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Waste Sector Working Paper

Introduction

Our vision for the Waste Management Sector for meeting GHG emissions and waste reductions goals out to 2050 is based on the principle that California must take ownership of the waste generated within the State. To carry out this vision, we must maximize recycling and diversion from landfills and build the necessary infrastructure to support a sustainable, low-carbon waste management system within California. We must also work with residents and producers to reduce the volume of waste generated. Enhanced collaboration with state and local agencies is necessary as California's waste-related issues are diverse and interconnected. Determining the best use of recycling alternatives, examining ways to increase the use of waste diversion alternatives and expanding their potential markets, obtaining funds and incentives for building the infrastructure, and evaluating the need for additional research to achieve GHG reductions and meet waste management goals are all actions that will be needed to reach our 2050 goals.

California must develop low-carbon, economically sustainable industries, technologies, and strategies that align with the state's long-term and integrated energy, waste, and environmental policy objectives. Waste has a critical role to play in enabling a sustainable, low-carbon future, in the context of each sector covered in the Scoping Plan. Waste sector-specific GHG and waste reduction targets and actions should align with the following overarching principles and priorities:

- Take Full Ownership of the Waste Generated in California
 - ✓ View waste as a resource
 - ✓ Develop a sustainable, low-carbon waste management system that processes collected waste within California
 - ✓ Eliminate, over time, the export of recyclable materials to other states or nations

- Maximize Recycling and Diversion from Landfills
 - ✓ Achieve continuous, measurable increases in the amount of materials recycled, reused, and remanufactured
 - ✓ Reduce the amount of organics and recyclable materials disposed of in landfills
 - ✓ Evaluate if regulator action is needed to phase out landfilling of organics

- Build the Infrastructure Needed to Support a Sustainable, Low-Carbon Waste Management System within California
 - ✓ Incentivize the most beneficial use of waste material based on California's economic, energy, waste, and environmental goals
 - ✓ Incentivize building new infrastructure within California for non-landfill alternatives

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- ✓ Provide technical and economic support to ensure multiple waste handling, processing, treatment, and remanufacturing pathways in California
 - ✓ Streamline air and solid waste permitting (including CEQA) for non-landfill alternatives
 - ✓ Develop California-based post-processing and re-manufacturing capabilities
 - ✓ Foster State, local, and private sector leadership to help build the infrastructure
 - ✓ Ensure that environmental justice concerns are part of the decision making process
- Improve the Sustainability of California's Waste Management Infrastructure
 - ✓ Identify and support development of markets for recycled, reused, and remanufactured materials
 - ✓ Stimulate markets and demonstrate State leadership by establishing State purchasing and product end-of-life requirements
 - ✓ Stimulate new technologies that reduce GHGs and co-pollutants
 - ✓ Upgrade existing facilities as technology evolves to improve energy efficiency and reduce direct emissions
 - ✓ Reduce direct GHG and co-pollutant emissions from existing waste treatment options
 - Reduce the Volume of Waste Generated
 - ✓ Educate all residents on their ability to help achieve California's waste management goals and reduce their carbon footprint
 - ✓ Enhance packaging and product optimization (longer lasting and easier to recycle)
 - ✓ Enhance producer responsibilities for hard-to-manage waste materials
 - ✓ Identify opportunities to reduce food waste

Our vision emphasizes a regional focus for integrated planning, project implementation, and governance for waste management. Successfully meeting our goals also requires reducing divergent state policies and effectively resolving conflicts between competing policy objectives.

Care should be taken to avoid misplaced investments that contribute to single or arbitrary milestones, conflict with other priorities, or otherwise divert resources from achieving long-term objectives.

The Waste Management Sector's continued contribution to meeting the 2050 GHG goals depends on the increased use of different waste alternative technologies and the push towards achieving net zero-emissions by Mid-term, between 2020 and 2050, and further reductions in direct GHG emissions by 2050.

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A detailed summary of our vision, as well as how we will accomplish the vision (Follow-Up Actions) and background technical papers that were used to inform the vision are shown in the Appendix to this working paper.

The Waste Management Sector GHG Emission Goals for Mid-term and 2050

The following is a discussion of the proposed Waste Management Sector GHG emission goals for Mid-term and 2050 as well as the challenges and potential actions that can be done to accomplish the future GHG and waste reduction goals.

The proposed goals are as follows:

- Mid-term Goal: Achieve Net-Zero GHG emissions from the entire Waste Sector¹
- 2050 Goal: Achieve a 25% reduction in direct GHG emissions from mid-term levels

Achieving Net-Zero GHG emissions from the Waste Sector by Mid-term

Beyond 2020, additional reductions in GHG emissions from the Waste Sector will be needed to achieve a Net-Zero GHG emissions goal. To achieve these reductions, even greater diversion of organics and other recyclable commodities from landfills must be realized and further expansion and enhancement of the alternative non-disposal pathways must be developed. In addition, greater emphasis will need to be placed on reducing the volume of waste generated, recycling/reusing products at the end-of-life, and remanufacturing these materials into beneficial products. To achieve Net-Zero, the direct GHG emissions from the Waste Sector would have to be fully offset by avoided GHG emissions. Avoided GHG emissions are reductions in life-cycle GHG emissions that would occur because waste is shifted from landfilling to alternative non-disposal pathways.

Achieving a 25% reduction in direct GHG emissions from Mid-term levels by 2050

As a 2050 goal, staff recommends a reduction of direct GHG emission in California from the Waste Sector to 25% below the direct emission associated with meeting the Mid-term goal.

Challenges and Potential Solutions to Meet the GHG and Waste Reduction Goals

The challenges to meeting GHG and waste reduction goals need to be addressed with the understanding that California must take full ownership for the wastes generated within its borders (“California Owns It”). Shipping waste, even recyclable products, to other state or nations is not a viable, long-term, environmentally appropriate, waste management practice for California. Furthermore, exporting waste denies California the economic opportunity of significant job growth that would result if these materials were

¹ Will need to quantify this in terms of a GHG reduction goal.

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remanufactured in California. Some of the key challenges in achieving the stated goals are discussed below.

Infrastructure

The current waste management infrastructure will need to be expanded to accommodate the increases in recycling and remanufacturing of waste material that would occur in order to meet the GHG and waste reduction goals. This would mean more facilities and technologies that can use organics from the waste stream as well as more remanufacturing facilities for the various types of recycled material. This may also mean more sorting of material before disposal at the consumer level and may lead to more job opportunities in the waste management field.

Sources of funding will need to be secured in order for adequate infrastructure to develop, due largely to the relatively lowered cost of landfilling. Policies and regulations that encourage or promote the siting, permitting, building and operating of the facilities and/or technologies will be necessary. It is also essential, in this regard, for a streamlining of the permitting requirements of new and up-graded facilities and technologies for the waste management sector, while addressing cross-media regulatory issues. Facility operators may consider co-locating new waste treatment facilities at existing waste sites to minimize permitting issues and environmental impacts. In addition, it will be important to facilitate siting of new and upgraded waste management facilities with respect to length of time for approval, CEQA, and local community and regional planning and acceptance, including environmental justice concerns.

Technology

Some technologies that can be used to process the recovered waste material and for the remanufacturing processes still need to be developed and/or demonstrated. Funding is needed to incentivize the research, development and deployment of new, innovative technologies due to economic constraints. Additionally, incentives and funding may be needed to develop GHG-friendly sources of electricity and biogas from waste processing facilities.

Markets

As an increasing amount of recycled material is diverted and recovered from the landfills and the infrastructure for handling the recycled material is developed, markets for the recycled, reused, and remanufactured materials will need to grow. Coupled with the increased recycling is an increased amount of residual waste materials generated from non-disposal alternatives (such as ash from biomass combustion). Markets will need to be developed for these materials if non-disposable alternatives are to be viable in California. Alternatively, incentives and research of potential usage of the residual materials will assist with market build up.

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Finally, to take ownership of the waste generated in California, state agencies must show leadership by purchasing products in keeping with the GHG and waste reduction goals. This will further increase the market for remanufactured materials.

Education

Another essential element in achieving the GHG and waste reduction goals is educating the public and government agencies on relative topics such as, the benefits of reducing GHG and waste, the various opportunities that can be taken to reduce GHG and waste in everyday activities, and taking responsibility for the waste that they generate. This could include outreach to the public agencies on the benefits of procuring products with low-waste or no-waste attributes, thereby reducing their carbon footprint. Additionally, education could be provided on packaging options and their impact on GHG and waste, as well as producer responsibilities, and reducing food wastes through more efficient farm, packing house, retail, and consumer practices.

Regulations and Policies

As mentioned, California's waste-related issues are diverse and interconnected impacting various state and local agencies. Therefore, the policies and regulations that are put in place to address these issues should be treated consistently across the agencies. Conflicting permitting and regulatory requirements must be avoided between agencies, districts, and jurisdictions. In addition, model permits and guidance documents are needed to streamline the permitting process and to assist project proponents for new and modified infrastructure projects. These actions will support the development of a low-carbon, sustainable waste management system in California.

Recommendations

In order to move forward with the Vision of the Waste Sector and achieve the future goals set for Mid-term and 2050, certain actions are recommended for the next five years to set the groundwork. These actions affect several broad areas within the Waste Sector and are necessary for reducing the challenges facing this sector. These recommendations include:

- Working with other agencies, districts, and jurisdictions to streamline the permitting process and address conflicting requirements, including cross media issues;
- Streamlining the permitting process for new and upgraded composting and anaerobic digestion facilities;
- Developing guidance documents and tools to assist in the permitting process and environmental reviews;
- Investigating regulatory or statutory actions to further reduce GHG emissions, including Best Management Practices and removal of organics at landfills;
- Identify and seek funding to incentivize activities to accomplish GHG and waste reduction goals;

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- Developing new financial incentives for building adequate infrastructure in-state for non-landfill alternatives;
- Conducting research on the best use of waste management alternatives to further achieve the goals of the program;
- Revising the existing and developing new emission factors to better characterize emissions for various materials and processes including avoided landfill emissions;
- Addressing the obstacles and evaluate the feasibility of using biogas in natural gas pipelines;
- Identifying offset opportunities for various waste management alternatives, including recycling, compost, anaerobic digestion, and bioenergy processes;
- Initiating a public education campaign addressing goals of waste sector and benefits of increased recycling on carbon footprint;
- Improving the State procurement rates through education of purchasing officials, revision of current requirements, and product information system;
- Ensuring sustainability of current programs by establishing front-end processing standards for waste;
- Working with industry to standardize quality requirements of products from composting and anaerobic digestion;
- Determining the status of Municipal Solid Waste Thermal facilities and landfills in the Cap-and-Trade program; and
- Tracking the progress for achieving the AB 32 GHG emissions and AB 341 waste reduction goals.

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Appendix Overview of the Waste Management Sector, Six Technical Papers, and Follow-Up Actions

Introduction

Issues related to managing and utilizing California's waste resources are diverse and interconnected. Decisions addressing these issues will directly impact how and how quickly we achieve greenhouse gas (GHG) and waste reduction goals. These decisions will also have direct and indirect impacts on other sectors covered in the 2013 Scoping Plan Update. This document outlines the framework for developing a Waste Management Sector Plan and provides information critical to its development. This Overview is organized as follows:

1. Background – What is the purpose of this overview?
2. Process – How is the Waste Management Sector Plan being developed?
3. Principles and Priorities – What is the high-level, integrated vision for addressing waste-related issues?
4. Goal Setting – What are the GHG and waste reduction targets for 2020, Mid-term, and 2050?
5. Progress Measurement – What performance metrics will be used to track progress?
6. Implementation Mechanisms – What mechanisms will be used to achieve the principles and priorities, and goals identified in 3 and 4?
7. Key Challenges – What are the key challenges to meeting the GHG and waste reduction goals?
8. Follow-Up Actions – What actions need to occur, who is responsible, and what is the timeline for the actions?

1. Background - What is the purpose of this overview?

The purpose of this overview is to provide guidance and recommendations for developing a Waste Management Sector Plan for achieving California's GHG and waste reduction goals. It also serves to inform the Waste Management Sector element of the 2013 Scoping Plan Update. The Waste Management Sector includes all municipal and commercial solid waste-related activities (e.g., collection, processing, recycling, remanufacturing, treatment, or disposal) from generation to final disposition of the material within California.² When looking at the impact of waste reduction activities on GHG emissions, we will be evaluating net environmental impacts throughout the entire life cycle for these waste materials. That is, we will look at changes in the energy requirements beginning with the raw materials and ending when the material is no longer responsible for GHG emissions in California.

² Two waste streams that are not addressed in the Waste Sector Plan are medical wastes and hazardous wastes.

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The 2008 Assembly Bill (AB) 32 Scoping Plan initiated the process of identifying opportunities to achieve GHG reductions from the Waste Sector. Control of landfill methane emissions was identified as an early action measure. The 2008 Scoping Plan also identified the need for mandatory commercial recycling and other programs to develop and implement alternatives to landfilling. In the Scoping Plan Resolution 11-32, the Board directed staff to work with CalRecycle and other stakeholders to characterize emission reduction opportunities for handling solid waste, including recycling, reuse, remanufacturing of recovered materials; composting and anaerobic/aerobic digestion; biomass conversion; waste thermal processes; and landfilling.

Further, in the Cap-and-Trade Regulation Resolution 12-33, the Board directed staff to propose a comprehensive approach for the most appropriate treatment of the Waste Sector under the Cap-and-Trade program based upon the analysis of emission reduction opportunities. This document outlines ARB and CalRecycle staff response to the Board's directives.

2. Process – How is the Waste Sector Plan being developed?

In response to the Board directive, ARB and CalRecycle established a joint workgroup to begin developing a Waste Management Sector Plan. The first task of this group was to prepare a series of background technical papers to assist in understanding the issues critical to the development of a Waste Management Sector Plan. The six technical papers cover:

- Recycling, Reuse, and Remanufacturing
- Composting and Anaerobic Digestion
- State Procurement
- Biomass Conversion
- Municipal Solid Waste Thermal Technologies
- Landfilling of Waste

Each paper provides a general description of the waste treatment process, discusses current activities, and identifies opportunities for greater GHG and waste reductions in the future. Each paper also discusses key challenges to achieving a sustainable, low-carbon waste management future and identifies potential solutions to those challenges. The six technical papers are provided in Appendix A.

In addition to the technical papers, staff has prepared a table of follow-up actions based on the findings and recommendation from the technical reports and stakeholder comments. The follow-up actions document is provided in Appendix B and will be updated regularly to address the dynamic nature of the implementation of the Waste Management Sector Plan.

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3. Principles and Priorities - What is the high-level, integrated vision for addressing waste-related issues?

California's waste-related issues should be treated consistently in the development of the Waste Management Sector Plan and throughout the 2013 Scoping Plan Update, with the intention of developing low-carbon, economically sustainable industries, technologies, and strategies that align with the state's long-term and integrated energy, waste, and environmental policy objectives. Waste has a critical role to play in enabling a sustainable, low-carbon future, in the context of each sector covered in the Scoping Plan. Waste Sector-specific GHG and waste reduction targets and actions should align with the following overarching principles and priorities:

- Take Ownership of the Waste Generated in California
 - ✓ View waste as a resource
 - ✓ Develop a sustainable, low-carbon waste management system that processes collected waste within California
 - ✓ Eliminate, over time, the export of recyclable materials to other states or nations

- Maximize Recycling and Diversion from Landfills
 - ✓ Achieve continuous, measurable increases in the amount of materials recycled, reused, and remanufactured
 - ✓ Reduce the amount of organics and other recyclable materials disposed of in landfills
 - ✓ Evaluate if regulatory or statutory action is needed to phase out landfilling of organics with the goal of initial compliance actions in 2016

- Build the Infrastructure Needed to Support a Sustainable, Low-Carbon Waste Management System within California
 - ✓ Incentivize the most beneficial use of waste material based on California's economic, energy, waste, and environmental goals
 - ✓ Incentivize building new infrastructure within California for non-landfill alternatives
 - ✓ Provide technical and economic support to ensure multiple waste handling, processing, treatment, and remanufacturing pathways in California
 - ✓ Streamline air and solid waste permitting and siting of non-landfill alternatives
 - ✓ Develop California-based post-processing and remanufacturing capabilities
 - ✓ Foster State, local, and private cooperation in achieving the Waste Sector goals
 - ✓ Ensure that environmental justice concerns are part of the decision making process

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- Improve the Sustainability of California's Waste Management Infrastructure
 - ✓ Identify and support development of markets for recycled, reused, and remanufactured materials
 - ✓ Stimulate markets and demonstrate State leadership by establishing State purchasing and product end-of-life requirements
 - ✓ Stimulate new technologies that reduce GHGs and co-pollutants
 - ✓ Upgrade existing facilities as technology evolves to improve energy efficiency and reduce direct emissions
 - ✓ Reduce direct GHG and co-pollutant emissions from existing waste treatment options
- Reduce the Volume of Waste Generated
 - ✓ Educate all residents on their ability to help achieve California's waste management goals and reduce their carbon footprint
 - ✓ Enhance packaging and product optimization (longer-lasting and easier to recycle)
 - ✓ Enhance producer responsibilities for hard-to-manage waste materials.
 - ✓ Identify opportunities to reduce food waste

Care should be taken to avoid misplaced investments that contribute to single or arbitrary milestones, conflict with other priorities, or otherwise divert resources from achieving long-term objectives.

4. Goal Setting - What are the GHG and waste reduction goals for 2020, Mid-term, and 2050?

The Waste Management Sector Plan and the Waste Sector Element of the 2013 Scoping Plan should identify 2020, Mid-term, and 2050 goals for GHG and waste reduction. The proposed goals are as follows:

- 2020 Goal: Achieve the AB 341 75% recycling goal and associated 20 to 30 MMTCO₂e reduction
- Mid-term Goal: Achieve Net-Zero GHG emissions from the entire Waste Sector and associated GHG reductions³
- 2050 Goal: Achieve a 25% reduction in direct GHG emissions from Mid-term Net-Zero levels

2020 Goal: Achieve the AB 341 75% Recycling Goal and 20-30 MMTCO₂e Reduction
With the adoption of AB 341 (Chesbro, Chapter 476, Statutes of 2011), a clear mandate was established to achieve a statewide recycling goal of 75% by 2020. Preliminary estimates are that about 22 million tons per year of material will need to be removed from the landfill waste stream and used in non-disposal alternatives by 2020. Achieving AB 341's 75% recycling mandate will result in an estimated 20 to 30 MMTCO₂e reduction in 2020 compared to business as usual. Meeting these combined GHG and

³ An estimate of the GHG emission reductions will be developed in the future.

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recycling goals will require greater utilization of existing alternative pathways for waste processing and development of new alternative pathways. Existing alternative pathways include: enhanced recycling, reuse, and remanufacturing; composting; anaerobic and aerobic digestion; biomass conversion; and waste minimization. Additional pathways that can also achieve GHG reductions, but, by statute, would not count towards the 75% recycling goal, include municipal solid waste thermal technologies.

Mid-term Goal: Achieve Net-Zero GHG emissions from the Waste Sector

Beyond 2020, additional reductions in GHG emissions from the Waste Sector will be needed. To achieve these reductions, even greater diversion of organics and other recyclable commodities from landfills and further expansion and enhancement of the alternative non-disposal pathways developed to meet the 2020 goals will be needed. In addition, greater emphasis will need to be placed on reducing the volume of waste generated, recycling/reusing products at the end-of-life, and remanufacturing these materials into beneficial products. Staff proposes a Mid-term goal of Net-Zero GHG emissions for the Waste Sector. To achieve Net-Zero, the direct GHG emissions from the Waste Sector would have to be fully offset by avoided GHG emissions. Avoided GHG emissions are reductions in life-cycle GHG emissions that would occur because waste is shifted from landfilling to alternative non-disposal pathways.

2050 Goal: Achieve a 25% reduction in direct GHG emissions from Mid-term Net-Zero levels

As a 2050 goal, staff recommends a reduction of direct GHG emission in California from the Waste Sector to 25% below the direct emission associated with meeting the Mid-term goal.

5. Progress Measurement - What performance metrics will be used to track progress?

The Waste Management Sector Plan and the Waste Management Sector element of the 2013 Scoping Plan should identify how progress in meeting the GHG and waste reduction goals will be measured. These measurement tools must clearly identify issues so that corrective actions can be implemented if necessary. The proposed progress measurement approaches are as follows:

- Now – 2020: Waste Characterization Studies
- 2020 – Mid-term: Waste Characterization Studies, improved tracking systems, new innovative data collection approaches
- Mid-term – 2050: Waste Characterization Studies, further improvements in tracking, data collection, and data analysis

Now – 2020: Waste Characterization Studies

Measuring progress in meeting the 2020 goal (22 million tons of waste per year shifted from disposal and an associated 20 – 30 MMTCO_{2e} reductions) would involve estimating the amount and type of waste going to a particular treatment option (i.e.,

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landfilling, recycling, composting, etc.) using data obtained from the proposed 2014/15 and the 2019 Waste Characterization Studies. Waste reductions meeting the AB 341 2020 goal would be determined directly from the data obtained from the Waste Characterizations Studies. Progress in meeting the associated GHG emission reduction goal would be estimated taking the information provided by the Waste Characterization studies and calculating GHG reduction estimates for the amount and type of waste going to each treatment option. To estimate GHG reductions, new and updated emission reductions factors with need to be developed.

2020 – Mid-term: Waste Characterization Studies, improved tracking, enhanced data collection

Measuring progress in meeting the Mid-term goal will likely involve periodic Waste Characterization Studies, improved waste activity tracking, enhanced data collection and developing new and updated emission reduction factors.

Mid-term – 2050: Waste Characterization Studies, further improvements in tracking, data collection, and data analysis

Measuring progress in meeting the 2050 goal would focus on direct emissions from the Waste Sector and the impact of specific actions to reduce direct emissions from the collection, processing, reuse, and remanufacturing of waste. We envision that data collection would be more real-time and traditional Waste Characterization Studies would be replaced by automated tracking and data collection techniques. Improvements in information tracking and data sharing should allow great access to data being collected for other purposes.

6. Implementation Mechanisms - What mechanisms will be used to achieve the principles and priorities, and goals identified in 3 and 4?

The Waste Management Sector Plan and the Waste Management Sector element of the 2013 Scoping Plan Update need to identify what mechanisms or approaches will be used to implement program goals and targets. Implementation mechanisms could include voluntary measures, direct regulation, incentive-based program, bringing Waste Sector sources under Cap-and-Trade, or some combination of these options. It is also important to identify back-up approaches if the selected implementation mechanism is making insufficient progress toward achieving the identified goals. The proposed implementation mechanisms are as follows:

- Now - 2020: AB 341 75% Recycling Goal
- 2020 – Mid-term: New Direct Regulations or Cap-and-Trade Requirements
- Mid-term - 2050: To Be Determined

Now – 2020: AB 341 75% Recycling Goal

AB 341 established a clear mandate to achieve a 75% recycling goal (and associated GHG reductions) by 2020. Full implementation of the Commercial Recycling Regulation will achieve on the order of 3-5 MMTCO_{2e} reductions but will not be sufficient by itself

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to achieve the 75% mandate. CalRecycle is preparing a Report to the Legislature, due January 1, 2014, that will provide additional recommendations on how to achieve the AB 341 75% statewide goal. Much of this will likely entail financing of new recycling manufacturing infrastructure, continued focus on moving organic materials from landfills to other non-disposal uses, establishing new funding sources for local and state programs, establishing a broader extended producer responsibility framework, and clarifying the role of energy recovery.

For the Commercial Recycling component, it will be critical that ARB and CalRecycle closely monitor its implementation from now through 2020. If information from Waste Characterization Studies or other sources indicates that insufficient progress is being made to achieve the initial GHG reduction goal associated with the Commercial Recycling regulations or the AB 341 75% recycling mandate, then adopting direct source-specific regulations (i.e., restrict landfilling of organics) or bringing landfills and/or mass burn thermal technology facilities under Cap-and-Trade would become necessary.

2020 – Mid-term: New Direct Regulations or Cap-and-Trade Requirements

Beyond 2020, additional mechanisms may be needed to achieve the Net-Zero goal. Possible options include developing source specific regulations (i.e., restrict landfilling of additional recyclable commodities) or bringing Waste Sector sources under Cap-and-Trade.

Mid-term – 2050: To Be Determined

Mechanisms needed to achieve an additional 25% reduction in direct emissions by 2050 remain to be determined. Adjustments to existing regulations or Cap-and-Trade requirements, or developing new regulations may be needed. At the same time, a combination of voluntary, fee-based, or incentive programs may prove effective in providing further improvements to the waste infrastructure.

7. Key Challenges - What are the key challenges in meeting the GHG and waste reduction goals?

The challenges to meeting GHG and waste reduction goals need to be addressed with the understanding that California must take full ownership for the wastes generated within its borders. Shipping waste, even recyclable products, to other state or nations is not a viable, long-term, environmentally appropriate, waste management practice for California. Furthermore, exporting waste denies California the economic opportunity of significant job growth that would result if these materials were remanufactured in California.

Within the framework of “California Owns It”, challenges in achieving the GHG and 75% recycling goals are those associated with reducing generated waste and those

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associated with developing non-disposal alternatives for handling waste that we generate.

Specific challenges to reducing the amount of waste generated in California include:

- Educating Californians to take responsibility for the waste they generate
- Evaluating what type of regulatory or statutory action is needed to phase out landfilling of organics
- Empowering the public to purchase products with low-waste or no-waste attributes, thereby reducing their carbon footprint
- Emphasizing packaging option and producer responsibilities
- Reducing food wastes through more efficient farm, packing house, retail, and consumer practices

Specific challenges to making non-disposal alternatives viable in California include:

- Developing financing options to achieve needed infrastructure expansion
- Streamlining permitting of new and up-graded facilities, including addressing cross-media regulatory issues
- Facilitating siting of new and up-graded waste management facilities with respect to length of time for approval, CEQA, and local community and regional planning and acceptance, including environmental justice concerns
- Developing markets for recycled, reused, remanufactured materials (such as paper) and for residual waste materials generated from non-disposal alternative (such as ash)
- Incentivizing purchase of GHG-friendly sources of electricity and biogas from waste processing facilities
- Showing State leadership by purchasing products in keeping with the GHG and waste reduction goals
- Co-locate new waste treatment facilities at existing waste sites to minimize permitting issues and environmental impacts

8. Follow-Up Actions - What actions need to occur, who is responsible, and what is the timeline for the actions?

For the Waste Management Sector, ARB and CalRecycle staffs have developed a "Follow-Up Actions" document based on the tasks identified in the technical papers: Recycling, Reuse, and Remanufacturing; Composting and Anaerobic Digestion; State Procurement; Biomass Conversion; Municipal Solid Waste Thermal Technologies; and Landfilling of Waste. Follow-Up Actions serves as a working model to address the issues and activities associated with achieving the AB 32 GHG emissions and AB 341 waste reduction goals.

The Follow-Up Actions document is provided in Appendix B and includes:

- Ongoing activities related to the issues discussed above
- Additional activities and decisions that will need to be made in order to achieve the goals listed above
- Timelines for completing ongoing activities and initiating new activities

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9. Appendices

- Appendix A, Technical Papers
 - Recycling, Reuse, and Remanufacturing
 - Composting and Anaerobic Digestion
 - State Procurement
 - Biomass Conversion
 - Municipal Solid Waste Thermal Technologies
 - Landfilling of Waste

- Appendix B, Follow-Up Actions

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Appendix A – Technical Papers RECYCLING, REUSE, AND REMANUFACTURING January 2014

I. INTRODUCTION

This paper focuses on the opportunities, challenges, and potential solutions to achieve greenhouse gas (GHG) reductions from increased capture, reuse, and remanufacture of recyclable materials in the waste stream. For the purpose of this paper, recyclable materials include: recyclable fibers (paper, textiles, and carpet), plastic resins, glass, metals, lumber, wood waste, and inert materials.⁴ Source reduction (including reuse) and recycling are at the top of the waste management hierarchy and the preferred approach to reduce GHG emissions from the Waste Management Sector. Both result in decreased GHG emissions from landfills; conserve energy; and reduce environmental impacts associated with the upstream production of materials, products, and packaging.

The sections that follow describe the waste collection and processing infrastructure in California, what happens with the collected recyclable materials, what are California's statewide recycling targets and the associated GHG emissions benefits, what are the challenges in meeting and exceeding these targets, and what actions may be taken to meet these challenges. This paper is one of several papers being prepared to provide information critical to the discussion about the role that the Waste Management Sector can and should play in meeting the goals of Assembly Bill (AB) 32.

II. GENERAL DESCRIPTION OF THE RECYCLING INFRASTRUCTURE IN CALIFORNIA

A. Collection

How are recyclable materials collected?

Recyclable materials are collected in a variety of ways including: a) collection program offered by a city, town, or county, or by private haulers under contract with a local governmental agency; b) back-hauling by businesses (or private hauling under contract) that develop their own strategies for collecting and handling recyclable materials; c) pickup of source-separated recyclables (e.g., only cardboard, only metal, only plastics) by independent recyclers; or; d) self-haul of recyclables to a recycling center, drop-off facility, or material recovery facility. Unlike traditional recycling materials, construction and demolition debris (C&D) is collected almost exclusively in large containers (e.g., drop-boxes) or in large bodied trucks (e.g., end-dumps) and might be collected by the municipality, private haulers, or independent recyclers depending upon the local collection system.

⁴ Organic materials are addressed in the Biomass Conversion and the Composting and Anaerobic Digestion Technical Papers.

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What portion of the collected material is capable of being recycled?

In 2010, about 73 million tons of waste materials were generated in California. Roughly 37 million tons of this material went into landfills and about 36 million tons were recycled. The 37 million tons landfilled includes disposal-related activities (i.e., alternative daily cover, alternative intermediate cover, and beneficial reuse at California landfills, material transformed at California transformation facilities, and tire derived fuel). Nearly two-thirds of the paper, plastic, and metal materials found in the disposed waste stream are uncontaminated when they arrive at disposal facilities and could be recycled into feedstock for reuse and remanufacturing facilities with minimal additional preprocessing.

B. Processing

How is collected material processed to recover recyclable material?

There are a variety of types of facilities where materials are sorted, consolidated, and prepared for end uses/markets. A material recovery facility (MRF) receives recyclables and sorts the materials by type or grade to meet the commodity specifications of the end use markets. The primary types of MRFs are Multi-Stream and Single Stream, and mixed-waste processing. At a Multi-Stream MRF, incoming recyclables have usually been collected separate from each other, for example through a curbside dual stream program that separates paper from glass, plastic, and metal materials. At a Single Stream MRF, incoming recyclables have been collected in one stream and often have a higher level of contamination than materials received at a Multi-Stream facility. A mixed waste processing facility (sometimes called dirty MRF) receives municipal solid waste which is then processed and sorted to recover recyclable commodities. Another MRF processing method is to collect wet (e.g., food) and dry (e.g., paper, clean containers) materials separately and process them separately at the MRF.

In addition, there are many facilities that focus on construction and demolition (C&D) materials. Aggregate, ready mixed concrete, and asphalt plants collect and recycle inert materials, primarily hardened concrete and asphalt. Mixed C&D processing facilities receive mixed construction and demolition debris which is then sent through a series of manual and automated sorting processes to extract the recyclable commodities. Mixed C&D facilities focus their efforts on recovery of heavy and bulky materials like wood, metal, concrete, asphalt, dirt, and cardboard. Some source separated C&D materials are also processed at MRFs. After the initial processing at a MRF or C&D processing facility, some recyclable commodities go through secondary processing to upgrade the value or utility of the material prior to use as feedstock in a remanufacturing facility.

What is the current capacity of the processing infrastructure in California?

The current capacity of the processing infrastructure is estimated based on information collected in CalRecycle's Facility Information Toolbox and is shown in Table 1. Not counting the 6.6 million tons per year in secondary processing, approximately 42 million

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tons of materials are currently processed in California while 36 million tons of materials are recycled annually. The difference between the tons of materials processed and the tons of material recycled is attributed to residues from processing facilities that are landfilled or used for a disposal related activity. As shown in Table 1, there is adequate processing capacity at materials recovery facilities, construction and demolition processing facilities and secondary recyclables processing facilities to accommodate significant increases in handling collected materials and readying them for use in the next step.

Table 1. Number and Throughput of Facilities in the Processing Infrastructure⁵

Type of Facility	Number of Facilities	Current Throughput M tons/year	Remaining Capacity M tons/year
Material Recovery Facilities	137	11.9	16.9
C&D Processing Facilities	242	29.9	30.2
Secondary Recyclables Processing Facilities	223	6.6	3.1
Totals	602	48.4	50.2

III. CURRENT STATUS ON THE UTILIZATION OF RECYCLABLE MATERIALS

How are the recycled materials used in California?

Once recoverable materials are collected and sorted or processed, they are delivered to recycling/remanufacturing markets, either in California, elsewhere in the United States, or internationally. Significant quantities of glass and some of the metals, plastics, and paper that are collected for recycling in California remain in the state for remanufacturing. However, the majority of recyclable commodities collected in California for recycling are transported out of state by rail or ocean-going vessel. California's recyclable commodities, with a value of about \$8 billion, constitute 28% of all California exports by sea⁶. Table 2 illustrates the remanufacturing destination of California's recycled materials.

⁵ Throughput and capacity estimates from the CalRecycle Facility Information Toolbox (FacIT), September 2012, and are based on continually-updated data from industry operators, survey results, and self-reported data. <http://www.calrecycle.ca.gov/FacIT/> -

⁶ <http://www.calrecycle.ca.gov/Actions/Documents/85/20132013/906/Export%20Report%20for%202012%20California%20Recyclable%20Materials.pdf>

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Table 2. Remanufacturing distribution of recycled materials in California⁷

Material	Remanufacturing Destination
Aluminum	99% Southeastern U.S., 1% Mexico, Europe, Brazil
Steel	90% Pacific Rim, 10% California
Glass	85% California, 8% Texas, Colorado, Washington, Oklahoma, 7% Mexico
HDPE	46% California, 36% in China, 18% Southeast U.S.
PET	77% China, 14% California, 10% Southeastern U.S.
Cardboard & Paper	64% U.S., 36% China

The number of remanufacturing facilities in operation in California, their throughput and their remaining capacities are tabulated in Table 3. As shown in Table 3, California's remanufacturing facilities handle a total of 2.3 million tons of material with little remaining capacity. Considering that there are 22 million tons of recyclable materials being exported from California and an additional 22 million tons of materials (including organics) currently being disposed in landfills annually that need to be recycled by 2020 in order to meet the AB 341 75% recycling goal (see Section IV), the information shows that there is a lack of recycling manufacturing capacity to handle increased amounts of materials that could be collected and processed. Inert materials from C&D facilities are excluded from Table 3 since additional remanufacture is not required as processing results in final products or commodities. For example, most of the concrete and asphalt is crushed and converted to aggregate during the initial processing for use as road base.

⁷ http://www.arb.ca.gov/cc/protocols/localgov/pubs/recycling_method.pdf

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Table 3. Number and Throughput of Facilities in the Remanufacturing Infrastructure⁸

Type of Facility	Number of Facilities	Current Throughput M tons/year	Remaining Capacity M tons/year
Glass Remanufacturing Facilities	13	0.7	0.1
Paper Remanufacturing Facilities	14	1.1	0.005
Plastic Remanufacturing Facilities	21	0.4	0.07
Tire Remanufacturing Facilities	74	0.05	0.04
Totals	122	2.3	0.2

With the existing remanufacturing infrastructure only handling a little over 2 million tons and having minimal remaining capacity, there is insufficient capacity to handle the recyclable materials for California to sustainably manage its own waste. This lack of recycling infrastructure for certain commodities and the state’s close ties with the Pacific Rim make Asia one of the primary destinations for recyclable commodities. While international markets were a convenient and much-needed outlet for commodities over the past two decades, they are subject to global uncertainties. The 2008 worldwide economic downturn highlighted California’s dependence on foreign markets for recycled materials. During the 2008 economic downturn, demand for recycled commodities decreased, commodity prices plummeted, and stockpiles of recycled commodities began to build up at material recovery facilities and ports, highlighting California’s precarious reliance on export markets for recycled commodities. California’s dependence on foreign markets has been illustrated again in 2013 with China’s recent “Green Fence” policy that has adversely impacted export markets for recyclable commodities and re-emphasized the need to develop new, in-state remanufacturing capacity.

IV. GOALS FOR INCREASING RECYCLING/REMANUFACTURING AND ACHIEVING GHG BENEFITS

Using recycled commodities as feedstock for remanufacturing and energy production will achieve significant GHG reductions. In particular, reintroducing recyclables back into the manufacturing process reduces greenhouse gas emissions from multiple phases of product production including extraction of raw materials, preprocessing, and manufacturing. With the adoption of AB 341 (Chesbro, Chapter 476, Statutes of 2011), a clear mandate was established to achieve a statewide recycling goal of 75% by 2020. Preliminary estimates are that about 22 million tons per year of material will need to be removed from the landfill waste stream and used in non-disposal alternatives by 2020,

⁸Throughput estimates from FacIT may include virgin as well as recycled feedstocks. <http://www.calrecycle.ca.gov/FacIT/>

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in order to meet this 75% goal. Achieving AB 341's 75% recycling mandate will result in an estimated 20 to 30 MMTCO₂e reduction in 2020 compared to business as usual⁹.

When looking at the impact of waste reduction activities on GHG emissions, future life cycle analysis on net environmental impacts will be needed. To estimate the GHG reduction benefits of recycling and remanufacturing, ARB has developed emission reduction factors (ERFs) for a majority of the materials that are recycled. Figure R-1 and Figure R-2 illustrate the amount of material and the corresponding GHG reductions that could be achieved by meeting the 75% recycling goal¹⁰.

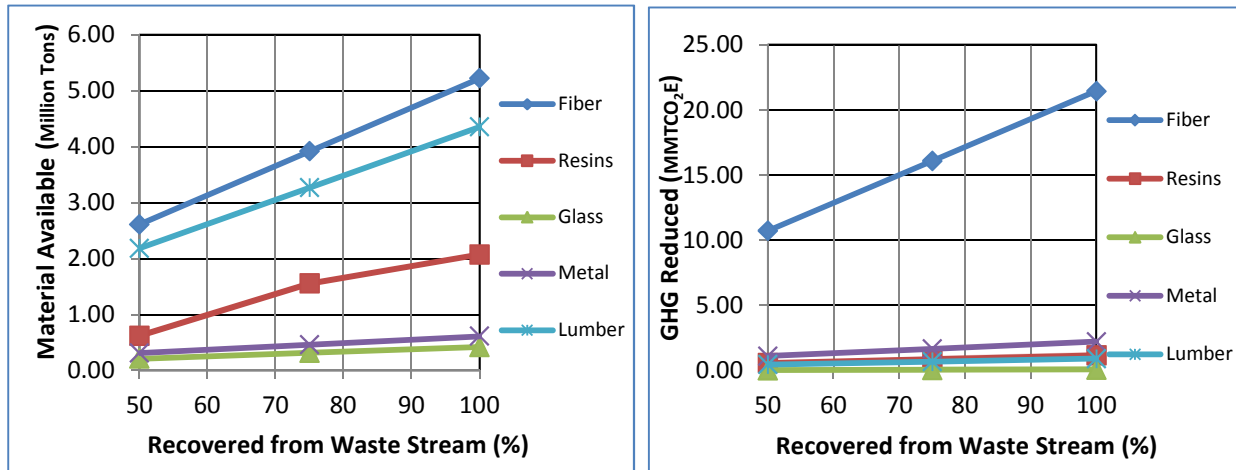


Figure R-1. Amount of Material Available **Figure R-2. Potential GHG Reduced**

Beyond 2020, additional reductions in GHG emissions from the Waste Management Sector will be needed. Staff proposes a 2035 goal of Net-Zero GHG emissions for the Waste Management Sector. As a 2050 goal, staff recommends a reduction of direct GHG emission in California from the Waste Management Sector to 25% below the direct emission associated with meeting the 2035 goal. To achieve these reductions, even greater diversion of organics and other recyclable commodities from landfills and further expansion and enhancement of the alternative non-disposal pathways will be needed to meet the 2020 goals. In addition, greater emphasis will need to be placed on reducing the volume of waste generated, recycling/reusing products at the end-of-life, and remanufacturing these materials into beneficial products.

⁹ Includes 5-6 MMTCO₂e GHG emissions reduction by recycling organics. See the Composting and Anaerobic Digestion Technical Paper. Methodology for estimating the remaining amount of GHG emission reductions is shown in Appendix 1.

¹⁰ Achieving the 75% recycling goal requires recycling organics in addition to these materials as addressed in the Biomass Conversion and Composting and Anaerobic Digestion Technical Papers.

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A. Existing requirements, programs, and regulatory policies

This section provides a summary of the existing regulations, policies, incentives and permitting requirements that influence the reuse and remanufacturing of recyclable materials.

How are processors and re-manufacturers of recycled products permitted to operate in California?

Remanufacturing facilities using clean, source separated, feedstock generally do not need a solid waste facilities permit (SWFP) but do require local land-use approval and environmental review under the California Environmental Quality Act (CEQA). Remanufacturing facilities may also require water and air permits and, depending upon facility discharges, environmental impact mitigations may be required. MRFs require a Solid Waste Facility Permit unless the incoming material is source-separated, contains less than 10 percent residuals and is less than 1 percent putrescible.

What regulations have an impact on recycling and remanufacturing recycled materials?

Regulations that have either a direct or an indirect impact on recycling and remanufacturing recycled materials are listed below:

- AB 939 - In 1989, the California Integrated Waste Management Act of 1989 (AB 939, Sher) was passed, which required cities and counties to reduce the amount of waste going to landfills by 25 percent in 1995 and 50 percent by the year 2000, through source reduction, recycling, and composting activities.
- AB 341 – In 2011, AB 341 established a policy goal of not less than 75 percent of the solid waste generated be source reduced, recycled or composted by 2020. AB 341 also requires businesses that generate 4 cubic yards or more of waste and multifamily residential dwelling of five units or more to recycle.
- AB 32 – AB 32, signed into law in 2006, established a first-in-the-world comprehensive program of regulatory and market mechanisms to achieve real, quantifiable, cost-effective reductions of GHG. Several measures in the Waste Management Sector have been identified under the AB 32 process for having GHG reduction potential.
- Cap-and-Trade – The Cap-and-Trade program is established under AB 32 to reduce GHG emissions. The program will cover major sources of GHG emissions in the State such as refineries, power plants, and other large industrial facilities which includes some manufacturers using recyclable materials as feedstock. The Cap-and-Trade program includes an enforceable GHG cap that will decline over time. ARB will distribute allowances, which are tradable permits, equal to the emission allowed under the cap.

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- California Beverage Container Recycling and Litter Reduction Act (BCRLRA) (AB 2020, Sher, 1986) – This law sets a goal of recycling at least 80 percent of all beverage containers sold in the State by imposing a deposit of 5 or 10 cents per container, depending on size. The program helps ensure a steady supply of recycled aluminum, glass and plastic that can be used to manufacture new products. The law also created several programs to develop or enhance demand for recycled content products (see below).
- The Rigid Plastic Packaging Container (RPPC) law (SB 235, Hart, 1991) requires specified containers to meet one of several compliance options, including 25 percent recycled content. The program helps ensure manufacturing demand for California recycled plastics.
- The State Agency Buy Recycled Campaign (SABRC), a joint effort between CalRecycle and the Department of General Services (DGS), supports markets for recycled materials by requiring State agencies to purchase certain recycled-content products. The program implements several statutes, covering products such as paper, plastics, tire-derived products, compost and others. The product specifications, minimum recycled content levels, and purchase conditions vary by product.
- Several California “minimum-content” laws require manufacturers (or publishers, in the case of newspapers) to use minimum levels of recycled materials in products made, sold or used in California. These include glass containers (35 percent recycled content), newsprint (50 percent of newsprint used must have at least 40 percent recycled content), fiberglass (30 percent) and plastic trash bags (10 percent). Definitions of “recycled” and other specifications vary by product.
- Certain labeling laws indirectly support recycled-content manufacturing by ensuring truthful claims of recycled content or other environmental benefits. For instance, California law (Business and Professions Code Section 17580) requires product labels and advertisements to document such claims and to comply with the Federal Trade Commission “Green Guides” for environmental advertising. California also requires (Public Resources Code Sections 18000 – 18016) rigid plastic containers to be labeled with resin identification codes to facilitate recycling.
- The Construction Demolition Inert (CDI) regulations in Title 14 of the CCR set statewide minimum handling requirements for facilities that transfer and process those materials.
- Caltrans currently has specifications that allow for the use of: up to 100% recycled aggregate in road base, recycled and reclaimed concrete aggregate in some concrete applications, 25% reclaimed asphalt pavement (RAP) in hot mix asphalt (HMA), and 5% reclaimed asphalt shingles (RAS). Public Resources Code

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Section 42704 allows Caltrans to develop a specification for the use of up to 40% RAP in HMA by 2014.

- Public Resources Code Sections 16000-16004 – Authorizes re-use of returned plastic concrete through reference to the Greenbook Standard Specifications for Public Works Construction.
- The California Green Building Standards Code (CALGreen), Title 24, Part 11 of the California Code of Regulations, requires that all construction and demolition residential and non-residential building projects, requiring a permit, must divert a minimum of 50% of construction waste materials generated.

What are some programmatic funding sources and incentives for recycling and remanufacturing recycled materials?

Some of the programs that provide funding and/or incentives for recycling and remanufacturing are listed below:

- Recycling Market Development Zones (RMDZ) loans - The intent of the RMDZ loan program is to help California manufacturers increase their processing capabilities and create additional markets for recycled-content products. Eligible applicants are businesses with manufacturing and processing facilities that produce recycled-content materials and products in designated zones in California. Funding for this program currently relies on repayment of principal and interest from prior loans, which typically amounts to only about \$5 million or less per year.
- Beverage Container Recycling Program – Beverage containers covered under the Beverage Container Recycling and Litter Reduction Act (BCRLRA) are subject to California Redemption Value (CRV), a cash incentive of 5 cents for containers less than 24 ounces and 10 cents for containers 24 ounces or larger. Beverage producers also pay a “Processing Fee” to the State when the cost of recycling is greater than the scrap value of the recycled containers. CalRecycle disburses these fees and unclaimed deposits to pay for a variety of programs to increase recycling, reduce contamination and encourage use of the recycled materials. These include:
 - Direct payments to cities and counties to reduce costs of curbside collection and other local programs;
 - Collection and litter reduction grants to local jurisdictions, Conservation Corps and businesses;
 - Quality Incentive Payments to processors who sort and clean recycled beverage container material to specified standards;
 - Handling Fees and incentive payments to certified recyclers who increase collection;

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- Public education; and
- Plastic Market Development Payments (PMDPs – see below).
- Electronic Waste Recycling Program – The Electronic Waste Recycling Act of 2003 and SB 50 (Sher, Chapter 863, Statutes of 2004) established a funding system for the collection and recycling of specified electronic wastes.
- Plastic Market Development Program (PMDP) – The PMDP provides \$10 million or more per year to encourage both the processing and remanufacture of recycled beverage container plastics (primarily PET and HDPE) within California rather than outside the State. The payments are split between product manufacturers and reclaimers. Each company receives up to \$150 per ton of CRV plastic processed and used to make a new plastic product.
- California Pollution Control Financing Authority (CPCFA) – CPCFA's Tax-Exempt Bond financing Program gives California businesses help with acquisition and installation of new equipment.
- Tax Credits – Federal and State tax credits may be available for green equipment purchases.
- Industrial Development Bond (IDB) Financing Program – California Industrial Development Financing Advisory Commission (CIDFAC) approves the issuance of IDBs, which provide manufacturing and processing companies low-interest financing for capital expenditures.
- Other programs that provide financial and other assistance include the Go-Biz program, Small Business Development Centers (SBDC), Service Corp of Retired Executives (SCORE) and Employment Training Panel (ETP) assistance.

V. CHALLENGES TO MEETING GOALS

This section discusses the current and future challenges to meeting the recycling and GHG reduction goals by increasing the reuse and remanufacturing of the recyclable materials in California. In general, there are a number of overarching challenges to increased recycling including: lack of sufficient domestic recycling infrastructure to remanufacture recycled materials, insufficient markets for recycled materials, and the relatively low cost of landfilling which adversely impacts the economics of recycling. The challenges to effectively and efficiently increase the reuse and remanufacturing of recycled materials can further be placed into short-term actions and long-term actions. Overall, California has sufficient capacity to process materials currently collected for recycling, but there is insufficient capacity to remanufacture these materials into products in California. Approximately 2 million tons of recycled materials processed in California are remanufactured into products in California while roughly 22 million tons of recycled materials processed in California are exported for remanufacturing. Furthermore, an additional 22 million tons of material needs to be recycled to meet the AB 341 75% recycling goal and there is insufficient remanufacturing capacity in California to turn these materials into products. Additional work is also needed to educate Californians to take responsibility for the waste they generate, to empower the

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public to purchase climate-friendly products, to optimize product packaging, and encourage producer responsibility for recycling.

A. Short-Term

The first step in meeting the challenges to achieving these goals involves identifying and prioritizing immediate actions that could be taken to meet the 2020 GHG and waste diversion goals for the waste management sector. Some of the challenges to full utilization of the available recyclable materials are addressed below.

GHG emissions reduction quantification

- There is an insufficient number of emission reduction factors (ERFs) for alternative waste processing pathways (e.g., aerobic digestion) and materials that can be recycled (e.g., carpet), limiting the ability to quantify some potential reductions.
- Review California-specific data for benchmarking recycling facilities that are subject to Cap and Trade.
- Exported recyclables do not necessarily meet the same commodity standards as in-state markets and consideration of final destination, e.g., closed-loop recycling, downcycling, or incineration, should be included in GHG emission reduction factors.

Permitting and Siting New and Modified facilities

- Building new and up-grading existing facilities will face multiple challenges including: multiple permits and regulatory compliance requirements, the length of time for approval processes, CEQA issues, and local community and regional planning and acceptance, including environmental justice concerns.
- Lack of consensus that for California to meet its GHG and waste reduction goals there needs to be greater acceptance of ownership for the waste generated within California.

Financial limitations

- The relatively low cost of landfilling and the lack of financial incentives for non-landfilling alternatives may hinder increases in new facilities for remanufacturing.
- The Recycling Market Development Zone (RMDZ) program, which combines recycling with economic development to start new businesses, expand existing ones, create jobs, and divert waste from landfills, only serves half the geographic area of the State of California and has very limited sustainable funding.

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Market Development

- Insufficient market demand for recycled, reused, and remanufactured materials (such as paper) and for residual waste materials generated from non-disposal alternatives (such as ash).
- Lack of adequate specifications and acceptance of the use of reclaimed or recycled C&D materials (RAS, RAP, etc.) into paving applications at both the state and local levels.
- There is a decreasing quality of collected materials due to trend towards more mixed collection of recyclables.

Regulatory Development

- Determine the need to develop additional regulations if necessary to achieve GHG and waste reductions goals.

B. Long-Term

Some of the long-term challenges include the following:

Infrastructure Improvements

- Increase in productions of remanufactured commodities or new remanufacturing facilities will require continuous infrastructure development.

Quality of recyclable commodities

- The need to foster collection of cleaner recyclable materials.

Identify future research

- How to best identify and fund future research that could be used to further achieve the goals of the program.

Ultimately take ownership for waste generated in California

- The need to develop a sustainable, low-carbon waste management system that processes waste in California and minimizes the export of waste-related materials to other states or nations.

VI. POTENTIAL SOLUTIONS

Building new recycling remanufacturing facilities could help California meet its GHG emissions and recycling goals while at the same time increasing our “ownership” of waste generated in California. Discussed below are some potential solutions to the challenges described above. As with the discussion of Challenges, the potential solutions are organized by short-term and long-term categories.

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A. Short-Term

GHG Emissions Reductions Quantification

- Develop new ERFs for alternative pathways for waste processing (e.g., aerobic digestion) and materials that can be recycled (e.g., carpet).
- Amend existing ERFs as needed.
- Review Cap-and-Trade benchmarks for capped recycling manufacturing facilities (glass, paper, etc.) to ensure use of recycled feedstock is incentivized.
- Consider any additional quantifiable data on end use of exported recyclables and incorporate the information data into future updates to the RERFs as needed.

Permitting and Siting and Regulatory Compliance

- Work with other agencies, districts, and jurisdictions to identify and address conflicting permitting and regulatory requirements for recycling and remanufacturing facilities/operators.
- Develop a model permit that could be used to streamline the permitting process across several agencies.
- Create Programmatic EIRs and guidance documents to assist project proponents in the completion of environmental review and compliance with CEQA.
- Foster State, local, and private cooperation in achieving the Waste Management Sector goals and gaining public acceptance through public education outreach programs.

Financial Limitations

- Develop new financial incentives for building sufficient infrastructure in-state and ensuring the economic viability of various recycling pathways.
 - Explore potential offset project protocols for applicable recycling processes which may generate ARB offset credits.
 - Establish new incentive payments or loan/grant programs geared for the re-manufacturing of high-GHG commodities, for example through the use of Cap and Trade revenues.
 - Explore options such as tax credits and use of EPIC funds.
- Increase formal partnership with GO-Biz to further expand technical support for recycling and remanufacturing businesses.
- Expand sustainable financing for the RMDZ program and for recycling manufacturers throughout the State of California.
- Develop and implement product stewardship programs.

Market Development

- Increase markets for recycled products. This may be accomplished via incentives or requirements for increased recycled products purchasing by the State.

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- Maximize recovery potential by establishing grants and/or performance standards for MRFs and C&D facilities to recover higher-quality commodities from mixed waste streams.
- Work with state and local transportation agencies on research, testing, and development of specifications for greater use and acceptance of reclaimed and recycled C&D materials in paving applications.
- Increase education of residents and businesses regarding the collection of cleaner recyclable commodities.
- Educate public on their responsibility to recycle, reuse and minimize their carbon footprint.

Regulatory Options

- Develop regulation(s) if needed to achieve GHG and waste reduction goals.

B. Long-Term

Infrastructure Improvements

- Develop a sustainable waste management system that can adequately handle the increase in municipal solid waste that needs to be shifted from landfill to remanufacturing processes to meet GHG and waste reduction goals.
- Foster State, local, and private cooperation in achieving the Waste Management Sector goals.

Improve the sustainability of the California waste management infrastructure

- Developing markets for recycled, reused, and remanufactured materials (such as paper) and for residual waste materials generated from non-disposal alternatives (such as ash).
- Evaluate the effectiveness of recycling education efforts and modify as needed to improve the quality of recyclable commodities.
- Develop and implement additional product stewardship programs.

Quality of recyclable commodities

- Maximize recovery potential by establishing grants and/or performance standards for MRFs and C&D facilities to recover higher-quality commodities from mixed waste streams.
- Increase education of residents and businesses regarding the collection of cleaner recyclable commodities.

Identify future research

- Identify future research (e.g., improved sorting, processing, and re-manufacturing technologies) that could be used to further achieve the goals of the program.

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Reduce the volume of waste generated

- Maximize recycling of packaging materials.
- Evaluate opportunities to reuse materials.
- Enhance producer responsibilities for hard-to-manage waste materials.
- Continue to educate the public on their abilities to help achieve California's GHG and waste management goals.

Maximize Recycling

- Evaluate the effectiveness of the short-term incentives and modify as needed to achieve continuous, measurable increases in the amount of materials recycled, reused, and remanufactured.
- Incorporate recycling and recyclability as a front end design parameter for packaging and products.

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Appendix 1: Waste Management Sector Greenhouse Gas Emission Estimates

Appendix 1 details the initial effort to estimate the greenhouse gas (GHG) emission reductions from the Waste Management Sector that will be realized by meeting AB 341's 75% recycling goal. The GHG emission reductions are presented for the Waste Management Sector as a broad range because they are dependent on many variables including:

- 1) Reliance on existing emission reduction factors. As noted in the Technical Papers and the Follow Up Actions, additional work is needed to improve the emission reduction factors and to develop new ones. Future work will include updating the emission reduction factors for landfills, including avoided methane emissions for organics that are shifted to non-landfill management alternatives. New emission reduction factors will be developed for anaerobic digestion and for additional recyclable materials such as carpet.
- 2) The expected composition of disposal related materials and materials recycled in 2020.
- 3) The variability of different materials within a general material category such as paper, and the variability associated with appropriate emission reduction factors. For example, there are different types of paper (corrugated cardboard, magazines, newspaper, white ledger paper, mixed paper, etc.), each with different estimated tonnages in the waste stream and each with associated emission reduction factors that depend on how much of these materials are recovered and how they are processed into beneficial products.

Thus there is a broad range of potential GHG emission reductions from the Waste Management Sector, on the order of 20 to 30 MMTCO₂e. While this range will undoubtedly, due to obtaining new information and subsequent revised calculations, be refined over time, the bottom line is that there are significant GHG emission reductions that will be realized by achieving AB 341's 75% recycling goal.

2020 Waste Generation – Business as Usual (BAU) Scenario

In 2010, about 73 million tons of waste materials were generated in California of which roughly 37 million tons were disposal related (i.e. landfilling, alternative daily cover, alternative intermediate cover, beneficial reuse at California landfills, material transformed at California transformation facilities, and tire-derived fuel) and about 36 million tons were recycled. Under a business as usual (BAU) scenario, we estimate that waste generation will grow to 79 million tons by 2020. To estimate waste generation in 2020, CalRecycle selected the long-term average (1990 through 2010) per-resident waste generation rate of 10.7 lbs./person/day¹¹ multiplied by the 2020 population

¹¹ <http://www.calrecycle.ca.gov/75Percent/Plan.pdf>

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estimate of 40.6 million from the Department of Finance¹². Under a BAU scenario, where recycling remains constant at 36 million tons per year, California would generate an estimated 43 million tons of disposal-related material in 2020.

2020 Waste Generation, Increased Recycling, GHG Emission Reductions – AB 341 Scenario

In order to reach the 75% recycling goal of AB 341¹³, about 22 million tons of the 43 million tons of disposal related materials in 2020 under a BAU scenario will instead need to be recycled. We have applied relevant emission reduction factors¹⁴, including estimates for avoided landfill methane emissions¹⁵ where appropriate, to the 22 million tons of waste recycled to estimate the range of associated GHG emission reductions. The GHG emission reduction calculations are based on the assumption that the composition of the waste recycled is proportionate to the composition of the waste going to disposal-related activities in 2010¹⁶. For example, paper, which constituted 15% of the disposal-related material in 2010, is assumed to constitute 15%, or 3.2 million tons, of the additional 22 million tons of material that needs to be recycled in 2020 to achieve the 75% recycling goal.

Table 1 below shows the composition of the waste stream and the estimated tons of the various material types that go to disposal-related activities in 2020 under a BAU scenario. The table also shows rough ranges for GHG emission reductions for the various material types if 22 million tons of these materials are diverted from the waste stream and sent to recycling, composting, anaerobic digestion, or biomass conversion facilities instead. By recycling the additional 22 million tons needed to achieve the AB 341 75% goal, we will also achieve roughly 20 to 30 MMTCO₂e in GHG emission reductions¹⁷. Note that these emission reductions are based on best estimates of avoided landfill emissions and use existing Recycling Emission Reduction Factors (RERFs), Composting Emission Reduction Factor (CERF), and in some limited cases (i.e. metals, electronics, and carpet) factors from the USEPA WARM model. The Follow Up Actions commit to updating some of these factors as part of the overall Waste Management Sector Plan.

¹² <http://www.dof.ca.gov/research/demographic/reports/projections/P-2/>

¹³ About 22 million tons of additional recycling plus the 36 million tons of existing recycling will be needed to achieve the 75% recycling goal.

¹⁴ http://www.arb.ca.gov/cc/protocols/localgov/pubs/compost_method.pdf; http://www.arb.ca.gov/cc/protocols/localgov/pubs/recycling_method.pdf As noted in the Technical Papers and the Follow Up Actions, additional work is needed to develop new and revise some of the existing emission reduction factors.

¹⁵ As noted in the Landfill Paper, additional work is needed to quantify landfill emissions.

¹⁶ We recognize that this composition assumption is not ideal; however, it is the best assumption given available data and is sufficient to provide an estimated range of GHG emission reductions.

¹⁷ Note that GHG emission reductions are presented as a broad range because they are dependent on many variables. For example, there are many different types of paper (corrugated cardboard, magazines, newspaper, white ledger paper, mixed paper, etc.), each with different estimated tonnages in the waste stream and each with associated emission reduction factors that depend on how much of these materials are recovered and how they are processed into beneficial products.

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Table 1: Estimated GHG emission reductions from Waste Management Sector

Material	% of Material Composition ¹⁸	2020 BAU Disposal-Related Tons (million)	2020 GHG Emission Reductions (MMTCO ₂ e) from increased Recycling, Composting, Anaerobic Digestion or Biomass Conversion
Paper ¹⁹	15	6.3	8 - 10
Glass ²⁰	1.4	0.6	<0.5
Metal ²¹	4	1.7	3 - 4
Plastics ²²	8.2	3.5	2 - 3
Food ²³	13	5.6	2 - 4
Green ²⁴	10.9	4.7	2 - 3
Lumber ²⁵	12	5.2	0.5 - 1
Other Organics ²⁶	9.5	4.1	3 - 4
Other Inerts	17	7.3	
Household Hazardous	0.3	0.1	
Special Waste	6	2.6	
Electronics ²⁷	0.5	0.2	<0.5
Mixed Residue ²⁸	2.5	1.1	< 0.5
Total²⁹	100	43	20-30

¹⁸ Differences from the 2008 Waste Characterization are attributable to the inclusion of 7 million tons of disposable related activities which were not included in the 2008 Waste Characterization Study (ADC, AIC, beneficial reuse, transformation, tire-derived fuel).

¹⁹ **Paper:** There are different ERFs for the various types of paper (corrugated cardboard, magazines, newspaper, white ledger paper, mixed paper, etc.) ERF range of 0.54 - 5.53 MTCO₂e/ton of material. Lower end of range estimate based on ERF of 0.3 MTCO₂e/ton material ([RERF](#)) plus adjusted avoided landfill ERF of 0.24 MTCO₂e/ton material (adjusted by ARB). Higher end of range estimate based on ERF of 5.0 MTCO₂e/ton material ([RERF](#)) plus avoided landfill ERF of 0.53 MTCO₂e/ton material (CalRecycle).

²⁰ **Glass:** ERF 0.2 MTCO₂e/ton of material.

²¹ **Metal:** There are different ERFs for the various types of metal. ERF range of 1.5 - 12.9 MTCO₂e/ton of material.

²² **Plastics:** There are different ERFs for various types of plastic. ERF range of 0.8-1.4 MTCO₂e/ton of material.

²³ **Food:** ERF range of 0.66 to 0.95 MTCO₂e/ton of material. Lower end of range estimate using ([CERF](#)) of 0.42 MTCO₂e/ton material plus adjusted avoided landfill ERF of 0.24 MTCO₂e/ton material (adjusted by ARB). Higher end of range estimate using ([CERF](#)) of 0.42 MTCO₂e/ton material plus avoided landfill ERF of 0.53 MTCO₂e/ton of material (CalRecycle).

²⁴ **Green:** IBID

²⁵ **Lumber:** ERF 0.21 MTCO₂e/ton of material.

²⁶ **Other Organics:** ERF range of 0.66 to 0.95 MTCO₂e/ton of material.

²⁷ **Electronics:** ERF of -2.35 MTCO₂e/ton of material from USEPA Waste Reduction Model (Warm).

²⁸ **Mixed Residue:** ERF of 0.24 - 0.53 MTCO₂e/ton material based on avoided landfill emissions.

²⁹ Numbers do not total exactly due to rounding.

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COMPOSTING AND ANAEROBIC DIGESTION³⁰ January 2014

I. INTRODUCTION

The primary focus of this paper is to identify opportunities and potential solutions for capturing organic materials that are currently landfilled and putting this material to a more beneficial use as feedstock for composting and anaerobic digestion. Successfully capturing a significant portion of this material for composting or anaerobic digestion is essential to ensure the success of meeting California's waste diversion and GHG reduction goals. In the sections that follow, staff describes how organic waste is processed in California, what happens with the end-use materials, what are California's waste reduction targets and the associated greenhouse gas (GHG) emissions benefits, what are the challenges in meeting and exceeding these targets, the potential solutions to these challenges, and next steps for evaluating the future of composting and anaerobic digestion in achieving Assembly Bill (AB) 32 and waste reduction goals.

II. GENERAL DESCRIPTION OF THE COMPOSTING AND ANAEROBIC PROCESSES

What are the processes involved in composting and anaerobic digestion?

Composting is the biological decomposition of biodegradable solid waste under controlled, predominantly aerobic conditions. Composting can be done at small-scale on-site facilities or at large-scale commercialized facilities that handle high volumes of organic material. Compost facilities have traditionally utilized open windrows to process compostable organics (mostly agricultural and green material) into finished compost. Some compost facilities incorporate more sophisticated technologies, such as aerated static piles and biofilters, to meet air quality requirements. End uses of the compost product include: soil amendment, fertilizer, mulch, boiler fuel, and a small amount used as alternative daily cover at landfills. The most common markets are agriculture and horticulture markets.

Organic material may also be processed via in-vessel digestion. Anaerobic digestion, the biological decomposition of organic material in the absence of oxygen or in an oxygen-starved environment, is the most common form of in-vessel digestion. Anaerobic digesters are fully enclosed structures, such as tanks or other sealed containers, in which the entire digestion process occurs. Anaerobic digestion produces biogas (consisting primarily of methane and carbon dioxide) and digestate. Digestate is the solid and/or liquid residual material remaining after organic material has been digested. There are a variety of controlled systems where anaerobic technology is

³⁰ Although anaerobic digestion, the biological decomposition of organic material in the absence of oxygen or in an oxygen-starved environment, is the most common form of in-vessel digestion, there are several other digestion technologies that do not utilize anaerobic digestion. Anaerobic digestion is used broadly throughout this paper and includes other lesser used technologies.

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currently utilized in the United States, including wastewater treatment facilities (also publicly-owned treatment works), and dairy manure digesters. In other countries (primarily Europe), anaerobic technology is utilized in municipal solid waste digesters to produce energy and to reduce the volume of solid waste that must be landfilled. Products produced through anaerobic digestion include biogas, liquid fertilizer, and compost.

While, aerobic digestion technologies have been in use for a long time in waste water treatment plants (WWTP), the technology is being investigated for potential scale-up to commercial level production for organic materials from the waste stream. There is currently one demonstration facility in West Sacramento, California that has been in operation since June 2012. This technology uses freshly discarded food in its process. The current product from the demonstration facility is a liquid soil amendment that can be distributed via a drip system. The end-uses of compostable organics generated through aerobic digestion are soil amendments which reduces synthetic fertilizer use.

There are also other in-vessel digestion technologies that process organic material. For example, fermentation is the biological conversion of carbohydrates into acids or alcohol in the absence of oxygen and aerobic digestion is the biological decomposition of organic material in the presence of oxygen. While the term anaerobic digestion is used broadly throughout this paper, the general discussion applies to these other lesser-used technologies as well.

III. CURRENT STATUS OF COMPOSTING AND ANAEROBIC FACILITIES IN CALIFORNIA

A. Collection

How much organic waste is currently collected that could be diverted to composting and anaerobic digestion?

The composition of currently landfilled solid waste materials according to 2010 data is shown in Table 1. California disposes an estimated 37 million tons of waste in landfills each year, of which roughly 30 percent - more than 10 million tons per year - are compostable organic materials which are suitable for composting and anaerobic digestion. These compostable materials are food waste, green waste, a portion of other organics, and soiled (non-recyclable) paper. Total paper disposed of in landfills was about 5.4 million tons, with an estimated potential of 39% of these being soiled paper. In addition, about 4.4 million tons of lumber are landfilled annually. Diverting compostable organics from the landfill and using it as feedstock in composting and anaerobic digestion processes will achieve significant GHG reductions as well as waste reduction goals.

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Table 1. Composition of 2010 Landfilled Solid Waste¹

Material²	Amounts (Million Tons³)	Percentage of Solid Waste
Paper	5.4	14.7%
Glass	0.5	1.4%
Metal	1.5	4.0%
Plastics	3.0	8.2%
Food	4.8	13.0%
Green	4.0	10.9%
Lumber	4.4	12.0%
Other Organics	3.5	9.5%
Other Inerts	6.3	17.0%
Household Hazardous Waste	0.1	0.3%
Special Waste	2.2	6.0%
Electronics	0.2	0.5%
Mixed Residue	0.9	2.5%
Total	37	100%

1. Source: CalRecycle (2013)
2. Definitions of material types are available at:
<http://www.calrecycle.ca.gov/wastechar/MatDefs.htm>
3. Numbers rounded to the nearest hundred thousand.

B. Capacity

How many composting and anaerobic digestion facilities are currently operating in California and what is the total capacity of these facilities?

Currently, there are almost 140 composting and anaerobic digestion facilities operating in California. Additionally, there are another 160 chip and grind facilities processing organics. Organic materials comprise a wide range of material types: grass, leaves, branches, prunings, stumps, wood waste, agricultural wastes, food waste, and biosolids. A range of facility types are needed to process these diverse materials: chipping and grinding, composting, and anaerobic digestion facilities. In addition, data from 2011 indicates that there are 22 biomass plants that handle about 1.5 million tons per year of urban wood waste combined with forest wood waste to make bioenergy. More recent data shows that the number of biomass plants have increased to about 30. Roughly 10 million tons per year of organic materials are recycled into beneficial products such as compost, mulch, biofuels, and bioenergy. Additional organics processing capacity is needed to handle about 15 million tons that are still being

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landfilled annually which includes over 4 million tons of wood waste and nearly 5 million tons of food waste.

Chipping and Grinding – Chip/grind facilities primarily handle woody materials and do not complete a pathogen reduction process. There are about 160 chip/grind facilities processing 3.6 million tons of material per year. Markets for chip/grind material have been impacted by limited demand for chipped woody materials as a fuel for biomass facilities due to lack of incentives and inexpensive natural gas, competing interests of alternative daily cover at landfills, and concerns regarding land application of mulch products (e.g., pathogens, metals, salts, contaminants like glass or plastics, and invasive pests included in the mulch such as Asian Citrus Psyllid or European Grapevine Moth). In fact, land application concerns may dictate that in the future this material should be handled at composting facilities to ensure pathogen and invasive pest destruction. There is some interest in high temperature drying of wood waste as well as gasification to produce electricity or fuel that if deployed commercially in California could increase market demand for woody wastes.

Composting – Compost facilities can handle diverse organic feedstocks, ranging from grass and leaves, branches and wood waste to biosolids, food waste, and digestate depending on the facility design and technology. Composting infrastructure expansion has remained stagnant over the past 10 years because of increased costs of air quality and water quality requirements, feedstock competition due to low landfill tipping fees and alternative daily cover use, and the need for increased demand and use of compost products. Due to these constraints, composting facilities are operating at roughly 70% of total statewide capacity leaving about 2.3 million tons/year of unutilized capacity. Currently, there are more than 130 composting facilities in California processing about 5.8 million tons of organic feedstock per year.

Anaerobic Digestion - There are currently six anaerobic digestion facilities in California handling organic materials from the waste stream with 0.14 million tons per year³¹ of processing capacity. Because these facilities use in-vessel processing, they are particularly suited to handle food waste which has high intrinsic energy values and significant odor challenges. Anaerobic digestion technologies include co-digestion at WWTPs, dry fermentation, and high or low solids wet digesters. Currently, anaerobic digestion technologies at some WWTPs are receiving source separated, mostly liquid waste. Because WWTPs have infrastructure in place to handle and anaerobically digest organic waste, as well as excess digestion capacity, there is near-term potential for municipal solid waste digestion at these existing plants. In addition, these WWTPs have established facilities for handling wastewater from digestate dewatering and the processing of digested solids, as well as the biogas management facilities for generation of heat and power. For the other technologies, it is anticipated that 11 new anaerobic digestion projects under development will add 0.4 million tons per year of digestion capacity. With nearly 5 million tons of food waste still being landfilled, additional incentives are needed in order to achieve widespread deployment of

³¹ The Inland Empire-Environ anaerobic digestion project has 0.08 million tons per year processing capacity but is currently operating significantly below capacity.

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commercial scale anaerobic digestion facilities in California due to the economic disparity between the costs of landfilling versus anaerobic digestion. Additional anaerobic digestion of food waste will result in GHG emissions reductions in addition to production of renewable energy and new job creation.

C. GHG Emissions

What are the GHG emission benefits from diverting organic materials from landfills and sending it to compost or anaerobic digestion facilities?

Instead of landfilling, using organic material as feedstock for composting and anaerobic digestion can result in reductions of GHG emissions. The GHG emission reductions from these activities would occur due to avoided landfill emissions, displacement of fossil fuel with biogas, and reduction in synthetic fertilizer and water usage.

Table 2 provides a rough estimate of the potential GHG emission reductions from diverting organic material from landfills to composting/digestion. In 2010, 37 million tons of wastes were disposed in California's landfills. Compostable/digestible materials, including food waste, account for roughly 30 percent (more than 10 million tons) of the disposed tonnage. If half of the compostable/digestible materials are diverted from landfills and are processed to usable beneficial products, the resulting GHG emissions benefits are estimated to be approximately 3.0 to 3.7 MMTCO_{2e}. This emissions benefit includes reduced GHG emissions from avoided landfill emissions, decreased synthetic fertilizer usage, decreased water use, increased soil carbon storage, decreased soil erosion, and decreased herbicide use. When 75 percent of compostable/digestible materials are diverted from landfills in 2020 and beyond, which is needed in order to achieve the AB 341 75% recycling goal, the resulting GHG emissions benefits are estimated to be approximately 4.5 to 5.6 MMTCO_{2e} per year. Most of the estimated GHG benefits would occur within California if the infrastructure and market challenges are resolved.

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Table 2. Assessment of GHG Emission Benefits from Diverting Organics from Landfills

Process	Organics Disposed in Landfills (tons/year)	Annual Tons Diverted (50% of total disposed in years 2015 - 2020)	Resulting GHG Emissions Benefits from 50% Diversion MMTCO ₂ e per year (2015 -2020)	Annual Tons Diverted (75% of total disposed in years 2020 and beyond)	Resulting GHG Emissions Benefits from 75% Diversion MMTCO ₂ e per year (2020 and beyond)
Composting		2.5 million	1.65 ¹ – 2.38 ²	3.75 million	2.48 ¹ – 3.56 ²
Anaerobic Digestion		2.5 million	1.38 ³	3.75 million	2.06 ³
Total	10 million	5 million	3.03 - 3.76	7.5 million	4.54 – 5.62

- ¹ Estimated using Emission Reduction Factor (ERF) of 0.42 MTCO₂e/ton material processed (ARB draft Mandatory Recycling Report) plus adjusted avoided landfill ERF of 0.24 MTCO₂e/ton material processed (adjusted by ARB)
- ² Estimated using ERF of 0.42 MTCO₂e/ton material processed (ARB draft Mandatory Recycling Report) plus avoided landfill ERF of 0.53 MTCO₂e/ton material processed (CalRecycle)
- ³ Estimated using ERF of 0.55 MTCO₂e/ton material processed by HSAD (ARB LCFS report). As noted in the Follow Up Actions, additional work is on-going to include the downstream process emission benefits in the AD ERF in addition to the avoided landfill methane emissions benefits of AD that are included here.

Additional research is needed to better quantify the benefits from avoided landfill emissions and anaerobic digestion. Staff is presenting a range of emission benefits as some of the emission reduction factors are still considered preliminary and are presented here only to provide the reader with understanding of full potential for GHG emission reduction benefits.

Who currently regulates composting and anaerobic digestion facilities?

Compost and anaerobic digestion facilities are required to obtain permits from local land use and fire agencies, the local air district, the regional water board, and CalRecycle. Local air district permits are in accordance with the Clean Air Act and increasingly will include requirements to reduce fugitive emissions of volatile organic compounds, especially in non-attainment areas. New regulations are requiring facilities to implement best management practices (BMPs) such as using a compost biofilter cap or different technologies such as aerated static piles or in-vessel systems to meet Clean Air Act standards. Regional Water Board permits have generally required increasingly stricter standards for compost facilities since 2003 when a conditional waiver for “green waste-only” composting facilities was in effect. A change in the law required all waivers to either be renewed or replaced with Waste Discharge Requirements. For CalRecycle, compost and anaerobic digestion facilities are typically regulated Compostable

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Materials Handling Operations and Facilities Regulatory Requirements, Title 14, CCR 17850 et seq. These regulations take into consideration the type of feedstock, activity, location of the activity, and the volume of materials involved. The California Department of Food and Agriculture (CDFA) requires facility licensing and product registration and labeling of bulk compost intended for organic production, or for any compost sales where nutrient claims are made. Livestock and poultry carcasses from farms and parts or products of animals disposed of by United States Department of Agriculture and CDFA inspected slaughter and processing establishments, retail stores, and custom processors are required to go to CDFA licensed rendering plants, pet food processors or collection centers.

IV. GOALS FOR INCREASING COMPOSTING AND ANAEROBIC DIGESTION AND ACHIEVING GHG BENEFITS

The use of composting and anaerobic digestion processes can play a significant role in achieving California's goals for reducing GHG emissions and reducing the volume of material deposited in landfills. The GHG emission reductions from these activities would occur due to avoided landfill emissions, displacement of fossil fuel with biogas, reduction in synthetic fertilizer and herbicide usage, decreases in soil erosion, and less water usage.

Discussed below are some of the existing state programs, regulation, and goals for reducing GHG emissions through composting and anaerobic digestion processes.

Are there established goals that must be met for the waste sector?

AB 32 and Executive Order S-3-05, established goals of reducing GHG emissions to 1990 levels by 2020 - a reduction of approximately 30 percent (20% AB 32 and 10% S-3-05), and then an 80 percent reduction below 1990 levels by 2050. These near and long-term goals will guide the process in evaluating the waste sector, pointing to a sustainable, low-carbon and near-zero-waste future.

With the adoption of AB 341 (Chesbro, Chapter 476, Statutes of 2011), a clear mandate was established to achieve a statewide recycling goal of 75% by 2020. Preliminary estimates are that about 22 million tons per year of material will need to be removed from the landfill waste stream and used in non-disposal alternatives by 2020. Achieving AB 341's 75% recycling mandate will result in an estimated 20 to 30 MMTCO_{2e} reduction in 2020 compared to business as usual. Meeting these combined GHG and recycling goals will require greater utilization of existing alternative pathways for waste processing and development of new alternative pathways. A significant portion of the solid waste is compostable/digestible organics. Diverting organic waste from landfilling and using it as feedstock in composting and anaerobic digestion processes will achieve GHG reductions and will be critical in achieving our waste reduction goals.

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Are there other regulations, policies, or programs that provide incentives for composting and anaerobic digestion?

Additional programs that provide incentives to advance composting and anaerobic digestion are shown in Table 3 below.

Table 3: Additional Programs that Provide Incentives for Composting and Anaerobic Digestion

Regulatory Programs	Description
Landfill Methane Control Measure	This measure reduces emissions of methane, a GHG, from MSW landfills by requiring installation of control equipment and good operating practices.
Cap-and-Trade Program	The Cap-and-Trade program is established under AB 32 to reduce GHG emissions. The program will cover major sources of GHG emissions in the State such as refineries, power plants, and other large industrial facilities. The Cap-and-Trade program includes an enforceable GHG cap that will decline over time. ARB will distribute allowances equal to the emission allowed under the cap. It is estimated that about 23 manufacturing facilities that use recyclable material as feedstock are currently under the Cap-and-Trade program.
Low Carbon Fuel Standard (LCFS)	The LCFS requires fuel producers to ensure that fuels sold in California would meet a declining standard for GHG emissions. This regulation is likely to incentivize and provide a market for biogas.

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<p>Renewable Portfolio Standards (RPS)</p>	<p>RPS applies to all electricity retailers in the state including publicly owned utilities (POUs), investor-owned utilities, electricity service providers, and community choice aggregators. All of these entities must adopt the new RPS goals of 20 percent of retail sales from renewables by the end of 2013, 25 percent by the end of 2016, and the 33 percent requirement being met by the end of 2020. This regulation is likely to incentivize and provide a market for biogas.</p>
<p>AB 1900 (Gatto, 2012) and AB 2196 (Chesbro, 2012)</p>	<p>AB 1900 requires the Office of Environmental Health Hazard Assessment (OEHHA) to determine the health protective levels for all constituents of concern that appear in biogas at concentrations significantly higher than in natural gas that could pose risks to human health. The California Air Resources Board (ARB) then must determine the allowable concentrations of those constituents. Under AB 1900, the California Public Utilities Commission (CPUC) must also establish safety standards, monitoring and reporting requirements, and open pipeline access rules for the use of biomethane. Further, it must adopt policies that promote in-state production and distribution of biomethane. Additionally, the State Energy Resources Conservation and Development Commission (a.k.a. California Energy Commission or CEC) must hold public hearings to identify impediments to the procurement of biomethane in the State, and offer solutions to those impediments in its biennial Integrated Energy Policy Report.</p> <p>Among other things, AB 2196 amends the definition of a renewable electrical generation facility under the California Energy Commission's Renewable Energy Resources Program.</p>

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Funding Programs	Description
AB 118 (Núñez, Statutes of 2007, Chapter 750)	Directs the California Energy Commission (CEC) to develop the Alternative and Renewable Fuel and Vehicle Technology Program. Implementation of this program can provide funding in furthering the use of anaerobic digestion in producing renewable energy.
Recycling Market Development Zones (RMDZ) loans	The intent of the RMDZ loan program is to help California manufacturers increase their processing capabilities and create additional markets for recycled-content products. Eligible applicants are businesses with manufacturing and processing facilities in California that produce recycled-content materials and products.
California Pollution Control Financing Authority (CPCFA)	CPCFA's Tax-Exempt Bond financing Program gives California businesses help with acquisition and installation of new equipment.
Tax Credits	Federal and State tax credits may be available for green equipment purchases

Other programs that provide financial and other assistance include the Go-Biz program, Small Business Development Centers (SBDC), Service Corp of Retired Executives (SCORE) and Employment Training Panel (ETP) assistance.

V. CHALLENGES TO MEETING GOALS

Currently, about 30 percent of the solid waste going into landfill is comprised of materials, such as food and green waste, which are suitable for composting and anaerobic digestion. Successfully capturing a significant portion of this material for composting and anaerobic digestion is essential to ensure the success of meeting California's waste diversion and GHG reduction goals. This section discusses the current and future challenges facing increases in composting and anaerobic digestion. The challenges discussed below are further divided into short-term and long-term actions.

A. Short-Term

The first step in meeting the challenges involves identifying and prioritizing immediate actions that could be taken to meet the 2020 GHG and waste diversion goals for the waste sector. Some of the challenges to increasing the use of composting and anaerobic digestion technologies are addressed below.

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GHG Emissions Reduction Quantification

- To better understand the role composting and anaerobic digestion can play in meeting our GHG and waste reduction goals, the direct and avoided emissions from the use of these technologies need to be analyzed and quantified.

Permitting of New and Expansion of Existing Composting and Anaerobic Facilities

- Cross media and multi-jurisdictional challenges including: multiple permits and regulatory compliance requirements, the length of time for approval processes, CEQA issues, federal law issues, and local/regional planning and acceptance, including environmental justice concerns.
- Lack of consensus that for California to meet its GHG and waste reduction goals there needs to be greater acceptance of ownership for the waste generated within California.

Financial Risk

- The relatively low cost of landfilling and the lack of financial incentives for non-landfilling alternatives may hinder increases in composting and anaerobic digestion.

Market Development

- Markets for compost and digested commodities are not adequate to accommodate what is needed to reach the waste reduction goals.
- Insufficient organics pre-processing close to feedstock sources to remove contaminants.

Regulatory Development

- Determine the need to develop additional regulations to achieve GHG and waste reduction goals.

Public Acceptance

- There are difficulties in siting compost or anaerobic digestion facilities in proximity to urban areas where most of the compostable organics are generated. There is currently low public acceptance of these facilities in these neighborhoods.
- Contamination in green and food materials, in particular post-consumer materials, increases operating costs for processors and can adversely affect the salability of compost and digestate made from these materials.

B. Long-Term

Some of the long-term challenges, those beyond 2020, include: developing the needed infrastructure, increasing the markets for composted or digested commodities, improving the quality of composted or digested commodities, and addressing research needs

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Infrastructure Improvements

- Increases in production or use of compost and end products of the anaerobic digestion technologies will require continuous infrastructure development.

Market Development

- Glass and plastic contaminants are difficult to remove from feedstocks and finished products.
- Benefits of composted products are often undervalued as an agricultural input.

Future Research

- Identify and fund future research needs to achieve the stated goals.

VI. POTENTIAL SOLUTIONS FOR MEETING GOALS

Discussed below are some potential solutions to the challenges described above in our effort to achieve waste diversion and GHG reduction goals. As with the discussion of “Challenges,” the potential solutions are organized by short-term and long-term categories. There may be additional solutions to the challenges beyond those mentioned below.

A. Short-Term

The key to determining the most efficient and effective solutions for reducing GHG emissions and achieving the waste management goals are by continuing to evaluate possible strategies and prioritizing immediate and future actions. To this effect, staff has identified some potential solutions to overcome some of the short-term challenges stated above. Some of the short-term solutions include:

GHG Emissions Reduction Quantification

- Revise the compost emission reduction factor to include avoided landfill emissions.
- Develop new emission reduction factors for the anaerobic and aerobic digestion processes which include the GHG benefits of any renewable energy or liquid fuels produced.
- Complete research on GHGs from compost production and use.

Permitting of New and Expansion of Existing Composting and Anaerobic Facilities

- Continue to work with other agencies, districts, and jurisdictions to identify and address redundant or conflicting permitting and regulatory requirements for composting and anaerobic digestion facilities/operators.
- Prepare a programmatic EIR and/or model permits for compost facilities that provide enhanced air and water quality protection and odor control.
- Support the co-location of organics processing at existing WWTPs and landfills, including integrated facilities that combine composting, AD, low-carbon electricity and fuel production, or other related processes.

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Financial Risk

- Develop incentive payment and/or grant programs for compost and anaerobic digestion organics infrastructure that processes organic materials while providing environmental protection and GHG reduction.
- Identify opportunities and develop the framework for composting and anaerobic digestion activities to be a source of GHG offsets. Offsets could provide funding to build and expand infrastructure, reduce the cost differential between these activities and landfilling, or provide emission offsets for new facilities.
- Investigate the feasibility of criteria pollutant offset banks for new composting facilities, and the generation of offsets by upgrading existing facilities to reduce emissions.
- Continue to provide regulatory certainty that fuel produced from anaerobic digestion of organic waste can qualify for Low Carbon Fuel Credits.
- Provide funding for facility improvement to meet air, water, and environmental justice goals.
- Establish feed-in-tariffs for electricity production to make in-state renewable energy production more competitive with low-cost natural gas.
- Increase AB 118 funding to make more funding available for anaerobic digestion projects.
- Continue pursuing pathways for Low Carbon Fuel Credits for anaerobic digestion.
- Expand sustainable financing for the RMDZ program and for compost and digestion facilities throughout the State of California.
- Take advantage of technical support through GoBIZ.

Market Development

- Provide incentives to move materials out of landfills.
- Disallow the use of green waste Alternative Daily Cover (ADC) to count as recycling.
- Increase compost and anaerobic digestion products purchasing by Federal, State and local government agencies.
- Increase agricultural, rangeland and landscaping markets for composting and anaerobic digestion products. This may be accomplished via financial incentives and promoting the highest standards for product safety and quality.
- Support third-party product-quality standards for composted and digested products.
- Work with stakeholders to promote the sorting of urban organics, particularly food, at transfer stations, MRFs and other locations, in order to provide clean feedstocks for composting and digestion.
- Support development of advanced processes and/or equipment that enables cost-effective removal of contaminants from the organics waste stream, particularly glass and plastic.

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Regulatory Development

- Complete updates to CalRecycle regulations for composting and anaerobic digestion of food materials and other highly putrescible wastes.
- Consider ARB regulations requiring phasing organics out of landfills and into composting and anaerobic digestion alternatives.
Consider mandatory organic waste recycling for large commercial generators.

Public Acceptance

- Outreach and education to the public on the benefits of using products derived from organic residuals, and to encourage the public to correctly sort organics materials.
- Promote next-generation composting facilities that minimize odors and emissions and can be sited closer to urban centers.

B. Long-Term

Staff has identified some potential solutions to overcome some of the long-term challenges stated above. Some of the long-term solutions include:

Infrastructure Improvements

- Develop a sustainable waste management system that can adequately handle the increase in municipal solid waste that needs to be shifted from landfill to compost and anaerobic digestion processes to meet GHG and waste reduction goals.
- Foster State, local, and private cooperation in achieving the Waste Sector goals.
- Encourage new technologies that handle food waste and make value-added products such as fuels or fertilizers.

Market Development

- Continue to support incentives, education, and product quality standards for compost and anaerobic digestion products that will increase demand from agricultural markets.

Future Research

- Improve the characterization of the direct and avoided GHG emission from composting and anaerobic digestion of organic waste.
- Characterize the properties of the digestate from anaerobic systems and determine its suitability for various uses.
- Continue to support research and development projects demonstrating the newest best management practices for composting and anaerobic digestion processes.
- Investigate carbon sequestration and water savings potential of compost use in agricultural settings such as irrigated croplands and rangelands.

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STATE PROCUREMENT January 2014

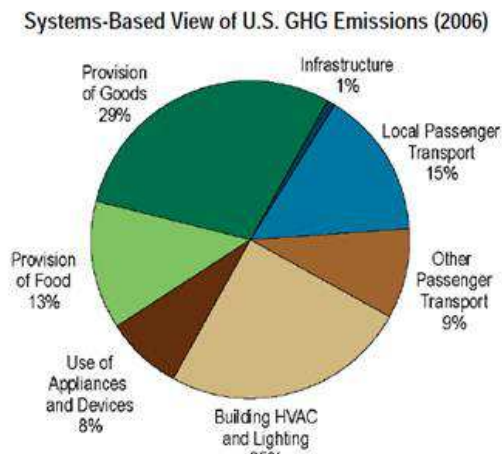
I. INTRODUCTION

Procurement decisions made by State agencies and departments are directly linked to the climate change goals of AB 32 and the recycling goals of AB 341. These decisions impact the greenhouse gas (GHG) emissions and the carbon footprint of State operations, and offer an opportunity to increase markets for post-consumer recycled content (PCRC) products, which will be critical in helping to achieve AB 341's 75% Statewide recycling goal.

The State of California purchases large volumes and a wide variety of goods. The State spent approximately \$12.8 billion on services and \$1.5 billion on goods in 2012 (which was a relatively low-spending year due to budget cuts). The Department of General Services (DGS), which is the central purchasing authority for all State agencies, CalRecycle, and other State agencies have programs that influence procurement decisions.

As an illustration of how purchasing can impact GHG emissions, a study prepared for Cal/EPA and the ARB³² suggests that significant life-cycle GHG emissions reductions can be achieved via use of product carbon labels and procurement of PCRC products. In addition, a U.S. Environmental Protection Agency (USEPA) study³³ shows that over 40 percent of GHG emissions are associated with the provision of goods and food as indicated in Figure 1.

Figure 1:



Emissions from U.S. Territories are not included in this figure.

³² http://www.arb.ca.gov/research/single-project.php?row_id=64820

³³ "Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices", U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, September 2009.

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DGS and CalRecycle have made major strides in recent years in promoting the purchase of environmentally preferable products (EPP) and PCRC products. However, as described below, only a small portion of overall State spending, less than \$200 million annually, is known to be on PCRC products; how much of the overall \$14 billion in State goods and services might be for products that could entail PCRC is unknown. Based on existing purchasing data, it is difficult to determine which products to focus our efforts on, and which agencies purchase these products and how they purchase them. Additional data is needed in order to know how to modify current purchasing practices that will result in reduced GHG emissions and increased markets for PCRC products.

These challenges are not insurmountable but will require a high degree of collaboration among State and local government agencies, goods providers, and end users. Improvements can be made throughout the State purchasing system including:

- standardize tracking all State purchases (CalCard, Request for Quotes, leveraged procurement agreements, and service contracts),
- ensure that all purchasing mechanisms (state contracts, delegated authority contracts, and service contracts that include goods procurement) incorporate recycled-content requirements and considerations ,
- identify statutory changes to improve/expand recycled-content products purchasing, and
- require product manufacturers to provide environmental information on their products and improve availability of this information to individuals making purchasing decisions.

II. BACKGROUND/OVERVIEW

Understanding and influencing procurement decisions requires basic data on what goods are purchased, by whom, and in what volumes. Given the wide variety of goods purchased each year by a multitude of State agencies, this is not an easy question to answer. DGS is responsible, in consultation with the California Environmental Protection Agency (CalEPA, represented by CalRecycle and other CalEPA departments), for implementing the EPP program pursuant to Public Contract Code Section 12400. In response to PCC 12400, the DGS/EPP Program has been integrated into the State contracting procurement process by reviewing the commodities being procured and analyzing opportunities for establishing specifications that incorporate EPP where applicable or achievable. As evidenced by purchasing data presented below, there are significant data gaps on whether all state purchases use prescribed EPP contracting processes for the vast amount and types of products purchased by the state.

As part of the EPP program, DGS has established the Performance and Environmental Standards (PES) Workgroup in 2013, which is comprised of State agency purchasing authority representatives and subject matter experts to encourage green purchasing and to assist DGS in developing EPP policy. State agencies in the PES, and prior

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workgroups, have been engaged in developing EPP policy memorandums for commodities such as, remanufactured toner cartridges, architectural paint, and paper products. One of the PES objectives is to aid in developing specifications and/or purchasing standards that include EPP for use by all agencies (to ensure EPP and postconsumer recycled content requirements are considered and used when state agencies buy under their purchasing delegation authority). DGS has also developed several Statewide contracts that are available through its *Buying Green Guide* (e.g., ink and toner cartridges, copy paper, computers/monitors, multi-function devices, recycled paint, open office panel systems, disposable food service supply, and vehicles). These “green” contracts incorporate multiple environmental (i.e., EPP) considerations, and often include minimum levels of post consumer recycled content to conform to State Agency Buy Recycled Campaign (SABRC) requirements. State agencies can use these contracts when purchasing those products, although most State agency purchasing appears to be conducted via other mechanisms. The EPP Program is exploring a system to capture EPP purchases from DGS contract mechanisms. In addition, DGS offers training through the California Procurement & Contracting Academy on EPP principles and how they are incorporated into the procurement process.

CalRecycle is responsible for the SABRC, pursuant to Public Contract Code Sections 12153-12320, under which State agencies have mandated goals regarding the purchase of post-consumer recycled content products. State agencies are required to report annually to CalRecycle the results of their recycled content purchases within 11 categories of material types. Products with post-consumer recycled content provide multiple benefits to California (e.g., increased economic development, reduced pollution and lower greenhouse gases) and by purchasing these products the State supports businesses making PCRC products and influences recycling markets. According to SABRC reporting, in 2011/2012 State agencies spent more than \$185 million in SABRC purchasing categories; about \$130 million of these purchases were PCRC products. This represents only about 8% of direct goods purchases. In comparing the SABRC and EPP programs and the focus of the respective departments, DGS works primarily with State agencies on government purchases and has a broad scope with respect to covering multiple environmental attributes in its EPP program. Additionally, DGS has multiple statutory sustainability priorities besides the environment, including socio-economic activities to encourage small business and disabled veteran business enterprises. Meanwhile, CalRecycle and ARB activities cover a wide range of products and purchasers (both government and non-government entities), but they have a more narrow focus on achieving GHG and waste reduction goals (rather than a detailed focus on all environmental and socio-economic considerations).

Purchasing Data

The information in this document is derived from two sources of State procurement data: the State Contract & Procurement Registration System (SCPRS) and the SABRC reports. Each has different emphases and limitations. SCPRS covers all purchases of goods and services over \$5,000, while SABRC focuses on purchases of recycled-content products in 11 broad product categories.

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Analysis of SCPRS Data

The State Contract & Procurement Registration System (SCPRS) is maintained by DGS and tracks goods and services over \$5,000 procured by the State of California. As shown in Table 1, State procurement of goods and services totaled approximately \$14.3 billion in 2012. Of this, \$1.5 billion of these purchases are directly for purchase of goods.

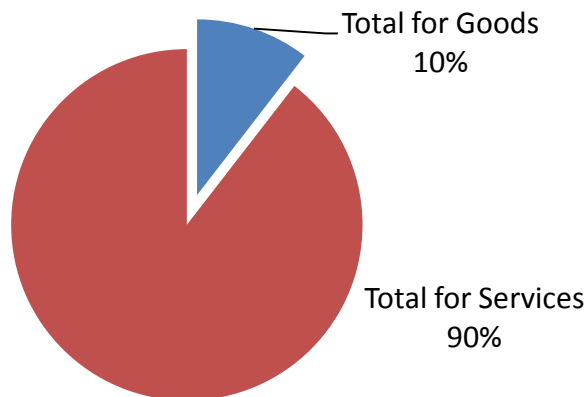
However, as explained below, an unknown amount of goods is also purchased as part of overall services purchases.

Table 1. State Procurement of Goods and Services (2012)

<u>Procurement Type</u>	<u>Unit Total</u>
IT Goods Total	\$374,592,000
IT Services Total	\$1,188,124,000
NON-IT Goods Total	\$1,119,869,000
NON-IT Services Total	\$11,580,335,000
Grand Total	\$14,262,920,000
Total for Goods (IT and non-IT)	\$1,494,461,000
Total for Services (IT and non-IT)	\$12,768,459,000

The “IT Goods” and “NON-IT Goods” categories include goods or commodities such as computers, electronics, office supplies, highway construction and maintenance material, building materials, landscaping maintenance supplies, food, vehicles, vehicle parts and supplies, and numerous other type of goods. The “IT-Services” and “NON-IT Services” categories include expenditures associated with services such as temporary labor, equipment maintenance contracts, and goods purchased within those service contracts. Depending on the purchasing agency, the amount of a service contract that can be used to purchase goods may vary.

Figure 2. Expenditures for Goods and Services (2012)



As shown in Figure 2, about 10% of the expenditures in 2012 were used to purchase goods. However, that percentage is likely much greater since goods purchases are

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also included in the services expenditures which account for about 90% of the total expenditures in 2012. Agencies with delegated and/or statutory purchasing authority may purchase goods and services independently, including through service contracts. Service contracts can include up to 40% being spent on goods (unless the agency has its own delegation, such as Caltrans, in which case the 40% maximum does not apply).

NON-IT Services categories comprise the largest percentage of annual expenditures and, given that 40% or more of these expenditures could potentially be used to purchase goods, it is a category that deserves additional investigation to determine if there are opportunities for increasing the purchases of environmentally preferable and PCRC products.³⁴ In addition, major services areas such as Health Care Services and Education and Training Services are potential targets for further investigation because together they account for almost \$8 billion in total purchasing.

SCPRS also provides information regarding the purchases by individual State agencies. The SCPRS data reported for 2012 indicates that State agencies with the highest purchases of goods and services are as follows:

- Department of Public Health \$4.3 billion
- Department of Social Services \$1.9 billion
- Caltrans \$1 billion
- Correctional Health Care Services \$687 million
- Department of Water Resources \$650 million
- Department of Corrections and Rehabilitation \$601 million
- Employment Development Department \$558 million
- State Hospitals \$553 million
- Department of Health Care Services \$504 million
- Energy Commission \$285 million

Analysis of SABRC Data

The SABRC is a joint effort between CalRecycle and DGS to implement State law requiring State agencies and the Legislature to purchase post-consumer recycled content products. SABRC includes purchasing and reporting requirements for 11 broad recycled-content product categories. For each of these products, minimum recycled content specifications have been established. It should be noted that there are major categories of products included in SCPRS that are not under the scope of the SABRC program (e.g., lumber, textiles, and concrete). This is reflected in a comparison between the total SABRC expenditures and those reported to SCPRS. As a result, total SABRC reporting of \$185 million is dwarfed by data in SCPRS, indicating that goods purchases alone are about \$1.5 billion. However, within individual categories such as “printing and writing papers”, SABRC reports higher numbers. This may be due to

³⁴ Available data does not allow delineation of how much of service contract funding is spent on goods. It is difficult to identify areas with the most expenditure on goods, as service categories appear to cover a wide array of activities (medical supplies, training, delivery, maintenance, furnishings, food services, foster care services, public safety, etc.).

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several factors: inconsistencies in choosing the category in which to report purchases by staff entering the data, different category definitions between the two data systems, and the limitation that SCPRS reporting is voluntary under \$5,000 (e.g., a large portion of paper procurement may be under this level).

Across the 11 products under SABRC, there is a wide range of compliance with the SABRC specifications.³⁵ For some categories, the percent of purchases compliant with the SABRC specifications is very high, over 85% for compost, co-compost and mulch, and metal products. For others, there is room for improvement. For example, only 7% of the reported antifreeze purchases are compliant with the SABRC specifications. Improvement in the program can also be made by modifying the recycled content requirements. An example of where this could provide additional benefits for printing and writing paper is provided in a case study in Appendix 2. Additional categories such as concrete, carpet, and lumber could be incorporated into the program. Finally, products that are purchased through service contracts or through non-Statewide contracts could be better incorporated into the SABRC program. Currently, it appears that SABRC accounts for less than 8% of State product purchases.

Table 2: Total SABRC reported purchases, Fiscal Year 2011-2012

Product Category	Total SABRC Reportable Dollars	Total SABRC Compliant Dollars	% SABRC Compliant Spending	No. of Agencies Reporting in each Category
Antifreeze	239,900	18,255	7%	37
Compost, Co-compost Mulch	1,930,803	1,896,039	98%	39
Glass Products	1,557,086	929,060	59%	76
Lubricating Oils	1,605,676	743,859	46%	77
Metal Products	96,413,159	83,289,646	86%	168
Paint	935,361	113,949	12%	89
Paper Products	19,264,038	11,092,601	57%	192
Plastic Products	22,075,743	12,037,875	54%	190
Printing and Writing Paper	29,384,140	17,226,378	58%	201
Tire-derived Products	1,774,310	1,393,552	78%	41
Tires	9,976,596	1,157,368	11%	77
Totals	185,156,812	129,898,582	70%	201

³⁵ Reporting agencies indicate that recycled antifreeze is hard to find and agencies cannot control the choice of products sold or used by vendors with which they contract. Also, in some cases, state cars are sold before antifreeze needs to be changed out as many manufacturers recommend 100,000 miles for antifreeze change-out.

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Related Procurement Activities

There are several activities underway to improve upon the SABRC and EPP programs, reduce GHG emissions, or improve the tracking of purchases. These are discussed below.

Many State agencies have delegated purchasing authority, under which they have the discretion to purchase on their own behalf without using DGS Statewide contracts developed under the EPP program. DGS is considering implementation of a new procedure that includes SABRC compliance checks during the annual certification and renewal of each agency's delegated authority. Based on informal discussions to date, this could result in a modification to DGS's annual determination regarding State agencies' delegated purchasing authority, whereby DGS would inform a non-compliant agency that it needs to meet the minimum SABRC requirements. This could also lead to a requirement of additional assistance and training for that agency.

CalRecycle also has been working to incorporate SABRC categories and reporting into the Financial Information System for California (FI\$Cal), which is intended to enable the State of California to combine accounting, budgeting, cash management, and procurement operations into a single financial management system. In March 2013, the FI\$Cal team notified CalRecycle that SABRC requirements will be included within the FI\$Cal system, of which the first phase is scheduled for testing in 2014. The FI\$Cal team also approved the inclusion of 7 product categories (carpet, vehicles, mulch, open panel office systems, janitorial paper supplies, IT equipment, and printer/duplication cartridges) in addition to the 11 existing SABRC product categories.

DGS has taken active steps related to vehicle procurement. It implemented Executive Order S-14-09, which required all State agencies and departments (agencies) to reduce their motor vehicle fleets by 15 percent and reduce take home vehicle storage permits by 20 percent. As of the July 2010 Report³⁶, agencies subject to the Executive Order have reduced their fleets by 23 percent and reduced greenhouse gases by 3,744 to 20,577 tons per year; reduced fuel consumption by over 10 percent; and increased procurement of alternative fuels. In addition, the DGS Office of Fleet and Asset Management created a Petroleum Reduction Advisory Committee to develop a plan outlined in AB 236 (Chapter 593, Statutes of 2007). DGS has compiled resulting fuel data in its 2012 Progress Report for Reducing or Displacing the Consumption of Petroleum Products by the State Fleet.³⁷ Another DGS program that results in reduced GHG through energy savings is the DGS Green Building Action Plan required by Executive Order B-18-12.

DGS's Procurement Division also offers frequent EPP training for State procurement officials through its California Procurement and Contracting Academy (Cal-PCA). In collaboration with CalRecycle, annual revisions to the Basic Acquisition training course

³⁶ <http://www.documents.dgs.ca.gov/ofa/FleetReduction/FleetReduction-FinalReport-July2010.pdf>

³⁷ [http://www.documents.dgs.ca.gov/ofa/ab236/PetroleumReductionStatusReport\(RevMay2012\).pdf](http://www.documents.dgs.ca.gov/ofa/ab236/PetroleumReductionStatusReport(RevMay2012).pdf)

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incorporate SABRC updates. DGS's longer-term plan is to convert the course and deliver EPP training as a webinar to increase attendance by State procurement staff.

In 2013, DGS re-convened the previous EPP Taskforce (which functioned from 2002 to 2009) in the form of the Performance and Environmental Standards (PES) workgroup in order to assist procurement professionals in improving policies and practices in order to achieve best value procurements. The workgroup consists of a majority of the State's environmental agencies and other State agencies with significant procurement expenditures, including those with delegated authority. The group will help ensure that EPP initiatives are consistent with the efforts and initiatives of the other environmental agencies through the State. Key goals of the PES are to:

- Provide guidance and assist procurement professionals in achieving best value, thereby reducing risk to procurement audits.
- Reduce risk in the procurement process: cost, processing time and protests.
- Create a transparent process and central clearing house for standards development.
- Increase the State's purchase of products lowering the State's carbon footprint.
- Provide a means of coordination with other State and federal agencies programs and work groups involving regulatory, research, and data collection efforts.
- Introduce policy in the State Contracting Manual.

III. CHALLENGES

Clearly, there are additional opportunities to increase the procurement of environmentally preferable and post-consumer recycled content goods. Increasing compliance in SABRC product categories that have low compliance rates, adding new SABRC product categories, increasing the recycled content specifications, and targeting consumption of goods that are reported under the IT-Services category are a few examples of actions that can be undertaken that will help further progress in meeting the State's GHG emission reduction and increased recycling goals. However, there are several challenges/issues that need to be addressed to facilitate implementation of these opportunities which are briefly described below.

1. **Data Gaps:** There are several issues with how data is reported and recorded which makes it difficult to track the volumes and types of goods purchases. For example, product purchases under construction and service contracts can be aggregated, not allowing for tracking of individual products; service contracts are not required to delineate monies expended on goods; little information is available on what is purchased through delegated authority versus through a DGS-developed State contract; State contractors do not necessarily purchase, or report on purchases of recycled-content goods; and the product categories in SCPRS generally do not distinguish the materials composition of products and/or their packaging, which makes it more difficult to determine potential GHG emissions associated with the categories.

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2. **SABRC Statutory Provisions:** SABRC does not cover all products with recycling (AB 341) or GHG (AB 32) implications (such as lumber, textiles, carpet, and concrete), the minimum PCRC percentages are outdated in some categories, and some categories include mixed materials that cause difficulties in reporting. Community Colleges and the University of California system are not included.³⁸ In addition, there is no enforcement mechanism for non-compliance.
3. **State Contractors:** State contractors and their subcontractors, including those on service contracts, are required to use recycled products to the maximum extent economically feasible in the performance of the contract work. According to General Contract Agreements, State contractors are required to report³⁹ on the recycled content of goods offered or sold to the State. However, State contractors are not required to meet the same purchasing requirements as are State agencies (e.g., SABRC). These requirements are generally not implemented, there is no clear reporting mechanism, and it is unclear if the requirement applies to subcontractors.
 - DGS Procurement Division develops specifications/contracts for products having a Statewide contract and the Green Buying Guide hosts information on Statewide contracts that have incorporated EPP. Additionally, there are many other products that are used in State facilities and are purchased through service providers/contracts. For example, paint, carpet, and many building materials are not purchased off of statewide contracts, but rather are purchased through individual construction-related service contracts via DGS-Real Estate Services Division, other DGS entities, and delegated agencies. Building contractors cannot purchase off statewide contracts so these types of purchases are not directly impacted by the EPP statewide contracts and these contractors may or may not be including language in their solicitations that is consistent with EPP.
4. **Delegated Authority:** As noted above, many State agencies have delegated purchasing authority, under which they have the discretion to purchase from a wide variety of purchasing mechanisms. While State agencies are required to adhere to SABRC requirements regardless of the procurement mechanism used or who conducts the purchase, it is not clear if these delegated decisions adhere to SABRC requirements, including reporting, and there is no enforcement mechanism for non-compliance with the SABRC requirements.
5. **Reporting Issues:** There is potentially under-reporting of purchases in SABRC and different reporting requirements between the SABRC and the SCPRS databases. It is not clear whether all agencies purchasing off of State contracts provide that data to both SCPRS and SABRC. SCPRS has only one data field to list the United Nations Standard Products and Services Code (UNSPSC) code, which is used to identify specific products and services, so when an order contains many products, the UNSPSC code is more difficult to decipher and include in the analysis (this covers about \$850 million of purchases). There is also a lack of reporting requirements (e.g., see “State Contractors” above).
6. **Verification of PCRC:** There is no system to track that all State agencies are requiring suppliers to verify the PCRC of their products and there is not an enforceable requirement on suppliers to provide the verification for their products.

³⁸ Local jurisdictions also are not required to meet the same PCRC/EPP purchasing requirements.

³⁹ Excluding interagency agreements

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7. **Lack of Product Information:** Manufacturers and suppliers are not consistently required to disclose their products' environmental information so that specification writers, contract managers, and buyers would have readily available access to basic information on environmental performance.
8. **Cost of Recycled Content Products:** In some cases, recycled-content products may cost more than virgin and, in these cases, many employees are unaware that the recycled content products may still be purchased. Statute directs State agencies and the Legislature to purchase fewer of those more costly products or apply cost savings, if any, gained from buying other recycled products towards the purchase of those more costly products (Public Resources Code Sections 12217 and 12305.5.)
9. **Need for Additional Education:** There continues to be a need for education that reaches all State agency purchasing officials, but it also needs to go beyond and reach staff within agencies that do the ordering of materials.
10. **Emission Reduction Factors:** There is a need to develop additional emission reduction factors for key products and product categories to assist in defining GHG emission reductions associated with procurement of EPP and PCRC products.
11. **Competing Priorities:** This paper focuses on waste and GHG reductions opportunities that could be achieved through State purchasing decisions made by all State agencies and their contractors. ARB and CalRecycle acknowledge that other statutory and policy requirements regarding State purchasing may sometimes conflict or compete with these waste and GHG reduction goals, particularly with respect to environmentally preferable purchasing contracts generated by DGS. At this time, it is unclear how great an impact competing requirements might have on State purchasing to help achieve the State's waste and GHG reduction goals.

IV. POTENTIAL OPPORTUNITIES FOR SUPPORTING WASTE REDUCTION AND ACHIEVING GREENHOUSE GAS EMISSIONS REDUCTIONS THROUGH STATE PROCUREMENT

Based on the analysis of the SCPRS and SABRC data and the large volume of goods purchased for State operations, there is the potential to further leverage procurement decisions to support the State's broader waste reduction and climate change goals by increasing the procurement of environmentally preferable and post-consumer recycled content goods. However, without improved data on goods purchasing it is difficult to pinpoint what goods to target and what is the best mechanism to realize the needed changes in procurement practices. Below, we outline actions and a process for identifying a feasible path forward to capture potential opportunities for waste reduction and GHG emission reductions. While there are multiple factors and requirements that need to be addressed in purchasing decisions and these cannot be ignored, the focus in the discussion below is limited to potential waste and GHG reductions.

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- **Improve Goods Procurement Data Collection and Reporting**

Data gaps need to be addressed through improvements in current reporting of goods purchased such that individual product types and amounts can be tracked by purchasing agency. Data is needed for goods purchased under delegated authority and within service contracts. This may require statutory or regulatory actions.

- **Identify High Volume Product (Goods) Categories and Associated State Agencies/Contractors/Subcontractors with Greatest Potential for Waste/GHG Reductions**

Data analysis needs to be completed once a complete data set is available. There are hundreds of different product types purchased by State agencies or indirectly through contractors and subcontractors, and it is important to determine which products have the most potential for waste reduction and GHG emission reductions so those products and their purchasers can be targeted for further evaluation. As an initial prioritization of products, agencies, or processes with opportunities for waste reduction and GHG emission reductions, SCPRS data was used as a preliminary step to identify potential future focus areas. A total of 17 products were identified and categorized into two tiers. Ten products were identified as Tier 1 categories and are considered to be a higher priority based on synergism with other waste reduction goals, the contribution to waste disposal in California, and the availability of options for reducing waste and GHG emissions. Seven products were categorized as Tier 2 and initially given lower priority than the Tier 1 products. Table 3 lists the Tier 1 and 2 products.

Table 3: Priority Products for Evaluation with Potential for Waste and GHG Reductions

Tier 1 Product Categories		Tier 2 Product Categories
Food	Plastic Food Containers	Rock, Soil and Fines
Lumber (dimensional, engineered, pallets, plywood)	Durable and Miscellaneous Plastic Items	Mattresses
Concrete and Asphalt	Textiles (towels, sheets, uniforms, etc.)	Paper Towels, Toilet Paper
Paint		Computers, Printers, Monitors
Carpet		Batteries
Copy Paper		Photovoltaic Products
Compost and Mulch		Lubricating Oils

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Appendix 1: *State Purchases: AB32 Potential Opportunities for Waste Reduction and Greenhouse Gas Emissions Reductions*—is an initial attempt to provide an overview of State purchasing of Tier 1 and 2 materials. Appendix 1, summarizing the Tier 1 and 2 product categories purchased by State agencies, explains why a particular product category is important from a waste/GHG perspective, identifies the amount spent on products and services for a representative year (2012), and shows the agencies making most of the purchases in the category. The information presented in Appendix 1 was developed using publically available information from the SABRC and SCPRS databases. The data presented in the Appendix 1 table is incomplete, however does provide a starting point to help facilitate further discussions on products where procurement practices and the end-of-life management of products may offer opportunities for increasing recycling and reducing GHG emissions. This information should be considered to be a “living document” and will be refined as improved data becomes available. The Appendix 1 summary table also includes some smaller agencies that are not necessarily major purchasing entities, but may purchase significant amounts of a products identified in Tier 1 or Tier 2. These smaller entities include: California Conservation Corp, California Highway Patrol, CalRecycle, Department of Forestry and Fire Protection, Department of Mental Health, Department of Parks and Recreation, Department of Fish and Game, and the Military Department. An example of this is the Department of Parks and Recreation purchasing of compost and mulch. While the dollar amount of the purchases is relatively small, they are the second largest purchaser of these materials.

- **Legislative and/or regulatory changes may be needed.**

Legislation and/or regulations may be needed in order to affect identified reporting improvements and purchasing requirements.

- **Develop Waste and GHG Emission Reduction Factors**

Having the tools to quantify waste and GHG emission reductions associated with changes in procurement practices is critical to prioritizing actions and tracking progress in achieving California’s overall waste and GHG reduction goals. For products targeted for evaluation, lifecycle GHG emission reduction factors and waste reduction factors will need to be developed or updated. ARB, CalRecycle and DGS need to work together to prioritize where development of waste and emission reduction factors is most critical.

- **Identify and Implement Effective Approaches to Achieve Waste/GHG Reductions for Targeted Products**

For each targeted product, there is a need to identify potential options for adjusting or modifying procurement practices to enhance waste and GHG reductions goals. Options could include educational outreach/incentive programs, steps to improve compliance for products already having SABRC specifications, creating SABRC requirements and supporting specifications for new products, improving SABRC and SCPRS database

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interaction, increasing the recycled content specifications, development of mandates to ensure purchases by State agencies with delegated purchasing authority and those products purchased under service contract adhere to SABRC requirements.

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APPENDIX 1. State Purchases: AB32 Potential Opportunities for Waste Reduction and Greenhouse Gas Emissions Reductions

This table is intended to help facilitate further discussion among ARB/CalRecycle/DGS and others on commodities where procurement practices and the end of life management of products may offer opportunities for waste and GHG emission reductions. It lists various commodities typically purchased by the State, explains why a particular product category is important from a waste/GHG perspective, identifies the amount spent on products and services for a representative year (2012), and shows the agencies doing the most purchasing. The table also flags gaps in our knowledge that are represented by missing information on total spent. As a first step to prioritize the list of commodities, commodities are separated into two tiers. Tier 1 commodities are considered to be a higher priority based on synergism with other waste reduction goals, the contribution to waste disposal in California, and the availability of options for reducing waste and GHG emissions.

Purchased commodities or services	Why Important?	Total Spent (2012) ⁴⁰ SCPRS data	Key Purchasing Agencies						
			Cal-Trans	CDCR	DGS	Parks & Rec	Water Resources	Other	
Tier 1									
Food	<ul style="list-style-type: none"> Food waste is 15.5% of disposal (highest category) Generates methane USEPA has identified several food categories as having high material impacts and GHG impacts 	>\$118 million		>\$100 million Purchases through DGS/PD contracts					Other top food purchasers are: Dept of Forestry and Fire Protection (est \$6 million), Dept of State Hospitals (est \$4 million) and Dept of Mental Health (est \$3.5 million).
Lumber	<ul style="list-style-type: none"> Clean dimensional lumber, 	>\$3 million ⁴¹	>\$2.5 million	>130K	Indirect purchases				

⁴⁰ Overall, the data reported will be less than actual purchases. SCPRS reporting for purchases under \$5K is optional. Additionally, the total spent presented will be under reported because of how purchases or services are coded. If the data field for the UNSPSC code contained multiple entries some of these line items are not included in the analysis because it was not possible to match a code with a commodity.

⁴¹ Also purchased through construction projects, which may not be accounted for in this analysis.

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Purchased commodities or services	Why Important?	Total Spent (2012) ⁴⁰ SCPRS data	Key Purchasing Agencies					
			Cal-Trans	CDCR	DGS	Parks & Rec	Water Resources	Other
(dimensional, engineered, pallets, plywood)	<p>engineered lumber, and wood pallets are each > 2.5% of disposal</p> <ul style="list-style-type: none"> Generates methane Forest carbon sequestration is reduced when harvesting trees to produce wood products, resulting in significant GHG impact 				through construction contracts			
Concrete and Asphalt	<ul style="list-style-type: none"> High GHG impacts in production of cement that is used in concrete. Waste concrete composes greater than 1% of CA disposal On USEPA list of having high materials and GHG impacts Rubberized asphalt concrete uses waste tires and is an road surface alternative with lower GHG 	>\$4.3 million for concrete; >\$33 million for asphalt ⁴²	Purchases millions of dollars of construction services (\$2,854 million in 2009-June 2011) for transportation infrastructure (not including federal funds which were significantly more)	Purchases millions of dollars of construction services (planning for \$2,811 million in over 300 projects)	(K-12 education follows transportation in terms of construction dollars – overseen by the Div of the State Architect in DGS)		Purchases millions of dollars of construction services (\$63 million in 2010/ 2011) for levees and State water system.	CalRecycle >\$1.8 million of asphalt
Paint	<ul style="list-style-type: none"> Paint is a HHW, banned from disposal SABRC category (not compliant with targets) Certified product is available with post-consumer recycled content that meets performance standards of virgin paint Statewide collection program recently started that will generate more recycled paint Recycled paint provides GHG reduction over virgin paint 	> \$ 3 million ⁴³	>\$2.5 million		Indirect purchases through construction contracts		>\$100K	
Carpet	<ul style="list-style-type: none"> Discarded carpet comprises 3.2% of CA disposal Use of recycled plastics from carpet 	>\$800K ⁴⁴	>\$350K		Indirect purchases through construction			Employment Development

⁴² Also purchased through construction projects, which may not be accounted for in this analysis.

⁴³ Also purchased through \$160 million spent on building construction.

⁴⁴ Also purchased through \$160 million spent on building construction.

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Purchased commodities or services	Why Important?	Total Spent (2012) ⁴⁰ SCPRS data	Key Purchasing Agencies					
			Cal-Trans	CDCR	DGS	Parks & Rec	Water Resources	Other
	into new products significantly reduces GHG				contracts			nt Dept >\$300K
Copy paper	<ul style="list-style-type: none"> White ledger paper and office paper are 1.9% of CA disposal. Paper with higher post-consumer recycled content (PCRC) that offers additional GHG savings. Paper is widely used in State government facilities. 	>\$5.5 million copier paper ⁴⁵ >\$65 million various types of paper		>\$1 million Purchases the highest quantity via Statewide contract				Employment Development Dept (EDD) >\$1.3 million, CHP >\$300K, DMV >\$300K
Compost and Mulch	<ul style="list-style-type: none"> Commonly composted items like leaves and grass, and pruning and trimmings comprise 6.5 % of disposal in CA. Also food waste, much of which is compostable, comprises 15.5% of disposal in CA. Compost reduces GHG through avoided landfill methane emissions and improved soil quality that reduces water consumption and use of herbicides/pesticides/fertilizers. Opportunities exist to purchase landscaping plants that generate less debris and support markets for compost. 	>\$10 million	>\$10 million Purchases the most mulch/compost; large purchases likely within construction contracts		Large purchases likely within construction contracts	>\$125K		>\$90K California Conservation Corp
Plastic food containers	<ul style="list-style-type: none"> Estimated to comprise more than 1% of disposal in CA and is associated with food purchases, which are very significant State purchases. When plastic packaging is recycled or food has a longer shelf-life, there are GHG reductions. 							
Durable and	<ul style="list-style-type: none"> Comprise 1.9% of disposal in CA. 		80% of total	80% of total	Large purchases			

⁴⁵ This is likely lower than that actual amount. SCPRS only requires data on purchases over \$5K. Paper purchases may fall below this amount and not be included. Or they may be included with other office supplies and not accounted for in this analysis.

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Purchased commodities or services	Why Important?	Total Spent (2012) ⁴⁰ SCPRS data	Key Purchasing Agencies					
			Cal-Trans	CDCR	DGS	Parks & Rec	Water Resources	Other
misc. plastic items	<ul style="list-style-type: none"> Recycled plastic products provide reduction in GHG emissions and close the loop that makes recycling viable. Some recycled plastic products may replace a material, such as wood, and provide GHG reduction and close a loop for plastics recycling. If not recyclable (unable to be disassembled, lack of labeling that identifies resins), standards could be created to make recycling more feasible. 		spend for plastic is attributed to plastic bags between 2009-2013 per eSCPRS report. Caltrans purchasing 15% of the bags.	spend for plastic is attributed to plastic bags between 2009-2013 per eSCPRS report. CDCR purchases 21% of the bags.	likely within construction contracts			
Textiles (towels, sheets, uniforms, etc.)	<ul style="list-style-type: none"> Textiles are 2.2% of disposal in CA. Towels, linens, uniforms, blankets, safety apparel, etc. are purchased by the State in significant amounts. More durable textiles and recycling these materials can reduce GHG emissions. 	>\$20 million	>\$ 5 million	>\$ 10 million				> \$2.5 million Military Dept
Tier 2								
Rock, soil and fines	<ul style="list-style-type: none"> Comprises 3.2% of CA disposal. The extraction of these materials uses a lot of energy (GHG) Alternatives materials exist that reduce the need for virgin materials 	>\$2.5 million ⁴⁶	>\$1.8 million Caltrans likely purchases under A&E contracts as well		Large purchases likely within construction contracts		DWR likely purchases under A&E contracts	
Mattresses	<ul style="list-style-type: none"> Mattresses are a portion of bulky items that comprise 3.5% of disposal. 85% of mattresses (by weight) can be readily reprocessed into useful secondary resources. Material recycling is estimated to offset 45% of GHG emissions from production and landfill of mattresses and box springs. Recycling is currently low. 	>\$1.7 million		>\$1.3 million				>\$100K Dept of State Hospitals, >\$100K Dept of Mental Health

⁴⁶ Many purchases are likely made through construction related contracts and are not accounted for in the totals.

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Purchased commodities or services	Why Important?	Total Spent (2012) ⁴⁰	Key Purchasing Agencies					
			SCPRS data	Cal-Trans	CDCR	DGS	Parks & Rec	Water Resources
Paper towels, toilet paper	<ul style="list-style-type: none"> Misc. paper is more than 2.8% of CA disposal (there isn't a category for janitorial papers). Janitorial papers are very suitable for high PCRC (well above the 30% specified in the SABRC category for all paper products). Currently there doesn't appear to be a State contract or standards in place for these products to help ensure they are purchased with high PCRC. 	>\$6 million		>\$3.6 million	\$1 million (DGS)			>\$350K State Hospitals
Computers, printers, monitors	<ul style="list-style-type: none"> Computers, printers, monitors are a very significant category of expenditure by State agencies. These materials are banned from landfill disposal due to their toxic components. As a large purchaser, the State is able to foster advancements in sustainability. Use of recycled content materials reduces GHG emissions and recycling these products saves rare earth metals. 	>\$62 million	>\$15 million	>\$3.2 million			>\$3.2 million	>\$5.4 million CHP >\$4.2 million Correctional Health Care Services
Batteries	<ul style="list-style-type: none"> Batteries are banned from landfill disposal in CA, but are still disposed. More products (e.g., bathroom fixtures, power tools, small electrical devices) use batteries so their use increases. GHG emissions can be reduced through the selection of longer lasting batteries. There are a few eco-labels that cover batteries (e.g. Nordic Swan). 	>\$1.6 million ⁴⁷	>\$400K	>\$500K	>\$86K		>\$82K	>\$164,816 Correctional Health Care Services >\$62K CHP
Photovoltaic products	<ul style="list-style-type: none"> Many State facilities are installing PVs have hazardous components and are banned from landfill 	>\$1.3 million	>\$400K	>\$130K		>\$300K		>\$150K State Hospitals

⁴⁷ Many batteries are purchased with other supplies and not included in analysis.

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Purchased commodities or services	Why Important?	Total Spent (2012) ⁴⁰ SCPRS data	Key Purchasing Agencies					
			Cal-Trans	CDCR	DGS	Parks & Rec	Water Resources	Other
	disposal (a type of electronic waste). <ul style="list-style-type: none"> • Policies can reduce the future burden of managing these products. • Similar to other electronic products, recycled content and recyclable products will reduce GHG emissions and provide for the capture of rare earth metals. 							>\$115 Fish and Game
Lubricating Oils	<ul style="list-style-type: none"> • Recycled used motor oil is a SABRC product category with non-compliance participation rates (46%). • Purchasing recycled used motor oil supports recycling and has lower GHG emissions as compared to virgin motor oil. • 29 % of total spend for lubricating oil products are attributed to fuel oil, 24% pump lubricating oils, 16% engine oil and less than 3% synthetic oils between 2009-2013. 	>\$380K ⁴⁸	Caltrans purchases <2% of engine oil	>\$95K			>\$100K	>\$128K CHP

⁴⁸ Lubricating oils are probably part of maintenance services and do not appear in this value. The SABRC programs indicate \$1.6 million spent on this category.

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APPENDIX 2. CASE STUDY – CURRENT PRINTING AND WRITING PAPER PROCUREMENT AND GHG EMISSIONS

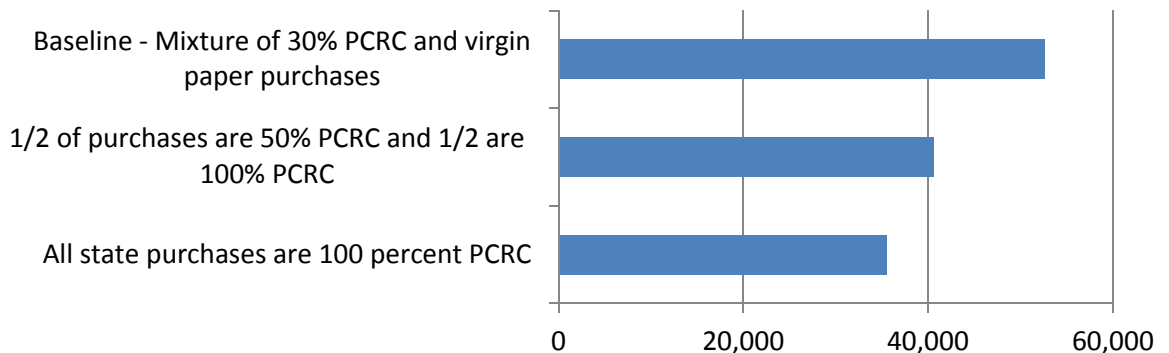
The following case study, using printing and writing paper as one example, is provided to illustrate how a change in the State’s procurement practices can result in GHG emission reductions and increased market demand for recycled content materials. Although this case study is focused on printing and writing paper procurement for illustrative purposes, CalRecycle’s procurement goals are not limited to this particular product type, and CalRecycle is committed to promoting the procurement of higher PCRC in other products, including all of the product types in the SABRC program.

According to SABRC, the State spent \$29 million in 2011 on printing and writing paper procurement, of which only \$17 million (approximately 366,750 cases) was spent on SABRC-compliant paper (at least 30% post-consumer recycled content (PCRC), see Table 3)⁴⁹. If the State increases procurement of printing and writing paper that has a higher percentage of PCRC, it will realize a reduction in the carbon footprint of State’s paper procurement, as shown in Chart 3.

Table 3. SABRC Data for Printing and Writing Paper, from fiscal year 2011-2012

Total SABRC Reportable Dollars (Million \$)	Total SABRC Compliant ¹ Dollars (Million \$)	Non-Compliant ¹ Expenditures Dollars (Million \$)
29.4	17.2	12.2
1. * “Compliant” refers to the paper having at least 30% post-consumer recycled content (PCRC)		

Chart 3 - State Writing and Printing Paper Purchases, Metric Tons CO2 Equivalent (2011)



⁴⁹ Once FISCAL is operating, state agencies will have increased abilities to report specific PCRC levels which should result in improved reporting and enable better estimates of GHG emissions from the State’s procurement.

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Business as Usual Paper Procurement GHG Emissions

Based on the 2011 SABRC data, 9,169 tons of noncompliant paper and 12,991 tons of compliant, minimum 30% PCRC, paper was purchased. The GHG emissions associated with the 2011 paper procurement are approximately 52,646 MTCO_{2e}.

Potential GHG Emission Reductions from changes in Paper Procurement

Scenario 1: If half of all State agencies' copy paper purchases contain 50% PCRC and half of the purchases contain 100% PCRC, the total estimated GHG emissions would be 40,709 MTCO_{2e}. This represents a 23% reduction in GHG emissions (11,937 MTCO_{2e}) from the emissions associated with the State's paper procurement in 2011, and would result in market demand for approximately 12,000 tons of recycled feedstock. This is equivalent to 1,360,766 gallons of gasoline saved⁵⁰. This scenario, which would increase market demand for recycled content fiber, illustrates how a change in the State's procurement practices can result in GHG emission reductions.

Scenario 2: If all State agencies copy paper purchases contain 100% PCRC, the total estimated GHG emissions would be 35,512 MTCO_{2e}. This represents a 33% reduction in GHG emissions (17,133 MTCO_{2e}) from the emissions associated with the State's paper procurement in 2011, and would result in market demand for approximately 18,000 tons of recycled feedstock. . This is equivalent to 1,953,187 gallons of gasoline saved⁵¹. This scenario, which also would increase market demand for recycled content fiber, illustrates how a change in the State's copy paper procurement practices can result in GHG emission reductions.

⁵⁰ <http://www.arb.ca.gov/cc/factsheets/1mmtconversion.pdf>

⁵¹ <http://www.arb.ca.gov/cc/factsheets/1mmtconversion.pdf>

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Table 4 contains a list of agencies or departments that have the greatest opportunity to reduce GHG emissions from paper procurement based on the volume of non-compliant paper procurement.

Table 4. Top 15 State entities with the most non-compliant expenditures (printing and writing paper, fiscal year 2011-2012)

Department	Total SABRC Reportable Dollars (Million \$)	Total SABRC Compliant Dollars (Million \$)	% SABRC Compliant Spending	Non-compliant expenditures (e.g., virgin paper) (Million \$)
California State University Chancellor's Office	4.0	1.8	45%	2.2
Department of General Services	7.6	6.0	79%	1.6
Department of Justice	2.5	1.3	50%	1.3
State Controller's Office	2.0	0.8	42%	1.1
California Medical Facility	0.9	0.1	10%	0.8
California Highway Patrol	0.8	0.1	13%	0.7
Prison Industry Authority	0.6	0.05	8%	0.6
Department of Industrial Relations	1.3	0.8	61%	0.5
State Board of Equalization	0.6	0.3	47%	0.3
California State Library	0.3	0.007	2%	0.3
Valley State Prison for Women	0.3	0.1	34%	0.2
California Department of Transportation	0.7	0.5	75%	0.2
California Department of Consumer Affairs	0.3	0.2	58%	0.1
California Public Employees Retirement System	0.4	0.3	66%	0.1
Department of Motor Vehicles	0.8	0.7	85%	0.1

Another factor to take into consideration when identifying opportunities is where the largest amounts of goods or commodities are purchased. As noted earlier, total expenditures for a given commodity are not readily extractable from the publically available data. However, as a surrogate, one can assume that if an agency has high expenditures, there is a good possibility that a portion of monies is expended on goods. Below is a list of the top 15 State agencies purchasing copy paper based on the SCPRS report for 2012. The total among all agencies was \$5.7 million. (SCPRS reporting is optional for purchases less than \$5,000 so it doesn't include all purchases or purchases of copy paper captured in other categories). Differences appear

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which could be attributed to different years, different papers being included in categories, and missing purchasing information.

Table 5. Top Purchasers of Copy Paper, 2012 (SCPRS)

<u>Department</u>	<u>Total Spent Million \$</u>
Employment Development Department	\$1.3
Department of Corrections and Rehabilitation	\$1.0
California Highway Patrol	\$0.4
Department of Motor Vehicles	\$0.3
Department of Justice	\$0.3
Department of Transportation (Caltrans)	\$0.2
Department of Rehabilitation	\$0.2
Franchise Tax Board	\$0.2
Department of Industrial Relations	\$0.2
Board of Equalization	\$0.2
Department of Public Health	\$0.2
Air Resources Board	\$0.1
Paper Purchases Overall	

The total spent in the paper category in 2012 was about \$65 million among 42 agencies. Table 6 shows the agencies that spent the most on a broad range of papers. Paper-types include: copy paper, forms, books, and janitorial supplies. It does not include printing orders and newspaper ads, which are about \$19 million.

Table 6. Top Purchasers of Papers, 2012 (SCPRS)

<u>Department</u>	<u>Total Spent Million \$</u>
Department of Social Services	\$35.9
Department of General Services	\$10.1
Department of Corrections and Rehabilitation	\$5.6
Employment Development Department	\$1.6
California Victim Compensation and Government Claims Board	\$1.5
Correctional Health Care Services, formally (Prison Health Care Services)	\$1.2
California Highway Patrol	\$1.0
Department of Motor Vehicles	\$0.8
Franchise Tax Board	\$0.8
Department of Transportation(Caltrans)	\$0.7

Addressing Concerns with Purchasing PCRC Paper

One concern with purchasing high PCRC paper is the issue of cost. However, by purchasing through the State contract, the cost issue can be minimized. For example, State contract offers two levels of PCRC paper: Type I (30 - 50% PCRC) and Type II (95 - 100% PCRC). The contract prices for Type I paper are between \$26.14 and \$34.27 per case. The contract prices for Type II paper are between \$32.17 and \$47.72 per case. There are many options available

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for State agencies. For example, CalRecycle purchases 100% PCRC paper from the State contract for \$37.63 per case.

Although high PCRC paper products may be more costly than virgin products in some cases, there are also examples demonstrating that purchasing paper with high PCRC can be more cost-effective. In cases where high PCRC paper products are more expensive than similar virgin paper products, the State still encourages buying recycled. CA Public Contract Code 12217(c) states that, "If a recycled product, as defined in subdivision (h) of Section 12200, costs more than the same product made with virgin material, the State agency shall, if feasible, purchase fewer of those more costly products or apply the cost savings, if any, gained from buying other recycled products towards the purchase of those more costly products to meet the solid waste diversion goals of Section 41780." By purchasing high PCRC paper products, State agencies have the opportunity to save money while also reducing GHG emissions.

Another concern with purchasing paper with high PCRC is the transportation of recovered paper to mills. While it is important to minimize transportation, both upstream and downstream, in all aspects of the paper product industry, literature suggests that Life Cycle Analysis (LCA) studies show that even after the energy used to collect, transport, and process recovered paper is accounted for, recycled paper uses much less energy overall than virgin paper ([Environmental Paper Network](#), 2013).

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BIOMASS CONVERSION January 2014

I. INTRODUCTION

The primary focus of this paper is to identify opportunities, challenges, and potential solutions for achieving greenhouse gas (GHG) and waste reduction goals from biomass conversion facilities in California. This paper focuses primarily on biomass combustion facilities, because these plants are numerous and well established in California. However, there are a few small gasification plants, and these may be a growing option for handling biomass in California. This paper does not cover other biomass conversion processes such as anaerobic digestion or fermentation, composting, trans-esterification, or rendering. This paper also does not address waste-to-energy facilities that handle only municipal solid waste (MSW).

The sections that follow describe the biomass conversion process, feedstocks, current utilization of biomass in California, and the goals, challenges, and potential solutions for achieving additional reductions in GHG emissions and waste through the use of biomass conversion facilities. This paper is one of several papers being prepared to provide information on the role that the Waste Sector can play in meeting the goals of AB 32 and waste reduction. Companion papers discuss Recycling, Reuse, and Remanufacturing; Composting and Anaerobic Digestion; Municipal Solid Waste Thermal Technologies; and Landfilling of Waste.

II. GENERAL DESCRIPTION OF THE BIOMASS CONVERSION PROCESSES AND FACILITIES IN CALIFORNIA

What is biomass conversion?

Biomass conversion is the process of generating energy by converting materials of recent biological origin, such as wood waste, to energy. Typically, biomass conversion is used to generate electricity for sale to the local utility. Biomass conversion can also produce marketable products such as fly ash used in cement manufacturing.

There are many benefits to the conversion of biomass, including reducing the volume of material that is landfilled, reducing forest fire hazards, generating renewable power, creating jobs, and reducing GHG emissions.

What types of biomass are available for conversion?

As mentioned above, biomass is material of recent biological origin. Included are materials such as forest and agricultural residues, but not materials like natural gas, oil, or coal. The main feedstocks for biomass conversion are forest residues, agricultural waste, and urban wood waste. Table 1 below provides an estimate of the amount each feedstock, measured in terms of the energy content in the feedstock. As shown in

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Table 1, each of these biomass types is used in significant quantities. Many biomass conversion facilities use more than one of these types of biomass as a feedstock. Some plants also use a small amount of supplemental fossil fuel.

Table 1: Biomass Use in California by Energy Content (2011)¹

Biomass Type	Energy Content (mm BTU)	Percentage
Agricultural Waste	19,000,000	28%
Forest Wood Waste	24,000,000	36%
Urban Wood Waste	24,000,000	36%
Total	67,000,000	100%

¹ California Energy Commission

Agricultural waste includes orchard prunings, nut shells, fruit pits, grain straw, and other agricultural waste products. Forest wood waste typically includes undergrowth from forest thinning or logging, and sawmill waste such as bark, sawdust, shavings, and trimmings. Urban wood waste includes lumber from construction and demolition, wood, crop residues, yard and garden clippings, prunings and nonrecyclable pulp or nonrecyclable paper. Biomass does not include recyclable pulp, recyclable paper or hazardous materials such as treated wood waste as defined by the Department of Toxic Substance Control (DTSC).

What biomass conversion systems are currently being used?

According to information from the California Biomass Collaborative, there were 22 biomass conversion (combustion) facilities in commercial operation in California in 2011 (see Table 2). However, the list is subject to frequent changes due to economic conditions. More recent information indicates that there are currently about 30 operational facilities. However, we do not have emissions information for these additional facilities (as shown in Table 3 for the 2011 facilities), so we used 2011 information for this paper.

Biomass conversion facilities are located throughout the state, often near timber harvest or agricultural operations. Most of these facilities were built in the 1980s or early 1990s, after the federal Public Utilities Regulatory Policy Act (PURPA) of 1978 required utilities to purchase power provided by qualifying independent power producers at relatively attractive rates. However, California's regulatory policies were restructured in 1996, decreasing the financial incentives available for biomass conversion facilities.

Biomass conversion facilities generally accept waste deliveries by truck and then move the feedstock with conveyors. In the boiler, the feedstock is burned and combustion gases flow past water tubes where steam is produced at high pressure. The steam is used to power a turbine-driven generator that produces electrical power that is sold to the local utility. The boiler combustion designs include "stoker" type furnaces with traveling or fixed (inclined) grates, and potentially more efficient circulating fluidized bed (CFB) designs. As shown, six of the facilities use cogeneration (cogen) systems which improve overall efficiency by recovering waste heat.

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Table 2: Operational Biomass Conversion Facilities in California¹

Facility Name	Location (City)	Electrical Capacity (MW)
Blue Lake Power	Blue Lake	11
Burney Forest Power	Burney	31
Collins Pine Co. Project	Chester	12 (cogen)
Colmac	Mecca	47
Delano Energy Co., Inc.	Delano	50
Dinuba Energy Inc.	Dinuba	12
Honey Lake Power	Wendel	32
Madera Power LLC	Firebaugh	28
Mendota Biomass Power Ltd.	Mendota	25
Pacific Oroville Power Inc.	Oroville	18
Pacific Ultrapower Chinese Station	Jamestown	22
Rio Bravo Fresno	Fresno	25
Rio Bravo Rocklin	Rocklin	25
Scotia Biomass	Scotia	28 (cogen)
Sierra Power Corporation	Terra Bella	10 (cogen)
Sierra Pacific Industries (SPI) Burney	Burney	20 (cogen)
SPI Anderson	Anderson	4 (cogen)
SPI Lincoln	Lincoln	18
SPI Quincy	Quincy	25 (cogen)
Wadham	Williams	27
Wheelabrator Shasta	Anderson	50
Woodland Biomass Power Ltd.	Woodland	25
Total		545

¹ Mayhead, Gareth, UC Berkeley, May 10, 2011

III. CURRENT STATUS OF BIOMASS CONVERSION FACILITIES IN CALIFORNIA

How much power is generated from biomass facilities in California?

According to the California Energy Commission (CEC), biomass-derived power provides about 2% of California's electricity demand, and about 19% of in-state produced renewable power. As shown in Table 2, the biomass facilities operating in 2011 had a net capacity to generate over 500 MW, with individual plants able to generate between 4 and 50 MW of electrical power. In addition to the facilities listed in Table 2, there are six idled facilities with the potential to generate an additional 90 MW (CEC PIER draft). The idled facilities are generally not operating because the price of electrical power received under their contracts with utilities is insufficient to justify operation. However, some of these plants could potentially be brought online in the future if governmental policies or other factors increase electricity rates for their power.

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How much GHGs and co-pollutants are emitted from biomass conversion facilities?

The 2011 reported GHG emissions from biomass conversion are shown in Table 3. Total GHG emissions are estimated to be 6.3 million metric tons of CO₂ equivalent (CO₂e) emissions. There is some uncertainty in these estimates because these facilities shutdown and restart relatively frequently based on economics and other factors. Of the total emissions, nearly all (6.2 million metric tons) were biomass-based. The distinction between biomass based (biogenic) and non-biomass based (non-biogenic) emissions is important because only the emissions from combustion of non-biogenic material (such fossil fuels) are counted as GHG emissions that contribute to climate change per protocols established by the Intergovernmental Panel on Climate Change (IPCC).

Table 3: GHG Emissions from Biomass Conversion Facilities in California (2011)¹

Facility Name	Biogenic Emissions (MT CO ₂ e)	Non-biogenic Emissions (MT CO ₂ e)	Total Emissions (MT CO ₂ e)
Blue Lake Power	18,200	400	18,600
Burney Forest Power	391,100	14,100	405,200
Collins Pine Co. Project	117,200	2,000	119,200
Colmac ²	516,100	16,200	532,300
Delano Energy Co., Inc.	630,400	3,400	633,800
Dinuba Energy Inc.	147,400	1,600	148,900
Honey Lake Power	226,100	6,400	232,500
Madera Power LLC	405,100	6,700	411,800
Mendota Biomass Power Ltd.	227,100	2,200	229,300
Pacific Oroville Power Inc.	256,800	600	257,400
Pacific Ultrapower Chinese Station	226,100	1,300	227,400
Rio Bravo Fresno	285,800	10,000	295,800
Rio Bravo Rocklin	289,700	9,300	299,000
Scotia Biomass/Eel River	265,200	5,600	270,800
Sierra Power Corporation	119,900	2,400	122,200
Sierra Pacific Industries Burney	223,300	2,800	228,100
SPI Anderson	69,900	0	69,900
SPI Lincoln	207,800	6,400	214,300
SPI Quincy	342,300	1,300	343,500
Wadham	269,900	3,700	273,600
Wheelabrator Shasta	684,100	15,000	699,100
Woodland Biomass Power Ltd.	252,400	6,400	258,800
Total	6,171,900	119,800	6,291,500

¹ ARB 2011 Greenhouse Gas Reporting Regulation.

² ARB 2009 data used. Colmac facility is on an Indian reservation.

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How much GHG emissions are avoided due to biomass conversion operations?

California biomass conversion operations result in net negative GHG emissions. While these facilities result in direct GHG emissions (mostly as carbon dioxide) when biomass is burned, the majority of these emissions are biogenic, and not counted as discussed above. In addition, these facilities produce electrical power that results in avoided utility emissions that would come mostly from the combustion of fossil fuels such as natural gas. Finally, biomass that is not combusted in a facility may otherwise be landfilled or “open” burned, resulting in more GHG and criteria pollutant emissions.

As shown in Table 4, preliminary estimates based on the facilities above indicate that biomass conversion facilities result in net negative GHG emissions of over 1 million MT CO₂e, or -0.24 MT CO₂e per ton of bone dry biomass. This is similar to a related ARB estimate (-0.21 MT CO₂e/ton) for the recycling of dimensional lumber, assuming that it is chipped and burned in a biomass facility. (ARB, 2011). The staff estimated emissions include the direct CO₂e non-biogenic emissions from Table 3, and credits for avoided utility emissions using the power capacity from Table 2 and an assumed overall output of 85% of capacity. Staff did not estimate transportation emissions associated with delivering waste to a facility, or emissions associated with processing waste, for example chipping wood. The estimates also did not account for avoided landfill emissions or avoided emissions from open-burning of biomass.

Table 4: Preliminary Estimates of Total Annual Net GHG Emissions from Biomass Conversion Facilities in California (year)

Biomass Waste (bone dry tons)	Non-biogenic Emissions (MT CO ₂ e)	Total MWh	Utility Avoided Energy Credit MT CO ₂ e ¹	Total Net Emissions (MT CO ₂ e)	Net MT CO ₂ e/Ton Waste
4,500,000 ²	120,000	4,051,000	-1,230,000	-1,110,000	-0.25

¹ Uses 2009-2010 average California grid emission factor of 668 lb CO₂e per MWh, and assumes facilities produce 85% of rated power capacity per Table 2.

² Figure from 2012 Bioenergy Action Plan

Can GHGs and co-pollutants be reduced from existing or new biomass conversion facilities?

While acknowledging that most GHG emissions from biomass conversion facilities are biogenic, there is some potential to reduce GHG emissions from existing biomass conversion facilities, especially those that are not cogeneration facilities. When a “life-cycle” approach is used, net GHG emissions could be reduced by: (1) conversion to cogeneration, where heat (steam) is utilized on site, (2) upgrades to the boiler, turbine, or generator that could provide improvements in the efficiency resulting in more electricity generated per ton of biomass combusted; or (3) greater utilization of ash in beneficial uses such as construction materials where it could replace virgin materials

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that would be mined or otherwise produced through processes that result in more GHG emissions.

Additional GHG reductions could come from restarting idled or non-operational biomass facilities, the conversion of fossil fuel plants to “co-fired” or 100% biomass fueled plants, or the construction of new biomass conversion facilities. Based on the emissions estimates in Table 4, the 22 operational plants in California result in an average annual emissions credit of 50,000 MT CO₂e each. In addition, much of the biomass material available is not utilized. According to the 2012 Bioenergy Action Plan, less than 15% of the available biomass in California is utilized for energy. However, there are additional biomass conversion facilities that could be operational under more favorable economic conditions. Also, new designs in biomass conversion and gasification systems sized from 0.5 to 2 megawatts are now available that can provide heat and electricity for manufacturing or a small community. (UC, Woody Biomass Utilization). Finally, there may be benefits to the utilization of biochar, such as reducing nitrous oxide emissions and improving soil fertility for agricultural use.

What is the current status of emissions control at biomass conversion facilities?

These facilities are generally subject to local air quality district regulations and permit requirements. For new or modified facilities, “New Source Review” (NSR) regulations may require the use of “best available control technology” (BACT) for PM, NO_x, SO_x, or other emissions. NSR may also require the use of emission reduction credits (ERCs). In addition, federal rules that govern the permitting of new or modified facilities may apply.

The primary GHG emitted from biomass conversion plants is carbon dioxide, which is not controlled. However, as noted above, these facilities result in net negative GHG emissions. The plants have air pollution controls to reduce emissions of PM and NO_x. For PM control, the facilities are equipped with various control devices, including multi-cyclones, baghouses, and electrostatic precipitators (ESPs). Permitted limits range from 0.01 to 0.2 gr/dscf at 12 percent carbon dioxide. For NO_x control, the facilities most often employ selective non-catalytic reduction (SNCR).

IV. GOALS FOR REDUCING GHGS FROM BIOMASS CONVERSION FACILITIES

Biomass conversion facilities can play a role in achieving California’s goals for reducing GHG emissions and reducing the volume of material deposited in landfills. These facilities can help reduce GHG emissions from the Waste Sector in two ways: (1) new facilities can process additional waste that would otherwise be sent to landfills or open burned, and (2) as discussed above, existing facilities could be upgraded to improved energy efficiency. Discussed below are some existing state programs that will affect the extent to which GHG emissions can be reduced through biomass conversion facilities.

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Renewable Portfolio Standard

The Renewable Portfolio Standard (RPS) program requires utilities to increase their procurement from eligible renewable energy resources from 20% of total procurement by December 31, 2013, 25% by December 31, 2016, and 33% by December 31, 2020. Under the program, utilities will pay a premium for energy from renewable sources. Under existing state law, biomass conversion facilities are eligible for renewable energy credit. This could potentially make existing and new biomass facilities more economical to operate. However, as noted in Section V below, the utilities are purchasing most of their renewable energy from other renewable sources.

Biomass Conversion Facilities and the Cap-and-Trade Program

California's Global Warming Solutions Act (AB 32) established the goals of reducing GHG emissions to 1990 levels by 2020, and then an 80% reduction below 1990 levels by 2050. A central element of AB 32 is the Cap-and-Trade Program, which specifies an enforceable GHG emissions cap that will decline over time covers. Cap-and -Trade applies to major sources of GHG emissions, sources that emit more than 25,000 MTCO₂e per year. As shown in Table 3 above, biomass conversion facilities in California do not qualify as major sources since biogenic emissions are not counted toward the 25,000 MTCO₂e major source threshold. Further, as explained above, these facilities result in net negative GHG emissions.

Governor's Clean Energy Jobs Plan

In 2010, Governor Brown set a goal of installing 20,000 MW of renewable electricity by 2020. To spur investment in renewable energy and help meet the state's ambitious climate goals, Governor Brown established a Clean Energy Jobs Plan. The Plan included a specific target of 12,000 MW of distributed generation which would include biomass conversion facilities.

V. CHALLENGES FACING BIOMASS CONVERSION FACILITIES

This section discusses the current and future challenges facing biomass conversion facilities. The challenges discussed below are divided into short-term and long-term issues.

C. Short-Term

Permitting of New Facilities

The vast majority of California's biomass conversion facilities were built in the 1980s, when regulatory and economic conditions were more favorable. Now these plants are 25-30 years old and will need to be upgraded or replaced. The overall permitting process, and sometimes local opposition, makes it very difficult to construct new plants. A recent report noted that a number of attempts have been made to restart non-

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operational facilities since it is significantly less expensive than building a new facility. One reason for that is that old plants retain their original permits, while obtaining a permit for a new facility can be both expensive, uncertain, and time consuming. (California Agriculture, Volume 66, No. 1). The 2012 Bioenergy Action Plan also points out that some jurisdictions are ill-equipped to site and permit these projects, as they do not have the technical expertise or resources. Staff anticipates that the overall permit and construction process will take 3 to 5 years for biomass facilities.

New facilities are required to obtain several permits from different agencies. They are required to obtain permits from local jurisdictions, the Regional Water Quality Control Board, and local air quality management districts. Regarding the air quality permits, it would be difficult and expensive to site new plants using standard direct burn technology in California's non-attainment regions. New facilities would also face challenges preparing environmental documentation required by CEQA.

Financial Risk

The California Biomass Energy Alliance (CBEA) reported that a significant number of the existing biomass facilities have expiring contracts for their power and are facing uncertainty in the likelihood of contract renewal. Programs designed to spur bioenergy development at the CPUC, and recent procurement decisions of the Investor Owned Utilities (IOUs), have put existing biomass power facilities at a disadvantage for future renewable procurement opportunities (Draft 2013 Integrated Energy Policy Report, California Energy Commission, October 2013; <http://www.energy.ca.gov/2013publications/CEC-100-2013-001/CEC-100-2013-001-LCD.pdf>). The Draft IEPR highlights the difficulty of bioenergy resources competing with other renewables with lower costs. Over generation is also a growing grid complexity that may negatively impact the need for biomass as a baseload operation, when IOUs are seeking more flexible power sources that can balance out daily swings in solar generation. The biomass industry argues that a mix of renewable energy procurement by the IOUs, which includes biomass, is critical to the long term sustainability in the Waste Management and Natural and Working Lands sectors. Under present conditions, the biomass industry will probably need changes in government policies, incentives, or other mechanisms to be viable beyond their current contracts.

Interconnection Costs

The cost and difficulty of interconnection to the transmission grid has been identified as a significant hurdle for new facilities.

Barriers to Increased Utilization of Forest Biomass

According to the 2012 Bioenergy Action Plan, there are a number of challenges to increasing the utilization of forest biomass for energy. Among the challenges is the cost of transporting waste to the facility, and concern that increased markets for forest wood

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waste would promote more intensive harvest practices, resulting in unanticipated environmental impacts.

Gasification

Gasification of biomass has an advantage over conventional combustion in that it can potentially result in lower air emissions and higher thermal efficiencies. There are a number of commercial biomass gasification plants operationally internationally. However, the technology is only currently used at a few small facilities in California.

B. Long-Term

Development of Small Community-Scale Biomass Conversion Facilities

According to the 2012 Bioenergy Action Plan, smaller facilities would be a good fit for many rural communities. However, additional technical, financial, and stable supply of material is needed to encourage their development.

Emerging Technology

Conventional mass-burn plants produce combustion byproducts that require costly air pollution control equipment, and result in ash with limited market value. Emerging technologies may offer advantages in these areas, but more research is needed to demonstrate and commercialize these technologies.

Beneficial Uses for Ash Byproducts

In order to achieve a sustainable, zero waste system, beneficial uses need to be identified for the ash from biomass conversion plants. This includes both the boiler “bottom” ash and the “fly ash” from the air pollution control systems. A challenge with using ash is that it often contains toxic components which will impact acceptable uses of the material.

VI. POTENTIAL SOLUTIONS

Discussed below are some potential solutions to the challenges described above in our effort to achieve waste diversion and GHG reduction goals. As with the discussion of Challenges, the potential solutions are organized by short-term and long-term categories. Many of the potential solutions are discussed in the 2012 Bioenergy Action Plan. There may be additional solutions to the challenges beyond those mentioned below.

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Short-Term

Permitting of New Facilities

The 2012 Bioenergy Action Plan (BAP) provided a number of suggestions to improve the permitting process for biomass facilities. First, it suggested that Cal-EPA funnel these projects through its Consolidated Permit Application process (Public Resources Code § 71020 *et seq.*) to coordinate the process. It also recommended that bioenergy developers consult with GO-Biz and Cal-EPA before they submit their project application to determine if the Consolidated Permit route would help their permit applications.

Another suggestion was the development of industry-specific web-based tools for planning and permitting guidance, links, and agency contacts. The 2012 Bioenergy Action Plan noted that Cal-EPA is planning to develop a web portal with permitting guidance for dairy digester projects, and an online “drop box” for other technologies to coordinate submission of environmental permits. It was suggested that this technology could be replicated for other types of bio-energy projects, including biomass electricity generation.

It was also suggested that funding be secured to develop a programmatic Environmental Impact Report (EIR). While this suggestion was targeted more to noncombustion conversion technologies (such as gasification and pyrolysis), it could also be applied to combustion of biomass as well. The EIR could assist state and local agencies in preparing site-specific environmental documentation that may be required for conversion technology facility applications and/or permits.

Finally, it was suggested that ARB and the local air districts provide manufacturers of bioenergy generation technologies with guidance on how to expeditiously permit bioenergy projects by proposing technologies that meet the latest regulatory requirements and how to retrofit existing facilities to meet tightening air quality regulations.

Financial Risk

The 2012 Bioenergy Action Plan provided several suggestions to improve the financial standing of new or existing biomass conversion facilities:

- Ensure that a substantial portion of the CPUC’s Electricity Program Investment Charge (EPIC) fund is devoted to developing and commercializing new bioenergy facilities that are environmentally and economically sustainable, as well as upgrading and maintaining existing bioenergy facilities;
- Monitor the use of the CPUC’s Renewable Market Adjusting Tariff (“Re-MAT”) to assess whether and to what extent it incentivizes new bioenergy projects;
- Ensure that community-scale biomass projects benefit from the SB 32 feed-in-tariff and consider the use of other procurement mechanisms for small scale

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bioenergy projects, such as Assembly Bill 1122, which requires the procurement of at least 250 MW of generating capacity from new bioenergy projects with an effective capacity of not more than three megawatts; and

- Identify GHG, criteria, and air toxic offset or credit opportunities that could assist in financing and siting bioenergy projects.
- Utilize Cap and Trade Auction Proceeds to provide competitive grants for bioenergy production.

Interconnection Costs

Regulatory changes could address the cost, timelines and other hurdles to interconnecting to the electricity grid. The CPUC has a rulemaking underway to address these challenges.

Barriers to Increased Utilization of Forest Biomass

The 2012 Bioenergy Action Plan provided these suggestions to increase the use of forest biomass:

- Outreach to landowners and registered professional foresters regarding the Board of Forestry and Fire Protection's regulations for Modified Timber Harvest Plan for Fuels Management;
- Outreach to the public regarding the benefits of biomass use, including reducing wildfire risk and production of local energy;
- Define and ensure sustainable forest biomass utilization for energy. These efforts are already underway by the Interagency Forest Work Group;
- Develop fire threat maps indicating areas of elevated fire risk due to power-lines (with accompanying plans removal of biomass); and
- Update the assessment of California biomass resources, identifying locations of biomass material and uses by region, assessing the value for fire hazard reduction, and recommended cost-effective strategies for use.

Gasification

Incentive or grant programs could aid in the increased utilization of biomass gasification in California. Many of these programs are discussed above under solutions to financial risk. As an example, the U.S. Forest Service approved a grant to complete the design and engineering services for installation and commissioning of a small biomass gasification unit on a former sawmill site in the rural community of North Fork, California.

Long-Term

Development of Small Community-Scale Biomass Facilities

The 2012 Bioenergy Action Plan provided a number of suggestions to encourage the development of these facilities, including refining the criteria of "community-scale"

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biomass energy facilities, identifying a few candidate projects, and seeking developers and cost-sharing partners for deployment and demonstration.

Emerging Technology

State (and potentially Federal) agencies could coordinate resources to pursue research, development and commercialization of emerging state-of-the-art thermal technologies. As an example, the Energy Commission staff recommends that California state government should target installing 2,500 MW of renewable energy on state properties to help meet the overall 20,000 MW statewide goal in the Governor's Clean Energy Jobs Plan. Cal Fire is exploring opportunities for installing one to three biomass projects for heat and power using new technologies at Forestry Conservation Camps.

Beneficial Uses for Ash

State (and potentially Federal) agencies could fund research to supplement existing programs seeking to identify safe and beneficial uses for biomass conversion facility ash or other co-products such as biochar. Research is currently underway on potential uses of ash from MSW combustion. The results of this work may be applicable to biomass conversion waste also.

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MUNICIPAL SOLID WASTE THERMAL TECHNOLOGIES January 2014

I. INTRODUCTION

The primary focus of this paper is to identify challenges and potential solutions for achieving greenhouse gas (GHG) and waste reduction goals from municipal solid waste thermal technology (MSW Thermal) projects in California. The MSW Thermal processes discussed in this paper are thermochemical processes: MSW combustion, gasification systems and closely related technologies (e.g., pyrolysis and plasma arc), and the use of MSW as a supplemental fuel. Since conventional combustion operations are established in California, this paper provides more information for this technology compared to the other thermal technologies, which are not now in commercial operation in California. However, it is recognized that gasification, pyrolysis, and other non-combustion technologies provide additional options for handling MSW that may be used commercially in California at some point in the future. This paper does not provide a detailed technical discussion of the many emerging technologies that could potentially be used to treat MSW in California.

The sections that follow describe MSW Thermal processes, the current utilization of MSW Thermal in California, and the goals, challenges, and potential solutions for achieving additional reductions in GHG emissions and waste through the use of MSW Thermal facilities.

This paper is one of five papers providing information on the role various waste treatment technologies can play in meeting California's GHG and waste reduction goals. Companion papers discuss Recycling, Reuse, and Remanufacturing; Composting and Anaerobic Digestion; Biomass Conversion; and Landfilling of Waste.

II. GENERAL DESCRIPTION OF THE MSW THERMAL PROCESS AND FACILITIES IN CALIFORNIA

What is MSW Thermal Technology?

MSW Thermal technologies are processes that generate energy in the form of electricity, fuel, or heat from thermochemical processes such as combustion or gasification of municipal solid waste. MSW Thermal facilities are also referred to as waste-to-energy or transformation facilities. Combustion processes involving biomass, and biological processes, such as composting and anaerobic digestion are discussed in other technical papers.

What are the MSW Thermal systems currently being used?

The MSW Thermal systems discussed in this paper are: conventional combustion systems, gasification systems, and the use of MSW (or components of MSW) as a

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supplemental fuel along with conventional fossil fuels. Each of these systems is described below. Other thermochemical processes, such as torrefaction, are less prevalent and not discussed in this paper. Only combustion and supplemental fuel systems are in commercial use in California.

A. Conventional combustion (“transformation”) systems

Conventional combustion systems combust mixed (unprocessed or minimally processed) solid waste in an incinerator. There are about 90 such systems in the U.S, 3 in California. While designs vary, a typical system involves the transfer of waste by crane from a pit to a moving grate incinerator where combustion takes place. Combustion gases flow through a heat recovery boiler, where water is heated to produce steam. The steam can be used to power a turbine and associated generator, producing electric power that can be provided to the electric power grid. MSW combustion systems will have multiple air pollution control devices to control emissions of sulfur oxides, nitrogen oxides, particulate matter, and other pollutants.

After combustion, the waste volume is typically reduced by 90% or more. Ash and metals are the primary residual materials. Ferrous metals are typically recovered from the residual material and recycled. Some newer facilities can recover nonferrous metals such as aluminum, copper, bronze, and brass. Ash can be landfilled with other wastes, used as a landfill cover material, or sent to a “monofill,” where only ash is disposed of. The ash may contain heavy metals and other toxic components. However, research is underway to identify beneficial uses for the ash, such as use in road paving materials or construction materials. One operator is also investigating the possibility of recovering nonferrous metals from monofilled ash.

There are three MSW combustion facilities in California, as shown in Table 1 below. These facilities utilize combustion technology to combust unprocessed or minimally processed solid waste. Collectively, they have the capacity to process about 2,500 tons per day (TPD) of MSW, producing about 70 megawatts (MW) of electrical power. The three plants generally operate close to their rated capacity, although with scheduled downtime for maintenance, output may be 10-20% below capacity on average. All of the facilities have systems to collect ferrous metals, and one is currently planning to install a collection system for nonferrous metals as well. All of these facilities exceed the 25,000 metric tons CO₂e threshold and are subject to the AB 32 mandatory reporting requirements. However, as discussed later in this paper, their status under the Cap-and-Trade Regulation is under review.

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Table 1: MSW Thermal Combustion Facilities in California

Facility Name	Location	Start Date	Waste Capacity (TPD)	Electrical Capacity (MW)
Covanta Stanislaus	Crows Landing	1989	800	22
Commerce Refuse-to-Energy Facility	Commerce	1987	360	11.5
Long Beach SERRF	Long Beach	1988	1,380	36
Totals			2,540	70

A. Gasification systems

There are three main types of gasification systems: conventional, pyrolysis, and plasma arc gasification.

Conventional Gasification

Conventional gasification systems heat solid waste at high temperatures in an oxygen-deficient environment within a reactor vessel to produce synthesis fuel gases (syngas). The principal syngas products are carbon monoxide, hydrogen, methane, and other lighter hydrocarbons. Gasification processes may also produce liquids in the form of tars or oils, and solids such as char and ash. There are commercial gasification plants operating in Japan, Europe and North America that use MSW or sub-streams derived from MSW

Electricity and heat can be produced by burning the syngas in a steam boiler and turbine plant, a gas turbine, or an internal combustion or Stirling engine generator. The process may result in fewer pollutants than combustion, depending on whether the syngas is cleaned prior to combustion. Syngas can also be further processed to produce liquid fuels, fertilizers, and other chemicals by chemical reactions such as Fischer-Tropsch synthesis.

Pyrolysis

Pyrolysis systems thermally degrade solid waste in the absence of any air or oxygen. The process is similar to gasification but generally optimized for the production of fuel liquids or pyrolysis oils (sometimes called bio-oils if biomass feedstock is used). Pyrolysis also produces gases and a solid char product.

Pyrolysis liquids can be used directly (e.g. as boiler fuel and in some stationary engines) or refined for higher quality uses such as motor fuels, chemicals, adhesives, and other products. Direct pyrolysis liquids may be toxic or corrosive.

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Plasma Arc Gasification

Plasma arc gasification systems use high voltage to create an electric field that heats MSW to extremely high temperatures. The intense heat breaks up the organic molecules into simpler gaseous molecules such as hydrogen, carbon monoxide, and carbon dioxide. The inorganic portion of the MSW is vitrified into a glassy residue that can be used in construction or paving materials. There are no plasma arc gasification systems in commercial operation in the U.S.

B. MSW as a Supplemental Fuel

MSW or specific types of waste that are segregated from the waste stream but would otherwise be deposited in municipal landfills can be used as a supplemental fuel in some facilities. For example, scrap rubber tires are used by some cement manufacturing plants in California. Specifically, according to data reported in response to the Air Resources Board's Energy Efficiency and Co-Benefits Assessment of Large Industrial Facilities Regulation (EEA Regulation), about 7 percent (1.8 million MMBtu) of the total energy consumed in 2009 by reporting cement plants was derived from scrap tires. According to the EEA data, dried sewage sludge was also used by some cement plants (less than 1 percent of total energy reported by cement plants). Some electricity generating plants have used scrap tires as a fuel in the past, but we are not aware of any of these facilities that currently combust scrap tires. In some cases, biomass is also used as a supplemental fuel, as discussed in the companion paper Biomass Conversion.

III. CURRENT STATUS OF MSW THERMAL FACILITIES IN CALIFORNIA

How much MSW is handled by MSW Thermal combustion facilities in California?

As shown in Table 2, the three MSW Thermal combustion facilities in California are processing about 2,500 tons of MSW per day, or about 900,000 tons per year. This is about 1 percent of the 73 million tons of waste material generated in 2010. It is not likely that there will be additional MSW Thermal facilities in the near-term without changes to existing State policies.

The three existing MSW Thermal facilities were all built in the late 1980s, and there are significant barriers to the construction of new facilities. These barriers include economics, restrictions on siting, air quality concerns, and the lack of renewable energy and waste diversion credits.

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How much GHGs and co-pollutants are emitted from MSW Thermal facilities?

According to data reported for ARB’s Greenhouse Gas Reporting Regulation, the three MSW Thermal facilities emitted about 747,000 metric tons of CO₂ equivalent (CO₂e) emissions in 2011, of which about 498,000 metric tons were biomass based (biogenic). The distinction between biogenic and non-biogenic GHG emissions is important because only the emissions from non-biogenic organic matter (fossil fuel based material such as plastics) are counted per protocols established by the Intergovernmental Panel on Climate Change (IPPC). A summary of the emissions from each of the three plants is shown in Table 2 below.

Table 2: GHG Emissions from California’s MSW Thermal Facilities¹

Facility Name	Total CO ₂ e tonnes	Non-biogenic CO ₂ e tonnes	Biogenic CO ₂ e tonnes
Covanta Stanislaus	222,310	79,590	142,710
Commerce Refuse to Energy	108,920	53,760	55,160
Long Beach SERRF	415,650	115,790	299,860
Total	746,870	249,150	497,730

¹ ARB 2011 Greenhouse Gas Reporting Regulation

How much GHG emissions are avoided due to MSW Thermal systems?

Although the California MSW combustion operations have not been fully assessed for their lifecycle GHG emissions benefits, there appears to be GHG emission reduction benefits to MSW Thermal compared to landfilling. The U.S. EPA’s Municipal Solid Waste Decision Support Tool has demonstrated that modern conventional MSW Thermal combustion facilities avoid GHG emission in three ways:

- MSW Thermal facilities produce electricity that can offset electricity produced at conventional, petroleum-based, power plants using natural gas and coal.
- MSW Thermal facilities recover ferrous and/or nonferrous metals for recycling, which is more energy efficient than mining virgin materials for metals.
- MSW Thermal facilities remove materials from the landfill waste stream thus eliminating methane emissions that would have occurred if this material were landfilled.

U.S. EPA’s Waste Reduction Model “WARM” provides estimates of the life-cycle GHG emissions from different waste management practices, including conventional combustion facilities. Table 3 shows the estimated direct and avoided GHG emissions for MSW Thermal using combustion technology. Direct emissions include non-biogenic CO₂ and N₂O from solid waste combustion and from transporting waste material.

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Avoided emissions include reductions in utility emissions from displaced electricity and emission reductions associated with recycled metals. While not California-specific, it is illustrative of the direct and avoided emissions from MSW combustion facilities. As shown in Table 3, direct GHG emissions from mixed MSW combustion (0.40 MTCO_{2e} per ton of waste) are less than the avoided emissions from both utilities and ferrous metal production from virgin ores. WARM also provides data for specific types of waste, some of which are included in Table 3. Yard trimmings and mixed paper result in very little emissions because CO₂ emissions from biogenic waste are not counted under WARM, but burning this waste results in significant avoided utility emissions. In contrast, HDPE plastic results in significant direct facility emissions that are only partially offset by avoided utility emissions. Steel cans primarily result in avoided emissions due to recycling of the recovered metals.

Table 3: Estimated MSW Combustion Direct and Avoided GHG Emissions¹
(MTCO_{2e}/Ton Waste)

Material Combusted	Direct Emissions (CO ₂ ,N ₂ O, transportation)	Avoided Emissions (Utility)	Avoided Emissions (Metal Recovery)	Net GHG Emissions
Mixed MSW	0.40	-0.39	-0.05	-0.04
Yard Trimmings	0.06	-0.22	0	-0.15
Mixed Paper	0.06	-0.55	0	-0.49
HDPE Plastic	2.82	-1.55	0	1.27
Steel Cans	0.03	0.02	-1.59	-1.59

1. Estimate based on U.S. EPA WARM (Version 12, February 2012). Direct Emissions of CO₂ excludes biogenic CO₂.

Since waste treated at a MSW Thermal facility would otherwise likely be landfilled, a comparison to landfill emissions based on the WARM model is provided below. As shown in Table 4, WARM estimates higher GHG emissions for landfills on average. However, the comparison varies with how the landfill gas is controlled. Net GHG emissions are very similar to MSW plants for landfills with gas recovery systems and electricity generation from the collected gas. However, WARM estimates that landfills which do not generate electricity from collected gas will have higher emissions per ton of waste, and landfills without gas recovery will have dramatically higher emissions.

Table 4: Estimated Direct and Avoided Landfill GHG Emissions¹
(MTCO_{2e}/Ton Waste)

Material Combusted	National Average	No Landfill Gas (LFG) Recovery	LFG Recovery with Flaring	LFG Recovery with Electricity Generation
Mixed MSW	0.98	3.10	0.31	-0.03

1. Estimated based on U.S. EPA WARM (Version 12, February 2012)

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Official lifecycle emissions data for the three California MSW Thermal facilities is not available. However, preliminary staff estimates shown in Table 5 below indicate that combusting waste in the three MSW Thermal facilities in California results in net negative GHG emissions, ranging from -0.16 to -0.45 MT CO₂e per ton of waste disposed, when considering that the waste would otherwise be deposited in landfills resulting in higher emissions. The estimates include the direct CO₂ equivalent emissions (excludes biogenic CO₂ emissions consistent with IPPC protocols and U.S. EPA WARM Model), and emissions credits for avoided utility emissions, recycling of metals, and avoided landfill methane emissions. Depending on the methodology used, avoided landfill emissions may range from 0.24 to 0.53 MT CO₂e/MT of MSW. Emissions from the transportation of waste were not included (as they are in WARM), but this is a relatively minor factor in the overall emissions. Emission estimates related to landfill carbon storage associated with buried material was also not included. Staff believes that additional evaluation and discussion on how best to account for landfill carbon storage are needed.

**Table 5: ARB Staff Preliminary Estimates of
Net GHG Emissions from California MSW Thermal Facilities***

(MTCO₂e/Short Ton Waste)

Facility	Waste (TPD)	Non-biogenic MT CO ₂ E Emissions	Energy Credit MT CO ₂ E ¹	Metal Recycled (Tons)	Metal Recycling Credit MT CO ₂ E ²	Avoided Landfill Methane Emissions MTCO ₂ e ³	Net MT CO ₂ E per Ton Waste
Covanta Stanislaus	800	79,590	-49,740	5,690	-10,240	-70,080 to -154,760	-0.17 to -0.46
Commerce Refuse to Energy	360	53,760	-26,000	920	-1,660	-31,540 to -69,640	-0.04 to -0.33
Long Beach SERRF	1380	115,790	-81,390	6,500	-11,700	-120,890 to -266,960	-0.19 to -0.48
Total	2,540	249,150	-153,740	13,110	-23,600	-222,500 to -491,360	-0.16 to -0.45

1 Uses 2009-2010 average CA grid emission factor of 668 lb. CO₂e per MWh, and assumes facilities produce 85% of rated power capacity per Table 1.

2 Uses a metal recycling credit of 1.8 MT CO₂e per short ton of ferrous metal.

3 Estimated avoided landfill methane emission 0.24 to 0.53 MTCO₂e/MT

Can GHGs and co-pollutants from existing MSW Thermal facilities be reduced?

GHGs and co-pollutants from MSW Thermal facilities can be reduced. However, the available options may only achieve modest emissions reductions. One option to reduce GHGs is to decrease the amount of non-biogenic organic waste (e.g. plastics) in the material being combusted. This is because only the GHG emissions from non-biogenic organics are counted per IPPC protocols. Other options to reduce GHGs and co-

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pollutants, when a full “life-cycle” approach is used include: (1) improvements in front end pre-processing to recover recyclables (e.g., glass, plastics, cardboard) prior to combustion (2) upgrades to the incinerator, boiler, turbine, or generator that could provide some modest improvements in the efficiency of the plant, and associated electricity generated per ton of waste, (3) improvements in metals recovery equipment to increase the recovery of metals from the waste ash, or (4) increases in the use of ash in products such as construction materials where it could replace virgin materials that would be mined or otherwise produced through processes that result in more GHG emissions. Over the long term, newer MSW combustion technologies, such as gasification, may offer additional GHG benefits beyond existing mass-burn technology.

What is the current status of emissions control at MSW Thermal facilities?

The primary GHG emitted from MSW Thermal plants is carbon dioxide, which is not controlled. MSW Thermal plants have extensive air pollution controls to reduce emissions of criteria pollutants and toxic air contaminants. For example, the Covanta Stanislaus Facility utilizes flue gas scrubbers with lime injection to control acid gases such as sulfur oxides, fabric filter baghouses for particulate matter, selective non-catalytic reduction (ammonia injection) for nitrogen oxides, activated carbon injection for mercury, and a continuous emissions monitoring (CEM) system.

IV. GOALS FOR REDUCING GHG FROM MSW THERMAL FACILITIES

MSW Thermal facilities might play a role in achieving California’s goals for reducing GHG emissions and reducing the volume of material deposited in landfills. MSW Thermal facilities can help reduce GHG emissions from the waste sector in two ways: (1) new MSW Thermal facilities could handle waste residuals that would otherwise be sent to landfills, where GHG emissions may be higher over the long-term; and (2) the emissions from the three existing facilities in California could be modestly reduced, as discussed above. GHG emissions reductions are maximized when recyclable and compostable materials are removed from the MSW prior to use at MSW Thermal facilities.

Existing State policies and the waste management hierarchy focus on the highest and best use of waste materials, i.e., recycling, composting and anaerobic digestion. With respect to newly proposed MSW thermal facilities, several statutory definitions, especially with regards to transformation and gasification, affect how such facilities might be permitted, whether or not they are considered disposal, and whether or not they are eligible for Renewable Portfolio Standard credits for the energy they would produce. There may be situations where residual MSW streams contain BTU value that could be recovered if converted to energy rather than being landfilled, but one major challenge would be to ensure these streams do not contain recyclable and/or compostable materials that could achieve greater emission reductions via recycling, composting, and anaerobic digestion. Initial steps to address this issue could be to develop a Material Recovery Facility standard that specifies the quality of a residual waste stream such that sufficient recyclables/compostables have been removed, and/or

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to clarify a permitting pathway for facilities that use these types of residuals as a feedstock under specified conditions.

MSW Thermal Facilities and the Cap-and-Trade Program

California's Global Warming Solutions Act (AB 32) established a goal of reducing GHG emissions to 1990 levels by 2020, and then reducing GHG emission to 80% below 1990 levels by 2050. A central element of AB 32 is the Cap-and-Trade Program, which specifies an enforceable GHG emissions cap that will decline over time. The program applies to major sources of GHG emissions in the State, including the three MSW Thermal facilities in California. However, there are a number of concerns about including these facilities in the program, including the possibility that it may result in a shift of waste to landfills, which are not under Cap-and-Trade. Due to these concerns, ARB has proposed to temporarily exclude these three facilities from the Cap-and-Trade Program until 2015 to provide the time necessary to decide how best to treat MSW Thermal facilities in the context of the entire waste sector. Some potential options include: (1) remove MSW Thermal facilities from the Cap-and-Trade Program; (2) include the non-biogenic portion of emissions from MSW Thermal facilities in Cap-and-Trade; and (3) include MSW Thermal facilities in Cap-and-Trade and bring in other Waste Sector sources (such as landfills). These options are discussed in Section V below.

Renewable Portfolio Standard

The Renewable Portfolio Standard (RPS) program requires utilities to increase their procurement from eligible renewable energy resources to 33% of total procurement by 2020. Under the program, utilities will pay a premium for energy from renewable sources. This could make existing and new MSW Thermal facilities more economical to operate. However, under existing state law, only one of the three existing MSW plants (Covanta Stanislaus) is eligible for renewable energy credit, and new combustion facilities would not be eligible. New MSW Thermal facilities that meet the statutory definition of gasification (PRC 40117) would qualify as RPS eligible if the facility meets all the criteria in Public Resources Code Section 25741, Subdivision (b). Other MSW Thermal technologies, such as pyrolysis, that fall under the definition of transformation (PRC 40201) would not be RPS eligible.

V. CHALLENGES TO MEETING GOALS

This section discusses the current and future challenges facing MSW Thermal facilities in meeting California's waste diversion and GHG reduction goals. The challenges discussed below are divided into short-term and long term actions. In the short-term, many of the challenges will depend on the regulatory structure that applies to MSW Thermal facilities. Most of the challenges are interrelated. For example, government policies affecting MSW Thermal facilities will affect the financial challenges municipalities face in siting new MSW Thermal facilities. In turn, the economics of MSW

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Thermal plants can affect the viability of other waste options, such as recycling, composting, and anaerobic digestion.

D. Short-Term Challenges

Permitting of New MSW Thermal facilities

MSW Thermal facilities operators are required to obtain several permits from different agencies in order to operate. They are required to obtain a full solid waste facility permit as described in the Public Resources Code Sections 44001 - 44018 and California Code of Regulations, Title 27, Chapter 4, Subchapter 3. In addition, they are also required to obtain permits from local jurisdictions, the Regional Water Quality Control Board, and local air quality management districts. The overall permitting process, including the local planning process and local land use decisions, along with large capital costs and local opposition to MSW Thermal facilities, makes it very difficult to construct new plants. The three existing MSW Thermal plants were all built in the late 1980s when government policies encouraged the construction of new MSW Thermal facilities. Staff anticipates that the overall permit and construction process will take 5 to 10 years.

Renewable Energy Credit

The ability to generate electricity that qualifies for renewable energy credit is an important factor in the development of new plants. Only one of the three existing MSW Thermal plants (Covanta Stanislaus) is eligible for renewable energy credit, and new combustion facilities would not be eligible without a legislative change. In addition, for gasification projects, several stakeholders have pointed out that the statutory definition is technically inaccurate and infeasible to meet, making it difficult for these projects to qualify for RPS credits.

Potential Conflict with Recycling Goals

As noted above, MSW Thermal facilities have the potential to reduce GHG emissions compared to landfilling of MSW. However, other waste options such as recycling, composting, anaerobic digestion, and biomass conversion result in even lower GHG emissions. However, there is not clear guidance on the extent of the efforts required to remove recyclable and compostable materials from the MSW stream prior to MSW combustion. One concern expressed is that the provision of incentives to MSW Thermal facilities could lead to increased use of feedstocks that could otherwise go to recycling, composting, and/or anaerobic digestion facilities.

Cap-and-Trade Program Impacts

Currently MSW Thermal facilities are regulated under the Cap-and-Trade Program. However, the ARB has proposed to temporarily exclude them from the program until 2015 to provide the time necessary to decide the best regulatory framework for these facilities and for the Waste Sector as a whole with respect to Cap-and-Trade. If MSW

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Thermal facilities are under the Cap-and-Trade Program, GHG emissions from these facilities would be capped and need to decline over time. The main argument against this is that reducing the amount of MSW combusted or purchasing GHG credits are the only viable options for meeting the cap requirements. Some argue that reducing the amount of MSW combusted defeats the purpose of these facilities and will end up forgoing GHG emission reductions. Further, purchasing credits is likely to require increasing tipping fees to a point where it cannot compete with landfilling. This competitive disadvantage compared to landfilling will result in more waste being landfilled, resulting in more GHG emissions. MSW Thermal operators also report that they are already facing an uncertain economic future even without the potential impacts of the Cap-and-Trade Regulation.

Financial Risk

Municipalities face numerous financial risks in proposing new MSW Thermal facilities. MSW Thermal facilities are costly and face a lengthy process to obtain the necessary permits and address community concerns. There is a risk that new facilities will not perform as expected, especially with newer technologies. Finally, long-term financing may be necessary, but government policies and revenue generated from electricity can change over time in a way that affects the economic viability of a MSW plant. Even some of California's existing MSW Thermal facilities (Long Beach SERRF and Commerce Refuse to Energy) face an uncertain future in the next few years as electricity contracts expire. The current contracts provide price "floors" that provide much higher prices than current rates. When these contracts expire, rates paid for their electricity may fall by two-thirds, making these MSW Thermal plants potentially uncompetitive with landfills that are less expensive to operate and offer lower tipping fees.

B. Long-Term Challenges

Emerging MSW Thermal Technology

As noted above, conventional combustion MSW Thermal plants produce combustion byproducts that require extensive air pollution control equipment, and result in ash with limited or no market value. Gasification and related technologies may offer advantages in these areas, but the technologies are not yet mature. There are applications outside the U.S. handling relatively homogeneous waste. However, it is unclear whether the technology is feasible for unsegregated MSW.

Beneficial Uses for MSW Thermal Byproducts

In order to achieve a sustainable waste management system, beneficial uses need to be identified for the MSW Thermal combustion byproducts. Finding beneficial uses for incinerator "bottom" ash and "fly ash" from the air pollution control systems could reduce the carbon footprint of these facilities. However, care needs to be exercised in reusing

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ash since it often contains hazardous or toxic components such as heavy metals and dioxin.

VI. Potential Solutions for Meeting Goals

Discussed below are some potential solutions to the challenges discussed. Many of the potential solutions are discussed in the 2012 Bioenergy Action Plan. There may be additional solutions to the challenges beyond those discussed below.

A. Short-Term Solutions

Permitting of New MSW Thermal Facilities

Building new MSW Thermal facilities could help California meet its GHG and waste reduction goals and increase ownership of the waste generated within California. If this path is taken, action could be needed to facilitate the permitting of new MSW Thermal facilities for the portion of the waste stream that cannot be managed via recycling, composting and anaerobic digestion, or biomass conversion. If needed, State and local agencies could work together to streamline the permit and siting process. The 2012 Bioenergy Action Plan also suggested the development of a programmatic Environmental Impact Report (EIR) for facilities using thermal technologies. The EIR could assist State and local agencies in preparing site-specific environmental documentation that may be required for conversion technology facility applications and/or permits. In order to address the concern that these types of facilities may use feedstock that could otherwise be recycled or composted, a performance standard would need to be developed, to allow regulators and operators to determine when sufficient recyclable and/or compostable materials have been removed.

Renewable Energy Credit

The ability for MSW Thermal facilities to generate qualified renewable energy will become increasingly important as utilities move toward the 33% renewable energy mandate in 2020. As stated above, only one of the three existing MSW Thermal facilities in California qualifies. In addition, there is some uncertainty about the status of other thermal conversion processes. Potential solutions include allowing all MSW Thermal facilities to generate renewable energy credits, subject to meeting requirements that protect air quality, recycling, and composting programs. The 2012 Bioenergy Action Plan also proposes a review of proposed legislation and statutory definitions relating to conversion technologies such as gasification to clarify which processes can qualify for renewable energy credit.

Potential Conflict with Recycling Goals

To protect recycling programs, front-end processing standards could be developed for waste sent to MSW Thermal plants to ensure that recyclable and compostable materials are removed prior to MSW conversion. These standards should incorporate safeguards

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to protect existing recycling and composting systems and markets and allow for growth of these systems.

Cap-and-Trade Program Impacts

As discussed above, ARB staff is proposing to temporarily exclude the three MSW Thermal facilities from the Cap-and-Trade Program until 2015 to allow time for further investigation of the best approach for handling MSW Thermal facilities as part of an overall Waste Sector Plan. Discussed below are some potential options for addressing the issue of MSW Thermal facilities under Cap-and-Trade.

Remove MSW Thermal Facilities from Cap-and-Trade post-2015

Under this option, MSW Thermal facilities would be removed from the Cap-and-Trade Regulation for the foreseeable future. This approach would put MSW Thermal facilities on a level playing field within the Waste Sector, where none of the methods of handling MSW would be subject to the Cap-and-Trade Regulation. Under this approach, the incentive to reduce GHG emissions provided by the Cap-and-Trade Regulation would be removed. However, the GHG emissions from these facilities are already capped since they are operating at capacity. Further, given the age of these facilities and the uncertainty in long-term rates, the operating life of these facilities is likely to be limited. At the same time, the operation of MSW Thermal facilities (and other waste handling options) may need to be monitored over time to determine whether existing programs to increase recycling, minimize waste generation, and reduce emissions are sufficient to reduce GHG emissions over time. As necessary, additional programs or regulations may be needed that are tailored to MSW facilities or other waste handling processes. This approach may allow for a greater diversity of waste handling options that meet local needs (rural, urban, etc.) for both waste minimization and overall statewide GHG reductions goals.

Add MSW Thermal Facilities into Cap-and-Trade in 2015

Another approach is to add MSW Thermal facilities to the Cap-and-Trade program in 2015, while leaving other Waste Sector sources out. Under this approach, MSW Thermal plants would have an incentive to reduce their GHG emissions over time through control of input feedstock and other techniques. However, a challenge with implementing this approach is that MSW Thermal plants have a modest potential to reduce their GHG emissions. Over time, they may have to purchase more emissions credits, making them increasingly less competitive compared to traditional landfills. This approach would likely result in more GHG emissions if it results in an increase in MSW going to landfills.

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Add MSW Thermal Facilities and Other Waste Sector Sources to Cap-and-Trade in 2015

Under this approach, MSW Thermal facilities and other options for handling waste (such as landfills) would be subject to the Cap-and-Trade Regulation. This would provide a level playing field for power generation and potentially avoid increases in waste disposal at landfills from a reduction in combustion of MSW. However, accurately quantifying the emissions from some waste sectors will be very difficult. For example, landfill emissions occur over a large surface area, and will vary based on the specific location on the landfill. Emissions are likely to vary based on environmental factors (temperature, climate, and moisture), system design and operation consideration, landfill activities, and other factors.

Financial Risk

All of the potential solutions discussed above could help reduce the financial risk that municipalities face in siting new MSW Thermal facilities. For example, streamlining the permitting process, developing a programmatic EIR, developing a performance standard regarding the processing of feedstock to remove recyclable and/or compostable materials, allowing MSW Thermal facilities to generate qualified renewable energy, and changing MSW facility's status under the Cap-and-Trade Regulation, could lead to projects that are more economically viable and thus less financially risky. In addition, the 2012 Bioenergy Action Plan discusses a number of potential options for providing low interest loans for renewable energy projects. To address the risk of implementing new MSW Thermal plants, state agencies could develop a guidance document on existing MSW Thermal facilities and their performance, both in and outside California.

B. Long-Term Solutions

Emerging MSW Thermals

State (and potentially Federal agencies) could coordinate resources to pursue research, development and commercialization of emerging state-of-the-art thermal technologies. Research could include a survey of existing technologies, the economic and technical performance of existing facilities worldwide, new technologies under development, and funding of pilot projects.

Beneficial Uses for MSW Thermal byproducts

State (and potentially Federal agencies) could fund research to supplement existing programs seeking to identify safe and beneficial uses for MSW ash. Existing research is underway looking at construction materials such as cement/ash blocks and roadway materials.

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LANDFILLING OF WASTE January 2014

I. INTRODUCTION

The primary focus of this paper is to identify opportunities, challenges, and potential solutions to achieve greenhouse gas (GHG) and co-pollutant reductions from landfills. The sections that follow, describe the waste disposal and GHG emission trends for landfills in California, applicable regulations affecting landfills, California's GHG and waste reduction targets, the challenges in meeting and exceeding these targets, and what actions need to be taken to meet these challenges. This paper is one of several papers being prepared to provide information critical to the discussion about the role that the Waste Sector can and should play in meeting the goals of Assembly Bill (AB) 32.

II. GENERAL DESCRIPTION OF LANDFILLS IN CALIFORNIA

How many landfills are there and how much waste do they hold?

There are about 370 landfills in California which due to their waste-in-place or permitted volume, waste age, and other pertinent factors have the potential to emit significant quantities of methane. Methane is a GHG with a global warming potential of about 21⁵² times that of carbon dioxide. About 220 of the 370 are likely to be subject to ARB's Landfill Methane Control Measure (Landfill Measure), an AB 32 discrete early action measure adopted in 2009. The remaining landfills are likely to be exempted because they: ceased accepting municipal solid waste (MSW) prior to January 1, 1977, have waste-in-place that is below the 450,000 ton threshold, accepted only inert waste, or are hazardous waste sites. Approximately 1.2 billion tons of solid waste has accumulated in the State's landfills with an additional 30 million tons being added each year (ARB, 2009; CalRecycle, 2013).

What are the greenhouse gas emissions from landfills?

MSW landfills are the second largest anthropogenic source of methane in California (ARB, 2009b). The organic portion of solid waste disposed in MSW landfills decomposes to form landfill gas. Landfill gas contains approximately between 40 to 60 percent methane, 40 to 60 percent carbon dioxide, and trace amounts of non-methane organic compounds (NMOCs).

Depending upon the assumptions (collection efficiency, waste type, oxidation potential, etc.) and models used, fugitive emissions of methane from MSW landfills represent about one¹ percent of the statewide GHG inventory. If not captured, combusted, or treated in controlled systems, landfill gas can either be released into the atmosphere as

⁵² The global warming potential for methane is in the process of being updated. Once updated, the fugitive emissions of methane from MSW landfills may represent one to two percent of the statewide GHG inventory.

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fugitive emissions or migrate underground to cause groundwater contamination, cause explosive hazardous conditions in structures and utilities, or adversely impact nearby agricultural crops.

CURRENT STATUS OF LANDFILLS AND WASTE DISPOSAL TRENDS

How much and what type of materials are disposed of by landfilling?

About 37 million tons of MSW were disposed in California's landfills in 2010. The 37 million tons include disposal-related activities including: alternative daily cover, alternative intermediate cover, and beneficial reuse at California landfills; material combusted at the three MSW mass burn facilities; and tire derived fuel. The estimated composition of waste currently disposed is presented in Table 1.

Table 1. Composition of Currently Landfilled Solid Waste in California¹

Material ²	MM Tons ³	Percentage of Solid Waste
Paper	5.4	15%
Glass	0.5	1.4%
Metal	1.5	4.0%
Plastics	3.0	8.2%
Food	4.8	13%
Green	4.0	10.9%
Lumber	4.4	12%
Other Organics	3.5	9.5%
Other Inerts	6.3	17%
Household Hazardous Waste	0.09	0.3%
Special Waste	2.2	6.0%
Electronics	0.17	0.5%
Mixed Residue	0.93	2.5%
Total	37⁴	100%

1. Source: CalRecycle (2010).
2. Definitions of material types are available at: <http://www.calrecycle.ca.gov/wastechar/MatDefs.htm>
3. Includes disposal related activities (ADC, AIC, and beneficial use), material combusted at MSW mass burn facilities; and tire derived fuel.
4. Numbers may not total exactly due to rounding.

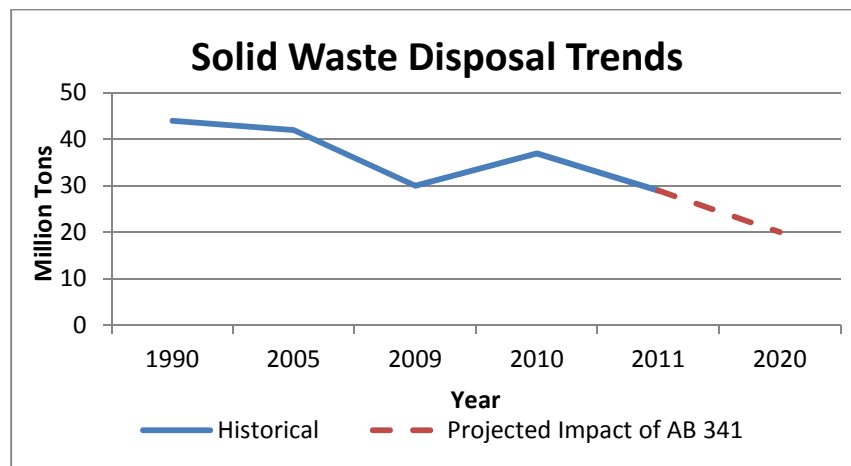
What are the landfill disposal rates and trends?

- California residents generated a twenty-year average of 10.7 lbs/person/day of disposed materials from 1990 through 2010 (CalRecycle, 2012).

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- Approximately 30.4 million tons of MSW were disposed in California's landfills in 2010, and another 5.8 million tons of waste materials were used in disposal-related activities at landfills including alternative daily and intermediate covers, and other beneficial reuse (as defined by Title 27 California Code of Regulations, section 20686), and as fuel (waste tires and solid waste residuals).
- About 0.9 million tons were burned (transformed) at three permitted MSW mass burn facilities in California. Provisions in the Public Resources Code, sections 40201 and 41783 allow limited diversion credit for transformation.
- Almost all (99 percent) of the California-created solid waste that is not recycled or diverted from waste disposal is landfilled in California. It is estimated that there is a potential of about 1.5 to 3 billion tons of landfill capacity available statewide should all permitted capacity be built and utilized. According to the American Society of Civil Engineers, California has sufficient landfill capacity through 2037. However, there may be some localized or regional landfill capacity issues. Should the 75 percent recycling goal be reached, the localized capacity issues will diminish and the overall state capacity will be extended.
- There has been an overall decline in waste disposal by landfilling over time. The decrease in tonnage is primarily related to both increased recycling efforts (e.g., AB 939 discussed in Section IV.) and the economic downturn. This trend is shown below in Figure 1. It includes material disposed in landfills, used in disposal related activities, material combusted at MSW mass burn facilities and tire derived fuel. With medium growth projections, landfill disposal is estimated to increase to 43 million tons in 2020. If the 75 percent recycling goal is met, disposal would decrease to approximately 21 million tons of material disposed in landfills in 2020.

Figure 1. Waste Disposal Trends in California



1. Data from 2010 forward includes both disposal and disposal-related trends.

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How much greenhouse gas emissions do landfills emit?

ARB staff estimates that landfills in California emitted approximately 6.72 MMTCO₂e in 2010. Based on 2006 data, GHG emissions from MSW landfills were estimated to be about 6.3 MMTCO₂e in 1990. In 2000, the GHG emission level dropped to 5.8 MMTCO₂e. However, landfill methane emissions are extremely difficult to estimate and are subject to substantial uncertainty. Recent limited direct measurement studies and computer modeling (CALMIM) indicate that landfill methane emissions may be higher than previously estimated (CalRecycle, July 2012). However, additional work is needed to evaluate the results of these limited studies and determine if it is appropriate to modify existing or develop new models to more accurately estimate landfill methane emissions.

During the time period 1990 to 2008, the solid waste and recycling industry reduced GHG emissions from landfills through increased recycling, improved biomass utilization, and more efficient landfill gas control. State, local air district and U.S. EPA also instituted several landfill gas control measures [e.g., ARB's suggested control measure for landfill gas emissions (1990), local air district landfill gas rules, and federal new source and hazardous air pollutant standards] to reduce landfill gas emissions. Although these measures targeted primarily NMOCs and volatile organic compounds (VOCs), they had the added benefit of reducing GHG emissions such as methane. In 2009, ARB adopted the Landfill Measure to reduce methane emissions from landfills by an estimated 1.5 MMTCO₂e by 2020.

How can GHG and co-pollutant emission be reduced at landfills?

The GHGs and co-pollutant emissions from landfills are reduced in two ways; either by capturing landfill gas or by reducing organics going into landfills. Landfill gas can be controlled by installing and operating an active gas collection and control system. The captured gas is then routed to a control device where it is combusted with or without energy recovery. The gas can also be sent to a pretreatment unit where it is processed and used as a product or shipped offsite for further processing or use. Optimizing gas collection efficiency is dependent on landfill design, operation and maintenance of the gas collection system, and closure/post-closure practices. Reducing the amount of organic materials going to landfills will help reduce future methane emissions. This is particularly true of materials that tend to decompose rapidly such as green waste and food waste.

What is the current status of emissions control at landfills?

Due to federal and local landfill gas rules, most of the approximate 220 landfills subject to the Landfill Measure have landfill gas collection and control systems. About 20 of the 220 have submitted plans to upgrade their existing gas collection and control systems to meet the requirements of ARB's Landfill Measure. Also, because of age and/or older technology, additional existing gas collection and control systems could be upgraded to maximize system efficiencies. We anticipate that about 14 landfills without gas

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collection systems will be required to install gas collection and control systems or demonstrate that their emissions are too low to support such a system.

III. GOALS FOR REDUCING GHG EMISSIONS FROM LANDFILLS

A. Legislation and Regulations

Two key pieces of legislation – AB 32 and AB 341 – provide the framework for reducing GHG emissions from the Waste Sector and meeting California’s waste reduction goals. AB 32 established a goal of reducing GHG emissions to 1990 levels by 2020 and then further reducing GHG emissions 80 percent below the 1990 levels by 2050. The 2008 AB 32 Scoping Plan initiated the process of identifying opportunities to achieve GHG emission reductions from the Waste Sector. Control of landfill methane emissions was identified as an early action measure. The 2008 Scoping Plan also identified the need for mandatory commercial recycling and other programs for developing and implementing alternatives to landfilling.

The ARB Landfill Measure (adopted in 2009 and effective June 17, 2010) imposes landfill gas collection and control system requirements (new systems for landfills without systems meeting thresholds and higher standards for existing systems) to reduce methane emissions from landfills. The implementation and enforcement of the Landfill Measure is expected to result in a GHG emission reduction of 1.5 MMTCO₂e, which exceeds the established goal of 1.0 MMTCO₂e presented in the 2008 AB 32 Scoping Plan and would represent a 20 percent reduction in landfill methane emissions compared to the 1990 levels. Larger MSW landfills are also subject to the federal New Source Performance Standards and Emission Guidelines (implemented by local air districts) to reduce NMOC, VOC and methane emissions.

AB 341 established a goal of 75 percent reduction in waste through recycling, composting, and other waste reduction efforts by 2020. To achieve this goal, about 22 million tons per year of solid waste would need to be shifted to non-landfilling alternatives by 2020. Preliminary analysis using one model (ARB’s Landfill Emissions Tool) indicates that an additional 0.61 to 0.74 MMTCO₂e reduction in 2020 and 3.8 to 5.5 MMTCO₂e in 2050 is possible if the AB 341 policy goal is met.⁵³ Using other models and/or assumptions will generate different results. However, in all cases diverting organic waste from landfilling will reduce methane generation and subsequent emissions from landfills.

Shifting material from landfills and using this material as feedstock in recycling and remanufacturing will also achieve significant upstream GHG emission reductions. Re-introducing recyclables with intrinsic energy value back into the manufacturing process reduces GHG emissions from multiple phases of product production including extraction

⁵³ The estimated emissions reductions are based on results from the ARB Landfill Emissions Tool using CalRecycle estimated disposal tonnages through 2050. Scenarios evaluated a baseline with no increased recycling, a scenario meeting the 75 percent recycling goal by 2020, and a scenario meeting the 2020 75 percent recycling goal with significant reductions in the organic fraction of the landfilled waste stream.

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of raw materials, preprocessing, and manufacturing. To the extent that recycling/remanufacturing occur in California, it would further support AB 32 goals of creating jobs in California and reducing our reliance on export markets to handle waste.

A key component in implementing the 75 percent goal in AB 341 is CalRecycle's Mandatory Commercial Recycling regulation which became effective May 7, 2012. The Mandatory Commercial Recycling regulation builds on the existing AB 939 residential recycling framework. The goal of AB 939 was to require each city or county to divert 50 percent of all solid waste by January 1, 2000, through source reduction, recycling, and composting activities. The Mandatory Commercial Recycling regulation establishes a statewide mandatory commercial recycling program which requires that business and multifamily residential dwellings (of five units or more) that generate four cubic yards or more of commercial solid waste per week to arrange for recycling services.

Two recently enacted bills, AB 1900 and AB 2196, may impact the use of landfill gas. AB 1900 (Gatto, Statutes of 2012) requires the California Public Utilities Commission (CPUC) to develop standards for constituents in biogas to protect human health and pipeline integrity and safety. In support of the CPUC standards development efforts, the Office of Environmental Health Hazard Assessment (OEHHA) and ARB, in consultation with other State agencies, are to undertake certain actions. Specifically, OEHHA is tasked with compiling a list of constituents of concern found in biogas that could pose a health risk and that are at levels that significantly exceed the concentrations of those constituents in natural gas. OEHHA is also to determine health protective levels for these constituents, after considering potential health impacts and risks. ARB is tasked with developing realistic exposure scenarios and identifying the associated health risk to utility workers and end users; determining the concentrations of these constituents in biogas necessary to protect public health; and identifying monitoring, testing, reporting, and recordkeeping requirements necessary to ensure that health protective levels are maintained. ARB and OEHHA submitted their recommendation to the CPUC on May 15, 2013. The CPUC is to adopt a final regulation by December 31, 2013.

The Statutes of 2012 impose certain requirements for eligibility of biomethane under the Renewable Portfolio Standards (RPS) program. It establishes minimum electricity targets for electrical corporations in their annual procurement updates to procure electricity from landfill gas. Moreover, the legislation requires the adoption of policies to promote in-state development of biomethane from wastewater treatment facilities and dairy farms.

The United States Environmental Protection Agency (U.S. EPA) is conducting a review of the New Source Performance Standards (NSPS) and Emissions Guidelines (EG) for MSW landfills and may consider setting more stringent limits on landfill gas emissions among other actions. U.S. EPA is planning to have a draft revised rule in February 2014 and a final rule by December 2014. It is anticipated that the proposed NSPS emission standards will not be as stringent as California's current landfill methane controls. However, the impact of the proposed emission standards, if any, will be assessed once EPA finalizes the proposed rule.

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B. Permitting and Regulation of Landfills

Before a landfill begins operation, landfill operators/owners are required to obtain permits and satisfy regulations pertaining to landfills. For example, landfills are required to obtain local Land Use Approvals from local planning (land use) agencies; State Solid Waste Facility Permits which are typically issued by Local Enforcement Agencies operating under CalRecycle regulatory oversight; waste discharge requirements (WDRs) from the appropriate Regional Water Quality Control Board; and air quality permits from local air districts. Furthermore, landfill operators need to meet hazardous waste requirements from the Department of Toxic Substances Control for Class I landfills, which are exempted from ARB's early action Landfill Measure.

IV. CHALLENGES TO MEETING GOALS

E. Short-Term

The challenges to further reduce GHG emissions from landfills and solid waste going into landfills are both short-term and long-term. The following provides a brief discussion of the short-term challenges.

Uncertainty in Landfill Emissions

Landfills are complex sources of methane (GHG) emissions. Depending upon site specific conditions, methane may be released for decades (and potentially centuries) after material is placed into the landfill. Current law also allows (pending several conditions being met) for decommissioning of gas systems before all the waste has been completely degraded.⁵⁴ Given the scale and scope of landfills and the variability in landfill sites, accurately predicting methane emissions from landfills with a high degree of certainty is difficult. Additional research is needed to improve both direct measurement and model estimation techniques of landfill methane emissions.

Regulatory Actions and Interagency Collaboration

Implementation of "Best Management Practices" (BMPs) for landfills may provide even greater reductions of GHG emissions from landfills. Such actions may include: specific requirements for gas collection system design, construction, timing, and operation; landfill unit and cell design and construction; waste placement methods; daily and intermediate cover materials and practices; use of compost or other biologically active materials in cover soils; phased closure or early landfill closure; and management of organic materials via composting or anaerobic digestion.

⁵⁴ ARB's landfill methane control measure only permits gas collection and control equipment removal after 15 years provided surface emissions standards are consistently being met. In some cases, landfills may be required to submit additional data supporting a request for equipment removal. In addition CalRecycle regulations require the landfill operator to demonstrate that subsurface migration of landfill gas above regulatory standards will not occur before the gas control equipment may be removed.

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The feasibility of a more stringent surface methane emissions limit should be evaluated. The Landfill Measure establishes an instantaneous surface methane emission limit of 500 parts per million by volume (ppmv). ARB staff had initially proposed a more stringent instantaneous surface methane standard of 200 ppmv; however, stakeholders expressed the concern that this may cause potential subsurface fires to occur due to overdraw on their gas collection systems. ARB staff will be evaluating data collected via required regulatory reporting on all instantaneous readings of 200 ppmv and greater to determine if a more stringent limit can be met.

Promote the Beneficial Use of Landfill Gas

Most of the landfill gas captured in the State is done so without energy recovery or the gas being used as a product. Local air district rules and emission offsets requirements along with expensive pretreatment costs to remove impurities from landfill gas may be factors in limiting or making some landfill gas-to-energy (LFGTE) projects unfeasible. Furthermore, most landfills are typically located in remote areas and not close to pipelines making it difficult to inject the gas (after proper processing) directly into a common carrier pipeline. These issues need to be addressed in order to further promote the beneficial use of landfill gas.

Landfill gas from existing waste in place may provide a viable source of liquefied natural gas (LNG) or compressed natural gas (CNG) vehicle fuel with carbon benefits under ARB's Low Carbon Fuel Standard. Landfill gas from existing waste in place is also being evaluated along with anaerobic digester gas for potential treatment and use in California as renewable high Btu to inject in natural gas pipelines.

A consequence of diverting organics from landfills would be a decline in future methane generation (beyond that already anticipated from existing waste in place). While this may negatively impact the economic viability (and capital investments by public and private parties) of both existing and potential landfill gas to energy projects, reducing the amount of organic waste being landfilled would also result in significant GHG emission reductions. Furthermore, these same organic materials could instead be used in composting and anaerobic digestion activities.

Greater Diversion of Readily Recyclable Materials

Achieving additional reductions in GHG emissions from landfills will require greater removal of recyclables, compostable, and digestible materials. To assist in prioritizing actions additional emission reduction factors need to be developed and some of the existing factor need to be updated.

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F. Long-Term

Identified long-term challenges in effectively meeting, implementing, and exceeding the requirements and goals that are in place, and therefore reduce GHG emissions and solid waste going into landfills, are summarized here:

Further Evaluate Landfill Gas Collection Efficiencies for California Landfills

Data on landfill gas collection efficiency is limited and further research is needed. However, measuring uncontrolled landfill gas emissions is problematic because the emissions vary over space and time making it very difficult to accurately quantify emissions. Landfill gas generation rates are highly variable due to several site specific factors including: rainfall, landfill temperature, waste composition, age of the waste, and other factors. The impact on gas collection efficiencies from implementation of the Landfill Measure should also be evaluated.

Improved Emissions Inventory Data

More complete California-specific data on landfill gas collection and composition will help improve emission estimates from the model used by ARB staff. Better information on the cover types present at landfills and further details on gas collection systems will allow for better collection and oxidation factor estimates.

Landfill methane emissions are extremely difficult to characterize and subject to substantial uncertainty. Recent limited direct measurement studies and modeling methods (CALMIM) indicate that landfill methane emissions may be higher than previously thought (CalRecycle July 2012 Report on Landfill Avoided Emissions and WtE). Additional resources/research would be needed to improve landfill methane estimations techniques (both direct measurement and modeling).

Markets

More markets and more stable markets for recycled, reprocessed, or remanufactured goods are needed within California to achieve our GHG emissions and waste reduction goals. To obtain future reductions of GHG emissions from landfills, recyclables must be shifted from landfills. This will require markets for compost and recycled materials. While the State can utilize its purchasing power to increase demand for compost and recycled materials, additional incentives are needed. Compared to landfilling, these environmentally beneficial alternatives are more expensive. The prevalence of less expensive landfilling makes composting and anaerobic digestion economically marginal industries, even though they create jobs and beneficial products, and reduce emissions. To further reduce landfill emissions from landfills that utilize flares for methane destruction from existing in-place waste, markets for produced electricity and landfill gas energy products would need to be developed to assist in shifting to energy producing projects that would possibly replace fossil fuels. Markets will be needed to purchase the electricity produced by LFGTE projects and/or other uses, such as landfill gas being

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used as a product (e.g., LNG, CNG, pipeline quality gas), or for shipment offsite for use in energy production.

V. Potential Solutions for Meeting Goals

Some potential solutions for overcoming the challenges to further reduce GHG emissions and solid waste going into landfills are summarized here:

A. Short-Term

Uncertainty in Landfill Emissions

The Landfill Measure requires the collection of data on an annual basis that will be used to improve estimation of GHG emissions from existing waste in landfills. This information will be provided to emissions inventory staff to further update the landfill inventory.

Although reducing organics disposal into landfills will produce the greatest GHG emissions reductions, to quantify these GHG emissions reductions, new and updated emission reduction factors will need to be developed, especially with respect to avoided methane emission for organics shifted to non-landfill alternatives. For example, an emission reduction factor for carpet is needed.

Regulatory Actions and Interagency Collaboration ("Phase II")

ARB staff will review its early action Landfill Measure and CalRecycle regulations and work with CalRecycle staff to investigate what regulatory actions can be taken to further reduce GHG emissions at landfills. These actions may include incorporating the BMPs identified under the short-term goals section of this report into the Landfill Measure. Additionally, ARB staff has collected approximately two years of surface methane emissions monitoring data from MSW landfills pursuant to the Landfill Measure. ARB staff will analyze the data to determine if the analysis indicates whether a 200 ppm instantaneous surface methane standard is feasible and does not result in potential adverse impact(s) on landfills and their control systems.

CalRecycle staff continues collaboration with ARB, OEHHA, California Energy Commission, and the CPUC in implementing AB 1900 and AB 2196 to maximize the safe and economically viable recovery of solid waste-related bioenergy resources.

ARB staff will work with U.S. EPA to avoid, or minimize the potential for duplication and/or inconsistencies between the Landfill Measure and USEPA's draft revised rule for MSW landfills.

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Promote the Beneficial Use of Landfill Gas

Special incentives, such as tax breaks or grants, may encourage landfill owners/operators to switch from installing inexpensive flares to more costly LFGTE systems. Landfills located close to pipelines should be identified and the feasibility of using their gas for injection into pipelines evaluated.

To incentivize and negate profitability issues, it would be helpful to have incentive payments and/or grant programs for projects that would reduce waste to landfills and also reduce GHG and co-pollutants emissions.

However, incentives for LFGTE systems may have an unintended consequence of promoting landfilling of organic waste in lieu of moving organics to composting, anaerobic digestion, and other non-landfilling alternatives and impacting the 75 percent recycling goal.

Greater Diversion of Readily Recyclable Materials

It would be helpful to increase markets for compost and remanufactured products and accelerate the deployment of anaerobic digestion projects. This may be accomplished via incentives or requirements for the targeted increased procurement by state agencies.

Consider ARB regulations requiring phasing organics out of landfills and moving toward inert only landfilling practices.

Consider whether landfills should be included in the Cap-and-Trade.

B. Long-Term

Further Research

- Research to improve our understanding on landfill gas collection efficiencies should be solicited in order to evaluate “typical” collection efficiencies at landfills within California. The impact on collection efficiencies for these landfills resulting from implementation of the Landfill Measure should be further evaluated.
- Research on the technologies needed, as well as education, to provide the needed education and outreach of contamination free feedstock for the processes.
- Develop contract concept(s) and funding source for statewide characterization of landfill methane emissions by best available direct measurement methods and validation of Inventory models.

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- Research and demonstration projects for methane capture equipment(s) and technology to convert it to commercial LNG are needed.

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Appendix B: Waste Management Sector Listing of Follow-Up Actions January 2014

The table below provides ARB and CalRecycle staff's current listing of follow-up actions identified in the six technical papers: *Recycling, Reuse, and Remanufacturing; Composting and Anaerobic Digestion; Biomass Conversion; Municipal Solid Waste Thermal Technologies; Landfilling of Waste; and State Procurement*. The table is meant to serve as a guide to aid agencies, industries and the public in the ongoing process of information gathering and analysis. The table below presents an initial set of potential actions and the estimated timeframe for completing these actions. Any actions taken by state and local agencies that result in the development of regulations or an action that must receive discretionary approval will undergo a full environmental review as mandated by CEQA.

High priority activities to receive focused attention are shown in green highlights. High priority actions already underway are highlighted in pink. Other actions will be pursued as incoming data merit and as resources permit.

Category/Task	Actions	Timeframe
1. Emission Reduction Factors	a. Revise compost emission reduction factors to include avoided landfill emissions as well as compost emissions	Short term/in progress by early 2014
	b. Develop new emission reduction factors for aerobic and anaerobic digestion that include avoided landfill emissions as well as digestion process emissions	Short term/2014
	c. Develop emission reduction factors for additional materials that can be recycled (carpet, paint, rubberized asphalt concrete, others)	Short term/2014
	d. Update emission reduction factors for landfills, including avoided methane emissions for organics that are shifted to non-landfill alternatives	Short term/mid-2014
	e. Consider any additional quantifiable data on end use of exported recyclables and incorporate into updates of existing emission reduction factors as needed and development of new emission reduction factors	Short term/2014-2020, ongoing element
2. Permitting	a. Work with State agencies, air districts, jurisdictions, and U.S. EPA to address conflicting or redundant requirements, including cross media and multi-jurisdictional issues	Short term/mid-2014, ongoing element
	b. Identify challenges and recommend adjustments to improve permitting process for new and upgraded facilities – develop programmatic EIRs and/or model permit and guidance documents to assist in environmental review and CEQA	Short term/2013-2014 (compost), 2013-2015 (AD)

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	c. Work with Institute for Local Government and others to develop industry specific web-based tools for planning and permitting guidance	Short term/mid-2015, ongoing element
	d. Investigate opportunities for co-location of organics processing at POTWs and landfills	Short term/mid-2015, ongoing element
	e. Work with the Regional Water Quality Control Boards regarding use of digestate on farmlands	Long term/ongoing through 2025
	f. Assist Water Board in air quality impact analysis for the Composting General Order EIR	Short Term/2014
3. Funding & Incentives for Infrastructure (also see Category 8)	a. Investigate various funding sources, including the potential use of Cap & Trade auction funds, for incentives, grant and loan programs for new projects and existing facility improvements to meet air, water, and EJ goals and to develop sustainable low-carbon waste management systems to handle waste shifted from landfills to compost, anaerobic digestion, biomass, recycling, remanufacturing and other technologies	Short term/2013-2014, ongoing element
	b. Identify opportunities to make instate baseload renewable electricity production more competitive through feed-in tariffs, direct access agreements, and other financial mechanisms	Short term/2013-2020
	c. Continued implementation support of AB 118 funding for anaerobic digestion projects	Short term/2014-2015, ongoing element
	d. Continue to provide regulatory certainty that fuel produced from anaerobic digestion of organic waste can qualify for Low Carbon Fuel Credits. Continue developing Low Carbon Fuel Standard (LCFS) pathways of waste-derived fuels including "wet" AD and wastewater facility biomethane production for Low Carbon Fuel Credits for anaerobic digestion	Short term/2013-2015, ongoing element

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	<p>e. Pursue expanded sustainable financing for infrastructure development for recycling, composting, anaerobic digestion, and biomass projects:</p> <ul style="list-style-type: none"> a. Expand RMDZ program (including recapitalization & fund stabilization) b. Obtain GoBiz support and expand technical support c. Identify, prioritize, and establish a timeline for developing offset protocols for recycling, composting, anaerobic digestion or other bioenergy processes d. Establish remanufacturing incentive payments, grant programs, or product stewardship programs to manage high-GHG commodities e. Support tax credit legislation to benefit remanufacturers in California 	<p>Short term/2014-2015, ongoing element</p>
	<p>f. Establish incentive programs geared to biomass conversion projects, including gasification projects, possibly through Cap-and-Trade revenues</p>	<p>Short term/2014-2020</p>
	<p>g. Encourage that the EPIC fund is devoted to new bioenergy facilities. Explore tax credits</p>	<p>Short-midterm/2014-2020</p>
	<p>h. Investigate the costs, application process, and potential improvements associated with interconnection to the transmission grid from biomass conversion projects</p>	<p>Short-midterm/2014-2020</p>
	<p>i. Identify landfills close to pipelines and evaluate economic feasibility of biogas injection for existing waste-in-place. Continue work with CPUC on pipeline injection issues. See 9c</p>	<p>Short term/2014-2015</p>
	<p>j. Monitor the Renewable Market Adjusting Tariff to assess whether it incentivizes new bioenergy projects</p>	<p>Short-midterm/2015-2020</p>
	<p>k. Investigate the feasibility of criteria pollutant offset banks for new composting & AD facilities and the generation of offsets by upgrading existing facilities to reduce emissions</p>	<p>Short-midterm/2015-2020</p>
	<p>l. Evaluate pros and cons of incentivizing municipal solid waste thermal technologies (MSW Thermal) by allowing renewable energy credits</p>	<p>Short term/2014-2015</p>

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4. Public Education /Acceptance	a. Initiate focused public education and outreach addressing: goals of waste sector, benefits of recycling/remanufacture in California, collection of cleaner recyclable commodities, need for contamination-free feedstocks, reducing carbon footprint through increased recycling, and purchasing California recycled products	Short term/2013, ongoing element
	b. Educate project developers about next generation organic processing facilities that minimize odors and emissions and can be sited closer to urban centers	Short term/2013-2020, ongoing element
	c. Foster State, local, and private cooperation in achieving Waste Sector Goals	Long term/ongoing through Mid-term
	d. Evaluate effectiveness of education programs and modify as needed	Long term/2015, ongoing element
	e. Provide education on State procurement requirements to all State agency purchasing officials and all staff within agencies, as well as state contractors, who purchase materials	Short term/2013-2020, ongoing element
5. Markets/Quality of Products	a. Evaluate feasibility of maximizing recovery potential by establishing performance standards for MRFs and C&D facilities to recover higher-quality commodities	Short term/2013-2020
	b. Support development of advanced processes and/or equipment that enables cost effective removal of contaminants from the organics waste stream, particularly glass and plastic	Short term/2013-2020
	c. Increase markets for anaerobic digestion and compost products by investigating potential financial incentives for increased usage of compost and anaerobic digestion products. See 8a.	Short term/late 2013/early 2014
	d. Work with industry to standardize quality specifications for products from composting and anaerobic digestion	Long term/ongoing through 2025
	e. Identify and support markets for recycled, reused, and remanufactured materials	Short term/ongoing through 2035
	f. Work with stakeholders to promote the sorting of urban organics	Short-midterm/2013-2020
	g. Create system to verify PCRC of products, identify suppliers of PCRC products, and track State procurement; require manufacturers and suppliers to disclose product environmental information	Short-midterm/2013-2020
6. Sustainability	a. To maximize the effectiveness of recycling, composting, and AD programs, investigate establishing front-end processing standards for waste sent to MSW-thermal plants	Short term/2013-2015

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	b. Promote source reduction principles into packaging and product design; foster recycling and recyclability as a front end design parameter for packaging and products that cannot be reduced; maximize recycling markets	Long term/ongoing element
	c. Evaluate opportunities to source reduce and promote reuse of materials	Long term/ongoing element
	d. Develop new product stewardship programs(e.g., mattresses)	Long term/ 2013-2020/ongoing element
7. Research		
	a. Improve characterization of direct and avoided GHG emissions from composting and anaerobic digestion and from compost use	Short term/late 2013-2014
	b. Investigate and determine the most suitable uses for digestate from anaerobic systems	Long term/2015, ongoing through 2025
	c. Support research and development projects demonstrating best management practices for composting, anaerobic digestion, and remanufacturing of non-organic materials such as carpet, plastics, and construction materials.	Long term/2015, ongoing through 2025
	d. Pursue research into development and commercialization of emerging biomass conversion and thermal technologies	Long term/ongoing through 2025
	e. Conduct additional research for safe and beneficial uses of MSW/ biomass ash and biochar	Long term/2025
	f. Investigate carbon sequestration and water savings potential of compost use in agricultural settings including irrigated croplands, rangelands, and natural lands.	Short term/2014-2020
	g. Evaluate possible research to improve understanding of landfill gas collection efficiencies	Long term/ongoing through 2025
	h. Conduct statewide characterization of landfill methane emissions and criteria pollutants by best available direct measurement methods and validation of inventory models	Long term/ongoing through 2025
	i. Support research and demonstration projects for methane capture equipment and technology to convert it to commercial LNG	Short term/ongoing through 2025
8. Cap and Trade		
	a. Consider use of Cap and Trade auction funds for infrastructure development	Short term/late 2013/early 2014
	b. Review benchmarks for capped recycling and remanufacturing facilities. Determine if Cap-and-Trade program can incentivize greater use of recyclable, organics, or other materials that are currently landfilled.	Short term/late 2013/early 2014
	c. Determine status of MSW-Thermal facilities in Cap-and-Trade	Short term/late 2014
	d. Review landfills for inclusion in Cap-and-Trade	Short term/late 2014
	e. Investigate opportunities to incentivize greater use of recyclable materials at facilities under Cap and Trade	Short term/late 2014

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9. Regulatory and Statutory	a. ARB and CalRecycle should lead the development of program(s) to eliminate disposal of organic materials at landfills. Options to be evaluated will include: legislation, direct regulation, and inclusion of landfills in Cap-and-Trade. If legislation requiring businesses that generate organic waste to arrange for recycling services for that waste is not enacted in 2014, then the ARB, in concert with CalRecycle, will initiate regulatory action(s) to prohibit/phase out landfilling of organic materials with the goal of beginning compliance actions in 2016.	Short term/2014-2015
	b. Investigate regulatory options to further reduce GHG emissions at landfills such as incorporating BMPs and establishing lower methane emissions standards	Short term/2013-2015
	c. Monitor and participate in potential regulatory changes that could address the cost, timelines, and other hurdles to interconnecting to the electricity grid. (See also 3i)	Short term/ongoing through 2020
	d. Investigate the feasibility and impact of not allowing the use of green waste Alternative Daily Cover (ADC) to count as diversion	Short term/2013-2020
	e. Consider mandatory organic waste recycling for large commercial generators; for small commercial and residential generators. (See also 9a)	Short term/2013-2014 (large), 2016-2017 (small, residential)
	f. Consider amending CalRecycle regulations for composting and anaerobic digestion of food materials and other highly putrescible wastes	Short term/2014-2015
	g. Evaluate/recommend amendments to SABRC statutes for State procurement (include more products with recycling or GHG implications; revise minimum percentages; include Community Colleges and University of California; require State contractors to meet same purchasing requirements as State agencies; establish enforcement mechanism for non-compliance)	Short term/2013-2020