BAY AREA
INTEGRATED WIN-WIN STRATEGIES

Strategies for Building Resilience and
Reducing Greenhouse Gas Emissions

Prepared by Laura Sasso
Climate Corps Bay Area
March 20, 2013

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EXECUTIVE SUMMARY

Win-Win strategies for addressing climate change are actions that both reduce greenhouse gas emissions and prepare people, infrastructure and natural systems for impacts like heat waves, extreme storm events and drought. Win-Win strategies are highly valuable in our current resource-constrained environment because they help us address these two major needs simultaneously. A growing number of Win-Win projects are currently being developed and implemented in the Bay Area.

This paper examines ten possible Win-Win strategies for implementation in the Bay Area. For each one, we describe how the strategy builds economic and environmental resilience, addresses social equity issues, reduces greenhouse gas emissions, and helps reduce one or more climate impacts. The paper then outlines a framework that stakeholders can use for more in-depth evaluation of these strategies for their own replication and implementation. The framework stresses the need to understand the particular vulnerabilities of a Bay Area sub-region or population before selecting the proper Win-Win strategy.

The ten strategies are grouped as follows:

INTEGRATED DEVELOPMENT

- Cooling Communities (Urban Heat Islands)
- Bay Area Priority Development Areas and Priority Conservation Areas (PDAs/PCAs)
- Integrated Building Design for New Buildings and Development

ENERGY RESILIENCE

- Local Renewable Power and Intelligent Grid (DG + IG)
- Community Choice Aggregation (CCA)
- Energy Efficiency for Existing Buildings

WATER RESILIENCE

- Wetland Systems as Adaptation Infrastructure
- Low-Impact Development/Stormwater Management
- Urban Water Conservation and Efficiency

COMMUNITY RESILIENCE

- Local Food Supply Chains

THE MOTIVATION TO TAKE ACTION

Climate Change Impacts

> "Climate change is already affecting the American people . . . many of the impacts associated with these changes are important to Americans' health and livelihood and the ecosystems that sustain us."
>
> National Climate Assessment Report
> Draft 1/11/2013

Even if we stopped producing greenhouse gas (GHG) emissions today, the existing levels of these pollutants will impact the climate for centuries to come.[1] International efforts to reduce GHG emissions have fallen short of established goals, making the negative impact of climate variability – including adverse effects on human health, vital infrastructure and ecosystems – inevitable.

The effects of climate change will not be evenly distributed across all geographic regions; nor will the effects on people be evenly distributed. The disparity of climate change impacts demands regional and local responses as well as global collaboration. Cities and regions around the globe are taking the lead in climate change adaptation because they are at the frontline of the impacts.

In the Bay Area, the primary climate change impacts are projected to be sea level rise, higher temperatures and changes in precipitation patterns, such as extreme storm events. If we do not take effective actions to respond to climate change impacts, our social, economic and ecological systems will be significantly affected. We must take thoughtful, meaningful actions to mitigate projected impacts and to sustain vibrant, diverse communities in the Bay Area.

ACTIONS FOR RESPONDING TO CLIMATE CHANGE

Mitigation Responses

Mitigation is the process of creating behavioral changes or policy mandates with the objective of reducing or offsetting GHG emissions. While international GHG reduction goals have been established, these targets are voluntary and not all countries have agreed to participate, making it impossible to enforce or achieve the reduction benchmarks.

Technological and non-technological responses can mitigate the amount of GHGs in the atmosphere. For example, innovative technologies are making buildings more energy efficient, allowing for the harnessing of renewable energy and reducing emissions from transportation sources. Non-technological responses include taking actions to preserve and expand carbon sinks. Carbon sinks are natural systems that sequester carbon from the atmosphere by storing

it. For example, the carbon-offset services provided by U.S. forests amount to about 13 percent of the total GHG emissions in the United States. [2]

Adaptation Responses

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPPC) defines climate change adaptation as "initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects."[3] Adaptation takes into consideration the context in which it will be implemented. Adapting to climate change could mean building a protective system to reduce threats, or it could mean retreating from a highly vulnerable place. Each adaptive action has social, economic and environmental considerations. Adaptation is a localized response to a given issue – there is "no one size fits all" approach. Ideally, adapting to climate change is an opportunity to achieve other societal aspirations, such as improving the quality of life, strengthening the economy and/or expediting the build-out of sustainable development.

We can take adaptive actions in anticipation of climate impacts, or we can take them in response to climate events that have occurred. Anticipatory actions are most desirable because they reduce the risk of loss of life and better manage economic costs over time. But anticipatory actions are difficult to shepherd through the political process; although they require immediate investment, we may not realize the long-term benefits for a generation. In addition, rapid environmental change calls for innovation. Strategies without a proven track record or an established evaluation process are less likely to be implemented. Gaps in knowledge – real or perceived – can be the biggest roadblocks for getting effective adaptation strategies funded.

To gain the support necessary to implement adaptive actions, project managers must convey that projects present an opportunity to learn by doing. One way to educate stakeholders is to use an adaptive management approach, which allows management objectives or methods to change over time in response to changing conditions. This approach has proven effective for working in uncertain conditions and is well suited to climate change adaptation.

Adaptive capacity is the degree to which a country, region, community or individual is able to adapt to changing conditions. The ability to understand the risks, the faculty to develop an effective plan, and access to financial and technical resources to implement that plan all help to define an entity's adaptive capacity.

Comprehensive Responses: Mitigation and Adaptation

Like the rest of the world, the Bay Area needs strategies that address both mitigation and adaptation. To focus all our efforts on mitigation would help reduce

the severity of climate change around the globe in the long run, but it would leave Bay Area communities unable to respond to inevitable climate change impacts along the way. Alternatively, if we focus all our efforts on adaptation, then Bay Area communities would be better prepared for short-term climate change impacts, but environmental changes over the long run would overwhelm any potential adaptive measures.

Comprehensive "Win-Win" responses for the Bay Area feature a range of approaches. We need bottom-up networks and top-down regulations, high-tech initiatives as well as low-tech actions. We also need to employ strategies at the state, regional and local levels. This multifaceted set of responses will ultimately support the development of community resilience throughout the diverse communities of the Bay Area.

Responding to Climate Change in the United States

California has been a leader in efforts to reduce GHGs with Assembly Bill 32, the Global Warming Solutions Act of 2006; Senate Bill 375, the Sustainable Communities and Climate Protection Act of 2008; California Clean Fuels Programs; California's Building Energy Efficiency Programs; and the 2013 California Cap and Trade Program – to name a few innovative initiatives. In the Bay Area, San Francisco, San Jose, Oakland, Sonoma County and other jurisdictions have developed innovative climate action programs to reduce GHGs. The region's first Sustainable Communities Strategy – designed to reduce transportation GHGs by integrating transportation, housing and land use improvements in Priority Development Areas – will be completed later this year.

While most climate discussions in California and the Bay Area have focused on GHG reduction, planning for climate impacts is starting to get significant attention at the state and regional levels, particularly in the post-Superstorm Sandy era. Increasing awareness and interest in adaptation planning is an essential first step, but we need to accelerate the move to action if we are to successfully meet the urgent climate change threats.

The appropriate distribution of effort should focus on GHG reduction on a global scale and climate adaptation on a local scale. Pursuing adaptation alone would eventually lead to catastrophic climate changes that will overwhelm our efforts to protect a basic quality of life for billions of people. Those with the fewest resources to adapt will be the most vulnerable. At the same time, we cannot pursue GHG reduction only, as that approach ignores the serious and significant impacts already emerging worldwide that will worsen in the coming decades.

Bay Area: Varying Impacts, Multifunctional Strategies

Climate change brings with it uncertainty, but uncertainty does not justify inaction. The lack of understanding about what the future holds is exactly why we

need to take action today. Starting now, we must begin to build incremental knowledge throughout the region about an array of adaptation strategies.

The research for Bay Area integrated Win-Win strategies focused on identifying regional strategies that reduce GHG emissions, address one or more Bay Area climate impacts (heat, sea level rise, extreme storms), and support social and environmental resilience. While some of the strategies are predominately focused on reducing GHG emissions and others are aimed primarily at reducing vulnerabilities in communities, all ten strategies outlined below will make a significant contribution to addressing both the causes and impacts of climate change in the Bay Area.

FINDINGS: INTEGRATED WIN-WIN STRATEGIES

Selection of Bay Area Integrated Win-Win Strategies

During the initial phase of the project, project staff identified ten candidates for Bay Area integrated Win-Win strategies. These ten were identified based on an initial review of climate change literature, summary findings from recently conducted stakeholder meetings and their potential for near-term implementation.

The ten strategies were then grouped into four networks: Integrated Development, Energy Infrastructure, Water Management and Community Resilience. The four networks integrated the strategies into the key sectors that are closely linked with climate change. The first network, Integrated Development, focuses on the planning and implementation of sustainable development. The Energy Resilience network is dedicated to reducing GHGs and building energy resilience. The Water Resilience network focuses on the complex interconnections between sea-level rise and flood-prone areas throughout the region. Finally, Community Resilience centers on improving the adaptive capacity of all Bay Area communities.

All ten of the strategies are being pursued in the Bay Area; they are at varying stages of development. Some are in the initial research phase, and some are well under way to set important precedence for the nation. Based on this initial qualitative analysis, project staff prioritized the following for further research:

INTEGRATED DEVELOPMENT

Integrated development focuses on adapting existing and future development to support social and ecological resilience. Effective integrated development processes should be informed by an aggregated risk assessment, which would include existing and future vulnerabilities.

Integrated Development Strategies:

- Cooling Communities (Urban Heat Islands)

- Bay Area Priority Development Areas and Priority Conservation Areas (PDAs/PCAs)
- Integrated Building Design for New Buildings and Development

Key Sectors: Transportation, Buildings, Land Use, Water, Energy and Waste
Key Concepts: 1) Supporting Healthy Communities- walkable, high air quality standards, overall well-being, natural resource integration, biophilic design and equitable distribution of resource- and 2) Multifunctional Infrastructure- integrating more than one objective within a given system.

ENERGY RESILIENCE

Energy Infrastructure is intricately linked to the cause of and the impacts from climate change. Energy Infrastructure is being redesigned to systematically reduce GHG emissions and to build energy resilience. Building energy resilience in communities is a critical objective, which supports the rollout of a more dependable daily supply of energy and it allows for energy supplies to be brought back online more quickly after a crisis.

Integrated Energy Strategies:

- Local Renewable Power and Intelligent Grid (DG + IG)
- Community Choice Aggregation (CCA)
- Energy Efficiency for Existing Buildings

Key Sectors: Transportation, Buildings, Land Use, Water, Energy and Waste
Key Concepts: 1) Reduce GHG emissions and 2) Support Energy Resilience

WATER RESILIENCE

Water resilience deals with the supply, demand and management of water resources in the Bay Area. In the Bay Area over two-thirds of the water supply comes from outside of the region. Reducing water consumption in Bay Area communities by implementing efficiency technologies and landscaping with drought resistant plant will help to relieve pressure on water supply chains. Dependence on external sources creates regional vulnerabilities, which could be exasperated with projected changes in precipitation patterns. In addition water related climate change impacts are projected to be particularly complex in the sub-regions that are susceptible to sea-level rise and terrestrial flooding.

Integrated Water Strategies:

- Wetland Systems as Adaptation Infrastructure
- Low Impact Development/Stormwater Management
- Urban Water Conservation and Efficiency

Key Sectors: Transportation, Buildings, Land Use, Water, Energy and Waste

Key Concepts: 1) Water supply chains and infrastructure and 2) Integrating sea level rise and flood prone area in to an integrated water management plan

COMMUNITY RESILIENCE

Community Resilience centers on improving the adaptive capacity of all Bay Area communities. Retrofitting and the future design of the built environment in the Bay Area should improve the adaptive capacity of individuals and communities.

Integrated Community Strategies

- Local Food Supply Chains

Key Sectors: Food, Buildings, Land Use, Water, Energy and Waste
Key Concepts: 1) Multifunctional urban landscapes and 2) Improves community's adaptive capacity.

Project staff created a report for each of the strategies. Each report contains a short summary, a database of key resources and minutes from an interview with a key expert or stakeholder in the sector. **Appendix A** (strategy resources) aggregates the strategy research into a 58-page document.

Integrated Win-Win Strategies: Synthesis Charts

During the next phase of the project, a second literature review was conducted along with fact-finding interviews with key stakeholder and experts. The research was synthesized into summary charts. One of the objectives of the interviews was to identify near-team implementation projects. Another goal of the interviews was to seek direct feedback on the charts to vet the research that was synthesized in the charts.

Notes from the each of the fact-finding interviews are located in **Appendix A** (strategy resources). The interview questions are located in **Appendix B** (supporting documents). The following ten pages contain the summary charts that synthesize the Win-Win consideration points, e.g., increases economic resilience, supports social equity, etc.

COOLING COMMUNITIES (Urban Heat Island) // Climate Impacts Addressed: Heat, Energy, Water

REDUCES GHGs	INCREASES ECONOMIC RESILIENCE	SUPPORTS SOCIAL EQUITY	IMPROVES HUMAN HEALTH & WELL BEING	BUILDS ECOLOGICAL RESILIENCE	NOTES
Reduces energy demand on hot days	Less need to expand energy infrastructure to meet growing demands (population growth + warmer climate)	Reduces energy bills for low income communities.	Lower day and nighttime temperatures in cities	Expansion of tree, shrub and groundcover habitat	The EPA has conducted UHI pilot projects in United States. Sacramento participated in the EPA's program. The BAAQMD is exploring developing a models ordinance to improve air quality and reduce UHI in the region.
Reduces Standing Car Emissions	Beautify the Bay Area: improves the quality of life which bolsters Bay Areas competitive edge.	Lower temperatures and beautifying neighborhoods Improves the quality of life	Improves air quality by reducing ground level ozone and particulate matter	Lower temperatures reduces stress on existing flora and fauna	
Expanding canopy cover will increase carbon sequestration	Canopy cover reduces flooding risks	Creates accessible, green infrastructure, local jobs- tree planting, pavement and roof retrofits.	Promotes walkability and expands recreational opportunities	Cooler pavements reduces runoff temperatures which improves water quality and protects aquatic flora and fauna	
Brighter surfaces, mean less energy is needed for street lights, which reduces GHG emissions.	Creates local jobs- tree planting, pavement and roof retrofits.		Brighter surfaces, particularly pavement, improves visibility and creates safer walking environments.	Vegetation and permeable surfaces reduces flooding risks	Lawrence Berkeley Laboratory has done extensive research on Cooling Surfaces and Communities.
Global Cooling Affects (LBNL): large scale implementation of strategies reduces energy demands, (cooler environment)	UHI reduction strategies can be integrated into urban development plans. Phasing in measures over time will be more cost effective.		Lower temperatures better for outdoor workers	Aids in local food production if fruit trees are planted	Work to find projects - urban forestry, green roofs , cool paving & cool roofing. (Are there integrated projects?)
	Improves stability of the energy grid by reducing energy demands and reducing heat impacts on equipment			Vegetation increases evapotranspiration which helps to disperse heat in cities	

BAY AREA PRIORITY DEVELOPMENT AREAS // Climate Impacts Addressed: Sea level rise, Storms, Heat, Energy, Water

REDUCES GHGs	INCREASES ECONOMIC RESILIENCE	SUPPORTS SOCIAL EQUITY	IMPROVES HUMAN HEALTH & WELL BEING	BUILDS ECOLOGICAL RESILIENCE	NOTES
Transit Oriented Development (TOD) reduces GHGs by reducing vehicle miles traveled (VMT)	Requires less infrastructure	Improves accessibility to services, amenities and jobs.	Reduces air pollution by reducing VMT	Urban infill development reduces sprawl and helps to conserve surrounding habitats.	Communities and cities in the Bay Area have already identified PDAs and PCAs. The current designation of PDAs accommodates 1/2 of the Bay Area's projected grow for 2035. 7.5 million dollars have been allocated to PDAs in the form of Station Area Planning grants. Over the next three years $15 million will be designated.
Focused development requires less infrastructure-construction and maintenance than sprawl-type development	Reduces transportation cost so more money can be spent on other sectors in the local economy (lower VMT)	Broader range of housing options to meet wide ranging needs of the Bay Area	Walkable and bikeable neighborhoods promote recreational opportunities in cities.	Reduces air pollution for plant and animals.	
Attached building types are most common in PDAs and are more energy efficient and use less water than single family homes	More attractive and convenient urban center makes the Bay Area more competitive		Reduces commute times and stress.	PDAs are part of a two part strategy: PDAs & PCAs. Priority Conservation Areas (PCAs) focus on conserving cultural significant open spaces.	
	Preserves open space land for agriculture		Active lifestyles, promoted by the design of PDAs can increase life expectancy		2013 SCS (Sustainability Community Strategies) is built on PDA approach
	Can reduce total housing costs including utilities		Can improve social cohesion and networks		

INTEGRATED BUILDING DESIGN FOR NEW BUILDINGS AND DEVELOPMENT // Climate Impacts Addressed: Energy, water supply

REDUCES GHGs	INCREASES ECONOMIC RESILIENCE	SUPPORTS SOCIAL EQUITY	IMPROVES HUMAN HEALTH & WELL BEING	BUILDS ECOLOGICAL RESILIENCE	NOTES
Building efficiency reduces GHG emissions associated with heating, cooling and lighting. Buildings account for 42% of total GHG emissions in the U.S.	Improving energy efficiency in buildings reduces operating costs over the long run.	Reduces energy bills and saves low income customers money. Lower income households spend a greater % of income on utilities.	Creates healthier indoor environment and improves air quality. SAY HOW	Reduces pollution from fossil fuel power.	In the nine counties of the Bay Area, development patterns vary. In order to maximize results, targeted policies will need to be developed based on existing and projected building permit types. Countywide coordination can enhance the region's efforts. For example, the counties of Sonoma and Alameda adopted the same building standards to create consistency for design and construction of practitioners.
In San Francisco about half of the cities GHG emissions comes from buildings. ABAG Bay Area Study 2010 (emissions by sector): residential: 7.12 % + Industrial Commercial 36.40% totals to 43.52%	Reduces energy demand and extends life of existing energy infrastructure.			Reduces construction waste, which reduces the volume of trash taken to landfills.	
				Promotes the use of sustainable wood and other materials.	
				The design of buildings can help to reveal the interconnections in the built environment and natural systems. Therefore engaging design can support environmental understanding and stewardship.	

LOCAL RENEWABLE POWER + INTELLIGENT GRID // Climate Impacts Addressed: Energy supply/price

REDUCES GHGs	INCREASES ECONOMIC RESILIENCE	SUPPORTS SOCIAL EQUITY	IMPROVES HUMAN HEALTH & WELL BEING	BUILDS ECOLOGICAL RESILIENCE	NOTES
Reduces the use of fossil fuels for electricity generation.	Creates installation jobs.	Creates local jobs- solar panel installation and maintenance	Reduces local air pollution from power plants	No air pollution from the generation of energy	Financing is important part of creating renewable energy. Reducing or eliminating upfront costs results in faster growth in the sector. CA fiscal incentives, non-profit programs, public/private partnerships are all contributing to the implementation and expansion of solar power in the Bay Area.
Reduces long distance transmission losses	Diversifies energy sources	Financing programs like GRID Alternatives and Solar Mosaic make solar more affordable and accessible		Wind turbines create only a small footprint on the environment	
	Wind turbines are a source of extra income for farmers			Less water is used to generate energy than conventional power sources.	
	Promotes diversified business- not just large utilities			Avoid the use of pristine land for the production of energy.	
	Solar power generated on private or commercial property could be sold back to the grid for profit.				CA clean energy policies need "site-specific" road maps.
	Spurs the development of catalytic organizations and business partnerships to drive changes in the energy sector.				
	Reduces investments required in transmission infrastructure. Anticipated Costs= 80 Billion in the near Future)				

COMMUNITY CHOICE AGGREGATION (CCA) // Climate Impacts Addressed: Energy Supply/Price

REDUCES GHGs	INCREASES ECONOMIC RESILIENCE	SUPPORTS SOCIAL EQUITY	IMPROVES HUMAN HEALTH & WELL BEING	BUILDS ECOLOGICAL RESILIENCE	NOTES
Reduces the use of fossil fuels by increasing renewable sources	Supports the development of local energy economies.	Creates local jobs	Reduces air pollution from burning fossil fuels	Reduces air pollution	Following on Marin's success, other counties in the Bay Area are assessING or are actively developing CCAs. The cities of Oakland, Richmond, Berkeley and San Francisco are all at various stages in CCA development. Richmond has voted to join Marin's CCA programs accessible within its jurisdiction. San Francisco is actively developing a CCA program, Clean Power SF. Sonoma County is conducting their own analysis for a countywide CCA.
Increases efficiency thru statutory ability to take control of public goods charge to administer energy efficiency programs	Expands green job opportunities in local economies.	Competitive energy markets can result in lower rates.	CCAs are part of a shifting away from nuclear power.	Reduces the consumption or the destruction of finite natural resources.	
Can serve as a testing ground for innovative strategies to reduce GHGs.	Saves money for residential and commercial property owners that sell power back to the grid.	Empowers local communities; greater accessibility to renewable power sources.		Can reduce stress on local flora and fauna by reducing the loss of local habitat. EXPLAIN HOW	
CCAs can serve as a vehicle for advancing microgrid technologies and systems.	Competitive energy markets encourages new business development.				
May increase efficiency by coordinating deep energy efficiency retrofits with large non-residential customers.	Helps to facilitate the rapid expansion of lower cost renewable power & energy efficiency.				
	Provides an effective framework to create local energy independence.				

ENERGY EFFICIENCY FOR EXISTING BUILDINGS // Climate Impacts Addressed: Energy supplies/prices

REDUCES GHGs	INCREASES ECONOMIC RESILIENCE	SUPPORTS SOCIAL EQUITY	IMPROVES HUMAN HEALTH & WELL BEING	BUILDS ECOLOGICAL RESILIENCE	NOTES
Building efficiency reduces GHG emissions associated with heating, cooling and lighting. Buildings account for 42% of total GHG emissions in the U.S.	Creates local jobs-energy assessors, retrofit installers, contractors, etc.	Expands green workforce by creating local jobs-energy assessors, retrofit installers, contractors, etc.	Retrofits can improve working environments by improving indoor air quality.	Reduces pollution from heating and cooling in the building sector.	PUT BAY REN AT TOP SLOT. U.S. Department of Energy's Better Building Initiative is designed to jump-start the process of retrofitting existing buildings across the country.
Retrofitting buildings instead of tearing down lessens construction waste, which reduces methane released form landfills.	Reduces energy costs for businesses and homeowners saving can be spent in the local economy.	Reduces energy bills and saves low income customers money.	Improves outdoor air quality by reducing energy use.	The design of buildings can help to reveal the interconnections in the built environment and natural systems. Therefore engaging design can support environmental understanding and stewardship.	San Francisco implemented the Existing Commercial Building Energy Performance Ordinance in 2011.
	Businesses or building owners can be eligible for federal and state tax deductions			Fewer resources consumed to create new buildings, if old buildings are retrofitted	In 2009 California passed the Comprehensive Energy Efficiency Program for Existing Buildings (AB 758), which is a comprehensive energy program targeting residential and commercial buildings.
	Reduces overall building operational costs.			Reduces construction waste by extending the life of existing buildings.	

WETLAND SYSTEMS AS ADAPTIVE INFRASTRUCTURE // Climate Impacts Addressed: Sea level rise, extreme storms

REDUCES GHGs	INCREASES ECONOMIC RESILIENCE	SUPPORTS SOCIAL EQUITY	IMPROVES HUMAN HEALTH & WELL BEING	BUILDS ECOLOGICAL RESILIENCE	NOTES
Carbon sequestration reduces CO2 in the atmosphere	Protects existing infrastructure and housing.	Helps to protect vulnerable coastal or bayside low-income communities	Expands recreational opportunities: walking, running, biking birding, kayaking.	Maintains or restores vital habitats to maintain regional biodiversity	The Bay Conservation and Development Commission is working on an innovative pilot project, Lower Corte Madera Creek, to develop a better road map for effective restoration of tidal marshes in the region.
Reduces GHGs from construction processes for sea walls and other barriers	Promotes a healthy Bay ecosystem, which protects it multiple economic values.	Creates accessible, high quality public places	Improves the quality of life and creates a stronger sense of place	Improves water quality and nutrient cycling	
	Increases potential revenue from ecotourism.		Promotes education & engagement with important regional habitat	Helps to regulate salinity levels in the Delta by regulating interactions between ground and surface water.	
	Supports aquaculture (Fish Industry)			Reduces flooding risks	
	Provides storm protection, which protects businesses			Helps to replenish groundwater by slowing water flows helps the infiltration of water into the ground.	Bay Restoration Authority has the authority to place a measure on the regional ballot to raise $$ for wetlands restoration.
				Helps to regulate sediment retention and detention	
				Promotes shoreline stabilization	

LOW IMPACT DEVELOPMENT / STORMWATER MANAGEMENT // Climate Impacts: Sea level rise, storms, energy, water

REDUCES GHGs	INCREASES ECONOMIC RESILIENCE	SUPPORTS SOCIAL EQUITY	IMPROVES HUMAN HEALTH & WELL BEING	BUILDS ECOLOGICAL RESILIENCE	NOTES
More water is retained in the region which reduces the need to use energy to transport water from distant sources.	Retrofitting existing systems creates local jobs- engineers, contractors and installers.	Reduces flooding in vulnerable neighborhoods	Reduces flooding risks	Reduces flooding risks	The city of San Francisco implemented a model pilot LID project on Newcomb Ave. The design included the use of permeable pavement in parking spaces, permeable pavers and natural drainage areas lined with plants and trees. The project targeted a community that lacked an accessible, high quality public space.
Carbon is sequestered through the expansion of green infrastructure	Multifunctional Infrastructure systems are cost effective because they tackle multiple issues simultaneously. For example planting trees reduces runoff, sequesters carbon and reduces impacts from heat.	Improves air quality	Retrofitting the build environment to accommodate water creates more livable communities. LID can improve the quality of public space by increasing green areas and therefore improving the function of natural systems in urban environments.	Recharges ground water and retains water on site.	
Less energy is needed to clean water when natural cleaning systems are integrated into the water management system.		Planting trees and vegetation to improve water quality also reduces temperatures in urban neighborhoods.	Reduces air pollution by removing particulate matter from the near surface atmosphere. The pollution is brought into the natural systems where it can be broken down.	Supports flora and fauna biodiversity	
		Green Infrastructure can improve the quality of public spaces in communities	Increases walkability	Reduces habitat loss from eroded stream banks	
			Can creates a stronger sense of place.	Improves water quality	EPA SF Water Management Projects

URBAN WATER CONSERVATION AND EFFICIENCY // Climate Impacts Addressed: Energy Supplies/Prices

REDUCES GHGs	INCREASES ECONOMIC RESILIENCE	SUPPORTS SOCIAL EQUITY	IMPROVES HUMAN HEALTH & WELL BEING	BUILDS ECOLOGICAL RESILIENCE	NOTES
Reduces the use of energy in water supply chains- extracting transporting, treating- which reduces GHG emissions.	Efficient systems reduces operational and maintenance costs.	Greater efficiency in water systems saves customers money	Reducing energy demand improves air quality and reduces particulate matter, which lowers health risks.	Reduces energy pollution	In 2009 California passed the Urban Water Conservation Law (AB 1420), which establishes a statewide goal to reduce urban water consumption by 20% by 2020. In AB 1420 any state issued grant or loan for urban water supplies systems has to be implemented using best management practices with the objective of conserving water. In the Bay Area, the treatment of wastewater is an important, regional strategy to improve efficiency and conservation of energy and water.
	Water conservation and efficiency are more cost effective than the development of new infrastructure.	Helps to keep water prices down.	Improves the reliability of water supply for today and the future.	Recharges local ground water when water in captured locally	
	Water and energy are intricately linked. Improving efficiency in water system saves money.	Reduces water related vulnerabilities by extending existing water sources.		Protects natural water systems- above ground and in underground aquifer- by conserving water resources.	
				By conserving water in urban environments more water can be allocated to natural water systems. Maintaining unique aquatic plants and animals helps to preserve biodiversity in the region.	

LOCAL FOOD SUPPLY CHAINS // Climate Impacts Addressed: Energy, food prices

REDUCES GHGs	INCREASES ECONOMIC RESILIENCE	SUPPORTS SOCIAL EQUITY	IMPROVES HUMAN HEALTH & WELL BEING	BUILDS ECOLOGICAL RESILIENCE	NOTES
Reduces GHG emissions by reducing food miles.	Supports local economic growth	Supports local farmers	Increases the availability of higher quality, fresher foods	Reduces air pollution with shorter food transportation distances	
	Increases employment in local communities	Incentives for low income consumers to shop at farmers markets	Supports the reduction of obesity and other diet related diseases	Organic and low pesticide products reduce environmental impact	USDA "Know your farmer, Know your food" initiative. The goal is to create new economic opportunities and increase connectivity between producers and consumer.
Can reduce GHGs through more vegetarian diets (less food processing) in institutional procurement. (Schools, etc.)	Keeps food dollars in local communities	WIC farmers Market Nutrition Program (USDA) targets low-income women, infants and children.	The national network of Farm to Schools program improves nutrition by improving the quality of cafeteria food.	Improves water quality, by reducing pesticides and fertilizer in runoff, which supports healthier ecosystems.	
	Farmers markets have a positive impact on local economies.	Seniors Farmers Market Nutrition Program (USDA) targets low income seniors	Farm fresh food that travel shorter distances has higher nutrient content & better taste. Ex. Farm fresh eggs have more Vit. A & E and less cholesterol	Reduces the use of raw materials to package farm products	Bay Area growth of farmers markets has been significant in last two decades.
	Farmers markets provide low-risk opportunities for entrepreneurs and promotes new business skills	Supports rural development with federal loans and grants supporting local food supply chains	Improves "social embeddednes": economic relationships are shaped by and determined on social relationships in a community.	No-till farming (no plowing) releases less GHGs because fuel consumption is reduced and the soil is not disturbed. Urban farming typically employs no till farming techniques.	
	Farmers markets can stimulate consumer spending around the location of the market.	Reduces Food Deserts. Research indicates local food reduces food insecurity	Community Gardens support the development of intergenerational community networks.		The city of Oakland is a leader in urban farming in the Bay Area and nationally.

NEXT STEPS: INTEGRATED WIN-WIN PROJECT IDENTIFICATION

Strategic Objectives

Resilience is the ability of a region, city or individual to remain nimble in order to adapt, survive and thrive in changing conditions. Change can occur incrementally, or it can occur suddenly. Climate change will bring both types of changes to the communities of the Bay Area. Adaptation is a process of taking actions to sustain existing and future generations in the Bay Area. It is simultaneously a site specific process and it is an opportunity to develop broader knowledge for the region on effective methods for responding to dynamic environmental changes. Effectively responding to climate change necessitates a diverse range of actions; in the near term one of the most critical is the implementation of Bay Area pilot projects. Responding to climate change is an urgent issue

Because climate change is uncharted territory, we must continually build knowledge as we implement projects. Therefore pilot projects should be monitored during and after implementation. Accumulating quantitative knowledge throughout the life span of a project will provide insight on the project's performance. In addition, monitoring a project's progress over time will build incremental knowledge, will allow for in-progress changes and it will inform what strategies will be the most effective in which sub-region. An adaptive, step-by-step approach will be an effective way to stay flexible and respond to climate change impacts.

The implementation of adaptation pilot projects in the region is a critical opportunity to build resilience. Multifunctional projects that work to address more than one issue with one action will help expedite the process of adaption in the region. Fortunately, innovative adaptation pilot projects are in progress in the region. One regional precedent is the Bay Conservation and Development Commission's Adapting to Rising Tides (ART) project. This multi-step project is actively developing knowledge about adapting to sea level rise in the Bay Area. The goals in the initial pilot area, within a regional project, are to develop, implement and assess adaptive measures along the Alameda County shoreline. The ART project is an important model for the region: The innovative, multi-stakeholder process that BCDC is developing could be adapted to respond to other anticipated climate impacts.

Another example of a multifunctional pilot project that is underway in the region is the *Building Climate Change Resilience Along the Bay with Green Infrastructure and Treated Wastewater*. The objectives of the project are to integrate constructed wetlands into the redesign of wastewater treatment plants in the South Bay. In addition to cleaning wastewater, the restored wetlands will serve as a natural buffer to rising tides, support the restoration of critical Bay Area habitat and reduce nutrient loading in waste management processes.

Multifunctional projects will be more valuable for the region in both the short and long term. The ART project and the Green Infrastructure and Treated Wastewater pilot projects typify the types of pilot projects that would benefit the region, grander efforts to support and incentivize larger-scale innovative adaptation projects would build greater resilience in the region. As integrated Win-Win pilot projects are identified in the region, we must evaluate their potential for achieving three overarching objectives: building resilience, supporting multi-functionalism and experiential learning – or learning by doing.

Considerations for Action

Over the course of the last four months, we have explored ten integrated Win-Win strategies for the region that would support adaptation in the Bay Area. Adapting is a process of responding to change within a given context, which means there is no universal way to adapt. Each decision-making process will require an in-depth understanding of the particularities of a place and governing frameworks.

Project staff developed a framework through a literature review process, interviews with strategic experts and collaborations within the Kresge team. The four-step process outlined below is flexible and adaptable. It highlights the knowledge gained through the initial assessment process. The first step focused on exploring existing risks and anticipated climate impacts, to establish a solid foundation for informing the subsequent decision making process about adaptive actions. The other three steps setup the framework for an inclusive, a transparent and a multi-criteria evaluation process.

The four-step process outlined below is a starting point for selecting integrated Win-Win projects for implementation in the Bay Area. We recommend that this framework be considered for the selection of integrated Win-Win strategies moving forward.

Step 01: Spatial Distribution of Existing and Anticipated Climate Risks

Climate change will exacerbate existing inequities and vulnerabilities. To identify the most appropriate Bay Area sites for pilot projects, we must understand existing conditions and risks, e.g. anticipated climate change impacts and earthquake vulnerabilities for a specific sub-region or area.

In the Bay Area innovative research and datasets have been and continue to evolve that reveal the spatial distribution of climate risks and other environmental risks for various sub-regions and populations. Auspiciously, many of the key Bay Area datasets have been created through a network of innovative initiatives. Much of the information is publicly available through online portals. Websites such as Cal-Adapt, California Climate Commons, *Pacific Institute Database,*

ABAG GIS Data Catalog, *GeoFetch* (San Francisco Estuary Institute) and *city databases, e.g. San Francisco Data* host a wealth of relevant information.

All of the above mentioned websites contain valuable GIS datasets that can be downloaded into geospatial software to create influential visual and spatial narratives– maps. The maps can then serve as an evaluation tool and/or a communication tool for decision-making processes. Maps can create an effective bridge for building knowledge across sectors. They can consolidate complex information into a tangible communication tool, which can start to break down siloed decision making processes. The identification of integrated Win-Win strategies will require an interconnected evaluation process to assess regional trade-offs and risks.

While the existing datasets will help planners decide which Win-Win project will fit best within a sub-region of the Bay Area, we must do more work to build understanding across sectors and jurisdictions. Many of the climate change maps that have been created present one sector, an impact or a risk. This means each of the maps tells one chapter of a complex story. In order to get a clearer understanding of the whole story, we need all the chapters integrated into one book. Overlaying spatial datasets to create layered maps will start to illustrate and communicate interconnected risks in the region and help to build cross-sector partnerships.

Fortunately, aggregating datasets into one map is easier than generating the initial GIS datasets and online tools; the initial legwork has already been done by the regional experts. These types of maps would be useful for regional-scale analysis, nuanced maps of site-specific vulnerabilities and risks would need to be generated for each pilot project.

What are our greatest challenges? Where do we see the greatest risk? Which opportunities will provide the greatest benefit in the next few years?

Step 02: Inclusive and Transparent Process

Effective adaption processes will be inclusive. This means a diverse set of stakeholders should be involved in shaping the process of change within communities. Partnering with the community is a way to integrate local knowledge, which can highlight existing concerns that might not have been revealed through remote analysis of a site. In addition, adaptation processes transform the built environment of established community. Therefore it is imperative to get the community to embrace the changes since they will be the ones that are most directly impacted and/or will be in charge of the long-term maintenance of the adaptive measure.

For an in-depth assessment of inclusive Bay Area adaptation process reference the, *Mapping Our Future: A Work Plan for Community Engagement and Equity in Bay Area Climate Adaptation Planning*, from the Equity work group.

Step 03: Multi-criteria Framework for Prioritizing Community Goals

In the second phase of the research, the project team investigated the ten strategies to better understand their potential benefits, key issues and current presence in the Bay Area. Project staff conducted a targeted set of stakeholder interviews for each of the strategies and an in-depth literature review of the strategies and decision-making processes. The considerations outlined below take into account existing conditions, projected regional climate change impacts and future aspirations for the region. The set of considerations listed below were used to significantly increase our knowledge about the ten strategies in a systematic fashion. They allowed us to begin to compare the potential impacts among the collection of strategies. Following this step will give regional and local stakeholders a better lens for selecting Win-Win strategies for funding and implementation over the next few years.

1. REDUCE GHGS

   Reducing GHGs is an essential part of adapting to climate change. The region should continue to serve as an important leader in state and federal efforts to reduce emissions from transportation, buildings, industry and other sectors. Leadership in this area will have local and global impacts.

   To what extent does the strategy reduce GHGs in the Bay Area? What are the primary ways in which emissions are reduced?

2. INCREASES ECONOMIC RESILIENCE

   Increasing economic resilience is an essential component of any regional climate change strategy. For a regional adaptation strategy to be successful over the long run, it must be economically sustainable. Secondly, stimulating the economy by creating climate change jobs and new businesses to adapt the built environment builds social capacity and has the potential to improve the overall resilience of Bay Area communities. Finally, thoughtfully designed Bay Area efforts will protect the economy from climate impacts that threaten critical infrastructure and the region's quality of life.

   How does the strategy build Bay Area economic resilience? Is the strategy primarily focused on protecting vital socioeconomic infrastructure by reducing vulnerabilities to impacts? Does it create new jobs/businesses? Or does it do both?

3. SUPPORTS SOCIAL EQUITY

   Climate change is a global phenomenon, but its impacts are disparate. Climate change results in differential impacts that vary by geographic region

and the social capacity of communities. We understand now that climate change will exacerbate existing global inequities, which include social, political and economic disparities. Ultimately, the individuals that are most vulnerable to climate change impacts are those least capable of coping with short- and long-term changes to their surroundings. Prioritizing the most vulnerable communities is the morally responsible way to respond to climate change in the Bay Area. Working to support the most vulnerable communities will help build resilience for the region as a whole.

How does the strategy address vulnerable communities in the region? In what ways does it work to build the overall resilience of these groups?

4. IMPROVES HUMAN HEALTH & WELL BEING

Climate change is an opportunity to improve human health and well being in the Bay Area. Improved health and well-being benefits would generate short- and long-term paybacks for the region. Many health benefits would come from adapting the built environment to reduce climate change impacts. Retrofitting existing environments and building climate-ready development could increase the walkability of neighborhoods, improve access to public parks, expand urban canopy cover and improve access to vital services. Adapting the built environment also has the potential to reduce air pollution, moderate urban heat island effects, and promote healthier, active lifestyles.

In what ways does the strategy contribute to improving human health and well being? Is this a major contribution or a more minor impact?

5. BUILDS ECOLOGICAL RESILIENCE

The region's temperate climate and our renowned quality of life are intricately linked to the Bay Area's unique and bountiful ecological communities. The Bay Area has a diverse array of ecological systems ranging from wetter, cooler coastal areas to hotter, dry inland regions. Changes in the region's overall climate will impact the function of each of our many ecological communities in unique ways.

The Bay Area's ecological communities collectively provide the backbone for the region's vibrant economic and social system. Maintaining and conserving vital ecosystems is an important strategy for the region for the resources and environmental processes that benefit human beings and are the by-product of healthy ecological systems. Life-sustaining, regional ecosystem services include wetlands that buffer coastal communities, riparian zones that clean water and tree canopies that reduce heat and pollution in city centers.

How does the strategy protect the region's natural systems and build ecological resilience? Which ecosystem services does it protect and enhance? How does this help to build overall resilience in Bay Area communities?

6. NEAR-TERM IMPLEMENTATION POTENTIAL

Climate change requires both short-term responses and long-term strategic planning. Many projects with Win-Win characteristics are underway in the region. Amidst all the long-term projections and broad pictures of regional and statewide impacts, we can benefit by spotlighting existing, on-the-ground projections to both inform and boost confidence about our ability to take action.

7. ALIGN WITH PROJECTED REGIONAL CLIMATE CHANGE IMPACTS

Bay Area climate leaders predict three primary climate change impacts for the region: (1) an increase in regional temperatures, (2) changes in precipitation patterns, including more extreme storm events, and (3) sea level rise. [1] Due to the wide range of potential impacts to the region all of the nine counties will be affected by at least one of the impacts, but the severity of the impacts will vary.

Which of the impacts described below are most relevant to a particular strategy? To what extent will the strategy protect humans, natural systems and infrastructure from one or more climate impacts?

Increase in Temperatures

Higher temperatures are predicted for the region with a high degree of certainty. The California Adaptation Strategy anticipates a 4-9 F° increase by 2100. In the Bay Area, the eastern and southern regions will experience higher temperature increases than the coastal and northern regions. In addition to regional hotspots, cities like San Francisco could experience elevated temperatures due to Urban Heat Island effect, which is characterized by warmer microclimates within built-up areas. Increases in temperature will also lead to lower air quality, which will impact the distribution and diversity of plants and animals in the region.

Changing Precipitation Patterns

Changes in precipitation patterns are anticipated for the region. While we cannot be certain of the net change in the annual precipitation levels, some models predict higher totals, while others predict a slight reduction in volume. With a high degree of certainty, experts predict an increase in extreme storm events, resulting in higher volumes of precipitation in short periods of times and causing existing infrastructure to fail. These failures will result in flooding, which will endanger community safety, damage property, take human life and threaten human health.

Changes in precipitation patterns, coupled with higher temperatures, are expected to produce water shortages, longer periods of drought and

conditions that are ripe for wildfires. Higher water temperatures could also decrease water quality and threaten aquatic ecosystems with specific temperature ranges. At a regional scale, higher temperatures will accelerate the melting of the Sierra snow pack, which provides much of the water supply for the Bay Area.

Sea Level Rise (SLR)

Sea level rise (SLR) will have a significant impact on much of the Bay Area. Impacts from SLR will not be limited to coastal and bay communities because critical regional infrastructure is located in low-lying areas adjacent to the water's edge. This land at the water's edge includes roadways, wastewater treatment plants, ports and parks upon which millions of residents depend. When considering the impacts of SLR, we must also assess its impacts in conjunction with tidal surges from high tides, extreme storm events and upstream creek/river flooding.

SLR predictions are constantly evolving to incorporate the latest scientific data. SLR has increased by 50 percent in the last 15 years around the globe. [1] The National Resource Council predicts that by 2100 the coastline south of Cape Mendocino could experience SLR of 1.38 to 5.48 feet. Predicting SLR is difficult because it is impacted by GHG emissions, melting sea ice and plate tectonics. The interconnections between the variables and the feedback loops they create are not well understood. SLR is therefore difficult to model at this point.

8. POTENTIAL FOR PARTNERSHIPS

The process of adapting is collaborative. Surveying what is being done in the region is an opportunity to build on existing knowledge and/or to identify valuable partnerships to strengthen adaptation efforts. Understanding what else is going on in the region helps to streamline implementation processes and prevent duplicative efforts. A portion of this research was dedicated to exploring the adaptation landscape, particularly the ten integrated Win-Win strategies, in the Bay Area. The finding from this can be found in **Appendix A**.

Are there existing stakeholders running projects that are fairly well developed where additional support would boost regional knowledge and accelerate action? Does the strategy include Bay Area projects that are anticipated to be completed or will have competed their first phase within the next 18-24 months?

9. ADAPTIVE-MANAGEMENT APPROACH

Due to the inherent uncertainty associated with climate impacts, adaptation strategies must be responsive to changing contexts to prevent maladaptation. Historically, adaptive management has been used in biological conservation

and land management. Adaptive management is a collaborative process between scientists and land managers with the objective of successful conservation of land and biological resources. This planning process accommodates uncertainty by allowing for the plan to respond to changes in the system over time. Projects are typically phased to allow for monitoring, assessment and adaptation of project objectives to respond to changing conditions. The successful South Bay Salt Pond Restoration Project, which is working to restore more than 15,000 acres of wetlands in the Bay, currently uses adaptive management.

How does the strategy include an adaptive-management approach? How does it help to build knowledge about adaptation in the region?

10. SCALABILITY

Scalability is the extent to which a project can be replicated throughout the region. Projects that are highly scalable, with the ability to be implemented in multiple locations, are advantageous in the near term. Given the scope and scale of the challenge, our strategic focus should be on projects that have the greatest potential to help the Bay Area, as a region, move ahead. The top strategies should demonstrate the ability to significantly reduce vulnerabilities, mitigate risks, build resilience and reduce GHG emissions.

Is this a project that helps to build knowledge about critical issues in the region? Can the project be replicated? What impact would strategy have if it were implemented throughout the region?

Step 04: Pilot Project Identification: Integrated Win-Win Strategies

Strategic, integrated Win-Win pilot projects should be implemented in the Bay Area to build resilience and knowledge about best practices for an uncertain future. Adapting to climate change is an evolving process. The most important step the nine counties of the Bay Area can take today is to accelerate their actions over the next few years. This means working and exploiting the innovative resources that have already been developed. It also means developing processes that allow for the integration of new knowledge as it becomes available.

ADDITIONAL RESOURCES & REFERENCES

A brief summary paper, a database of key resources and minutes from the stakeholder interviews were developed for each of the ten strategies. **Appendix A** contains a section for each of the ten strategies. This 58-page document was developed to serve as a resource for the region. The intention of this research is to help build understanding about the types of multifunctional strategies that exist, to begin to analyze their potential benefits and to develop a set of critical considerations for adaptation processes in the Bay Area.

1) National Climate Assessment. Draft 1/11/2013
2) Georgetown: Climate Center
3) Center for Climate Strategies Adaptation Handbook
4) The Oregon Climate Change Adaptation Framework
5) Chicago: Adding Green to Urban Design
6) SPUR Climate Change Hits Home
7) Adaptation Scotland (Adapting to Climate Change)
8) McGregor, Alisdair, Cole Roberts, and Fiona Cousins. *Two Degrees: The Built Environment and Our Changing Climate.* New York: Routledge, 2013.

In addition, a bibliography was developed for each strategy to highlight key resources for additional information. These bibliographies can be found at the end of each section in **Appendix A**.

ENDNOTES

[1] SPUR Report. Climate Change Hits Home. 2011.
[2] National Climate Assessment (Draft 01/11/2013)
[3] IPCC Fourth Assessment Report, Glossary of Terms