
Greenhouse Gas (GHG) Emissions

Why/What/How

King County GreenTools Training

November 6, 2014



Quantifying and Reducing Greenhouse Gas (GHG) Emissions

Outline of Presentation

- What is a GHG and why care?
 - Climate as a “top three” County priority, plus the science
- How does your work fit in?
 - Plans, commitments, other action
- GBO and GHGs
- How to Calculate
 - How to prioritize
 - Calculators and tools
 - DOT approach – Autumn Salamack, Transit Sustainability Coordinator
- How to Reduce
 - Case studies of KC projects; plus more

Executive Dow Constantine



“Our resolve on equity must be matched by our willingness to protect the environment, and to confront the changes in climate that already threaten our planet and our community...

We can no longer wait for international consensus or a dysfunctional Congress. It's on us, and we've shown that this region can set the pace.” - *2014 State of the County Address*

Executive Dow Constantine

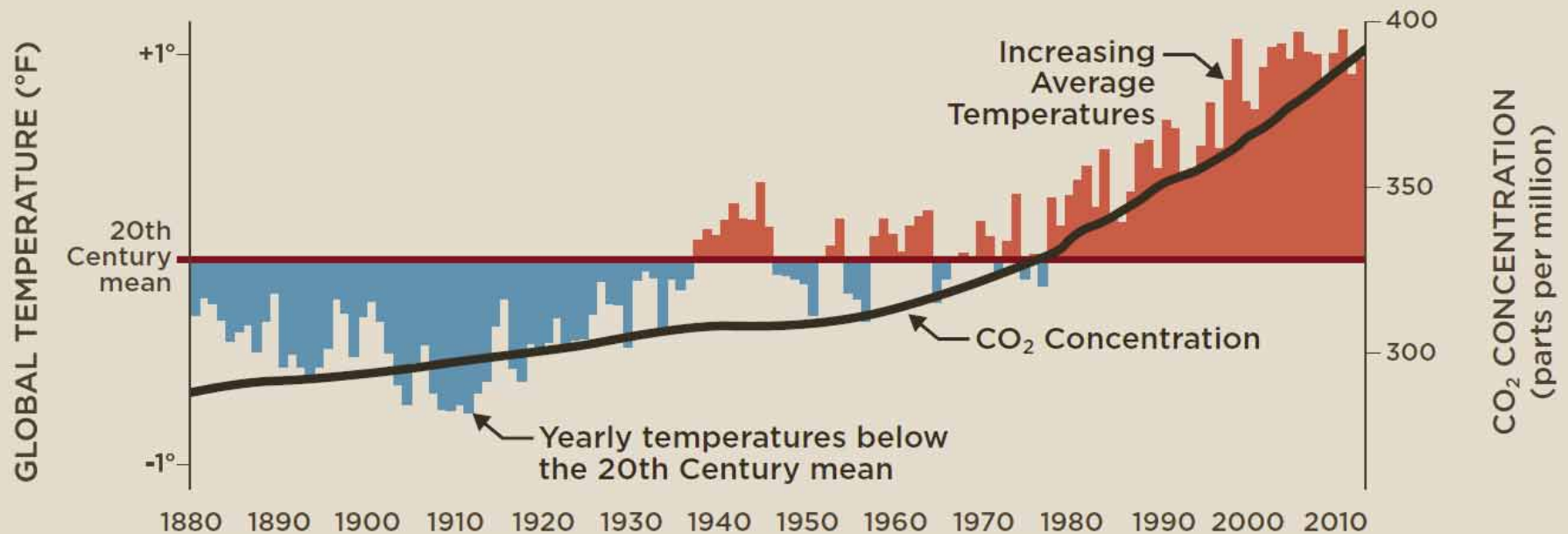


“By embracing the highest green-building standards in the nation, we are taking action to meet our goal of cutting in half the climate impact of County operations.”



WHAT IS HAPPENING ON A GLOBAL SCALE?

TEMPERATURES AND ATMOSPHERIC CARBON DIOXIDE (CO₂) LEVELS ARE RISING.



Climate change is already happening. Each of the past three decades has been warmer than the last, and warmer than any decade since we started keeping records. Sea levels are rising. Arctic ice cover is shrinking. Crop yields are changing — more often than not, getting smaller. It has been getting wetter, and storms and heat waves are getting more intense.

– *Paraphrase of observations from the IPCC Synthesis Report, November 2014*



WHAT RELATED IMPACTS ARE HAPPENING IN OUR REGION?

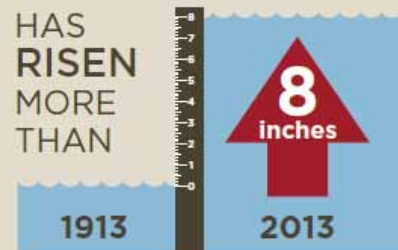
CLIMATE CHANGE IS AFFECTING OUR ENVIRONMENT, ECONOMY AND HUMAN HEALTH.

OCEANS

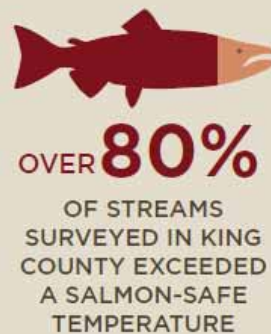
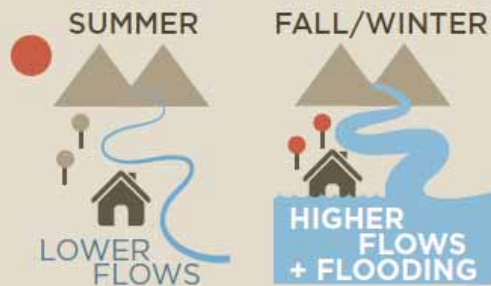
OCEAN WATER



PUGET SOUND



RIVERS



MOUNTAINS

AVERAGE CASCADE SNOWPACK



* Over the coming decades, the severity of global and local climate change impacts is largely dependent on whether greenhouse gas emissions decline or continue to rise.

WHAT IS KING COUNTY GOVERNMENT DOING ABOUT CLIMATE CHANGE?

KING COUNTY HAS REDUCED ITS OWN CARBON FOOTPRINT AND LEADS THE REGION IN BOLDER ACTION.

GREENING YOUR COMMUTE

NEW RAPID RIDE LINES

Encourage climate-friendly transportation by making Metro service faster and more reliable.

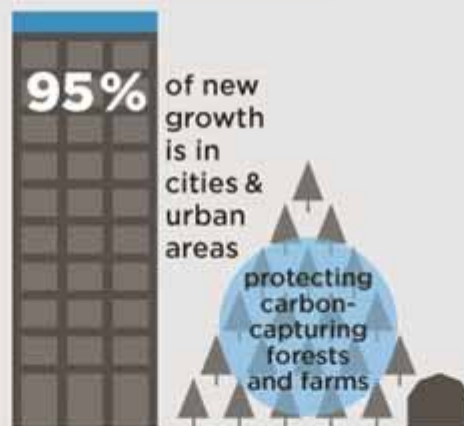


UP NEXT

Secure funding to sustain and expand buses and rail.



PROMOTING SMART GROWTH



UP NEXT

Lead the region to create vibrant, compact communities around high-capacity transit.

IMPROVING ENERGY EFFICIENCY

Achieved ambitious energy efficiency improvements through investments, realizing

\$2.6 MILLION



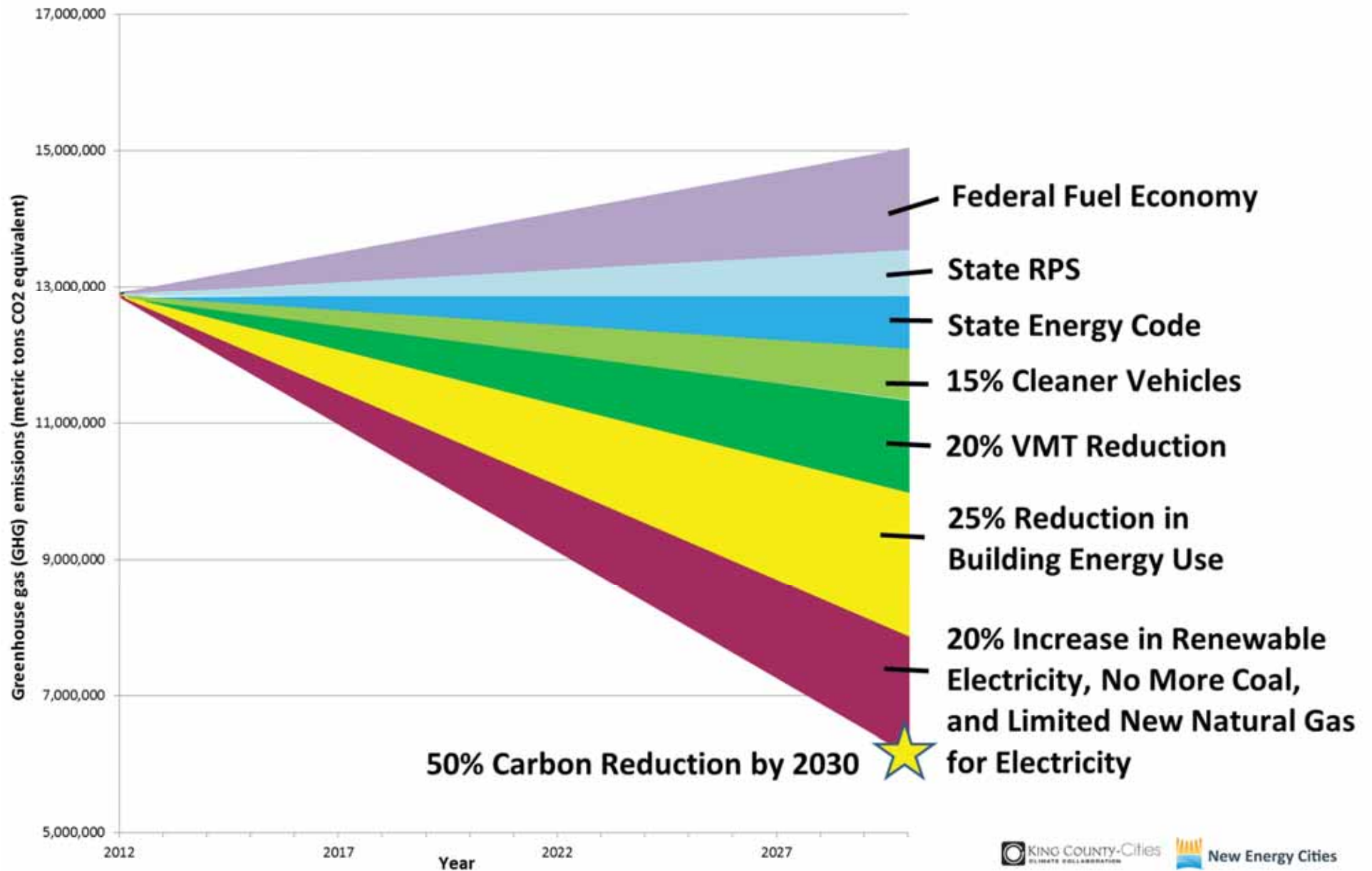
in annual savings since 2010.

UP NEXT

Increase King County's operational energy efficiency and reduce greenhouse gas emissions by 15% by 2015 (compared to 2007).



How are we going to get there?



GHGs and the GBO (17709)

Major policy changes:

- **Minimum Performance Requirements**
 - Meet Climate Action and Energy Plan requirements for emission and energy reductions
 - Reduce operational GHGs by at least 15% by 2015, 25% by 2020, and 50% by 2030; Energy use by 15% by 2015, 20% by 2020.
 - 80% C&D diversion rate by 2016, 85% C&D diversion rate by 2020
 - Use of King County Stormwater Design Manual



Required Elements

- Accounting for and mitigating GHG emissions is one of the prerequisites in the Sustainable Infrastructure Scorecard.

Required Elements - no points

eco-charrette

LCCA

account for and mitigate GHG

erosion & sedimentation control BMP

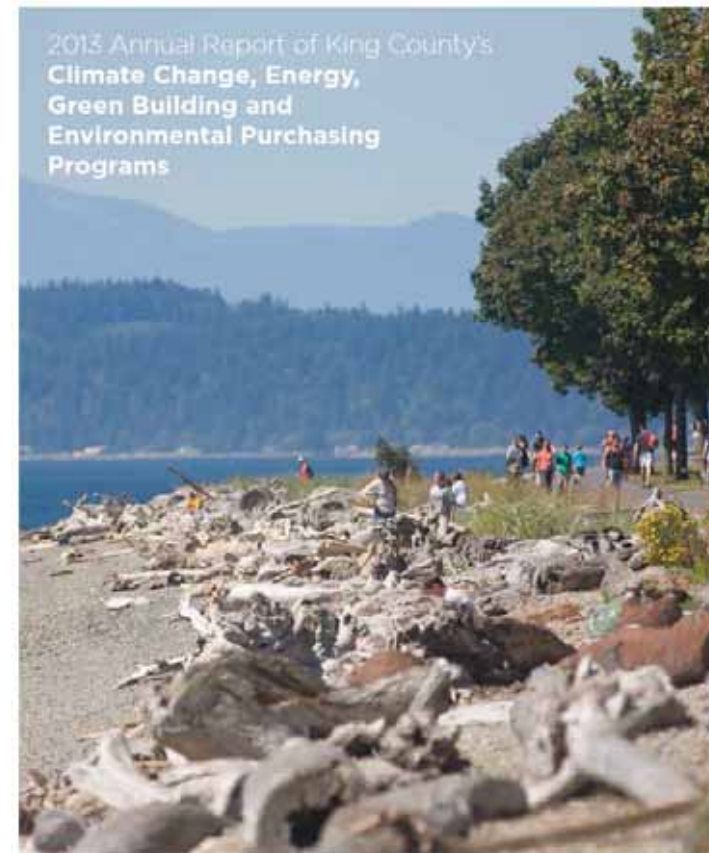
reduce energy use 15% over local code

install water-saving fixtures

implement green O&M (green cleaning)

Where Your Documentation Goes

- Annual reporting to County Leadership & Executive.
- Annual Sustainability Report is transmitted to the Council by June 30 of each year.
- Informing revisions to policy.



GHG Learning Objectives

- Know what your project's biggest GHG impact and opportunities are
- Ability to access and use simple GHG emission calculator tools
- See examples of strategies to reduce the GHG footprint of projects
- Green light to be thoughtful and innovative in your approach

Getting the Tools

Green Tools
Powered by the Solid Waste Division

King County Green Building

Sustainable Infrastructure Scorecard

The Sustainable Infrastructure Scorecard uses basic concepts of the LEED® rating system, adapted to more appropriately apply to infrastructure projects in King County. The resulting Scorecard includes nine categories, including a set of prerequisites, seven sets of credits (optional items) organized by key topics of sustainability, and an additional set of credits (also optional) for enhanced performance. This on-line Guide provides information for achieving each prerequisite and credit. Downloadable versions of the [Sustainable Infrastructure Scorecard \(PDF, 91 K\)](#) and [Guidelines \(PDF, 500 K\)](#) are also available.

For King County Project Managers
View this online training that explains the Green Building and Sustainable

Category:
Required Elements for a Sustainable Development Project

Because the scorecard is designed to apply to a wide variety of projects, many projects will not be able to meet all of the following prerequisites. For example, a project that does not have an energy component will not be able to reduce energy use by 10%. All prerequisites that don't apply to a particular project type should be marked "N/A"

- [Prerequisite 1: Hold an eco-charrette or similar planning meeting](#)
- [Prerequisite 2: Use Life Cycle Cost Assessment](#)
- ▼ [Prerequisite 3: Account and mitigate for greenhouse gas emissions](#)

Implementation Resources

- Greenhouse Gas (GHG) emissions [calculator tool](#). This is an Excel spreadsheet that includes several different GHG emissions calculators to accommodate a variety of project types.
- GHG Emissions Calculator and Mitigation Strategies [Guidelines \(PDF, 1.3MB\)](#). This document provides explanation on how to use the GHG Emissions Calculator tool as well as serves as a resource for alternative options to mitigate and reduce greenhouse gas emissions.

Step 1

Identifying the areas of biggest
impact

Impact Areas

- The GBO calls out four areas,
 - *Energy*
 - *Water*
 - *C&D*
 - *Transportation*
- but do what makes sense for your project.



Typical Footprint Tips

- For an average building project, the materials used represent roughly ~10% of the total GHGs; the building energy usage over the life of the project usually dominates
 - If your project uses a lot of concrete, asphalt, or cement, it could still be a significant and easily quantifiable source.
- Transportation is our region's biggest source, if your project affects transportation, it is likely its biggest impact
- Forests and soil can sequester a lot of GHG emissions over their lifecycle
- Unless your project uses a ton of water, it is going to be a very minor source of emissions

Typical Footprint Tips

Project managers are responsible for determining a reasonable level of analysis. GHG Scorecard Guidance:

Focus on the largest sources of emissions of your project - do not spend 80% of your time assessing 20% of your impacts.

Step 2

Calculating the baseline impacts of
those elements

Converting data to GHGs

- Collect the data that the calculator requests.
- Enter it into the relevant calculators.
- ***Report everything in metric tons of carbon dioxide equivalent (MTCO₂e).***
- ***Document if your estimates are annual or lifecycle.***
- ***Document what sources or savings you are making estimates for (energy? sequestration? C&D materials?)***



Required Elements

Energy

Water

Transportation

C&D

Energy

- KC Developed
- Converts units of energy into MTCO₂e
- Inputs:
 - Electricity
 - Gasoline
 - Natural gas
 - Steam
 - Propane
 - Green power
 - Biodiesel
 - Landfill gas

Project Input	Conversions		Input Unit
	kWh	MWh	
Energy Use	1	0.001	tons
	kg	Metric Tons	kWh
	1	0.001	gallons
	therm	MMBtu	gallons
Energy Use--	1	0.1	therms
	MLb	MMBtu	gallons
	1	1.095	MLb
	CCF	gallon	gallons
	1	748	kWh
			gallons
			MMBtu

Water

- KC Developed
- Converts the energy impact of water used into MTCO₂e
- Inputs:
 - Gallons (or CCF) potable water

Project Input	Data Input	Input Unit	Output	
Water Use ('watergy')			MTCO ₂ e	
		gallons	0	0

Transportation

- Transportation fuel use
- Vehicle Miles Traveled (VMT)
- Converts fuel or VMT into MTCO₂e
- Inputs:
 - Gasoline
 - Diesel / Biodiesel
 - VMT

Project Input		Data Input		Input Unit
Energy Use		Construction	Operations	
	Electricity			kWh
	Gasoline ¹			gallons
	Diesel ¹			gallons

Project Input		Data Input		Input Unit
Vehicle Miles Traveled				
				miles

C&D Waste Reduction Model (WARM)

- Developed by EPA
- Converts C&D tons into MTCO₂e
- Inputs:
 - Material (metal, plastics, food waste, etc)
 - Disposal (recycled, landfilled, composted, etc)
 - Landfill gas controls
 - Waste transport

Material	Baseline Scenario			
	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted
Aluminum Cans	<input type="text"/>	<input type="text"/>	<input type="text"/>	N/A
Aluminum Ingot	<input type="text"/>	<input type="text"/>	<input type="text"/>	N/A
Steel Cans	<input type="text"/>	<input type="text"/>	<input type="text"/>	N/A
Copper Wire	<input type="text"/>	<input type="text"/>	<input type="text"/>	N/A
Glass	<input type="text"/>	<input type="text"/>	<input type="text"/>	N/A
HDPE	<input type="text"/>	<input type="text"/>	<input type="text"/>	N/A
LDPE	N/A	<input type="text"/>	<input type="text"/>	N/A
PET	<input type="text"/>	<input type="text"/>	<input type="text"/>	N/A

C&D Waste Reduction Model (WARM)

Baseline Scenario					
Material	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Tons Generated
Carpet	<input type="text"/>	<input type="text"/>	<input type="text"/>	N/A	0

Alternative Scenario				
Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	N/A

Materials Embodied Energy

- KC Developed
- Converts concrete used into embodied MTCO₂-e
- Inputs:
 - Tons of concrete poured
 - Tons of cement used
 - Tons of asphalt used
 - Other materials

Project Input	
Materials Use	
	short tons) of material used
	Concrete
	Cement
	Asphalt
	Dimensional lumber
	Glass

Additional Tools

Calculator	Counts GHGs from	Source	Format
URBEMIS	Land Use projects (construction + VMT)	URBEMIS website	Download special software
Roadway Construction Emissions Model	Road construction projects, aggregated	SMAQMD web site	Download Excel file
Tree Carbon Calculator	Tree planting & building energy (sequestration)	USFS web site	Download ZIP file (Excel tool inside)
Reforestation Calculator	Tree planting (sequestration)	EPA / Duke University web site	Web form

Reality Check!

“For example, the XYZ project estimated it would save over 25,000 MTCO₂e in construction and materials related emissions.”

Rules of thumb:

- Driving an average car for a year, about 10,000 miles: **~5 MTCO₂e**.
- Per capita home energy usage, in King County: **~ 2 MTCO₂e**.
- 100 short tons of concrete: **~ 13 MTCO₂e**
- Per capita GHG emissions per King County resident, **~13 MTCO₂e** of emissions of local emissions, double that if you include the impacts of consumption
- An acre of western WA forest sequesters **~500 MTCO₂e** (at age 60)
- Running the King County Metro Bus Fleet, about 12 million gallons of diesel a year, about **125,000 MTCO₂e/year**.

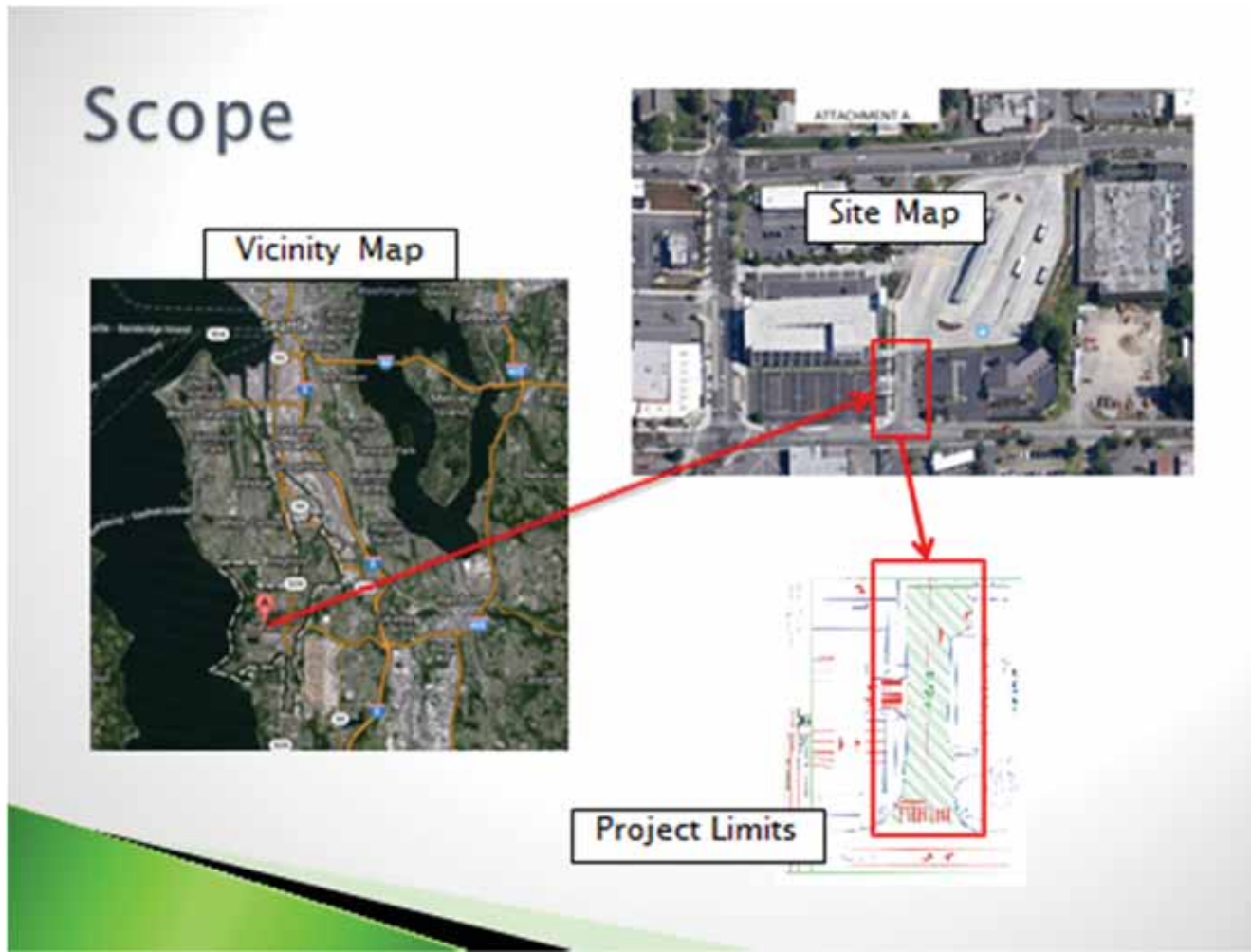
Transit PM Guidance

- Calculate early: planning/pre-design
- You determine appropriate level of detail for emissions assessment
- Focus on the largest sources of emissions



SOURCE OF EMISSIONS	WHAT TO INCLUDE IN ASSESSMENT
Energy Use	Ongoing emissions generated from the ongoing use of electricity, gas or other power source during the operations of the project after it is constructed. If you have an estimate of kWh or therms to be saved for a project, it is easy to calculate avoided emissions.
Water use	Ongoing emissions generated from the use of water during the operations of the project after it is constructed (i.e. the GHG impact from energy use required to pump and treat water to potable standards).
Construction and Demolition (C&D) Materials Diversion	Net emissions or emission reductions from C&D tons salvaged (source reduced), recycled, and landfilled as a result of the project.
Transportation	<ol style="list-style-type: none"> 1. Construction fuel use – emissions from construction equipment and emissions from the transportation of people and goods to and from the project during construction. AND/OR 2. Emissions from the transport of people and goods to the site after the project is completed or ongoing emissions from changes in land use which might affect travel demand patterns.

Burien Transit Center Project



Quantifying and Reducing Greenhouse Gas (GHG) Emissions



- Areas for potential emissions/mitigation:
 - C&D waste
 - Transportation (construction fuel use)

Calculator Q&A

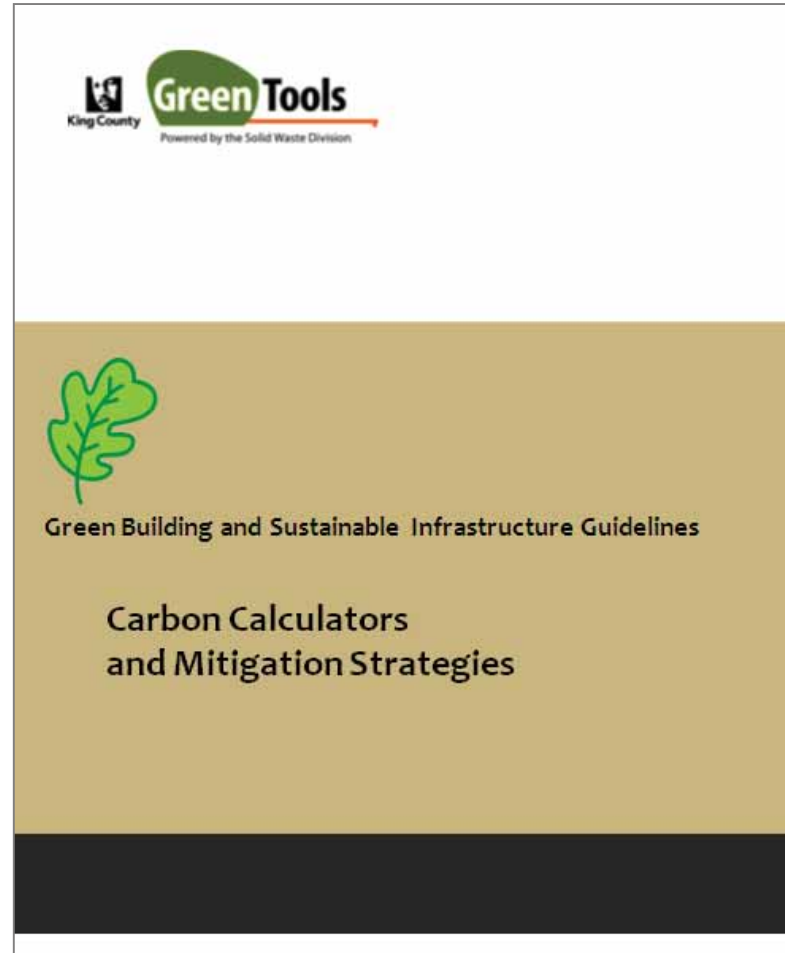


Step 3

Selecting Mitigation Strategies


Mitigation Document

- Introduction
- Calculation tools
- Project Mitigation Strategies
 - Materials
 - Landscape Disturbance
 - Energy
 - Waste
 - Transportation



Mitigation Document

Natural Heating and Cooling

Mitigation Strategy	Overview	Implementation
Plant trees and vegetation to shade buildings or structures ^{lxxiv} 	<p>Effectiveness: Actual effectiveness of GHG reduction depends on regional heat and cooling energy demands, as well as the heating and cooling current energy source (natural gas, hydroelectricity, coal, etc).</p> <p>Cost: Siting the project to maximize the use of existing trees onsite where possible will reduce costs. Cost for tree planting is variable, depending on the trees that are purchased. Projects can expect to see energy savings from avoided cooling costs, although this savings is not as significant as other parts of the country with greater cooling needs.^{lxxv}</p>	<p>Evergreen trees on the north and west sides afford the best protection from the setting summer sun and cold winter winds, while deciduous trees planted on the south side protect from the summer sun and allow the winter sun to shine through. Actual placement of the tree is critical to maximizing energy savings.</p> <p>Smaller transplanted trees (e.g. 1" caliper) have a higher survival rate than larger trees, but larger trees will provide carbon and stormwater mitigation and aesthetic benefits sooner.</p> <p>Develop effective long term maintenance and irrigation plan for transplanted trees to ensure long-term health.</p>

SYMBOL KEY



Green Building and Sustainable Development Scorecard Strategy



Recommended Mitigation Strategy

Mitigation Expectations

- Overarching goal is to reduce GHG emissions
- Do as much as possible within means
- Take into consideration early in project timeline for the most opportunity
- Mitigation options are examples
- Not limited to mitigation efforts in tool

King County GBO Scorecard Project Examples

*GHG Mitigation Strategy Highlights
with quantification*



Quantifying and Reducing Greenhouse Gas (GHG) Emissions

North Base Garage Green Roof Replacement Project

Mitigation effort

- Reused 3,000 tons of onsite soil
- Diverted 95% of C&D materials

GHG savings:

- Case study documented and highlighted GHG savings from avoided trucking:
 - 5.18 MTCO₂e
- Soil carbon
- C&D Materials



South Treatment Plant Lighting

Mitigation Efforts

- Replacing lamps with LED and induction lighting technologies
- Reduce electricity use by over 800,000 kWh annually

GHG savings

- Energy reductions
 - 510 MTCO₂e *per year*



Flood Buyout Projects

Mitigation Efforts

- Deconstructed homes
- Salvaged materials
- Diverted 2,300 tons or 81.4% C&D materials from landfill

GHG savings

- C&D Materials
 - 588 MTCO₂e



Puyallup Landfill Vegetative Cover

Mitigation Effort

- Planting trees on 20 acres to establish native forest cover

GHG savings

- Carbon sequestration:
 - 819 MTCO₂e



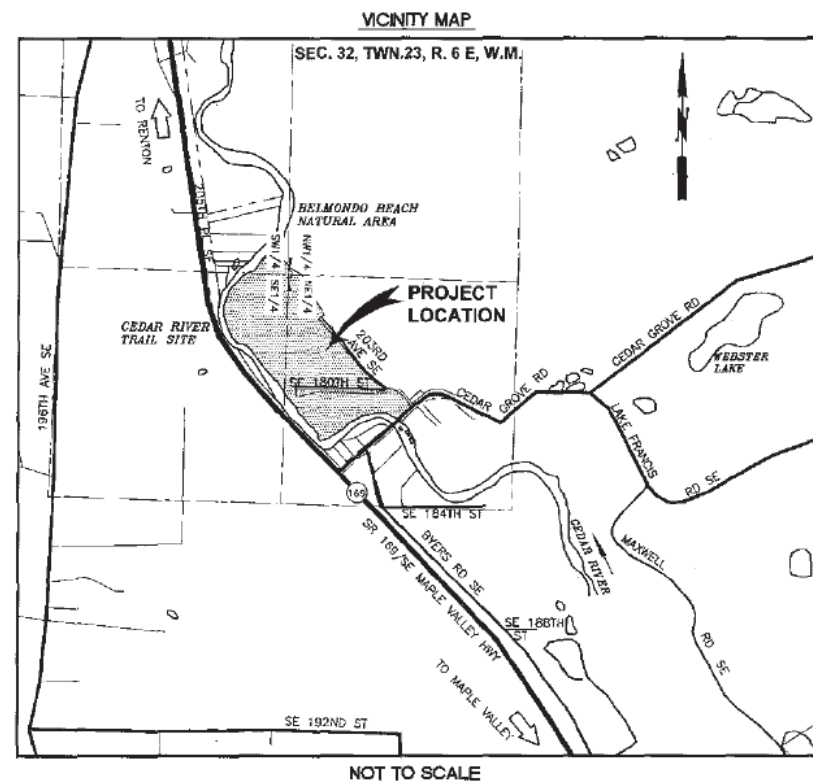
Rainbow Bend Levee Removal and Floodplain Reconnection Project

Mitigation effort

- Reuse of on-site materials
- Revegetation of site w/ native plants
- Local sourcing of materials

GHG benefits

- C&D Materials: 22 MTCO₂e



King County GBO Scorecard Project Examples

*GHG Mitigation Strategy Highlights
without quantification*



NE Novelty Hill Road Project

Project Description:

- Installed 2 roundabouts
- LID features
- Reuse of materials



GHG Benefits:

- Materials
- Transportation impacts to congestion and traffic
- Signal energy usage



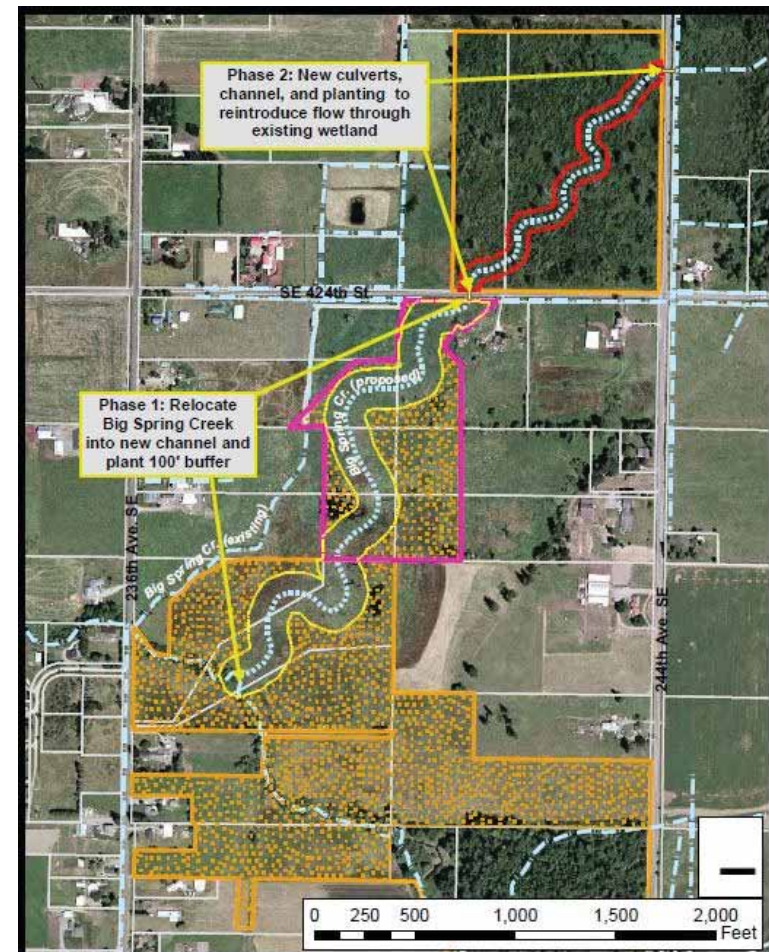
Big Spring Creek Stream and Wetland Restoration Project

Mitigation effort

- Restores 20 acres of wetland and riparian habitat
- 100,000 trees and shrubs planted
- Bio-fuel diesel in heavy equipment

GHG Benefits

- Carbon sequestration
- Alternative fuels



Lake to Sound Trail Segment B

Mitigation effort

- 1.5 mile trail 10-12 ft wide using pervious asphalt paving

GHG Savings

- Materials?
- Community GHG benefits of bike/ped infrastructure



S. Kirkland Park & Ride Garage

Mitigation effort

- Preferred parking for carpools
- Parking for electric vehicle charging
- Additional bike commuter parking

GHG Benefits

- Transit facility
- Alternative Vehicles
- Bike/ped project components



Maleng Regional Justice Center

Mitigation Efforts

- 96% C&D diversion
- Recycled content building materials
- LED lighting
- Water efficient fixtures saving 34K gallons/yr

GHG Savings:

- Energy, Water (small), Materials, C&D materials



Hangar 5 Deconstruction Project

Mitigation Effort

- Recycled approximately 200 tons of material compared to standard demolition

GHG Savings:

- C&D materials



Discussion

- How will you use this information to reduce GHGs on your upcoming project?
- How can this process help you continue to push the envelope with future projects?

Resources

- **Where to find the GHG Emissions Calculation Tool**
 - <http://your.kingcounty.gov/solidwaste/greenbuilding/scorecard.asp?CategoryID=1>
- **Make good use of the Green Building Team!**
 - Technical assistance
 - <http://your.kingcounty.gov/solidwaste/greenbuilding/county-green-building.asp>
- **Contacts**
 - nori.catabay@kingcounty.gov, (206) 477-5269
 - matt.kuharic@kingcounty.gov, (206) 477-4554
 - autumn.salamack@kingcounty.gov, (206) 477-5904

Division Representatives

Green Building Team Division Representatives

Denise Thompson	Facilities Management Division, DES
Gary Molyneaux	King County International Airport, DOT
Autumn Salamack	Metro Transit Division, DOT
Tina Morehead	Road Services Division, DOT
Chris Erickson	Parks and Recreation Division, DNRP
Neil Fujii	Solid Waste Division, DNRP
Jacquelynn Roswell	Wastewater Treatment Division, DNRP
Nathan Brown	Water and Land Resources Division, DNRP

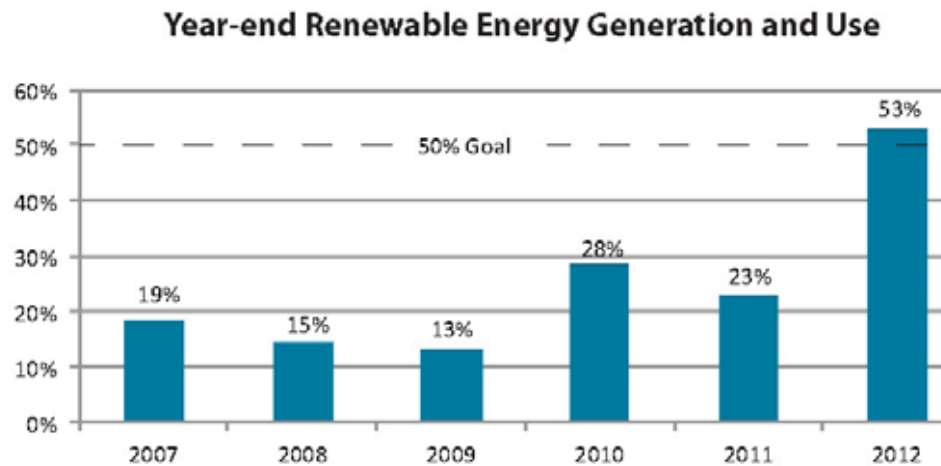
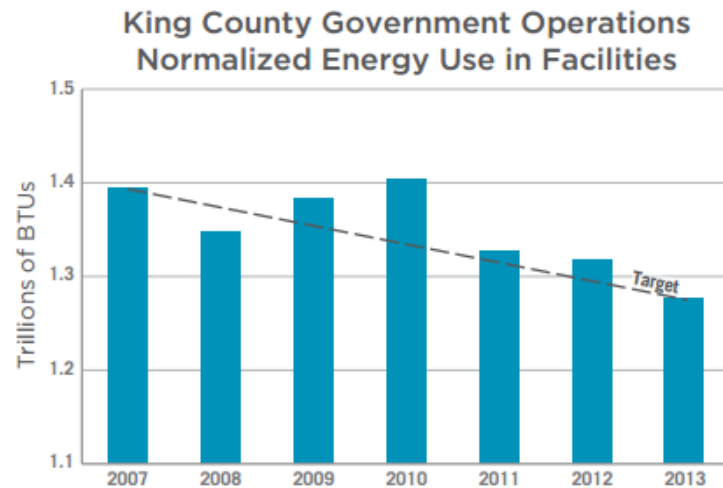
Final Q&A

Thank you!



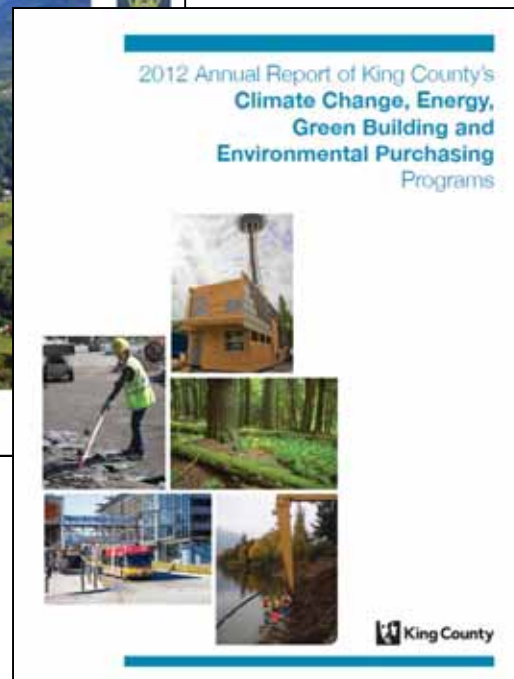
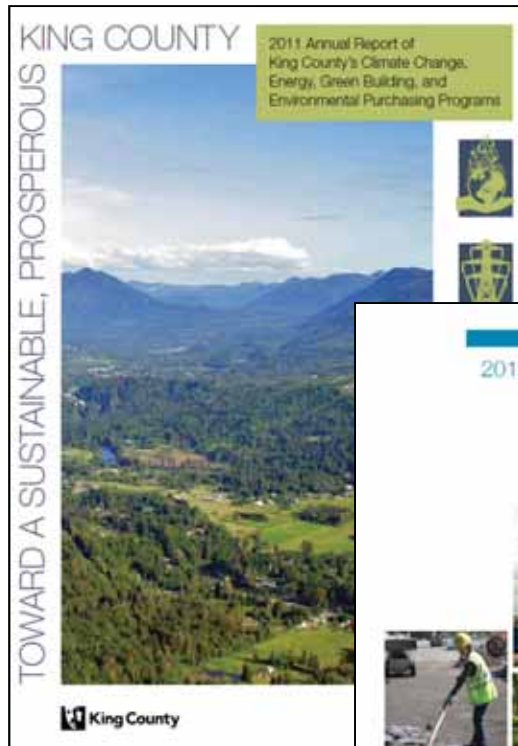
Quantifying and Reducing Greenhouse Gas (GHG) Emissions

Progress Towards Goals



Quantifying and Reducing Greenhouse Gas (GHG) Emissions

What Happens To Your Information



GREENHOUSE GAS EMISSIONS FROM KING COUNTY GOVERNMENT OPERATIONS

Total: 725,000 (in Metric Tons CO₂E)

