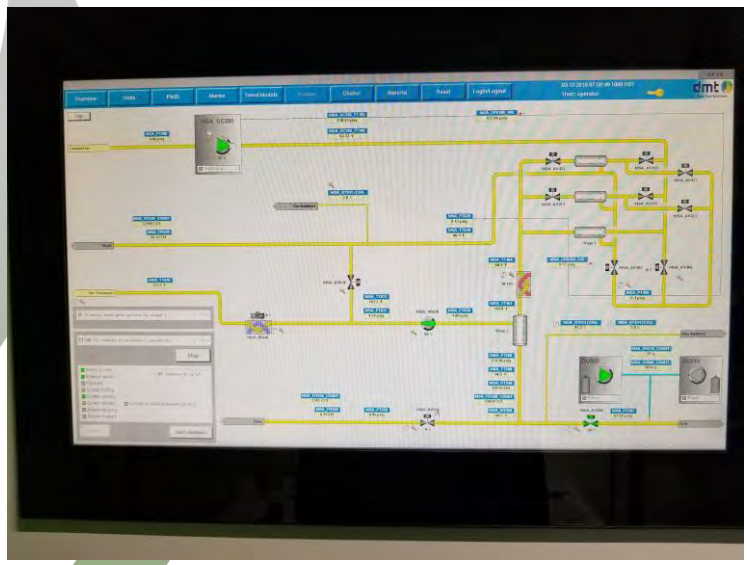
Activated Carbon Vessels

Compressor

2 stage Membranes

Gas Analyzer

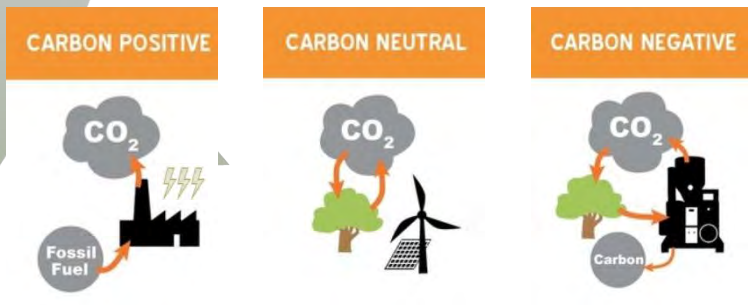
HMI (Human/Machine Interface)



RNG as a Carbon Neutral Fuel

Advantages of RNG:

- Eliminates the release of sequestered carbon by replacing SNG with RNG
- Eliminates flared methane at WWTP's and Landfills
- Recycles previously wasted energy



Fossil Fuels | Water, Wind, Solar | Biomass, Energy Crops

Biogas Upgrading

4,280 metric tons of CO2 eliminated annually

- Prior to the project, both the biogas and SNG were burned, now only the biomethane is burned.
- CO2 is eliminated from fossil fuel sources

Honouliuli Wastewater Treatment Plant

Actual Production

	Therms Produced	BTU's	Energy Equiv (barrels)
FEB	31,062	3,106,200,000	535 eliminated
MAR	53,743	5,374,300,000	926 eliminated

Total Cost to Build	Electrical Use	Op Cost (Elec+AC)
~$3.2M	1.2kWh/ therm	~$0.45/ therm

Mahalo

GOOD ENERGY WITH HAWAIʻI GAS

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

Electrification of Transportation

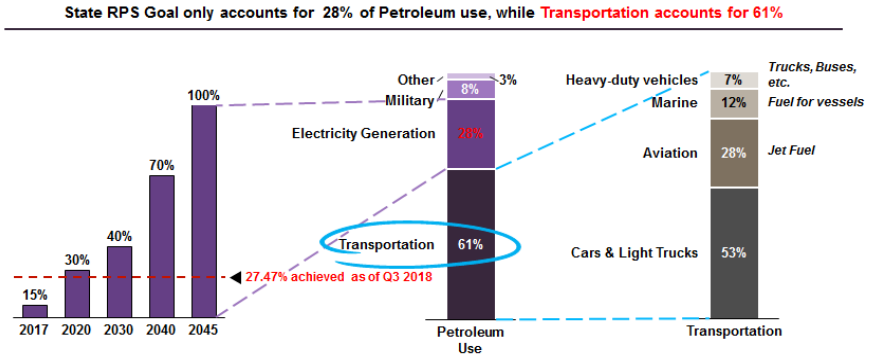
Light Duty Electric Vehicle Adoption

Carbon Offset Symposium

Hawaii State Capitol Auditorium

April 10, 2019

We view EoT as a high priority--it has a significant impact on RPS, climate change, energy security, and grid modernization



We cannot go it alone it's a *kākou* thing

Five near term action steps in our strategy…

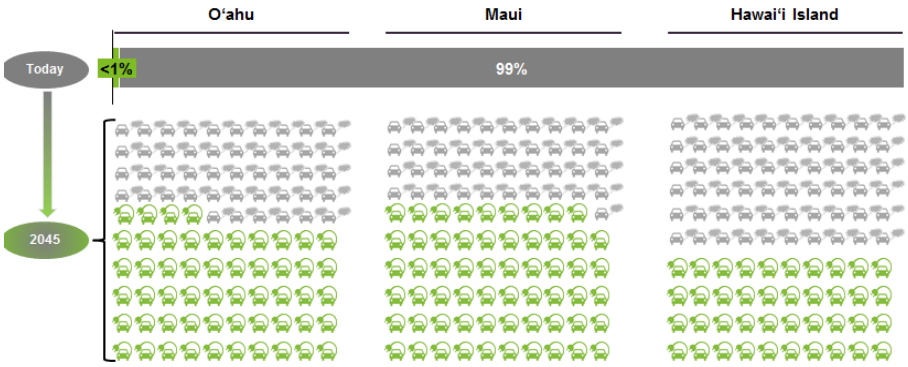
Near term action steps	Hawaiian Electric Role	Partner Role
Boosting EV adoption by working with automakers, dealerships and advocates to lower the cost and educate customers	◑	◑
Accelerating the buildout of charging infrastructure, especially in workplaces and multi-unit dwellings. Providing a critical backbone of reliable, public utility-owned chargers as the launching point from which the broader electric transportation and third party market in Hawaii can expand and solidify. Identifying and providing make-readies in gap areas to create opportunities for third party chargers that optimize grid and customer locations to meet driver needs	◑	◑
Supporting bus operators in transitioning to electric with targeted outreach and programs that reduce the upfront cost and provide practical charging solutions	◑	◑
Creating grid service opportunities by leveraging demand response programs and rates that incentivize EV charging to align with grid needs and save money for both drivers and all grid customers	◕	◔
Coordinating with ongoing grid modernization and planning efforts to ensure smooth integration of EVs into energy delivery networks and maximizing use of renewable resources	◕	◔

We need everyone working together towards transitioning to this clean energy future

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

Broad-based inclusion of stakeholders

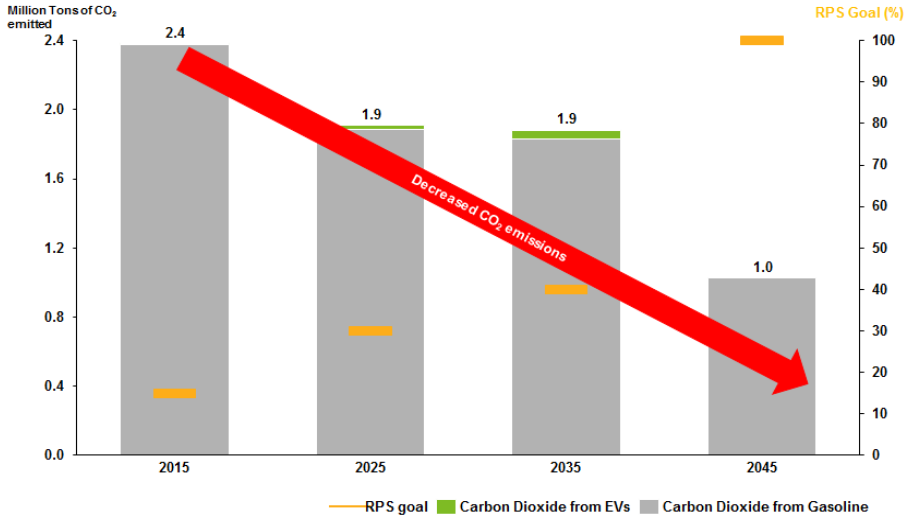
By 2045 we forecast that on O‘ahu one in two vehicles will be electric, on Maui ~ 60% and Hawai‘i Island ~40%



Hawai‘i is rated #2 nationally for electric vehicle adoption per capita!

Hawaiian Electric
Maui Electric
Hawai‘i Electric Light

CO_2 emissions are forecasted to reduce significantly, slowing climate change and increasing energy security by importing less fossil fuels



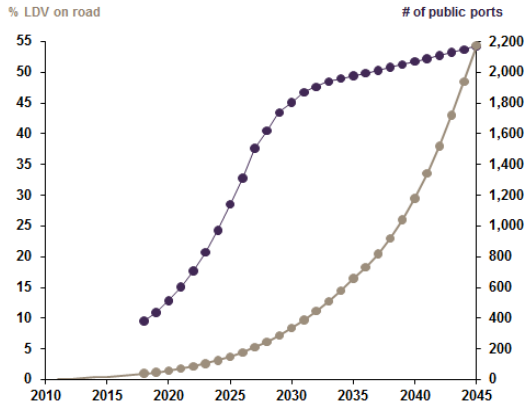
Hawaiian Electric
Maui Electric
Hawai‘i Electric Light

O‘ahu example in 2030, incremental LDV EV load ONLY

Thought experiment for today

O‘ahu forecasted # of ports and charging infrastructure cost

Forecasted public charging ports and light duty EV adoption



Charging infrastructure Cost Assumptions[1]

Includes cost of purchasing and installing EVSEs at three type of locations—residential, workplace and public

- **Residential:** conservative estimate that a level 2 EVSE is purchased at each home by a EV driver. Purchase and installation of $2300, annual reduction of 1.9%/year
- **Public ports (from forecast):**
  - DC fast charging ports: 1 DCFC port per DCFC (assume ~ 13%). Purchase and installation of ~$130k, annual reduction of 1.9%/year
  - Public L2 and Workplace L2: 2 ports per L2
    - Public L2 purchase and installation of $25k, annual reduction of 1.9%/year
    - Workplace L2 purchase and installation of $8k, annual reduction of 1.9%/year

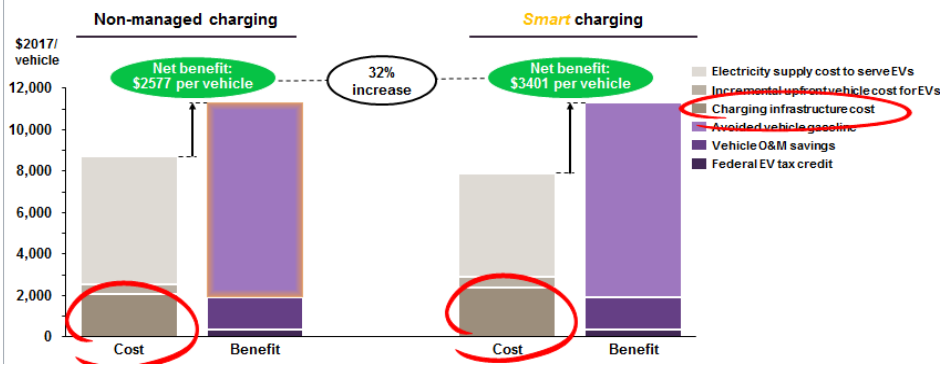
Hawaiian Electric
Maui Electric
Hawai‘i Electric Light

1. EoT Roadmap page 147 filed March 2018

Thought experiment for today

Charging infrastructure is ~ 24-30% of overall cost

Economic costs and benefits to O‘ahu per personal light duty electric vehicle, NPV 2018-2045



Hawaiian Electric
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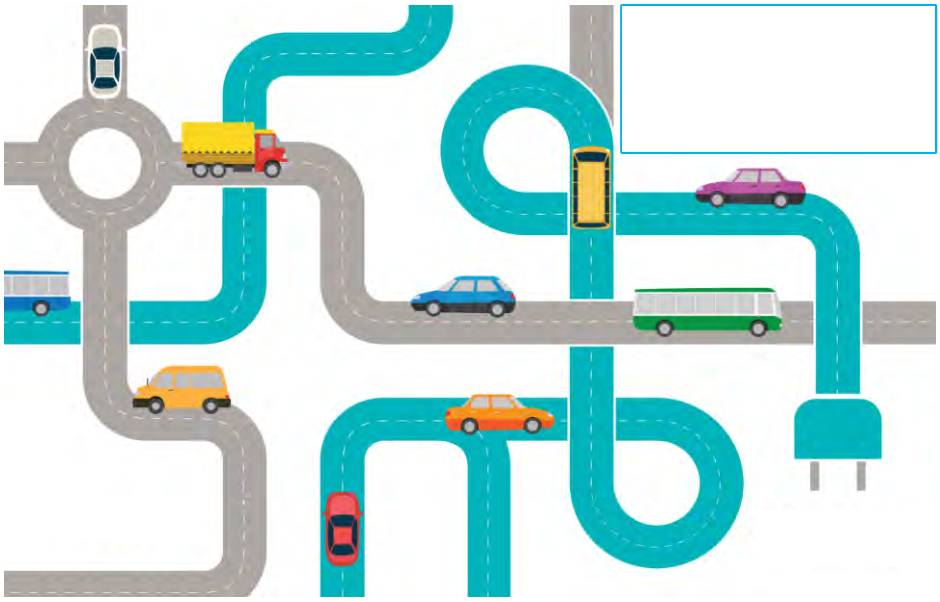
Hawai‘i Electric Light



Hawaiian Electric
Maui Electric
Hawai'i Electric Light

Environmental Justice Concerns: Places, People, Benefits

Trisha Kehaulani Watson, J.D., Ph.D.

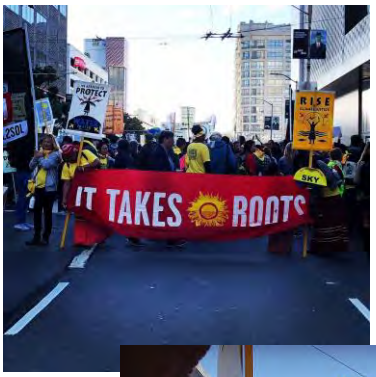
Honua Consulting

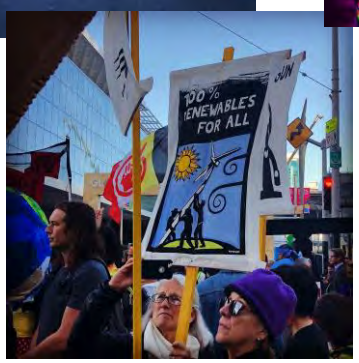
Environmental Justice, Energy Justice, and Climate Justice

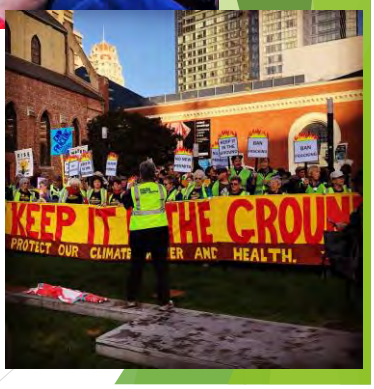
- Environmental Justice is the social movement whereby peoples of all origins, incomes, and classes receive fair treatment and opportunity to meaningful engage in decisions related to environmental policies that impact their living conditions and lives.
- Energy Justice is an emerging field and movement that applies an environmental justice framework to issues related to energy, including but not limited to how people, particularly marginalized communities, are impacted by energy development, infrastructure, and initiatives.
- Climate Justice is the growing global social movement that frames issues related to global warming and climate change within a justice framework, demanding consideration for how grassroots and marginalized communities are impacted by climate issues, including climate change solutions.

From Environmental Justice to Climate Justice

Photo Credit:
Greenpeace

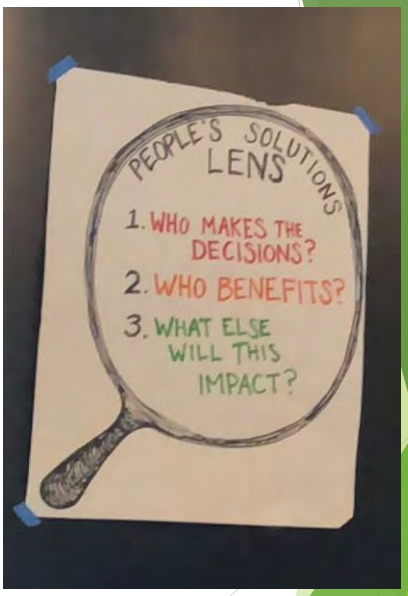






People's Solutions LENS

1. Who makes the decisions?
2. Who benefits?
3. What else will this impact?



Questions to Ask Prior to Offset Development

- Has climate change been considered as a global issue where the solutions require an interconnected approach between global communities?
- Will the GHG reduction project adversely affect indigenous peoples or local communities it is developed in?
- Will the GHG reduction project adversely affect developing communities or indigenous peoples around the world through shifts in supply and demand or resources?

Further Market Based and Government Tools

From Project to Program Feasibility (unpacking the day)

Carbon Pricing

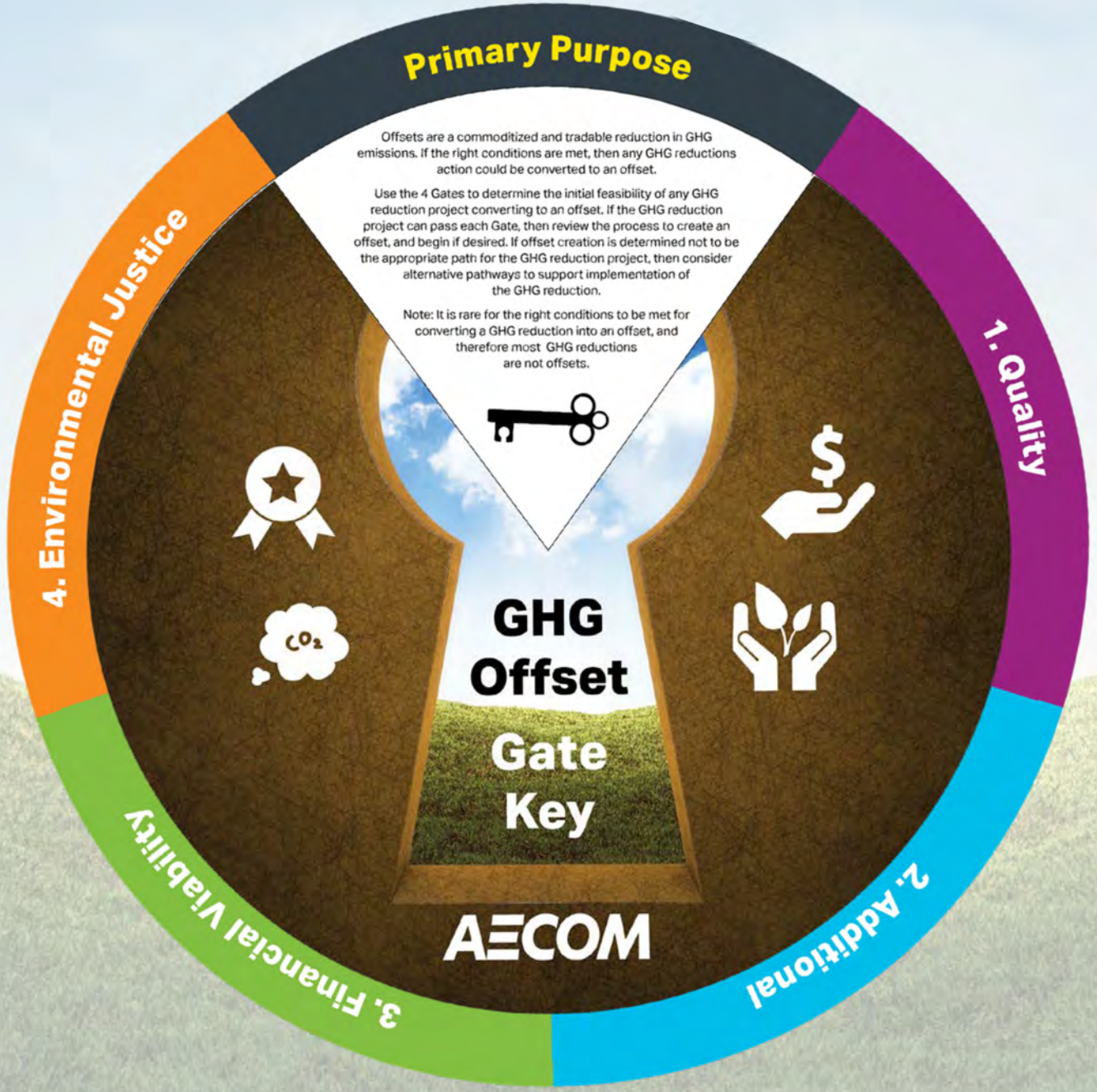
- Fees, Taxes and Cap-and-Trade
- Note: Offsets are Part of Carbon Pricing

Codes and Building Standards

Impact Investing

Voluntary Funds

c Offset Gate Key


Primary Purpose
Offsets are a commoditized and tradable reduction in GHG emissions. If the right conditions are met, then any GHG reductions action could be converted to an offset.
Use the 4 Gates to determine the initial feasibility of any GHG reduction project converting to an offset. If the GHG reduction project can pass each Gate, then review the process to create an offset, and begin if desired. If offset creation is determined not to be the appropriate path for the GHG reduction project, then consider alternative pathways to support implementation of the GHG reduction.
Note: It is rare for the right conditions to be met for converting a GHG reduction into an offset, and therefore most GHG reductions are not offsets.
1. Quality
2. Additional
3. Financial Viability
4. Environmental Justice
GHG Offset Gate Key
AECOM

Primary Purpose

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Note: It is rare for the right conditions to be met for converting a GHG reduction into an offset, and therefore most GHG reductions are not offsets.

4. Environ

3. Financial Viability

2. Additional

AECOM

1. Quality

Is there an existing protocol? If yes, go to Gate 2.
If no, GHG reductions must meet all of the following criteria:

- **Real:** GHG emissions reduced below an established baseline, based on scientifically sound practices.
- **Quantifiable:** The ability to consistently manage, measure, and calculate the total quantity of GHG emissions reduced.
- **Permanent:** The GHG reductions will last in perpetuity, without reversal.
- **Enforceable:** Offset credits must be supported by a regulatory or third party framework that guarantees transparency, traceability, and exclusive ownership.
- **Verifiable:** An auditing process performed by an accredited third party, to ensure the GHG reductions are calculated according to an approved protocol.

If all 5 Quality Criteria are met, proceed to Gate 2.

4. Environ

3. Financial Viability

2. Additional

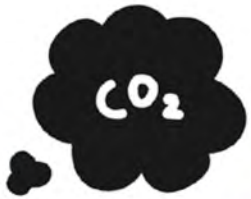
AECOM

2. Additional

The GHG reduction project must be an additional project, not one that would have been created in a baseline scenario. The primary tests for determining additionality include:

- **Legal Requirement Test:** The GHG reduction is not required by any federal, state, or local law, statute, rule, regulation, ordinance, court order, or other binding mandate.
- **Performance Test:** The project achieves greater GHG reductions or removals than the standard performance threshold for the given project type, as determined and defined in the applicable protocols.

Does the GHG reduction meet the Additionality Criteria?
If yes, then proceed to Gate 3.



Prima

4. Environmental Justice

3. Financial Viability

AECOM

3. Financial Viability

- **Quantity** - What are the expected annual GHG reductions?

* If the expected quantity of annual GHG reductions exceed 30,000 MTCO2e, then proceed to Costs below. If not, then reconsider offset creation or apply additional scrutiny to the analysis.

- **Costs** - What are the expected costs per $MTCO_2e$? What is the expected market value of the offset credits created?

* Typical price for offsets range from ~$2-15 per MTCO2e; however there are market outliers.

* If the expected market value of the offset outweighs the cost, then proceed. If not, then reconsider offset creation or apply additional scrutiny to the analysis.

Other financial aspects for additional scrutiny include access to aggregators, market and regularity risk profiles, target market for the project, etc.

If financially feasible, then move to Gate 4.

Primary Purpose

4. Environmental Justi

AECOM

4. Environmental Justice

- **Has climate change** been considered as a global issue where the solutions require an interconnected approach between global communities? If no, then reevaluate offset creation.
- **Will the GHG reduction** project adversely affect indigenous peoples or local communities it is developed in? If yes, then reevaluate offset creation.
- **Will the GHG reduction** project adversely affect developing communities or indigenous peoples around the world through shifts in supply and demand or resources? If yes, then reevaluate offset creation.

2. A

1. Quality

Primary Purpose

ustice

AECOM

d Act 16
Carbon Offset Program

EXECUTIVE CHAMBERS
HONOLULU

DAVID Y. IGE
GOVERNOR

June 4, 2018 **GOV. MSG. NO. 1116**

The Honorable Ronald D. Kouchi,
President
and Members of the Senate
Twenty-Ninth State Legislature
State Capitol, Room 409
Honolulu, Hawai'i 96813

The Honorable Scott K. Saiki,
Speaker and Members of the
House of Representatives
Twenty-Ninth State Legislature
State Capitol, Room 431
Honolulu, Hawai'i 96813

Dear President Kouchi, Speaker Saiki, and Members of the Legislature:

This is to inform you that on June 4, 2018, the following bill was signed into law:

HB1986 HD2 SD2 CD1 RELATING TO THE ENVIRONMENT
ACT 016

Sincerely,

DAVID Y. IGE
Governor, State of Hawai'i

Approved by the Governor
on JUN 04 2018

ORIGINAL

ACT 016

HOUSE OF REPRESENTATIVES
TWENTY-NINTH LEGISLATURE, 2018
STATE OF HAWAII

H.B. NO. 1986 H.D. 2 S.D. 2 C.D. 1

A BILL FOR AN ACT

RELATING TO THE ENVIRONMENT.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF HAWAII:

SECTION 1. The legislature finds that the State's natural environment and ecosystems are in a fragile state due to the amount of greenhouse gases released through human activities and the resulting impact on global climate change. The legislature also finds that the State should support programs that incentivize state agencies, private entities, and individuals to adopt practices that are more environmentally friendly and that result in reduced carbon emissions into the environment. The legislature notes that one mechanism that has gained success in Europe after adoption of the Kyoto Protocol is the transferring and selling of carbon offset credits. California and numerous other states and private industries have established these types of credits for purchase by polluters to offset their carbon emissions. Billions of dollars have been raised by California alone, and many industries are seeking new places to invest these dollars to offset their carbon emissions.

The legislature further finds that it is necessary to invest state funds to improve the State's water infrastructure

and ensure future water sustainability in the face of ongoing climate change. More specifically, the State must be prepared to provide more resources and support for those affected by disaster-scale flooding, coastal seawater inundation, and shortages of potable water and agricultural water. The legislature anticipates that the revenues raised by a state carbon offset program will greatly enhance mitigation and adaptation to climate change.

Accordingly, the legislature finds that it is in the public interest to create a carbon offset program in the State that would incentivize and reward the adoption of, practice of, and adherence to carbon emission reduction activities.

The purpose of this Act is to require the office of planning in partnership with the greenhouse gas sequestration task force to establish a framework for a carbon offset program, through which revenues realized from the sale of carbon offset credits may be invested into projects to generate further carbon offset credits or enhance the State's mitigation and adaptation to climate change.

SECTION 2. Chapter 225P, Hawaii Revised Statutes, is amended by adding a new section to be appropriately designated and to read as follows:

"**§225P- Carbon offset program.** (a) The office of planning in partnership with the greenhouse gas sequestration task force shall investigate and establish a carbon offset program that:

(1) Provides expertise in carbon offsetting to public agencies and private entities and assists in coordinating carbon offset projects of public agencies, including but not limited to the generation, certification, and marketing of carbon credits;

(2) Allows for proceeds and revenues generated by state departments from sales of offset credits to be deposited into suitable funds particularly for reinvestment to generate further carbon offset credits; provided that the funds are used in accordance with the purposes of the fund;

(3) Allows for proceeds and revenues generated by state agencies from sales of carbon credits other than as described in paragraph (2) to be invested in projects

enhancing the State's efforts to mitigate or adapt to climate change; and

(4) Is consistent with the State's sustainability goals and policies.

(b) The office of planning in partnership with the greenhouse gas sequestration task force shall submit a report of its findings and recommendations, including any proposed legislation, to the legislature and the climate change mitigation and adaptation commission no later than twenty days prior to the convening of the regular session of 2020.

(c) As used in this section:

"Carbon credit" means a tradable certificate or permit issued by a carbon registry that represents a greenhouse gas reduction or greenhouse gas removal enhancement that is equivalent to one metric ton of carbon dioxide and meets the requirements of the carbon offset program.

"Carbon offset" means a compensatory measure made by an agency, business, or individual to reduce carbon dioxide emissions or to increase carbon dioxide sequestration.

"Carbon registry" means any established international, national, or regional carbon registry program that serves

voluntary or compliance markets, provides an independent carbon standard to verify and certify carbon offsets, and issues carbon credits."

SECTION 3. There is appropriated out of the general revenues of the State of Hawaii the sum of $ 150,000 or so much thereof as may be necessary for fiscal year 2018-2019 to investigate and establish the carbon offset program.

The sum appropriated shall be expended by the office of planning for the purposes of this Act.

SECTION 4. New statutory material is underscored.

SECTION 5. This Act shall take effect on July 1, 2018.

APPROVED this 04 day of JUN , 2018

GOVERNOR OF THE STATE OF HAWAII

e Offset Protocols List

Offset Standard	Protocol and Methodology Examples	Project Category Types
Climate Action Reserve	Coal Mine Methane	Industrial Process and Fugitive Emissions
Climate Action Reserve	Forest	Land Management: Agriculture, Forestry, Grassland or other Land Use
Climate Action Reserve	Grassland	Land Management: Agriculture, Forestry, Grassland or other Land Use
Climate Action Reserve	Mexico Boiler Efficiency	Energy Distribution, Demand, or Efficiency
Climate Action Reserve	Mexico Forest	Land Management: Agriculture, Forestry, Grassland or other Land Use
Climate Action Reserve	Mexico Landfill	Waste Handling and Disposal
Climate Action Reserve	Mexico Livestock	Livestock and Manure Management
Climate Action Reserve	Mexico Ozone Depleting Substances	Industrial Process and Fugitive Emissions
Climate Action Reserve	Nitric Acid Production	Industrial Process and Fugitive Emissions
Climate Action Reserve	Nitrogen Management	Land Management: Agriculture, Forestry, Grassland or other Land Use
Climate Action Reserve	Organic Waste Composting	Waste Handling and Disposal
Climate Action Reserve	Organic Waste Digestion	Waste Handling and Disposal
Climate Action Reserve	Ozone Depleting Substances	Industrial Process and Fugitive Emissions
Climate Action Reserve	Rice Cultivation	Land Management: Agriculture, Forestry, Grassland or other Land Use
Climate Action Reserve	Urban Forest Management	Land Management: Agriculture, Forestry, Grassland or other Land Use
Climate Action Reserve	Urban Tree Planting	Land Management: Agriculture, Forestry, Grassland or other Land Use
Climate Action Reserve	U.S. Landfill	Waste Handling and Disposal
Climate Action Reserve	U.S. Livestock	Livestock and Manure Management
Verified Carbon Standard	VM0002: New Cogeneration Facilities Supplying Less Carbon Intensive Electricity to Grid and/or Hot Water to One or More Grid Customers	Energy Distribution, Demand, or Efficiency
Verified Carbon Standard	VM0025: Campus Clean Energy and Energy Efficiency	Energy Distribution, Demand, or Efficiency
Verified Carbon Standard	VM0008: Weatherization of Single Family and Multi-Family Buildings	Energy Distribution, Demand, or Efficiency
Verified Carbon Standard	VM0013: Calculating Emission Reductions from Jet Engine Washing	Energy Distribution, Demand, or Efficiency
Verified Carbon Standard	VM0018: Energy Efficiency and Solid Waste Diversion Activities within a Sustainable Community	Energy Distribution, Demand, or Efficiency
Verified Carbon Standard	VMD0004:Revisions to AMS-III.BC to Include Mobile Machiner	Energy Distribution, Demand, or Efficiency
Verified Carbon Standard	VMR0005: Methodology for Installation of Low-Flow Water Devices	Energy Distribution, Demand, or Efficiency
Verified Carbon Standard	VM0014: Interception and Destuction of Fugitive Methane from Coal Bed Methane Seeps	Industrial Process and Fugitive Emissions
Verified Carbon Standard	VM0030: Methodology for Pavement Application using Sulphur Substitute	Industrial Process and Fugitive Emissions
Verified Carbon Standard	VM0031: Methodology for Precast Concrete Production using Sulphur Substitute	Industrial Process and Fugitive Emissions

Verified Carbon Standard	VM0023: Reduction of GHG Emissions in Propylene Oxide Production	Industrial Process and Fugitive Emissions
Verified Carbon Standard	VMR0001: Revisions to ACM0008 to Include Pre-drainage of Methane from an Active Open Cast Mine as a Methane Emission Reduction Activity, v1.0	Industrial Process and Fugitive Emissions
Verified Carbon Standard	VMR0002: Revisions to ACM0008 to Include Methane Capture and Destruction from Abandoned Coal Mines	Industrial Process and Fugitive Emissions
Verified Carbon Standard	VM0001: Infrared Automatic Refrigerant Leak Detection Efficiency Project Methodology	Industrial Process and Fugitive Emissions
Verified Carbon Standard	VM0016: Recovery and Destruction of Ozone-Depleting Substances (ODS) from Products	Industrial Process and Fugitive Emissions
Verified Carbon Standard	VM0003: Methodology for Improved Forest Management through Extension of Rotation Age	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0004: Methodology for Conservation Projects that Avoid Planned Land Use Conversion in Peat Swamp Forests	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0005: Methodology for Conversion of Low-productive Forest to High-productive Forest	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0006: Methodology for Carbon Accounting for Mosaic and Landscape-scale REDD Projects	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0007: REDD+ Methodology Framework (REDD-MF)	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0009: Methodology for Avoided Ecosystem Conversion	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0010: Methodology for Improved Forest Management: Conversion from Logged to Protected Forest	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0011: Methodology for Calculating GHG Benefits from Preventing Planned Degradation	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0012: Improved Forest Management in Temperate and Boreal Forests (LtPF)	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0015: Methodology for Avoided Unplanned Deforestation	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0017: Adoption of Sustainable Agricultural Land Management	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0021: Soil Carbon Quantification Methodology	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0022: Quantifying N2O Emissions Reductions in Agricultural Crops through Nitrogen Fertilizer Rate Reduction	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0024: Methodology for Coastal Wetland Creation	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0026: Methodology for Sustainable Grassland Management (SGM)	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0027: Methodology for Rewetting Drained Tropical Peatlands	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0029: Methodology for Avoided Forest Degradation through Fire Management, v1.0	Land Management: Agriculture, Forestry, Grassland or other Land Use

Verified Carbon Standard	VM0032: Methodology for the Adoption of Sustainable Grasslands through Adjustment of Fire and Grazing	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0033: Methodology for Tidal Wetland and Seagrass Restoration	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0034: British Columbia Forest Carbon Offset Methodology	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0035: Methodology for Improved Forest Management through Reduced Impact Logging	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0036: Methodology for Rewetting Drained Temperate Peatlands	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0037 Methodology for Implementation of REDD+ Activities in Landscapes Affected by Mosaic Deforestation and Degradation	Land Management: Agriculture, Forestry, Grassland or other Land Use
Verified Carbon Standard	VM0019: Fuel Switch from Gasoline to Ethanol in Flex-Fuel Vehicle Fleets	Transport
Verified Carbon Standard	VM0020: Transport Energy Efficiency from Lightweight Pallets	Transport
Verified Carbon Standard	VM0028: Methodology for Carpooling	Transport
Verified Carbon Standard	VMD0038: Methodology for Electric Vehicle Charging Systems	Transport
Verified Carbon Standard	VMR0004: Revisions to AMS-III.BC to Include Mobile Machinery, v1.0	Transport
Verified Carbon Standard	VMR0003: Revisions to AMS-III.Y to Include Use of Organic Bedding Material	Waste Handling and Disposal
American Carbon Registry	Destruction of Ozone Depleting Substances and High-GWP Foam	Industrial Process and Fugitive Emissions
American Carbon Registry	N_2O Abatement from Nitric Acid Production	Industrial Process and Fugitive Emissions
American Carbon Registry	Replacement of SF_6 with Alternate Cover Gas in the Magnesium Industry	Industrial Process and Fugitive Emissions
American Carbon Registry	Transition to Advanced Formulation Blowing Agents in Foam Manufacturing and Use	Industrial Process and Fugitive Emissions
American Carbon Registry	Advanced Refrigeration Systems	Industrial Process and Fugitive Emissions
American Carbon Registry	Use of Certified Reclaimed HFC Refrigerants	Industrial Process and Fugitive Emissions
American Carbon Registry	Truck Stop Electrification	Transport
American Carbon Registry	Reduced Use of Nitrogen Fertilizer on Agricultural Crops	Land Management: Agriculture, Forestry, Grassland or other Land Use
American Carbon Registry	Rice Management Systems	Land Management: Agriculture, Forestry, Grassland or other Land Use
American Carbon Registry	Afforestation and Reforestation of Degraded Lands	Land Management: Agriculture, Forestry, Grassland or other Land Use
American Carbon Registry	Improved Forest Management (IFM) for Non-Federal U.S. Forestlands	Land Management: Agriculture, Forestry, Grassland or other Land Use

American Carbon Registry	Avoided Conversion of Grasslands and Shrublands to Crop Production	Land Management: Agriculture, Forestry, Grassland or other Land Use
American Carbon Registry	Compost Additions to Grazed Grasslands	Land Management: Agriculture, Forestry, Grassland or other Land Use
American Carbon Registry	Restoration of California Deltaic and Coastal Wetlands	Land Management: Agriculture, Forestry, Grassland or other Land Use
American Carbon Registry	Restoration of Degraded Wetlands of the Mississippi Delta	Land Management: Agriculture, Forestry, Grassland or other Land Use
American Carbon Registry	Restoration of Pocosin Wetlands	Land Management: Agriculture, Forestry, Grassland or other Land Use
American Carbon Registry	Grazing Land and Livestock Management	Livestock and Manure Management
American Carbon Registry	Landfill Gas Destruction and Beneficial Use Projects	Waste Handling and Disposal
American Carbon Registry	Methane Recovery in Animal Manure Management Systems	Waste Handling and Disposal
American Carbon Registry	Re-fining Used Lubricating Oils	Waste Handling and Disposal
American Carbon Registry	Recycling of Transformer Oil	Waste Handling and Disposal
American Carbon Registry	Carbon Capture and Storage Projects	Carbon Capture and Storage
Clean Development Mechanism	AR-AM0014: Afforestation and reforestation of degraded mangrove habitats	Land Management: Agriculture, Forestry, Grassland or other Land Use
Clean Development Mechanism	AR-ACM0003: Afforestation and reforestation of lands except wetlands	Land Management: Agriculture, Forestry, Grassland or other Land Use
Clean Development Mechanism	AR-AMS0007: Afforestation and reforestation project activities implemented on lands other than wetlands	Land Management: Agriculture, Forestry, Grassland or other Land Use
Clean Development Mechanism	AR-AMS0003: Afforestation and reforestation project activities implemented on wetlands	Land Management: Agriculture, Forestry, Grassland or other Land Use
Clean Development Mechanism	AM0001: Decomposition of fluoroform (HFC-23) waste streams	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0007: Analysis of the least-cost fuel option for seasonally-operating biomass cogeneration plants	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0009: Recovery and utilization of gas from oil fields that would otherwise be flared or vented	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0017: Steam system efficiency improvements by replacing steam traps and returning condensate	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0018: Baseline methodology for steam optimization systems	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0019: Renewable energy projects replacing part of the electricity production of one single fossil fuel fired power plant that stands alone or supplies to a grid, excluding biomass projects	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0020: Baseline methodology for water pumping efficiency improvements	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0021: Baseline Methodology for decomposition of N2O from existing adipic acid production plants	Industrial Process and Fugitive Emissions

Clean Development Mechanism	AM0023: Leak detection and repair in gas production, processing, transmission, storage and distribution systems and in refinery facilities	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0026: Methodology for zero-emissions grid-connected electricity generation from renewable sources in Chile or in countries with merit order based dispatch grid	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0027: Substitution of CO_2 from fossil or mineral origin by CO_2 from renewable sources in the production of inorganic compounds	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0028: N_2O destruction in the tail gas of Caprolactam production plants	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0030: PFC emission reductions from anode effect mitigation at primary aluminium smelting facilities	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0031: Bus rapid transit projects	Transport
Clean Development Mechanism	AM0035: SF_6 emission reductions in electrical grids	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0036: Fuel switch from fossil fuels to biomass residues in heat generation equipment	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0037: Flare (or vent) reduction and utilization of gas from oil wells as a feedstock	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0038: Methodology for improved electrical energy efficiency of an existing submerged electric arc furnace used for the production of silicon and ferro alloys	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0043: Leak reduction from a natural gas distribution grid by replacing old cast iron pipes or steel pipes without cathodic protection with polyethylene pipes	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0044: Energy efficiency improvement projects - boiler rehabilitation or replacement in industrial and district heating sectors	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0045: Grid connection of isolated electricity systems	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0046: Distribution of efficient light bulbs to households	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0048: New cogeneration project activities supplying electricity and heat to multiple customers	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0049: Methodology for gas based energy generation in an industrial facility	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0050: Feed switch in integrated Ammonia-urea manufacturing industry	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0052: Increased electricity generation from existing hydropower stations through Decision Support System optimization	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0053: Biogenic methane injection to a natural gas distribution grid	Energy Distribution, Demand, or Efficiency

Clean Development Mechanism	AM0055: Recovery and utilization of waste gas in refinery or gas plant	Waste Handling and Disposal
Clean Development Mechanism	AM0056: Efficiency improvement by boiler replacement or rehabilitation and optional fuel switch in fossil fuel-fired steam boiler systems	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0057: Avoided emissions from biomass wastes through use as feed stock in pulp and paper, cardboard, fibreboard or bio-oil production	Waste Handling and Disposal
Clean Development Mechanism	AM0058: Introduction of a district heating system	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0059: Reduction in GHGs emission from primary aluminium smelters	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0060: Power saving through replacement by energy efficient chillers	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0061: Methodology for rehabilitation and/or energy efficiency improvement in existing power plants	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0062: Energy efficiency improvements of a power plant through retrofitting turbines	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0063: Recovery of CO_2 from tail gas in industrial facilities to substitute the use of fossil fuels for production of CO_2	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0064: Capture and utilisation or destruction of mine methane (excluding coal mines) or non mine methane	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0065: Replacement of SF_6 with alternate cover gas in the magnesium industry	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0066: GHG emission reductions through waste heat utilisation for pre-heating of raw materials in sponge iron manufacturing process	Waste Handling and Disposal
Clean Development Mechanism	AM0067: Methodology for installation of energy efficient transformers in a power distribution grid	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0068: Methodology for improved energy efficiency by modifying ferroalloy production facility	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0069: Biogenic methane use as feedstock and fuel for town gas production	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0070: Manufacturing of energy efficient domestic refrigerators	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0071: Manufacturing and servicing of domestic refrigeration appliances using a low GWP refrigerant	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0072: Fossil Fuel Displacement by Geothermal Resources for Space Heating	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0073: GHG emission reductions through multi-site manure collection and treatment in a central plant	Livestock and Manure Management
Clean Development Mechanism	AM0074: Methodology for new grid connected power plants using permeate gas previously flared and/or vented	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0075: Methodology for collection, processing and supply of biogas to end-users for production of heat	Energy Distribution, Demand, or Efficiency

Clean Development Mechanism	AM0076: Implementation of fossil fuel trigeneration systems in existing industrial facilities	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0077: Recovery of gas from oil wells that would otherwise be vented or flared and its delivery to specific end-users	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0078: Point of Use Abatement Device to Reduce SF_6 emissions in LCD Manufacturing Operations	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0079: Recovery of SF_6 from Gas insulated electrical equipment in testing facilities	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0080: Mitigation of greenhouse gases emissions with treatment of wastewater in aerobic wastewater treatment plants	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0081: Flare or vent reduction at coke plants through the conversion of their waste gas into dimethyl ether for use as a fuel	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0082: Use of charcoal from planted renewable biomass in the iron ore reduction process through the establishment of a new iron ore reduction system	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0083: Avoidance of landfill gas emissions by in-situ aeration of landfills	Waste Handling and Disposal
Clean Development Mechanism	AM0084: Installation of cogeneration system supplying electricity and chilled water to new and existing consumers	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0086: Distribution of zero energy water purification systems for safe drinking water	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0088: Air separation using cryogenic energy recovered from the vaporization of LNG	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0089: Production of diesel using a mixed feedstock of gasoil and vegetable oil	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0090: Modal shift in transportation of cargo from road transportation to water or rail transportation	Transport
Clean Development Mechanism	AM0091: Energy efficiency technologies and fuel switching in new and existing buildings	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0092: Substitution of PFC gases for cleaning Chemical Vapour Deposition (CVD) reactors in the semiconductor industry	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0093: Avoidance of landfill gas emissions by passive aeration of landfills	Waste Handling and Disposal
Clean Development Mechanism	AM0094: Distribution of biomass based stove and/or heater for household or institutional use	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0095: Waste gas based combined cycle power plant in a Greenfield iron and steel plant	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0096: CF_4 emission reduction from installation of an abatement system in a semiconductor manufacturing facility	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0097: Installation of high voltage direct current power transmission line	Energy Distribution, Demand, or Efficiency

Clean Development Mechanism	AM0098: Utilization of ammonia-plant off gas for steam generation	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0099: Installation of a new natural gas fired gas turbine to an existing CHP plant	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0100: Integrated Solar Combined Cycle (ISCC) projects	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0101: High speed passenger rail systems	Transport
Clean Development Mechanism	AM0103: Renewable energy power generation in isolated grids	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0104: Interconnection of electricity grids in countries with economic merit order dispatch	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0105: Energy efficiency in data centres through dynamic power management	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0106: Energy efficiency improvements of a lime production facility through installation of new kilns	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0107: New natural gas based cogeneration plant	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0108: Interconnection between electricity systems for energy exchange	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0109: Introduction of hot supply of Direct Reduced Iron in Electric Arc Furnaces	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0110: Modal shift in transportation of liquid fuels	Transport
Clean Development Mechanism	AM0111: Abatement of fluorinated greenhouse gases in semiconductor manufacturing	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0112: Less carbon intensive power generation through continuous reductive distillation of waste	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0113: Distribution of compact fluorescent lamps (CFL) and light-emitting diode (LED) lamps to households	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0114: Shift from electrolytic to catalytic process for recycling of chlorine from hydrogen chloride gas in isocyanate plants	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0115: Recovery and utilization of coke oven gas from coke plants for LNG production	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0116: Electric taxiing systems for airplanes	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0117: Introduction of a new district cooling system	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0118: Introduction of low resistivity power transmission line	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AM0119: SF_6 emission reductions in gas insulated metal enclosed switchgear	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AM0120: Energy-efficient refrigerators and air-conditioners	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM0001: Flaring or use of landfill gas	Waste Handling and Disposal

Clean Development Mechanism	ACM0002: Grid-connected electricity generation from renewable sources	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM0003: Partial substitution of fossil fuels in cement or quicklime manufacture	Industrial Process and Fugitive Emissions
Clean Development Mechanism	ACM005: Increasing the blend in cement production	Industrial Process and Fugitive Emissions
Clean Development Mechanism	ACM006: Electricity and heat generation from biomass	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM007: Conversion from single cycle to combined cycle power generation	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM008: Abatement of methane from coal mines	Industrial Process and Fugitive Emissions
Clean Development Mechanism	ACM009: Fuel switching from coal or petroleum fuel to natural gas	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM010: GHG emission reductions from manure management systems	Waste Handling and Disposal
Clean Development Mechanism	ACM011:Fuel switching from coal and/or petroleum fuels to natural gas in existing power plants for electricity generation	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM012: Waste energy recovery	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM013: Construction and operation of new grid connected fossil fuel fired power plants using a less GHG intensive technology	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM014: Treatment of wastewater	Industrial Process and Fugitive Emissions
Clean Development Mechanism	ACM015: Emission reductions from raw material switch in clinker production	Industrial Process and Fugitive Emissions
Clean Development Mechanism	ACM016: Mass Rapid Transit Projects	Transport
Clean Development Mechanism	ACM017: Production of biofuel	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM018: Electricity generation from biomass in power-only plants	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM019: N_2O abatement from nitric acid production	Industrial Process and Fugitive Emissions
Clean Development Mechanism	ACM020: Co-firing of biomass residues for heat generation and/or electricity generation in grid connected power plants	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM021: Reduction of emissions from charcoal production by improved kiln design and/or abatement of methane	Industrial Process and Fugitive Emissions
Clean Development Mechanism	ACM022: Alternative waste treatment processes	Waste Handling and Disposal
Clean Development Mechanism	ACM023: Introduction of an efficiency improvement technology in a boiler	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM024: Natural gas substitution by biogenic methane produced from the anaerobic digestion of organic waste	Energy Distribution, Demand, or Efficiency

Clean Development Mechanism	ACM025: Construction of a new natural gas power plant	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	ACM026: Fossil fuel based cogeneration for identified recipient facility(ies)	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.A.: Electricity generation by the user	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.B.: Mechanical energy for the user with or without electrical energy	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.C.: Thermal energy production with or without electricity	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.D.: Grid connected renewable electricity generation	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.E.: Switch from non-renewable biomass for thermal applications by the user	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.F.: Renewable electricity generation for captive use and mini-grid	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.G.: Plant oil production and use for energy generation in stationary applications	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.H.: Biodiesel production and use for energy generation in stationary applications	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.I.: Biogas/biomass thermal applications for households/small users	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.J.: Solar water heating systems (SWH)	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.K.: Solar cookers for households	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.L.: Electrification of rural communities using renewable energy	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-I.M.: Solar power for domestic aircraft at-gate operations	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.A.: Supply side energy efficiency improvements – transmission and distribution	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.B.: Supply side energy efficiency improvements – generation	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.C.: Demand-side energy efficiency activities for specific technologies	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.D.: Energy efficiency and fuel switching measures for industrial facilities	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.E.: Energy efficiency and fuel switching measures for buildings	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.F.: Energy efficiency and fuel switching measures for agricultural facilities and activities	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.G.: Energy efficiency measures in thermal applications of non-renewable biomass	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.H.: Energy efficiency measures through centralization of utility provisions of an industrial facility	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.I.: Efficient utilization of waste energy in industrial facilities	Waste Handling and Disposal

Clean Development Mechanism	AMS-II.J.: Demand-side activities for efficient lighting technologies	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.K.: Installation of co-generation or tri-generation systems supplying energy to commercial building	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.L.: Demand-side activities for efficient outdoor and street lighting technologies	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.M.: Demand-side energy efficiency activities for installation of low-flow hot water savings devices	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.N.: Demand-side energy efficiency activities for installation of energy efficient lighting and/or controls in buildings	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.O.: Dissemination of energy efficient household appliances	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.P.: Energy efficient pump-set for agriculture use	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.Q.: Energy efficiency and/or energy supply projects in commercial buildings	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.R: Energy efficiency space heating measures for residential buildings	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.S.: Energy efficiency in motor systems	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-II.T.: Emission reduction through reactive power compensation in power distribution network	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.A.: Offsetting of synthetic nitrogen fertilizers by inoculant application in legumes-grass rotations on acidic soils on existing cropland	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.B.: Switching fossil fuels	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.C.: Emission reductions by electric and hybrid vehicles	Transport
Clean Development Mechanism	AMS-III.D.: Methane recovery in animal manure management systems	Livestock and Manure Management
Clean Development Mechanism	AMS-III.E.: Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.F.: Avoidance of methane emissions through composting	Waste Handling and Disposal
Clean Development Mechanism	AMS-III.G.: Landfill methane recovery	Waste Handling and Disposal
Clean Development Mechanism	AMS-III.H.: Methane recovery in wastewater treatment	Waste Handling and Disposal
Clean Development Mechanism	AMS-III.I.: Avoidance of methane production in wastewater treatment through replacement of anaerobic systems by aerobic systems	Waste Handling and Disposal
Clean Development Mechanism	AMS-III.J.: Avoidance of fossil fuel combustion for carbon dioxide production to be used as raw material for industrial processes	Industrial Process and Fugitive Emissions

Clean Development Mechanism	AMS-III.K.: Avoidance of methane release from charcoal production	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.L.: Avoidance of methane production from biomass decay through controlled pyrolysis	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.M.: Reduction in consumption of electricity by recovering soda from paper manufacturing process	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.N.: Avoidance of HFC emissions in rigid Poly Urethane Foam (PUF) manufacturing	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.O.: Hydrogen production using methane extracted from biogas	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.P.: Recovery and utilization of waste gas in refinery facilities	Waste Handling and Disposal
Clean Development Mechanism	AMS-III.Q.: Waste energy recovery	Waste Handling and Disposal
Clean Development Mechanism	AMS-III.R.: Methane recovery in agricultural activities at household/small farm level	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.S.: Introduction of low-emission vehicles/technologies to commercial vehicle fleets	Transport
Clean Development Mechanism	AMS-III.T.: Plant oil production and use for transport applications	Transport
Clean Development Mechanism	AMS-III.U.: Cable Cars for Mass Rapid Transit System (MRTS)	Transport
Clean Development Mechanism	AMS-III.V.: Decrease of coke consumption in blast furnace by installing dust/sludge recycling system in steel works	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.W.: Methane capture and destruction in non-hydrocarbon mining activities	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.X.: Energy Efficiency and HFC-134a Recovery in Residential Refrigerators	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.Y.: Methane avoidance through separation of solids from wastewater or manure treatment systems	Livestock and Manure Management
Clean Development Mechanism	AMS-III.Z.: Fuel Switch, process improvement and energy efficiency in brick manufacture	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.AA.: Transportation Energy Efficiency Activities using Retrofit Technologies	Transport
Clean Development Mechanism	AMS-III.AB.: Avoidance of HFC emissions in Standalone Commercial Refrigeration Cabinets	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.AC.: Electricity and/or heat generation using fuel cell	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.AD.: Emission reductions in hydraulic lime production	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.AE.: Energy efficiency and renewable energy measures in new residential buildings	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.AF.: Avoidance of methane emissions through excavating and composting of partially decayed municipal solid waste (MSW)	Waste Handling and Disposal
Clean Development Mechanism	AMS-III.AG.: Switching from high carbon intensive grid electricity to low carbon intensive fossil fuel	Energy Distribution, Demand, or Efficiency

Clean Development Mechanism	AMS-III.AH.: Shift from high carbon-intensive fuel mix ratio to low carbon-intensive fuel mix ratio	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.AI.: Emission reductions through recovery of spent sulphuric acid	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.AJ.: Recovery and recycling of materials from solid wastes	Waste Handling and Disposal
Clean Development Mechanism	AMS-III.AK.: Biodiesel production and use for transport applications	Transport
Clean Development Mechanism	AMS-III.AL.: Conversion from single cycle to combined cycle power generation	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.AM.: Fossil fuel switch in a cogeneration/trigeneration system	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.AN.: Fossil fuel switch in existing manufacturing industries	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.AO.: Methane recovery through controlled anaerobic digestion	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.AP.: Transport energy efficiency activities using post - fit Idling Stop device	Transport
Clean Development Mechanism	AMS-III.AQ.: Introduction of Bio-CNG in transportation applications	Transport
Clean Development Mechanism	AMS-III.AR.: Substituting fossil fuel based lighting with LED/CFL lighting systems	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.AS.: Switch from fossil fuel to biomass in existing manufacturing facilities for non-energy applications	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.AT.: Transportation energy efficiency activities installing digital tachograph systems to commercial freight transport fleets	Transport
Clean Development Mechanism	AMS-III.AU.: Methane emission reduction by adjusted water management practice in rice cultivation	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.AV.: Low greenhouse gas emitting safe drinking water production systems	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.AW.: Electrification of rural communities by grid extension	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.AX.: Methane oxidation layer (MOL) for solid waste disposal sites	Waste Handling and Disposal
Clean Development Mechanism	AMS-III.AY.: Introduction of LNG buses to existing and new bus routes	Transport
Clean Development Mechanism	AMS-III.BA.: Recovery and recycling of materials from E-waste	Waste Handling and Disposal
Clean Development Mechanism	AMS-III.BB.: Electrification of communities through grid extension or construction of new mini-grids	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.BC.: Emission reductions through improved efficiency of vehicle fleets	Transport
Clean Development Mechanism	AMS-III.BD.: GHG emission reduction due to supply of molten metal instead of ingots for aluminium castings	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.BE.: Avoidance of methane and nitrous oxide emissions from sugarcane pre-harvest open burning through mulching	Industrial Process and Fugitive Emissions

Clean Development Mechanism	AMS-III.BF.: Reduction of N_2O emissions from use of Nitrogen Use Efficient (NUE) seeds that require less fertilizer application	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.BG.: Emission reduction through sustainable charcoal production and consumption	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.BH.: Displacement of production of brick and cement by manufacture and installation of gypsum concrete wall panels	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.BI.: Flare gas recovery in gas treating facilities	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.BJ.: Destruction of hazardous waste using plasma technology including energy recovery	Industrial Process and Fugitive Emissions
Clean Development Mechanism	AMS-III.BK: Strategic feed supplementation in smallholder dairy sector to increase productivity	Livestock and Manure Management
Clean Development Mechanism	AMS-III.BL.: Integrated methodology for electrification of communities	Energy Distribution, Demand, or Efficiency
Clean Development Mechanism	AMS-III.BM.: Lightweight two and three wheeled personal transportation	Transport
Clean Development Mechanism	AMS-III.BN.: Efficient operation of public transportation	Transport
Gold Standard	Projects Based on One Detailed Standard	All Categories Are Available

Web Links for Each Standard's Protocols / Methodologies	
Climate Action Reserve	https://www.climateactionreserve.org/how/protocols/
Verified Carbon Standard	https://verra.org/methodologies/
American Carbon Registry	https://americancarbonregistry.org/carbon-accounting/standards-methodologies
Clean Development Mechanism	https://cdm.unfccc.int/methodologies/index.html

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