Climate Friendly Purchasing Toolkit

Construction

Asphalt

&

Concrete

www.westcoastclimateforum.com

Tuesday, May 17, 2016

West Coast Climate
& Materials Management Forum

West Coast Climate and Materials Management Forum

The West Coast Climate and Materials Management Forum is an EPA-convened collaboration of state, local, and tribal government

- Develop ways to institutionalize sustainable materials management practices.
- Develop tools to help jurisdictions reduce the GHGs associated with materials

West Coast Climate & Materials Management Forum

Check out the Forum's Resources

- Original Report Connecting MatIs/Climate
- Research Summaries
- Turnkey Materials Management Presentation
- Climate Action Toolkit
- Food Too Good to Waste Toolkit
- Climate Friendly Purchasing Toolkit
- www.westcoastclimateforum.com

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West Coast Climate Forum
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Climate Friendly Purchasing Toolkit: Asphalt and Concrete

Speakers

Jenifer Willer
City of Eugene
Jenifer.M.Willer@ci.eugene.or.us

Jordan Palmeri
Oregon DEQ
palmeri.jordan@deq.state.or.us

Moderator

Wes Sullens
StopWaste
AlamedaCounty
wsullens@stopwaste.org

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Climate Friendly Purchasing Toolkit

Climate Friendly Purchasing Toolkit

Harnessing the power of public purchasing to reduce Greenhouse Gas (GHG) Emissions

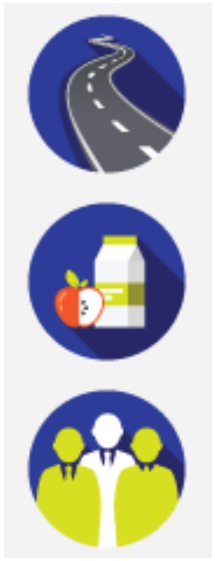
The Climate Friendly Purchasing Toolkit provides clear guidance, tested strategies, and critical resources for governments at all levels to reduce the GHG emissions through their supply chain.

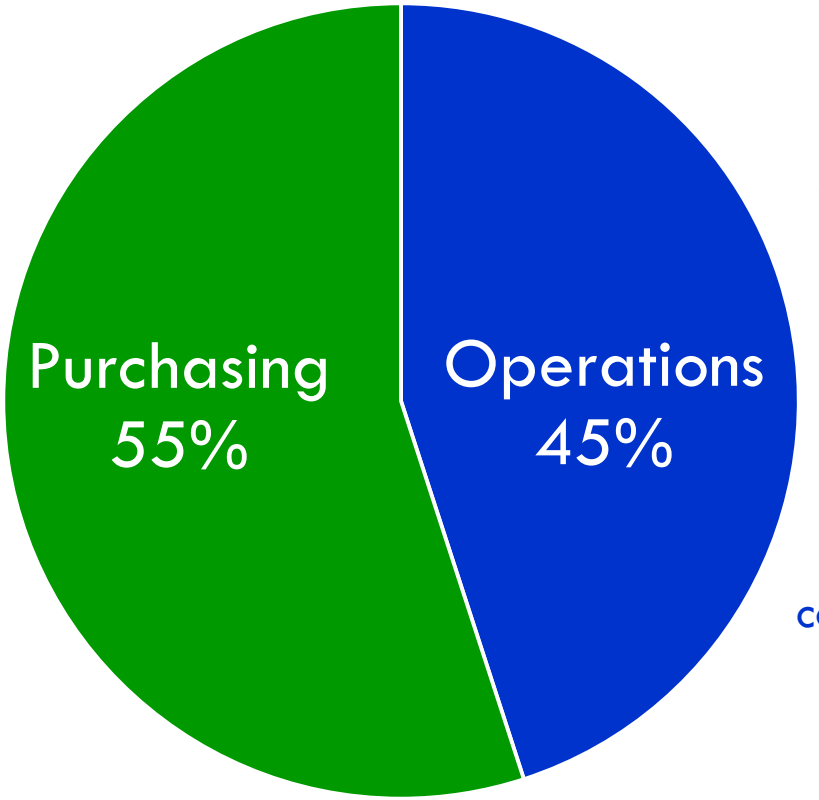
Learn More

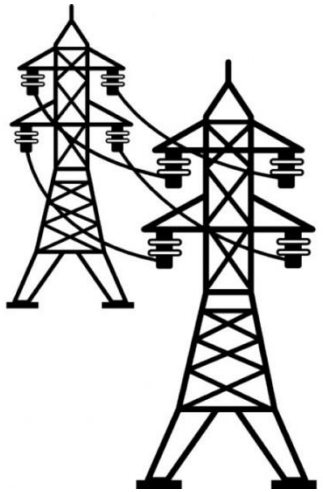
Public Institution Purchasing Power

Governments, collectively, spend over ***1.6 trillion dollars year***

GHG Emissions from Public Institutions







Examples:
Use of electricity,
company owned cars, etc.

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Toolkit Goals

Toolkit Goals:

- Reduce carbon footprint from purchases
- Identify the most carbon-intensive products and services
- Provide how-to guide for purchasing professionals

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Scope of Toolkit

- Cities, counties, public utilities, higher education
- Carbon lens
- Modular

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Toolkit Modules

- Construction
- Asphalt
- Concrete
- Carpet & Flooring
- Food
- Fuels
- Information & Communications Technology
- Professional Services

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Wes Sullens
StopWaste
AlamedaCounty
wsullens@stopwaste.org

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THANK YOU

- Fall Webinars:
  - Carpet, Food, Professional Services.
  - Watch your email for registration
- Survey for today's webinar

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The Construction Industry

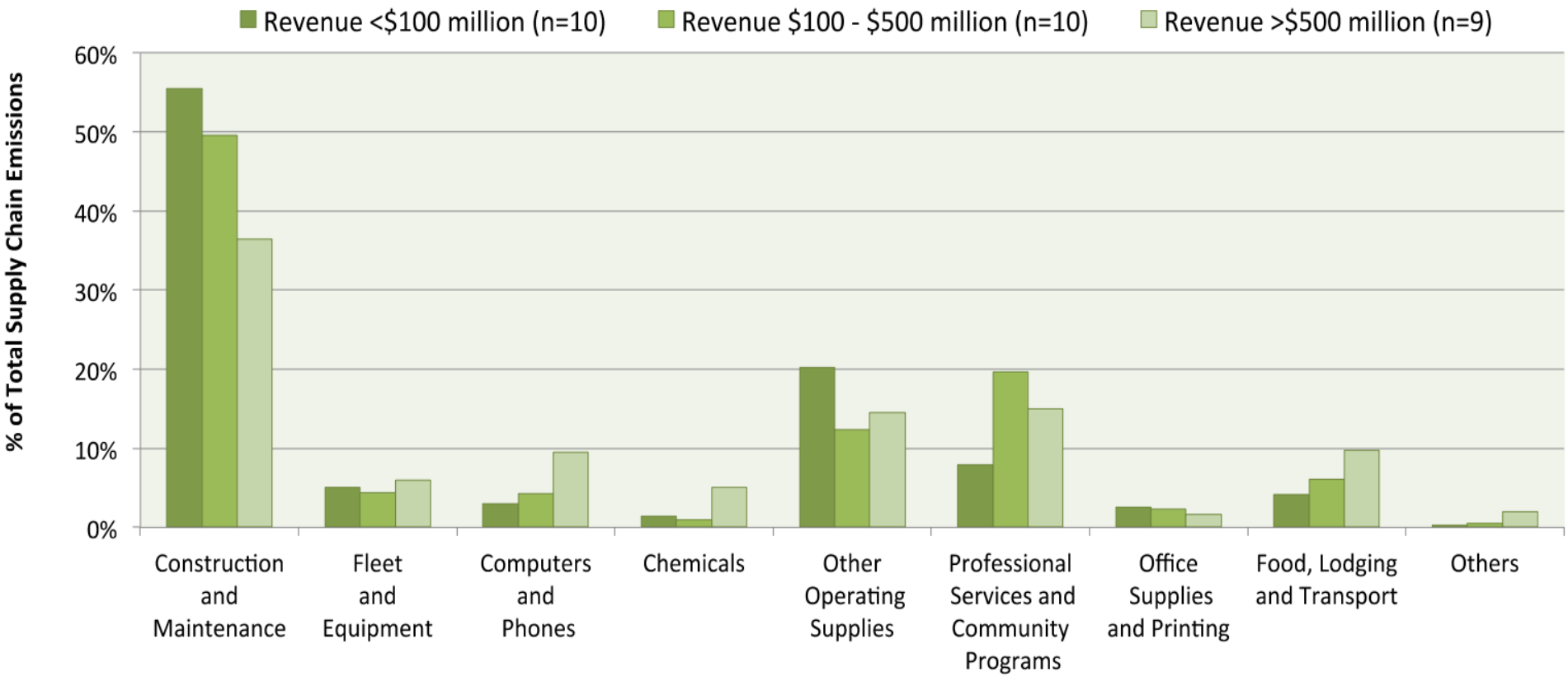
Startling Statistics

- Governments at all levels spend more than $1.3 Trillion annually on goods and services.
- Research shows that those purchases – the supply chain - account for 35-55% of the total greenhouse gas emissions associated with government operations.

- What about the construction sector specifically?

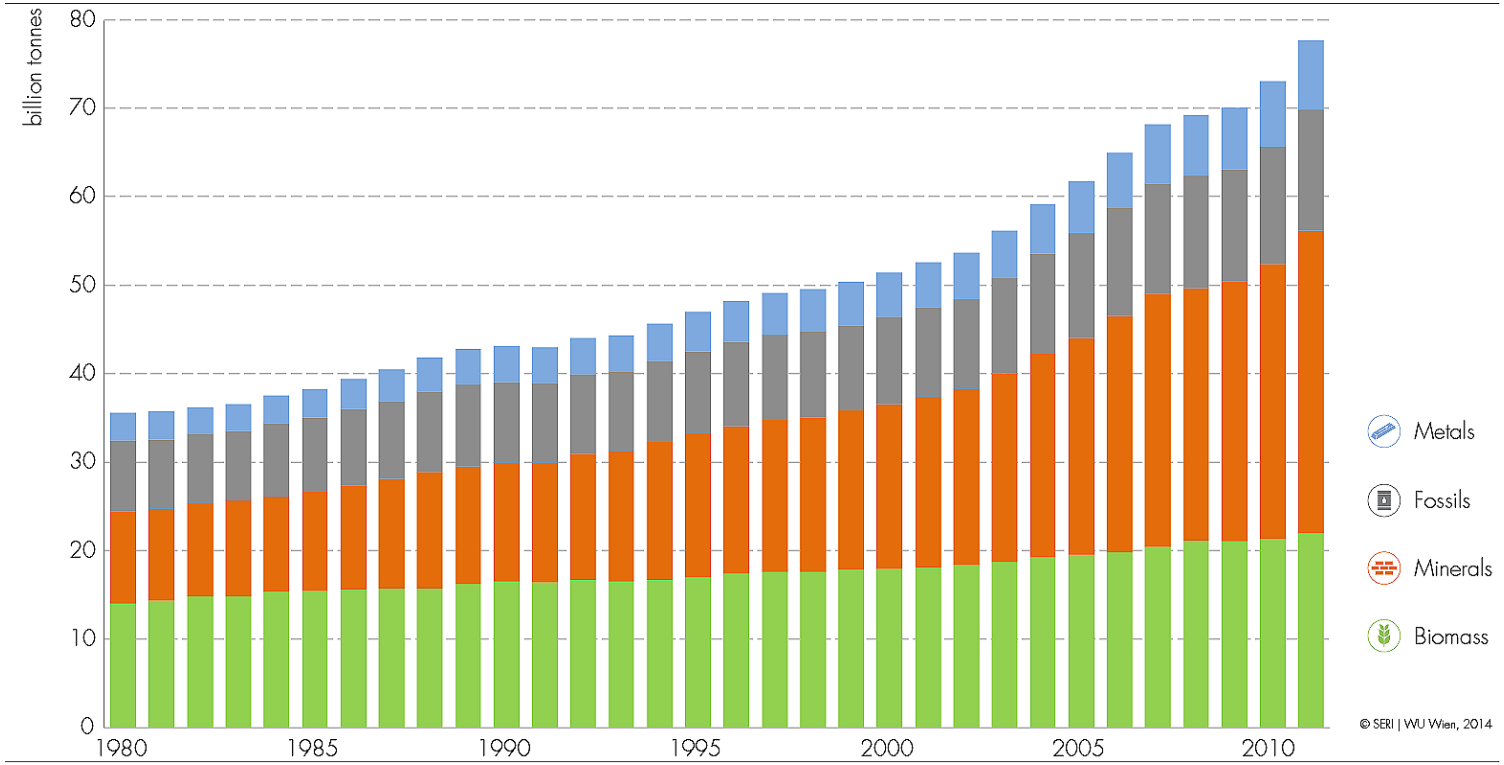
Percentage of supply chain emissions by annual revenue and purchasing category

Based on data for public agencies and institutions



Source: http://westcoastclimateforum.com/sites/westcoastclimateforum/files/related_documents/TA%20Final.pdf

Global resource extraction by material category 1980-2011



In this figure, global resource extraction (including only used materials) between 1980 and 2011 is presented.Four material categories are separately shown: metal ores, industrial and construction minerals, fossil fuels and biomass (from agriculture, forestry and fishery).

Resource extraction has doubled since 1980 worldwide, and nearly tripled for the construction and industrial sectors

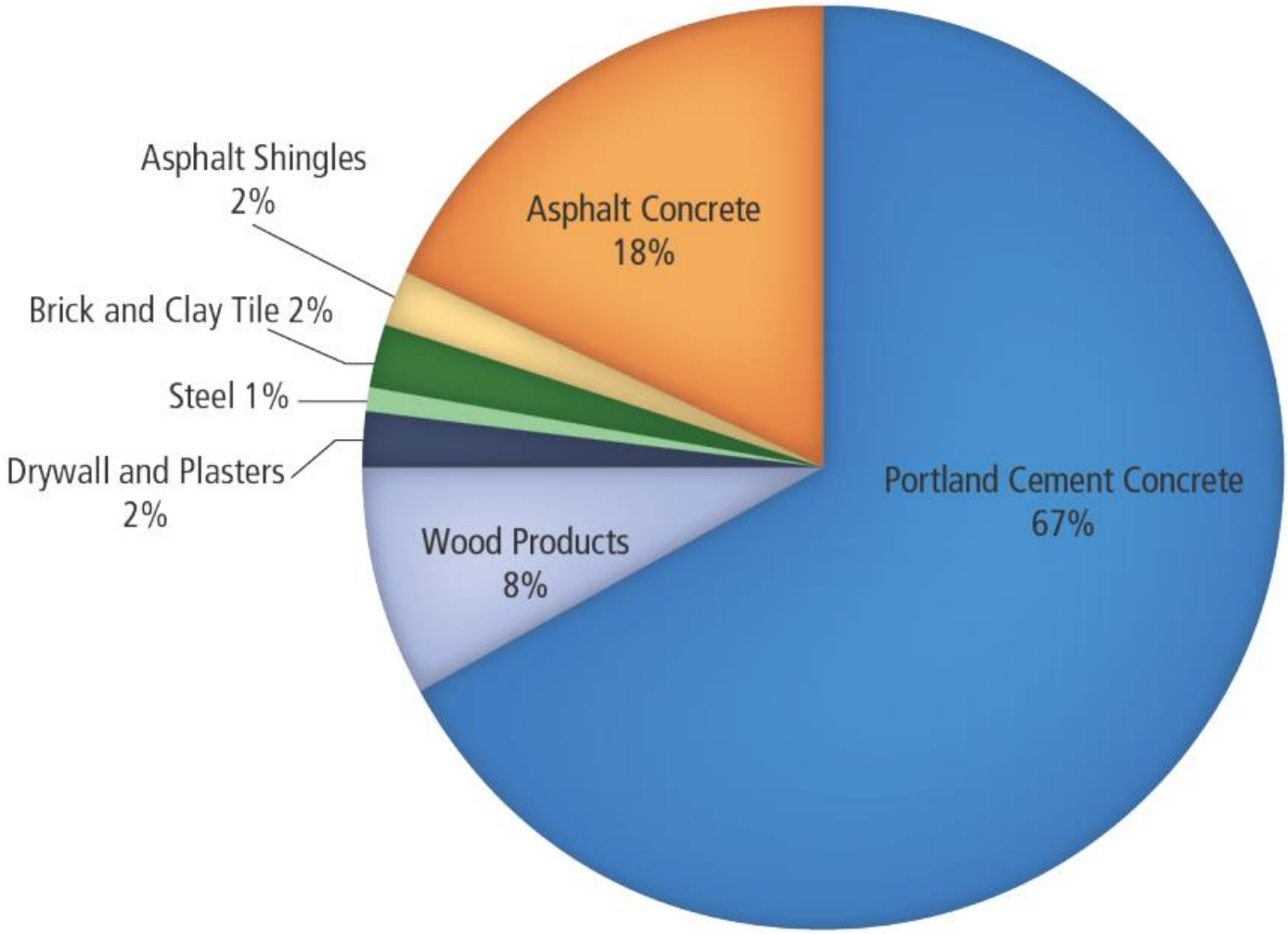

10-15% of building materials are wasted during the construction process
Image © businessmirror.info


The use of our buildings account for
38% of all CO_2 emissions and
73% of electricity consumption
image © targetcareers.co.uk

530 million tons of construction and demolition (C&D) debris were generated in the US in 2013—more than twice the amount of generated municipal solid waste

C&D Generation Composition by Material, 2013

530 Million Tons (before recycling)



Source: EPA, *Advancing Sustainable Materials Management: Facts & Figures 2013*, June 2015

Summary & Conclusions

Image © Chris Jordan

Benefits Matrix: Asphalt

		Hot-Mix Asphalt Concrete (Basecase)	*Warm-Mix Asphalt Concrete*
Cost	First Cost - Manufacturer	$	$$
	First Cost - Jurisdiction	$	$
	Ongoing/Maintenance Costs	$	$
Installation	Ease of Workability	✓	✓
	Worker Safety (from Less Exposure)	✓	✓✓
	Lead Time / Availability	Immediate	Depends
	Durability	✓	✓✓
Carbon	Virgin Materials Extraction	✓	✓
	Recycled Content Incorporation	up to 30%	35%+
	Manufacturing Phase Emissions	✓✓	✓
	Installation Phase Emissions	✓✓	✓
	Recyclability at End of Life	✓✓	✓✓

Note: Check marks and dollar signs are approximated and indicate where differences exist between the basecase and the alternative option. More checkmarks or dollar signs indicate a tendency to have greater impact or cost than a single mark. In cases where the basecase and alternative case are estimated to have the same cost or impact, those are shown with the same number dollar signs or checkmarks. This scorecard is for illustrative purposes only and results may vary based on location, availability of materials, and other factors.

Benefits Matrix: Concrete

		Portland Cement Concrete (Basecase)	*Flyash/Slag Replacement in Concrete*
Cost	First Cost - Manufacturer	$	$
	First Cost - Jurisdiction	$	$
	Ongoing/Maintenance Costs	$	$
Installation	Ease of Workability	✓✓	✓
	Worker Safety (from Less Exposure)	–	–
	Lead Time / Availability	Immediate	Depends
	Durability	✓	✓✓
Carbon	Virgin Materials Extraction	✓✓	✓
	Recycled Content Incorporation	0%	10 - 40%+
	Manufacturing Phase Emissions	✓✓	✓
	Installation Phase Emissions	✓	✓
	Recyclability at End of Life	✓✓	✓✓

Reducing Carbon Emissions From Concrete and Asphalt

All the presentations & resources can be found:

- West Coast Climate Forum: westcoastclimateforum.com
- Webinar archive: westcoastclimateforum.com/annualwebinar

Future Topics

More to come from the construction sector:

- ✧Best practices for construction waste recycling
- ✧Recycled content in the age of transparency
- ✧Updates in green codes & rating systems
- ✧Integrating green construction principles into everyday practices
- ✧Circular economy & construction materials

Wes Sullens
StopWaste
510-891-6511
wsullens@stopwaste.org

Toolkit Module: Asphalt

Reducing Carbon Emissions from Asphalt Pavement Construction

June 7, 2016

Jenifer Willer, City of Eugene

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Construction Module: Asphalt

Today's asphalt pavement outline:

- Why asphalt pavement was included in the toolkit
- The toolkit purchasing strategies in the asphalt pavement section
- Asphalt pavement section overview

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Why Asphalt Pavement?

For public institution construction projects:

- Construction emissions make up to 50% of total emissions
- Asphalt and asphalt pavements contribute about 10% to the total construction emissions

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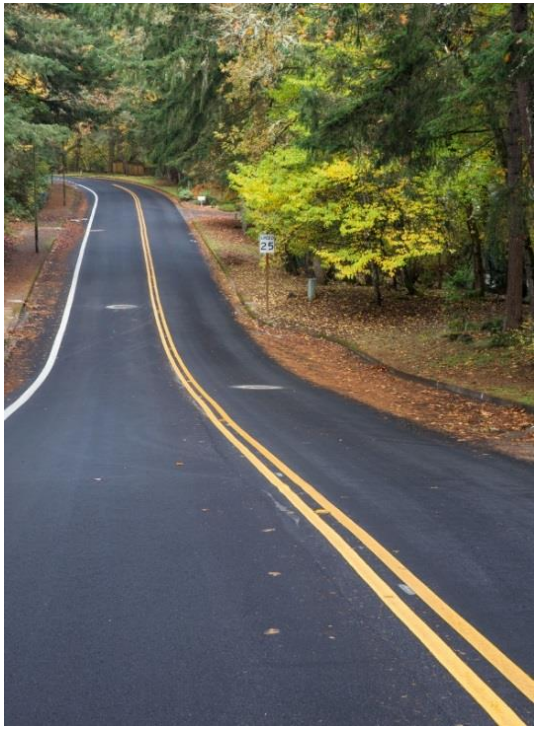
Why Asphalt Pavement?

What is asphalt pavement?

- A hard surfacing for vehicles
- Made of gravel and sand, held together with asphalt cement (the “binder”)



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Why Asphalt Pavement?

What is asphalt cement?

- A very thick liquid
- Heaviest part of crude oil after volatile and light fractions are distilled off for products like gasoline
- Needs to be “treated” to make it mixable

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Why Asphalt Pavement?

Climate Friendly Toolkit newest construction module for asphalt pavement includes:

- Warm Mix Asphalt Concrete (WMAC)
- Reclaimed Asphalt Pavement (RAP)

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Why Asphalt Pavement?

Example Asphalt Pavement Mixing Plant. Photo from Asphalt Pro Magazine (September 2012)

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The Strategies

What is warm mix asphalt pavement?

- Asphalt pavement is produced and placed at 50 to 100°F lower than conventional hot mix asphalt.
- Produced by a variety of technologies, primarily using a "foaming process" or additives.

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Why Warm Mix?

Warm Mix Asphalt Pavement

- Use of warm mix asphalt pavement reduces CO2e/ton of material by about 4%

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The Strategies

What is reclaimed asphalt pavement?

- Asphalt Pavement removed from existing roadways
- Ground/crushed and stockpiled for future uses
- Added to asphalt plant mixing process reducing virgin gravel and asphalt cement binder

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Why RAP?

Reclaimed Asphalt Pavement

Example RAP Content	Estimated CO2e/ton Reduction
20%	14%
30%	21%

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The Strategies

Warm Mix + RAP

Example Warm Mix + RAP	Estimated CO2e/ton Reduction
Warm Mix + 20% RAP	17%
Warm Mix + 30% RAP	24%

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Strategies: Asphalt Pavement

Two Strategies for Asphalt Pavement - Warm Mix Asphalt Concrete (WMAC) & Reclaimed Asphalt Pavement (RAP)

- Introduction
- Summary of benefits and concerns
- Best practices

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Toolkit Overview

Warm Mix Asphalt Pavement

Benefits	Concerns
• **Reduced energy use and GHG emissions** • **Cost savings from lower energy use** • **Improved working conditions** • **Long term quality**	• New equipment investment by asphalt plants or costs associated with proprietary materials • Unfamiliarity with product

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Toolkit Overview

Reclaimed Asphalt Pavement

Benefits	Concerns
• **Widely used and proven technique** • **Reduces costs, energy use and GHGs** • **Can be used in a variety of asphalt mixes** • **Improves strength and durability** • **Reduces consumption of natural resources**	• RAP can result in a very stiff and difficult to apply mixture. • Variability among RAP stockpiles

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Toolkit Overview

Purchasing Best Practices:

- Know what is available in your area and the properties of those materials
- Use a specification for the product available and the mix properties desired
- Require QA/QC of the mix

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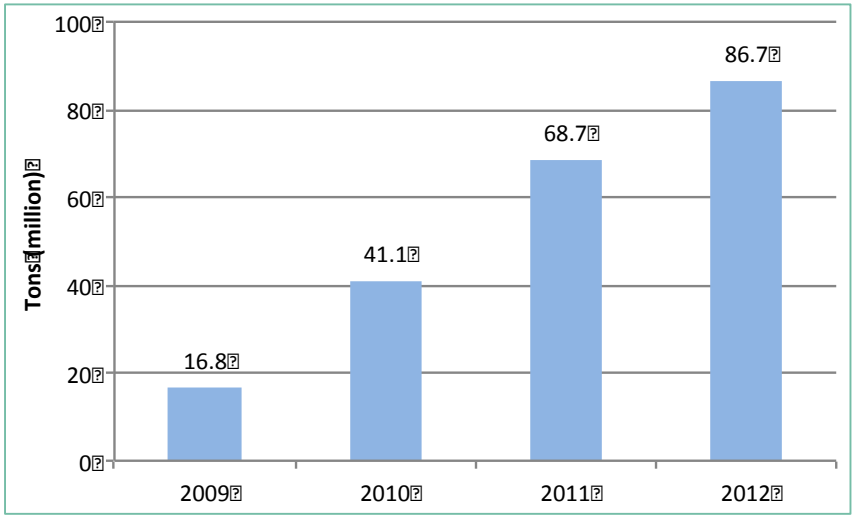
Toolkit Overview

Considerations

- Cost
- Operational Effects
- Local Availability



Use of WMAC in the U.S., 2009 - 2012

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Toolkit Overview

Measurement Resources

- Standardized analyses
- Calculators

Purchasing Resources

- Sample specifications
- Industry recommendations

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Case Study

Case Study – City of Eugene

- Using warm mix asphalt pavement and RAP mixes
- Agencies can influence materials and technology available

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Eugene

Case Study

Case Study – City of Eugene Warm Mix Asphalt Pavement & RAP

- Introduced at an Asphalt Pavement Association of Oregon annual conference
- Three pilot projects in 2009
- Standard specification in 2010
- Standard to combine with 30% reclaimed asphalt pavement, but this is increasing

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Eugene

Case Study

Case Study – City of Eugene Warm Mix Asphalt Pavement & RAP

- From 2009 – 2015, placed about 403,000 tons of WMAC + 30-35% RAP:
  - reduction of ~9,700 Metric Tons of CO_2e.
- In 2015, nearly 13,000 tons of RAP were used on capital paving projects:
  - reduction of ~750 tons of asphalt cement
  - reduction of ~12,000 tons of virgin aggregate

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Eugene

Next Steps…

- Add use of shingles to the toolbox.
- Add In-Place Reclamation to the tool box.
- Others?

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Thank You

Jenifer Willer, P.E.
City of Eugene Public Works Engineering
jenifer.m.willer@ci.eugene.or.us
(541)501-0376

Visit the Forum's website to learn more, view past webinars and sign up for the e-newsletter.

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Concrete Module

Climate Friendly Purchasing Toolkit

Webinar, June 7th, 2016 – Jordan Palmeri, Oregon DEQ

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Concrete Module Contributors

- Thank you:
  - Aron Toneys, Good Company, Eugene, OR
  - Wes Sullens, Stopwaste, Alameda County, CA
  - Shannon Davis, EPA, Region 9

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Toolkit Module: Concrete

Reducing Carbon Emissions from Concrete Purchases

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What is concrete?

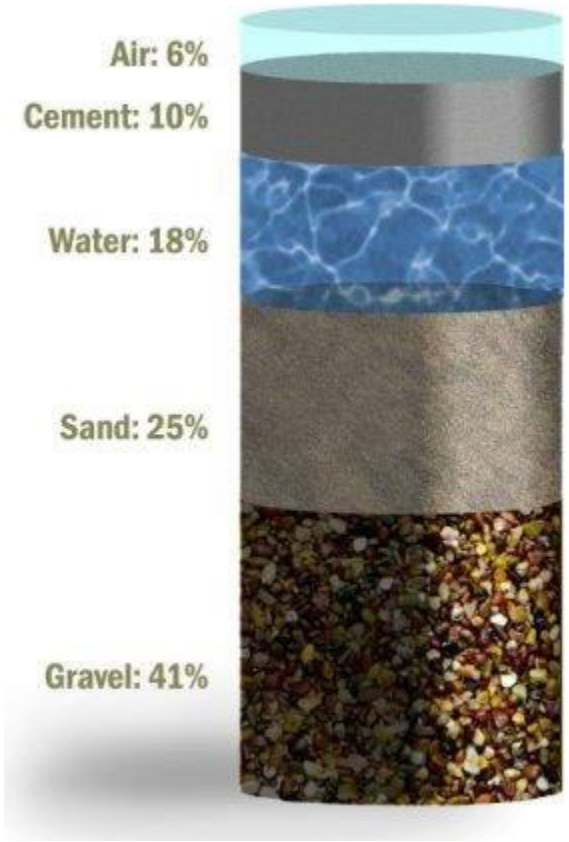

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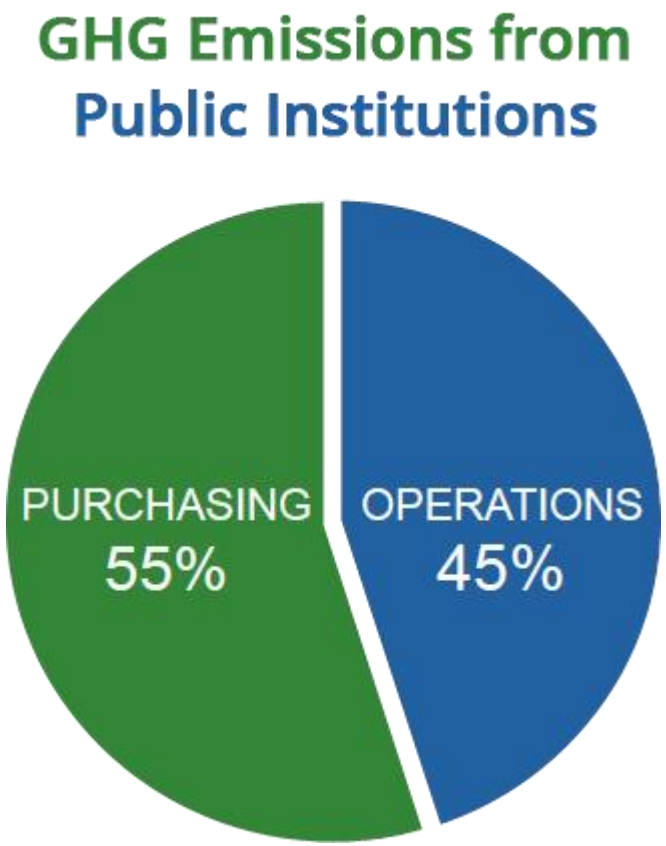
Photo: Concreteanswers.org

Why Concrete?



Concrete comprises between 5-15% of total GHG emissions.

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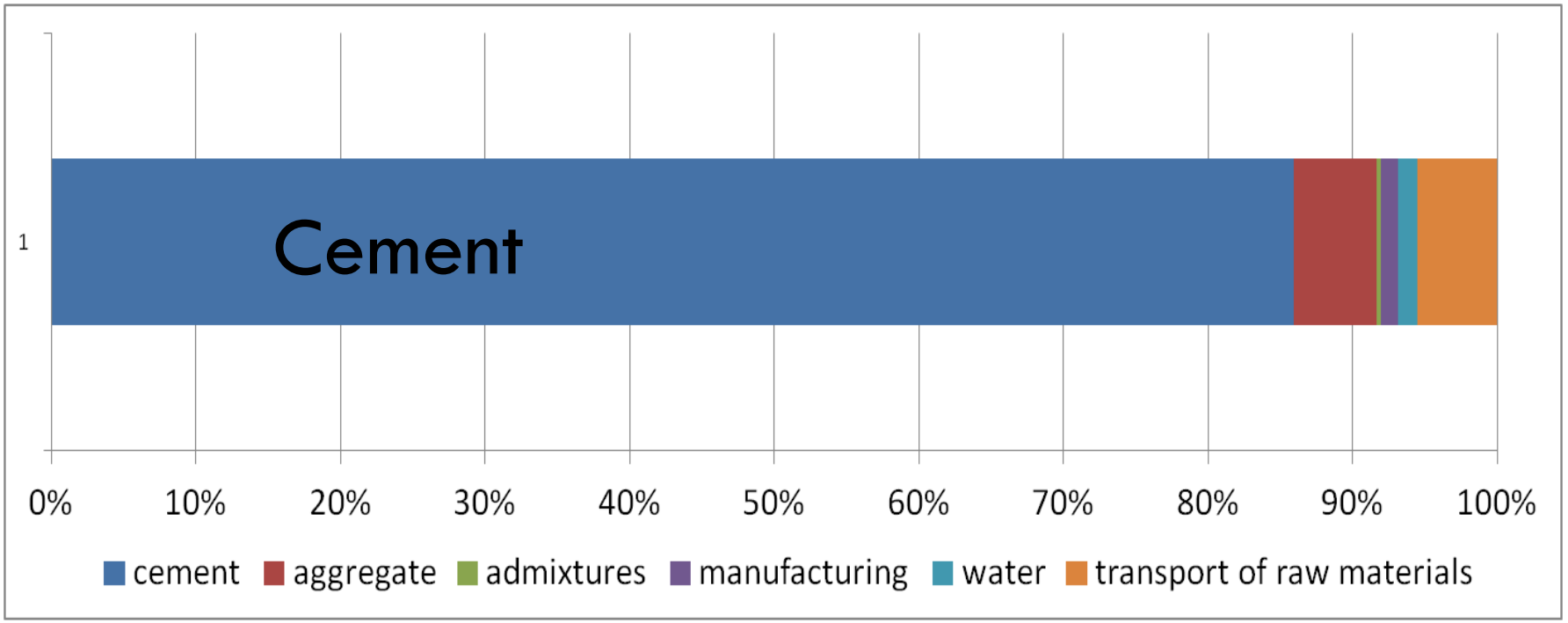
Greenhouse Gas Emission from Concrete



Source: 4000psi mix, CSI tool

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Making cement

Limestone + heat = lime + carbon dioxide

=

$$CaCO_3 \rightarrow CaO + CO_2(g)$$

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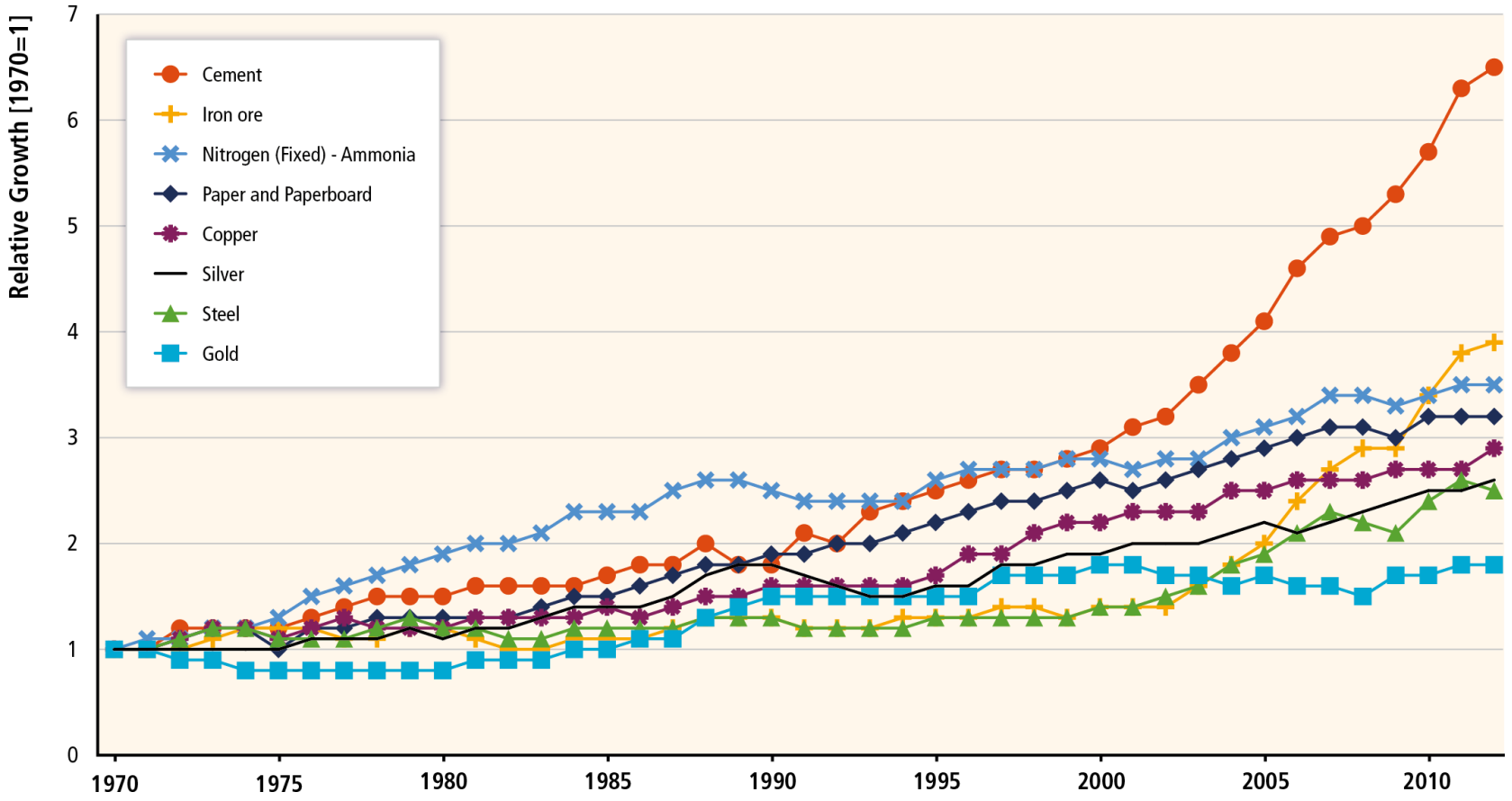
Cement Industry is Growing



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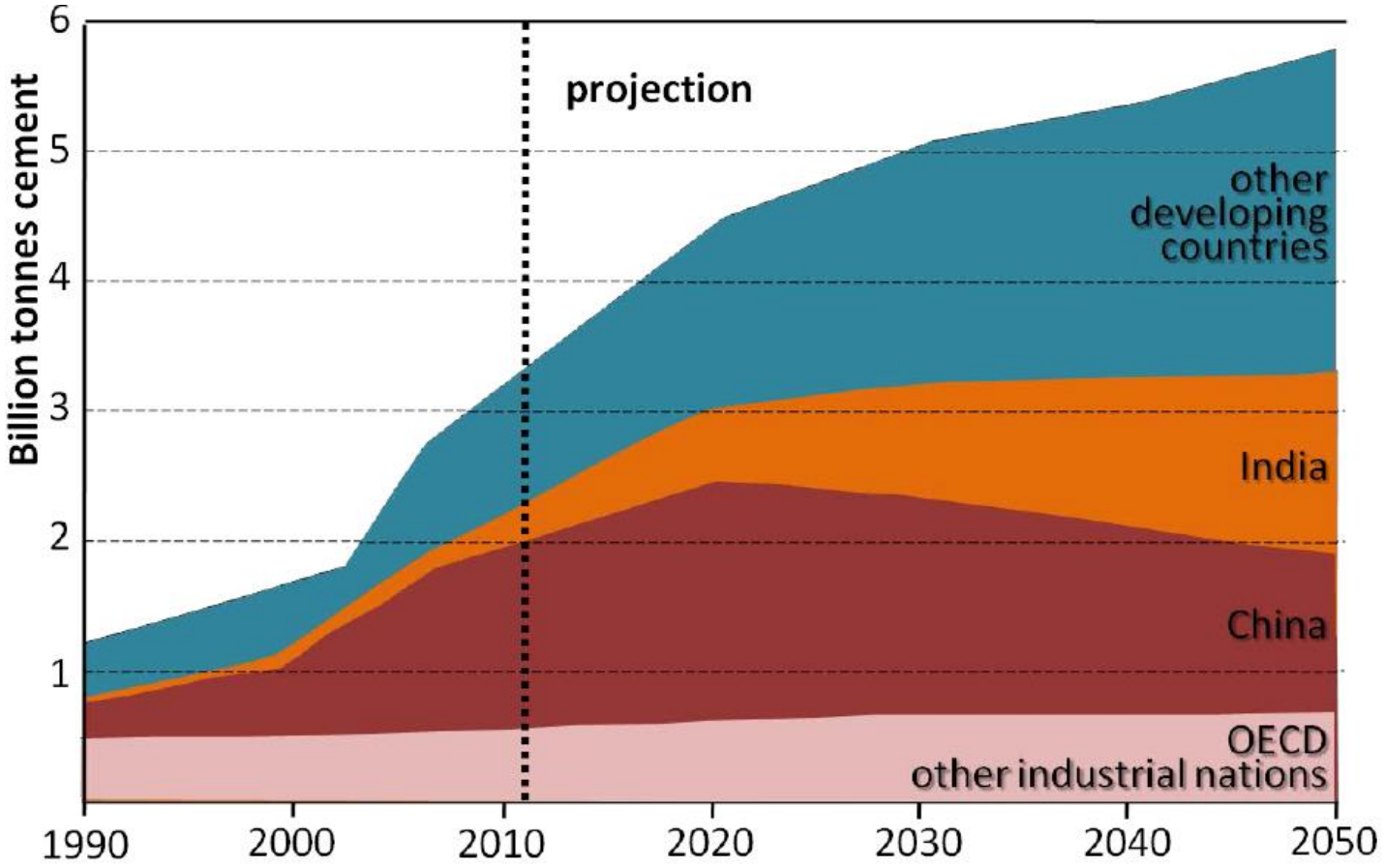
Source: IPCC AR5 Report

Cement Demand will rise



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Source: LC3.ch

Concrete-Key Purchasing Strategies

1. Request or require Environmental Product Declarations (EPDs)
2. Use Supplementary Cementitious Material (SCM)
3. Request or require recycled aggregate for concrete mixes

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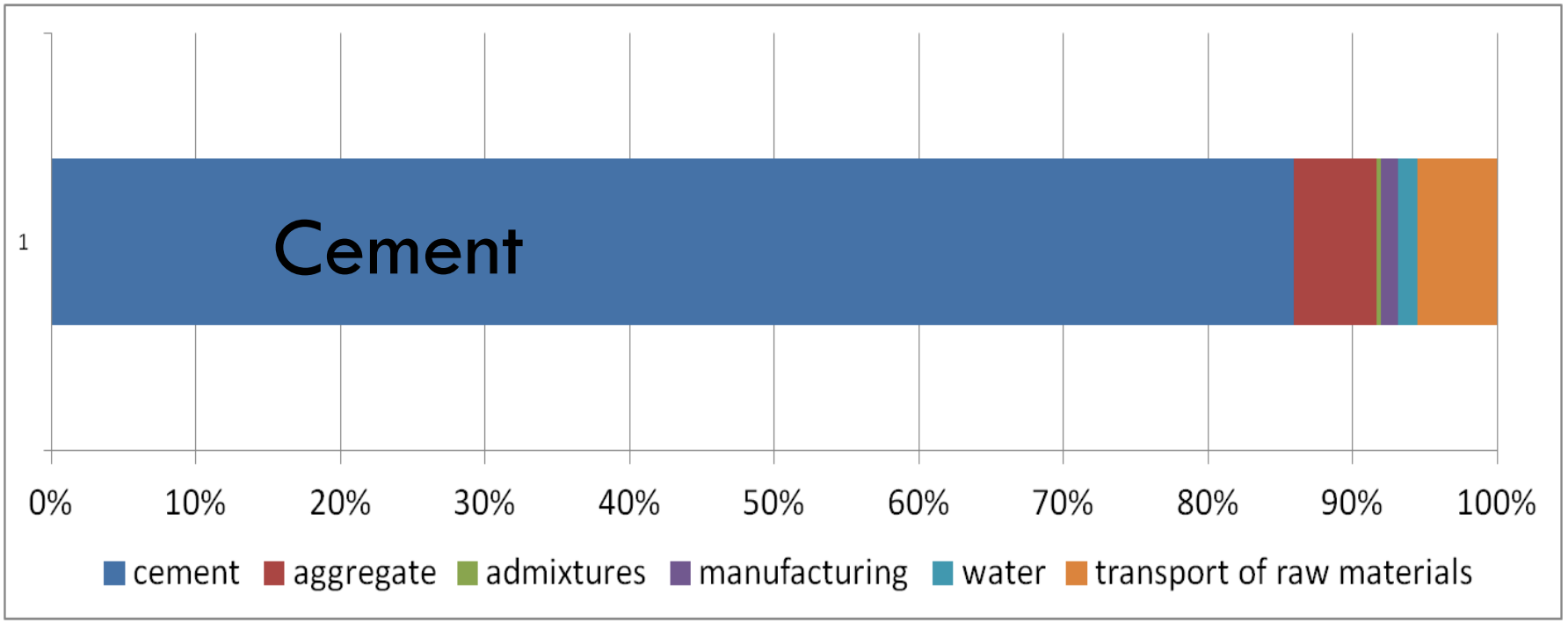
Greenhouse Gas Emission from Concrete



Source: 4000psi mix, CSI tool

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Supplementary Cementitcious Materials (SCMs)

Image: Portland Cement Association

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Supplementary Cementicious Materials (SCMs)

1. Coal fly ash
2. Granulated Blast furnace slag
3. Silica Fume
4. Natural Pozzolans
    1. Volcanic Ash
    2. Glass
    3. Calcined clay

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Fly ash benefits and concerns

Summary of Fly Ash benefits and concerns.

Benefits	Concerns
• Stronger, denser, and more durable • Less permeable to corroding water • Protects steel better than Portland cement • Reduced risk of micro cracking • Increased workability • Reduced water usage • Strength increased over time • Produces white architectural concrete	• Contains several chemicals that raise concerns about toxicity • Longer set time could delay construction times and reduce early strength • Transportation of fly ash can be cost prohibitive

COST of using SCMs = recent study showed range 8% savings to 3.5% increase in the Pacific Northwest

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Slag benefits and concerns

Summary of granulated blast furnace slag benefits and concerns.

Benefits	Concerns
• Greater workability • Reduced risk of micro cracking • Reduction of energy and GHGs • Produces white architectural concrete • Creates a higher quality concrete that is stronger, denser, and more durable	• Longer set time could delay construction times and reduce early strength • Increased risk of salt scaling • Human health and safety concerns

COST of using SCMs = recent study showed range 8% savings to 3.5% increase in the Pacific Northwest

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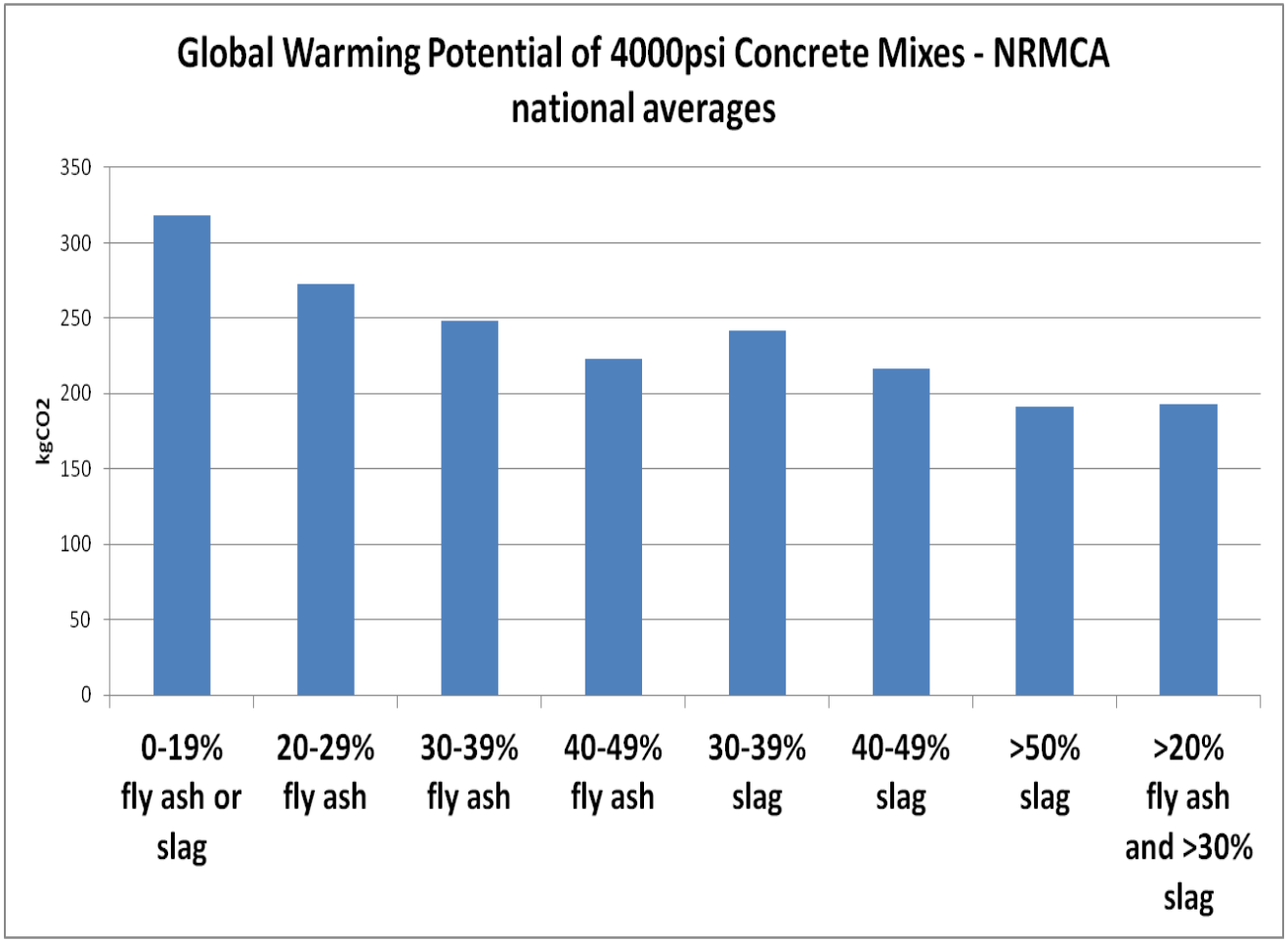
SCMs reduce carbon



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Concrete-Key Purchasing Strategies

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3. Request or require recycled aggregate for concrete mixes

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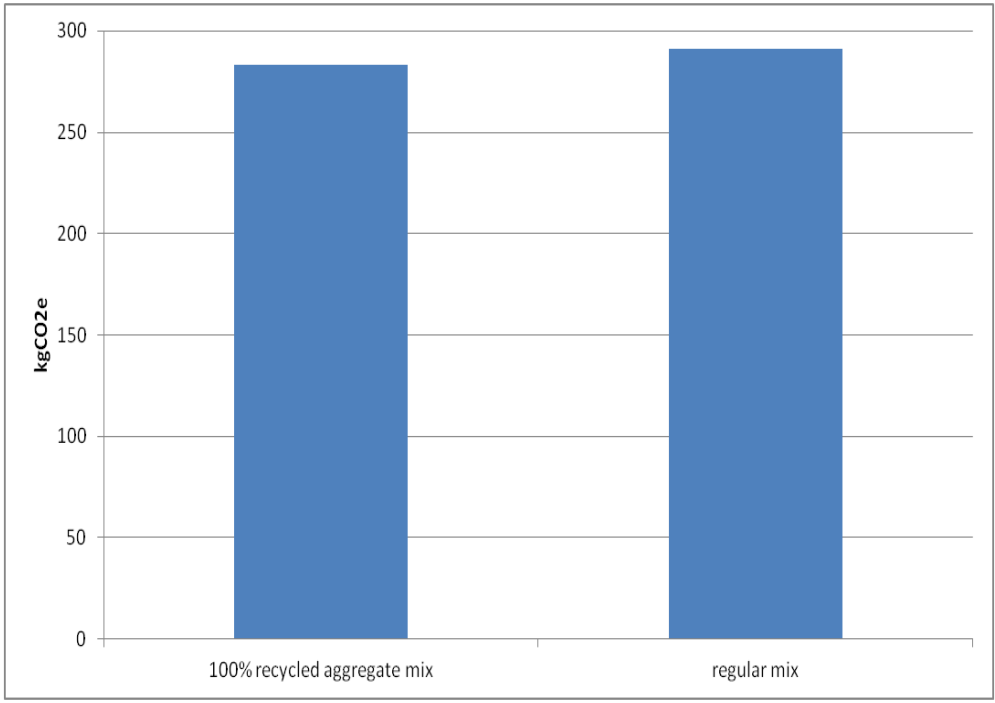
Use recycled aggregate concrete



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Concrete-Key Purchasing Strategies

1. Request or require Environmental Product Declarations (EPDs)
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3. Request or require recycled aggregate for concrete mixes

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Require minimum SCM use

City of Seattle sidewalks

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Raise allowable SCM max limits

Application	Allowed Max. Fly Ash by either WSDOT or SDOT	Actual Max. Fly Ash in WSDOT or SDOT Mixes	Allowed Max. Slag by either WSDOT or SDOT	Actual Max. Slag in Peer Agency Mixes
General Purpose	35%	25%	50%	35%
Roadway Concrete	25%	25%	25%	25%
Bridge Decks	20%	16.7%	30%	0%
Elevated Approach	20%	16.7%	30%	0%
Temp. Guide Walls	Not Specified	0%	Not Specified	50%
Underwater	35%	0%	50%	0%
Pilings / Drilled Shafts	35%	25%	50%	50%

Max SCM limits vs actual SCM use in Washington DOT and Seattle DOT projects

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Financial incentives for SCMs

Google Images

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Concrete-Key Purchasing Strategies

1. Request or require Environmental Product Declarations (EPDs)
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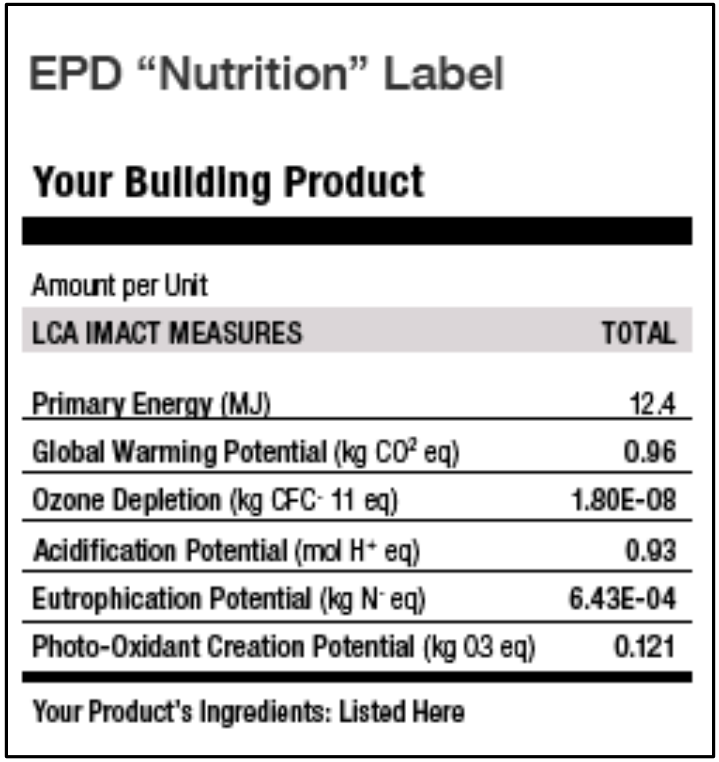
Request or Require Environmental Product Declarations (EPDs)

- Standardized ways of reporting environmental impacts of products
- Third party certified
- LEED V4 driving EPD market



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What's in a concrete EPD?

Environmental
Product
Declaration

CALPORTLAND®

CalPortland Company

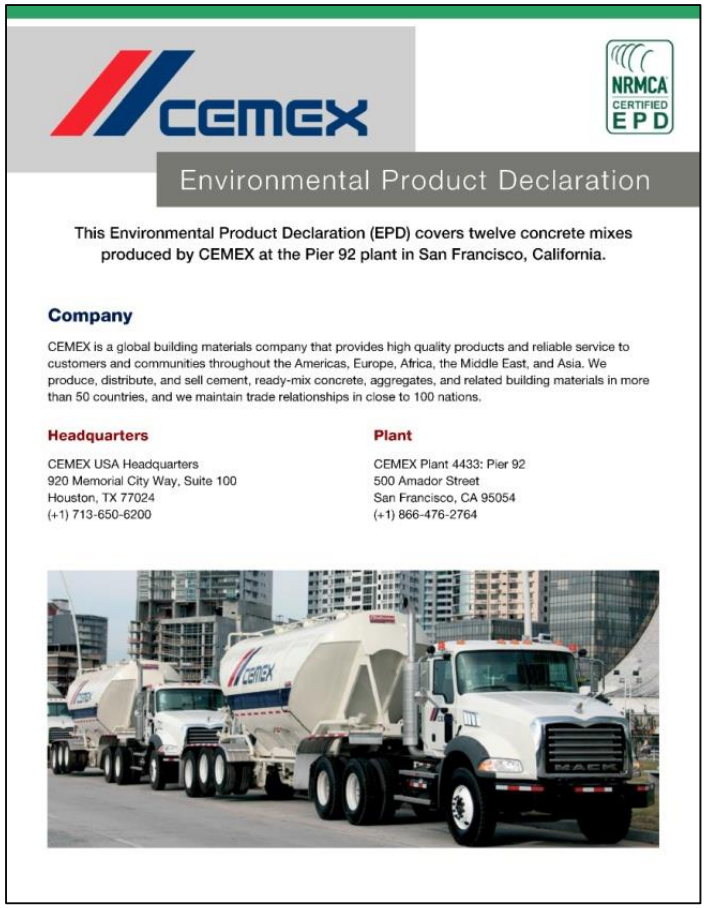
Dupont, Duwamish & Tumwater WA Plants

READY-MIXED CONCRETE

Table 5. Life Cycle Category Indicators and Inventory Metrics			
#	LCIA Indicators	Abbreviations	Units
1	Global Warming Potential (climate change)	GWP	kg CO2-eq
2	Ozone Depletion Potential	ODP	kg CFC-11-eq
3	Acidification Potential	AP	kg SO2-eq
4	Eutrophication Potential	EP	kg N-eq
5	Photochemical Ozone Creation/Smog Potential	POCP	kg O3-eq
	Life Cycle Inventory Metrics		
6	Total primary energy consumption	PEC	MJ (HHV)
7	Depletion of non-renewable energy resources	NRE	MJ (HHV)
8	Use of renewable primary energy	RE	MJ (HHV)
9	Depletion of non-renewable material resources	NRM	kg
10	Use of renewable material resources	RM	kg
11	Concrete batching water consumption	CBW	m3
12	Concrete washing water consumption	CWW	m3
13	Total water consumption	TW	m3
14	Hazardous waste	HW	kg
15	Non-hazardous waste	NHW	kg

How to use an EPD to purchase concrete

1. Reward companies that have EPDs during the bidding process with extra points
2. Require EPDs and specify either a carbon target or % reduction compared to industry averages
3. Require EPDs during bid process, select based on traditional methods, and use EPDs to obtain lowest carbon mix possible for your project


CEMEX

NRMCA CERTIFIED EPD

Environmental Product Declaration

This Environmental Product Declaration (EPD) covers twelve concrete mixes produced by CEMEX at the Pier 92 plant in San Francisco, California.

Company

CEMEX is a global building materials company that provides high quality products and reliable service to customers and communities throughout the Americas, Europe, Africa, the Middle East, and Asia. We produce, distribute, and sell cement, ready-mix concrete, aggregates, and related building materials in more than 50 countries, and we maintain trade relationships in close to 100 nations.

Headquarters

CEMEX USA Headquarters
920 Memorial City Way, Suite 100
Houston, TX 77024
(+1) 713-650-6200

Plant

CEMEX Plant 4433: Pier 92
500 Amador Street
San Francisco, CA 95054
(+1) 866-476-2764

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Contract language for EPDs

11. Provide documentation as requested by Sellen Construction Company, to achieve LEED Platinum certification of the project. Required documentation includes Environmental Product Declarations (EPDs) for all of the mixes. The EPDs will be specific to the mixes used in this project (not general industry-wide EPDs) and the EPDs will be in accordance to the requirements of the LEED version 4 credit, MRc2 (Building Product Disclosure and Optimization – Environmental Product Declarations), option 1, Product-specific Type III EPD (i.e. product's EPD has third party certification). The cost of developing EPDs is included in the unit prices.

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- 1063 Block Replacement Project, Olympia, WA
- State of Washington public office building

Oregon DEQ / OCAPA EPD Program

1. All concrete plants in Oregon get free access to a web based EPD tool
2. Technical support
3. Reimbursement for 3rd party verified EPD - $2,500/plant

DEQ
State of Oregon
Department of
Environmental
Quality

OCAPA

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Other toolkit components

- Purchasing Considerations
- SCM overview
- Emerging technologies
- Case studies

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Thank You

Jordan Palmeri
Oregon DEQ
Palmeri.jordan@deq.state.or.us
503-229-6766

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www.westcoastclimateforum.com

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