DRAFT – 3/29/2023

Oregon Global Warming Commission Natural & Working Lands

Community Impact Metrics Framework

The *Oregon Global Warming Commission Natural & Working Lands* proposal recommended that Oregon establish community impact metrics:

> "Community impact metrics should be developed to inform and evaluate the co-benefits and impacts of natural and working lands strategies. Environmental justice considerations should be prioritized throughout carbon sequestration programs, in line with recommendations from Oregon's Environmental Justice Task Force, the Racial Justice Council and Oregon's Interagency Workgroup on Climate Impacts to Impacted Communities. The community impact metrics and goals should be designed to evaluate the benefits and burdens associated with different strategies, practices, and programs. These metrics should include effects on jobs, local economies, public health, and access to programs, among other factors."

Impact measurement is a process of collecting and analyzing data to assess the effect of a program, intervention, or policy on a particular population.[1] Community impact metrics measure the benefits and burdens on communities associated with strategies for carbon sequestration in natural and working lands and waters[2] (Oregon Senate Bill 1534). Science-based targets should incorporate consistent and continual reporting processes, transparency in data sources and calculation methodologies, and interoperability with evolving standards and regulations.[3] Place-based community change efforts are geographically targeted initiatives that operate across systems (Brown 1996) and measure the extent to which the initiative causes or leads to changes in outcomes.

[1] https://www.sopact.com/

[2] https://www.oregon.gov/lcd/Commission/Documents/2021-11_Item-10_OGWC_Attachment-A_Natural-and-Working-Lands-Carbon-Sequestration-and-Storage-Proposal-OGWC.pdf

[3] https://tideline.com/wp-content/uploads/2022/10/Tideline_Truth-in-Climate-Impact-FINAL-Oct-2022.pdf

Criteria to consider when developing social and cultural metrics (Bessette and Gregory 2020):

- Incorporate impacts based on discussions with stakeholders and the recognition of both individual and community-level effects.
- Incorporate proxy[4] and constructed metrics[5] to help overcome measurement difficulties and provide information about context-specific impacts.
- Seek to meaningfully engage the diverse potentially affected interests. Develop measures that are readily understood, concise, and operational to facilitate implementation in decisions.
- Adopt a values-focused approach that allows for personal experience and facilitates analysis of alternatives.
- Document value trade-offs and key risk tolerances.
- Adopt best practices regarding risk and impact communication to highlight impact assessments.
- Incorporate stakeholder perceptions into assessments and inventories.
- Acknowledge that some co-benefits are difficult to quantify or monetize (NOAA 2015) (e.g., habitat, open space, increased property values, improved water quality), but should be described, included, and considered in overall community impacts.

Key issues associated with the development of social and cultural metrics include neglect of important impacts, difficulty in identifying clear and evaluable metrics, metrics that ignore formal regulatory, legal, or cultural criteria, measurements perceived as an overtly technical undertaking, and measures considered unimportant by decision makers or stakeholders (Bessette and Gregory 2020). Even when reasonable metrics are identified, measuring and comparing the outcomes across scales can be challenging because of the dynamic and complex nature of social-ecological systems, such as shifts in political support or ecosystem condition (Ostrom 2009, Nuno et al. 2014, van der Jagt et al. 2017). Context-specific metrics will increase understanding of nature-based solution effectiveness at the local level (Sutton-Grier et al. 2015).

[4] Proxy metrics are metrics introduced to help overcome measurement difficulties or a lack of data.

[5] Constructed metrics rely on quantitative or qualitative indices that reflect different levels of a specific value.

Tradeoffs

Assessing tradeoffs (Henrique et al. 2022) of a policy is important because of ethical concerns, to identify potential barriers to acceptability and public support, and to ensure the long-term sustainability of the policy (Penasco et al. 2021). How individuals navigate tradeoffs is crucial for community deliberation; adaption policy and practice must recognize the diverse values, interests, and experiences of those directly affected by climate change (Eriksen et al. 2020). Climate-smart land management strategies depend on the local character of the landscape as well as community goals (CNRA 2022).

Well adapted agricultural systems contribute to safe drinking water, health, biodiversity, and equity goals (DeClerck et al. 2016). However, tradeoffs may occur. For example, there may be increased risks for human health or reduced access to water if fertilizer and pesticides are used without regulation, or if irrigation reduces water availability for other purposes. Agricultural adaptations may increase workloads, may result in loss of income or culturally inappropriate food if crop mixes change, or may benefit farmers with more land.

Afforestation and/or bioenergy supply can compete with food production and raise food security concerns, and single-minded climate policy (aiming solely at limiting warming without concurrent measures for the food sector) can have negative impacts for global food security. Food price supports, improving productivity and efficiency of agricultural production systems, and programs focused on forest land-use change can add benefits to mitigation, improving resilience and livelihoods (Roy et al. 2018).

Karlsson et al. (2020) documented five types of tradeoffs:

- **Ecological** – Biodiversity, landscape, and land use. Direct land use changes (new crop system at a site) and indirect land use change (pressure on agriculture due to displacement of a previous activity of the use of biomass, which induces land use changes on other land areas to maintain previous level of food production) – also called leakage or displacement effect (Karlsson et al. 2020).

- **Environmental** – Balanced nitrogen fertilizer application can reduce acidification, nitrate leaching, and N_2O emissions (Oenema and Velthof 2007), but can trigger changes in fluxes of other GHGs, especially nitrous oxide and methane (Powlson et al. 2011). The negative environmental side effects of a measure are often referred to as pollution swapping (e.g., meat industry replaces plastic packaging with alternative packaging that reduces the shelf life of the meet, causing waste,

and pollution).

- **Economic** – Private economic impacts to a landowner, such as changes in yields, labor requirements, or investments in technology as well as education and training. Some examples of tradeoffs include:
    - Changes in consumer energy bills
    - Changes in the total energy budget of consumers or governments
    - Rural areas experiencing higher welfare losses from energy taxes compared with urban areas (Callan et al. 2009, Flues and Tomas 2015).
    - Increase in labor-intensive agricultural activities (e.g., mulching), which may increase costs.
    - Increase in prices for agricultural products because of mitigation costs borne by the sector, or increase in land prices (Melillo et al. 2012).
    - Private economic impacts to farmers through changes in yields or input purchases, labor requirements, or investments in technology (Freibauer et al. 2004, Beach et al. 2008, Breen, 2008, del Prado and Scholefield 2008, MacLeod et al. 2010).

- **Societal** – Mitigation measures in agricultural production may have societal impacts re: animal or public health and food security.

- **Political** – Mitigation measures can be legal instruments, incentive-based, or information and capacity building (Prager et al. 2011). These can result in private transaction costs for landowners and public transaction costs for government.

The identification and measurement of tradeoffs by multiple stakeholders, and potential compensation intervention is key to reduce potential conflict and enhance long-term effectiveness of mitigation strategies (Giordano et al. 2020, Dasgupta 2021).

Complementary policy packages can mitigate adverse side effects of climate change strategies (Liu et al. 2019). For example, in China, land and food security indicators worsened under simple climate mitigation, but remained near baseline with a food and forest protection policy package consisting of subsidies. By 2050, policy packages were cost negative. Implementing only the forest policy worsened food security because it tightened the land market and forced decreases in food production. Likewise, implementing only the food subsidy increased deforestation risk.

The Broader Social and Environmental Impacts of Carbon Removal

In 2015, the United Nations member states endorsed 17 sustainable development goals to assess carbon removal's economic, social, and environmental impacts.

Examples of metrics used for#11, Sustainable Cities and Communities are:

- % of population that breathes polluted air (using World Health Organization Air Quality Guidelines of $PM_{2.5}$<5 UG/M^3).
- % of city dwellers that have convenient access to public transportation

Figure 1. The United Nations member states endorsed these 17 sustainable development goals to assess carbon removal's economic, social, and environmental impacts.

Appendix A lists the goals and targets for each of the 17 indicators, which can serve as a resource for communities considering developing community impact metrics for climate-smart practices on Oregon's natural and working lands.

Barry and Seamus (2021) documented the environmental, economic, and social/cultural impact indicators of climate change (Figure 3).

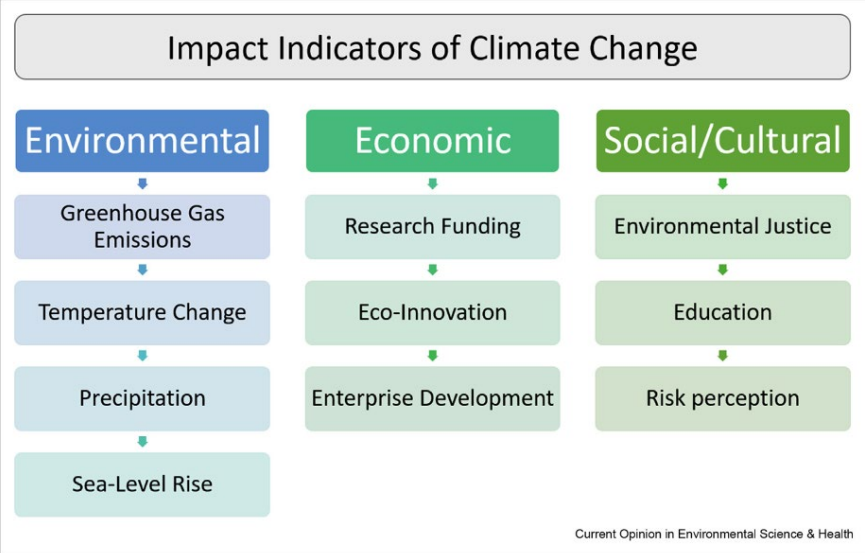

Figure 2. List of indicators that can be developed to assess the impacts of climate change.

Newell et al. (2018) expressed the co-benefits and trade-offs associated with specific climate actions strategies using models illustrating the strategies, co-benefits and tradeoffs. For example, in urban areas, urban trees and vegetation produce co-benefits, such as viewshed and microclimate (no tradeoffs identified) whereas gardens and local agriculture produce co-benefits of social interaction, food bank services, tourism, economic development, and food security, but also produce transport requirement tradeoffs (Figure 4). Use of this type of model allows individual communities to consider tradeoffs and co-benefits specific to their local community via collaborative government/stakeholder workshops that discuss the implications of climate practices (Newell et al. 2018).

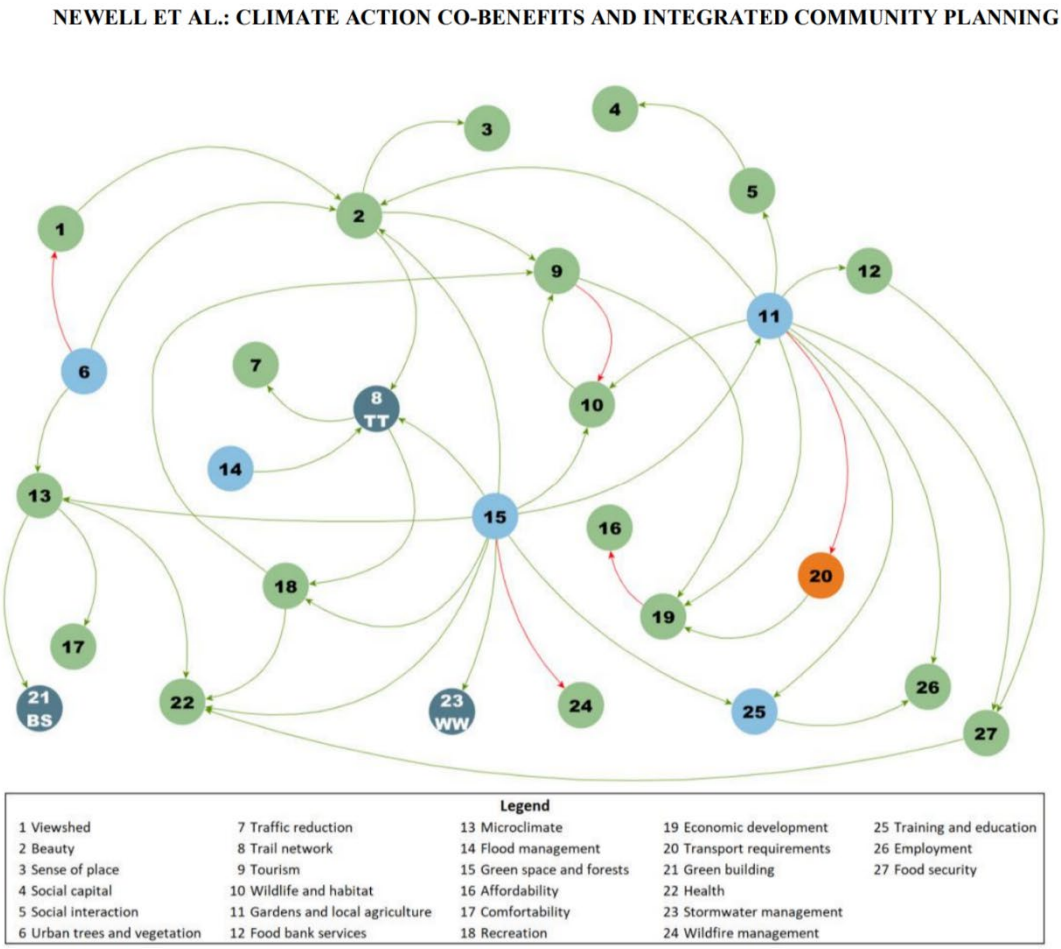

Figure 3. Urban trees and vegetation produce co-benefits and no identified tradeoffs whereas gardens and local agriculture produce numerous co-benefits and one identified tradeoff (Newell et al. 2018).

Theory of Change

Oregon will sequester an additional 5 MMTC02E annually by 2030 and at least 9.5 MMTC02E annually by 2050 by implementing practices on natural and working lands.

The following are examples of ecological, economic, infrastructure, social justice/equity, public health

Ecological Indicators

- Acres of land under durable conservation easements that include climate-smart management requirements
- Acres of land with restoration efforts underway
- Average trend of high severity wildfire patch size and occurrence
- Acres of land covered with landscape-level planning
- Total % of an area or community covered by urban tree canopy
- % decrease in ambient temperature during high heat months in urban areas, particularly in vulnerable communities
- % of agricultural acres with on-farm technical assistance, demonstration projects, and incentives
- % change in soil organic matter
- % change in soil moisture content
- % of infrastructure projects that incorporate nature-based solutions
- Quantifying land cover and land use changes as part of a monitoring framework
- Presence of pollinators
- Presence/distribution of native species/species richness
- Absence of nuisance/invasive species, pests, and disease
- Maintenance of current patterns of biodiversity
- Presence of multiple migration pathways for animals and plant species
- Native plant and animal dominance and presence/distribution of native species/species richness
- Lack of anthropogenic stream barriers
- Topographic diversity
- No net loss of biodiversity
- Maintenance or enhancement of conservation values important to conserving globally, regionally, or nationally significant biodiversity
- Land coverage
    - Acreage and continuity of freshwater and coastal wetlands
    - Acreage and distribution of protected land

- Acreage and distribution of water resources, permeable soils, and recharge zones
- Acreage and linear miles of protected riparian corridors
- Acreage of different forest stand types (oak woodland, riparian, redwood/Douglas fir, pine)
- Acreage of forestland by age and late seral forest characteristics
- Acreage of regulated and protected land within a property (e.g., forestland acres with exclusion zones, riparian buffers, Northern Spotted Owl core areas)
- Acreage and diversity of working lands using climate-resilient practices
- Acreage of land devoted to food production using regenerative practices
- Acreage of urban and suburban neighborhood-based gardens that contribute to local food production and benefit pollinator habitat
- No net loss of open space and native ecosystems on publicly owned land, or in targeted priority areas, including historically marginalized communities
- Trees and green spaces are distributed equitably across neighborhoods and communities in urban and suburban areas
- Net increase in urban and suburban green infrastructure to reduce climate risk
- No net loss or conversion of cropland/rangeland/grassland/forestland in Oregon

- <u>Land Management</u>
  - Acreage and diversity of fuels treatment and management projects
  - Acres of fire suppressed areas (with consideration of historic fire return intervals)
  - Acreage of forest treatments by silviculture type
  - Acreage of agricultural land stewarded using climate-resilient practices (e.g., practices that increase water retention, increase soil nutrients, decrease erosion, promote plant health and resilience to climate impacts, encourage native pollinators, etc.)
  - Diversity of production on agricultural lands/food system diversity
  - # of landowners using climate-resilient management practices (including grazing, croplands and vineyards practices, and timber practices)
  - Enhanced incentives for local food production (e.g., purchase of equipment to enable precision farming/machine harvesting resilient to extreme weather conditions, rebates for residential chickens)
  - Agricultural practices incorporate indigenous and local knowledge
    - Reduction and reversion of land degradation at a variety of scales

- Improved management of cropland and grazing lands
- Improved and sustainable forest management
- Increased soil organic carbon content
- % of land sector-based businesses that supply all or a portion of their electrical needs with solar, or alternative climate-friendly energy sources

Economic Indicators

- #of workers contributing to climate smart land management
- # of workers trained and placed into jobs, disaggregated by race, ethnicity, geography, with wages and other job quality indicators
- # of jobs in climate-smart related trades created or maintained
- Units of durable wood products (derived from woody material generated through forest health and resilience projects) sold
- # of accessible training opportunities that provided meaningful, transferrable skills for nature-based career development
- New investment motivated by nature-based climate solutions.
- Economic multipliers associated with investment in nature-based climate solutions

Infrastructure Indicators

- Regional, local, and traditional food harvesting, food processing, storage and related infrastructure to support the agriculture industry and food security
- Managed Aquifer Recharge capacity, particularly in critically over-drafted basins and other areas in need of long-term groundwater storage
- Changes in the timing of watershed runoff, and number of projects implemented to address these changes
- Compost infrastructure capacity
- Percentage increase in hard infrastructure investments that incorporate nature-based solutions

Social Justice/Equity Indicators

- # of acres managed, co-managed, transferred to, and owned by Oregon Native American tribes.
- Availability and use of programs that engage and support nature-based solutions that deliver environmental, equity, and economic benefits in communities most vulnerable to climate change.
- Prioritization of communities most vulnerable to climate change for financial incentives, technical assistance, and other supportive resources.
- # of nature-based solutions implemented in climate vulnerable communities.
- % of socially disadvantaged farmers and ranchers with on-farm technical assistance, demonstration projects, and incentives.
- Farmworker quality of life (including wages, health, and wellbeing).
- Access to capital and opportunity.
- Access to food and supply chain resilience.
- Access to parks/greenspace.
- Acres of community co-managed or owned properties managed for climate benefits.
- Management, ownership, and capacity
    - Capacity and access for broad participation in scoping, planning, design and implementation
    - Capacity for ongoing monitoring, maintenance, and adaptive management
    - Development of shared decision-making frameworks with tribal partners to identify tribal cultural properties and resources, as well as other conservation priorities and strategies
    - Incorporation of traditional ecological knowledge and tribal expertise into management
    - Increased partnerships among tribes and landowners/land management entities
    - Diverse land ownership and management—public, private, tribal
    - Ongoing, meaningful consultation and engagement with tribes regarding resilience priorities and actions related to advancing the Strategy
    - Participation of prescribed burn associations, cooperative burning, and fire training availability
    - Strengthened partnership with RCDs and SWCDs to identify needs and opportunities of small farms
    - Support for diverse organizations and individuals to own, manage, and steward land

- Support for small farmers to implement climate-resilient agricultural practices and shift to regenerative and ecological practices

Public Health Indicators

- # of emergency department visits / hospitalizations associated with heat, wildfires, wildfire smoke, etc.
- Excess deaths
- Physical activity levels associated with outdoor activities, e.g., hiking, walking, cycling, etc.
- Food security.
- Water security.
- Acreage of lands used for community/ urban farms.
- Market saturation with locally produced/ grown food.
- Access to nature or green spaces.
- Air quality.
- Water quality.
- Number of nature-based solution projects that reduce health risks.

Socioeconomic Indicators

- Contribution of natural and working lands to the state's economy and employment
- Contribution of natural and working lands to tribal economies and employment
- Health, safety, and capacity of workers (e.g., loggers, heavy equipment operators, and forest field staff and vegetation managers) to make a living wage and access housing in the community in which they work
- Health and capacity of workforce/number of workers
- Health, safety, and capacity of tribal communities
- Improved air quality (the following sub-bullets are from JLARC-Washington State Joint Legislative Audit and Review Committee)
    - Prevent air pollution from reaching levels that impact human health or air quality meeting or exceeding NAAQS and standards
    - Healthier air quality; fewer days of unhealthy air quality
    - Fewer air quality-related health problems and impacts
    - Reduced environmental damage to species and property
    - Healthier ecosystems
    - Reduced haze, and improved visibility, especially in parks and wilderness areas

- Increased livability
- Improved public health
- Implementation of community-based processes to strengthen capacity and increased participation (e.g., workforce development, access to green jobs, technical assistance)
- Protection of workers to climate hazards (e.g., worker exposure to wildfire smoke, heat, and chemicals)
- Prioritization and protection of tribal cultural resources and properties
- Tourism levels
- Amount of consumer incentives that reward people for taking steps to reduce their use of fossil fuels
- Increased local income generated in communities within and adjacent to natural and working lands
- No increase in energy costs to low-income households in communities within and adjacent to natural and working lands (via creation of climate rebates that assist with higher energy prices as well as other products and services that are sensitive to energy costs).
- Reduction in poverty and hunger in communities within and adjacent to natural and working landscapes
- Tax incentives available to landowners to support greenhouse gas emission reductions and promote carbon storage
- Short- and long-term sufficiency wage land sector jobs created
- Sufficiency wage employment in land sector jobs representative of the diversity of the local communities
- Increased student and teacher access to sustainability and land sector-based education and training
- Training for existing low-income workers for sufficiency wage "green jobs" that promote energy efficiency
- Increased community investments in training and education programs that create new jobs and emerging technologies that lead to reductions in greenhouse gas emissions and increased carbon storage
- Development and implementation of urban agriculture training programs to train new urban farmers in climate-resilient agriculture and business practices
- No net increase in resource insecurity among historically marginalized communities in Oregon
- Supply, diversity, and affordability of market-rate housing (e.g., # of new units by type and area median income, availability of units appropriate for families and multi-generational households, availability of lower-cost ownership units and qualitative discussion on availability to equity priority groups)*

    - Supply of income-restricted housing (# of net income-restricted units by type and AMI)*
- Residential displacement (e.g., estimated physical displacement, qualitative discussion of effect on economic displacement, citywide and in specific areas)*
- Exposure to air, noise, ground, and water pollution (amount and demographics of population living in areas with high exposure to air pollution, amount and percentage of population living near highways, arterials, flight paths, and industrial areas, and amount and % of population living in areas with high exposure to contaminated sites)*
- Vulnerabilities to the impacts of climate change (e.g., drought, fire, smoke) (e.g., amount and % of population living in areas with high exposure to flooding and landslides, amount and % of population living in areas with high temperatures, amount and % of population living in areas with low tree canopy coverage, amount and % of population living in areas affected by sea-level rise)*[6]
- Access to resources, food, water, healthcare, and other critical services in rural communities
- Equitable access to healthful, nutritious, fresh food (ideally locally grown for increased resilience to disruption, maximum nutrition, and local economic benefit)
- Equitable access to parks and open spaces and jobs opportunities
- Prioritization and protection of access (ingress and egress) to tribal lands through state and county roads during disasters
- Access to resources, food, water, healthcare, and other critical services in rural communities
- Equitable access to healthful, nutritious, fresh food (ideally locally grown for increased resilience to disruption, maximum nutrition, and local economic benefit)
- Equitable access to parks and open spaces and jobs opportunities
- Prioritization and protection of access (ingress and egress) to tribal lands through state and county roads during disasters
- Provision of green corridors and connections, as well as buffers, to provide access to nature and protection and relief from climate hazards
- Proximity of natural resource benefits to underserved and under-resourced communities
- Proximity to green spaces and green infrastructure within the County's developed lands to underserved and under-resourced communities

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6 https://www.seattle.gov/documents/Departments/OPCD/SeattlePlan/OneSeattlePlanEquityClimateMetrics.pdf

- Improved access to land-sector based education and training in communities within and adjacent to natural and working lands
- Mobility and reduced vehicle miles traveled (e.g., access to jobs via transit analysis, VMT and VMT per capita, access to pedestrian network, access to all ages and abilities bicycle network)*

Examples of Place-based Community Impact Socioeconomic Metrics

The Framework

Impact metrics measure the benefits and burdens on communities associated with strategies for carbon sequestration in natural and working lands and waters (Senate Bill 1534). Impact measurement is a process of collecting and analyzing data to assess the effect of a program, intervention, or policy on a particular population.[1] Community impact metrics measure the benefits and burdens associated with different strategies, practices, and programs that may inform and evaluate the co-benefits and impacts of GHG emissions reductions and increased carbon storage strategies on natural and working lands.[2] Science-based targets should incorporate consistent and continual reporting processes, transparency in data sources and calculation methodologies, and interoperability with evolving standards and regulations.[3]

Criteria to consider when developing social and cultural metrics[4]:

- Incorporate impacts based on discussions with stakeholders and the recognition of both individual and community-level effects.
- Incorporate proxy and constructed metrics to help overcome measurement difficulties and provide information about context-specific impacts
- Seek to meaningfully engage the diverse potentially affected interests
- Develop measures that are readily understood, concise, and operational to facilitate implementation in decisions.
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[3]https://tideline.com/wp-content/uploads/2022/10/Tideline_Truth-in-Climate-Impact-FINAL-Oct-2022.pdf
[4] Bessette and Gregory (2020)

Economic Stability

Employment
- Reductions in land sector unemployment/ increased employment
- Equitable access to green job opportunities
- Improved access to land-sector based education and training
- Investments in workforce development and local skilled jobs
- Short- and long-term sufficiency wage land sector jobs created and representative of the diversity of local communities
- Capacity of land sector workforce and number of workers
- Contribution of natural and working lands to the state's economy and employment
- # of individuals receiving land sector-based job training

Income
- Increases in medium household income
- Increased local income in communities within and adjacent to natural and working lands

Business Growth
- % change in business establishments
- $ invested in projects that enhance carbon storage and reduce GHG emissions
- Tax incentives available to landowners to support GHG emission reductions and support carbon storage
- Increase in tourism levels

Poverty and low-income
- % of children under 18 years of age in poverty
- No increase in low-income households in communities\

Energy
- Lower consumer energy bills

Neighborhood/ Physical Environment

Housing
- Increases in home ownership across racial and ethnic groups
- Population spending more than 30% of income on housing
- # subsidized housing units per 1,000
- % vacant housing units
- Worker access to housing in the community in which they work
- # of new green roofs

Transportation
- Access to all ages and abilities bicycle network
- % of community members with access to high-frequency public transportation choices within 1/2 mile

Parks
- Equitable distribution and access to parks and open spaces (including walkability)
- Green corridors and connections as well as buffers that provide access to nature and protection and relief from climate hazards
- Proximity to green spaces and green infrastructure within developed lands
- # of citizens benefitting from and using green corridors
- Increase in scenic values

Food

Food security
- % of population that is food insecure
- # of people whose calorie intake falls below FAO-defined specified values

Food quality
- Equitable access to healthy options (fresh food)

Education

Literacy
- % of 3rd graders reading at grade level

Training
- Access to technological and other training for farmers
- Access to vocational training

High School Education
- % CCSD high schools

Higher Education
- Population aged 25 and older with a bachelor's degree or higher

Health

Medical bills
- % of population 18-64 years of age with health insurance
- # of primary care physicians per 100,000

Life expectancy/quality
- Increases in life expectancy of residents
- Fewer air quality-related health problems and impacts

Workers
- Protection of workers to climate hazards

Hospital Visits
- # of asthma emergency department visits by children

Sustainability

Water
- # gallons per capita per day
- Enhanced water quality
- Volume of water reused
- # of violations of Safe Water Drinking Act
- Flood risk reduction

Recycling
- % of municipal waste recycled
- Reduction in total waste disposed

Air quality
- % of good air quality days annually
- Fewer days of unhealthy air quality
- Air pollution that does not exceed NAAQS and standards
- Reduced haze and improved visibility

Incentives
- Annual investment in weatherization, electric heat pump, and community solar incentive/subsidy programs
- Support for farmers to implement climate-resilient agricultural practices
- Amount of consumer incentives that reward people for taking steps to reduce their use of fossil fuels

Fossil Fuel Alternatives
- % of land sector-based businesses that supply all or a portion of their electrical needs with solar, or alternative climate-friendly energy sources
- # of electric vehicle charging stations

Temperature
- Relative decrease in local temperatures during summer period

Management, ownership, and capacity

Public engagement
- Capacity and access for broad participation in land sector-based scoping, planning, design, and implementation
- Inclusion of small farmers in program development and design
- Development of shared decision-making frameworks with tribal partners
- Incorporation of traditional ecological knowledge and tribal expertise into management
- Strengthened partnerships with RCDs and SWCDs to identify needs and opportunities of small farms, woodlands, and landowners
- % of private property owners and developers that implement climate change preparation measures (e.g., reducing impervious areas)

Land ownership
- Diverse land ownership and management
- Support for diverse organizations and individuals to own, manage, and steward land

Figure 4. Examples of place-based community impact socioeconomic metrics.

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