Oregon Climate Assessment Report

photo credit: Dudley Chelton

Kathie Dello and Philip Mote, OCCRI

www.occri.net/

hb 3543

- the Oregon Climate Change Research Institute must assess, at least once each biennium, the state of climate change science as it pertains to Oregon
- physical, biological and social sciences

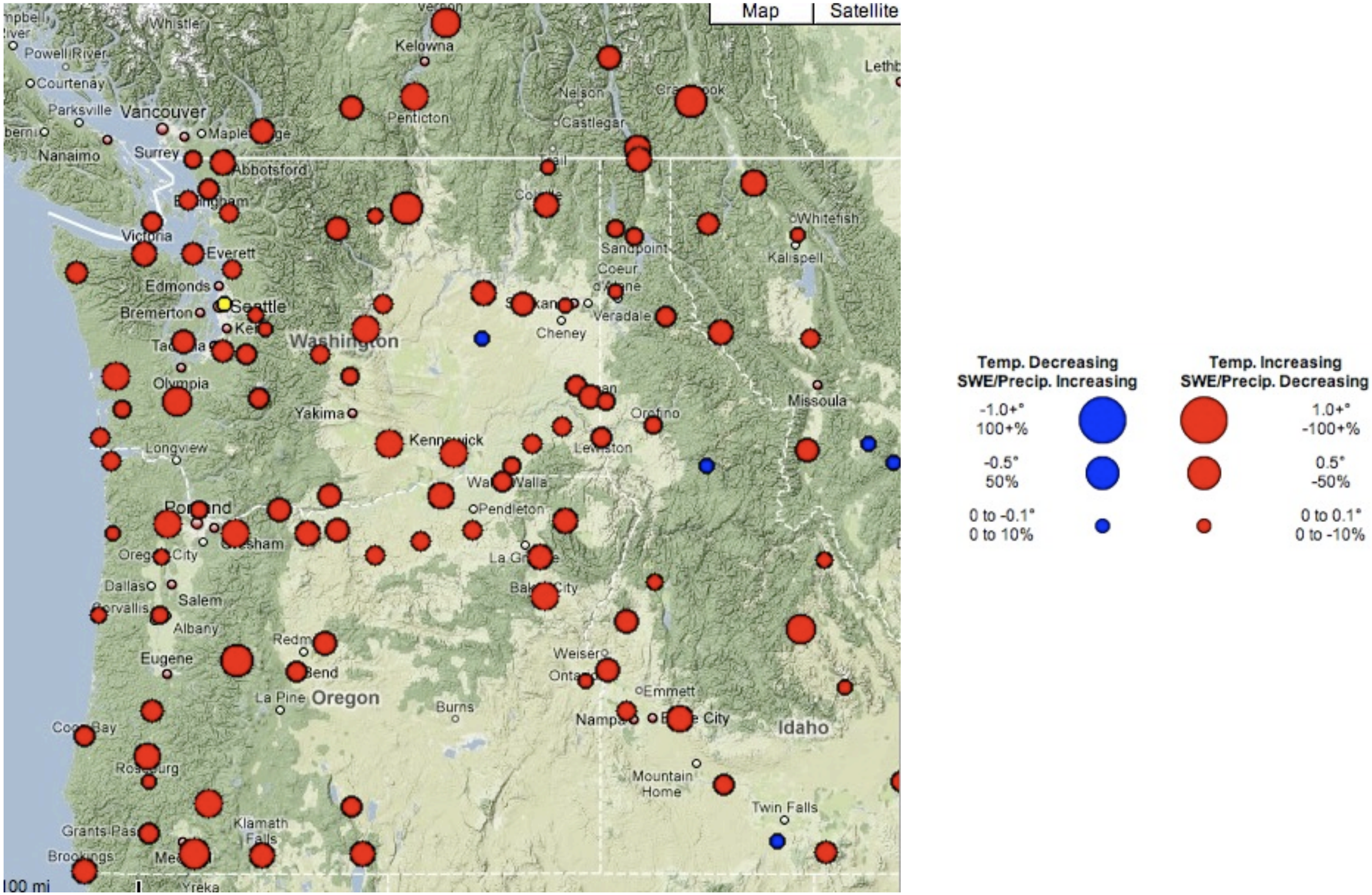
- 9 lead authors, OCCRI coordinated
- 70 + contributors from 4 OUS universities, state and federal agencies
- drew from peer reviewed literature and other climate assessments from WA (Climate Impacts Group) and CA (Climate Action Team)
- not a prescriptive or policy document
- link up to state adaptation framework (agency directors and workgroup)

Outline

- Legislative summary
- Executive summary
- Chapter 1 - Climate
- Chapter 2 - Defining the problem & causes
- Chapter 3 - Freshwater resources
- Chapter 4 - Agriculture
- Chapter 5 - Vegetation
- Chapter 6 - Coasts and estuaries
- Chapter 7 - Fish and wildlife
- Chapter 8 - Economics
- Chapter 9 - Human dimensions

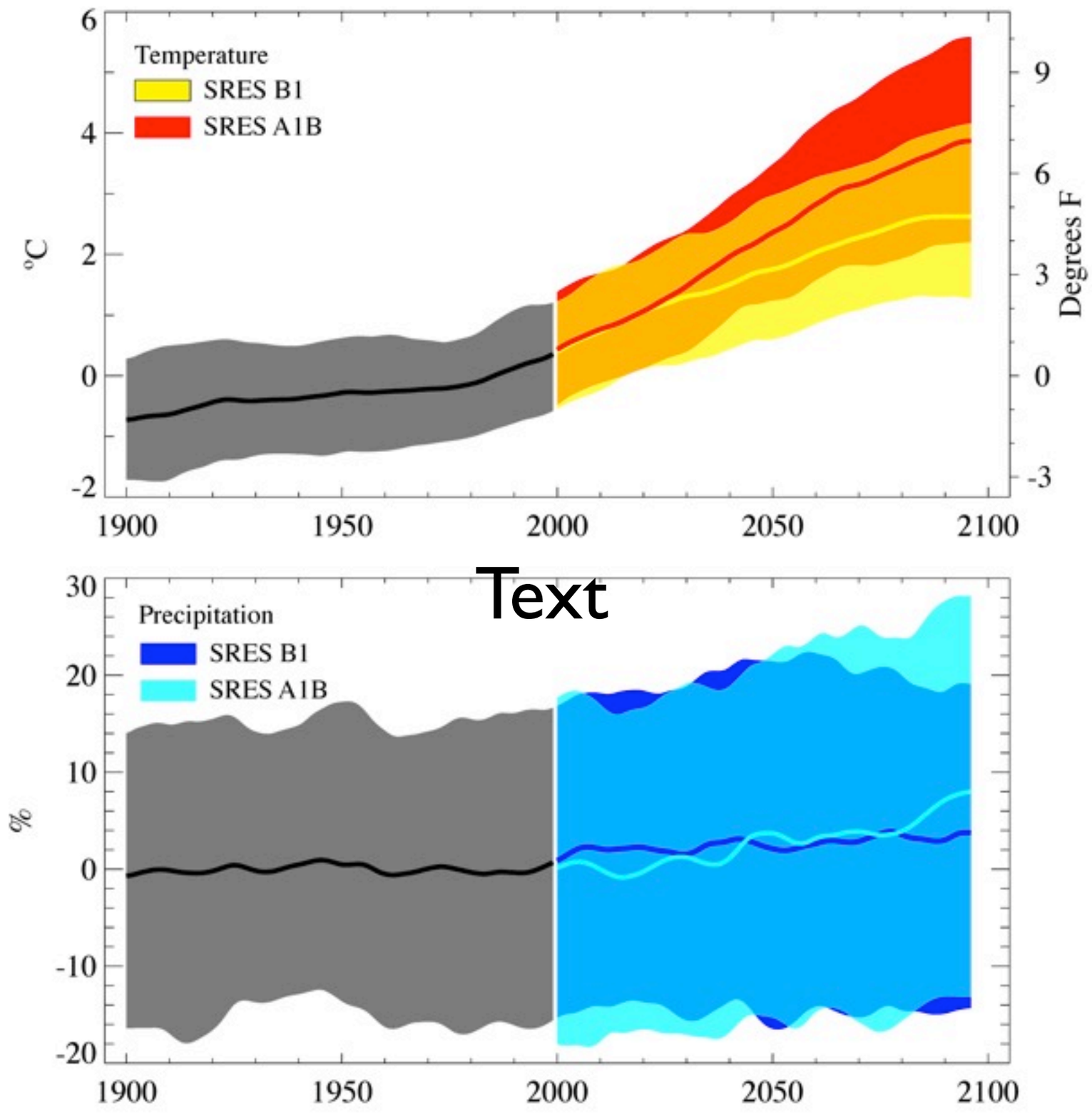
Ch. 1

Annual mean warming trends, 1920-2005



OWSC, www.climate.washington.edu/trendanalysis

Ch. 1

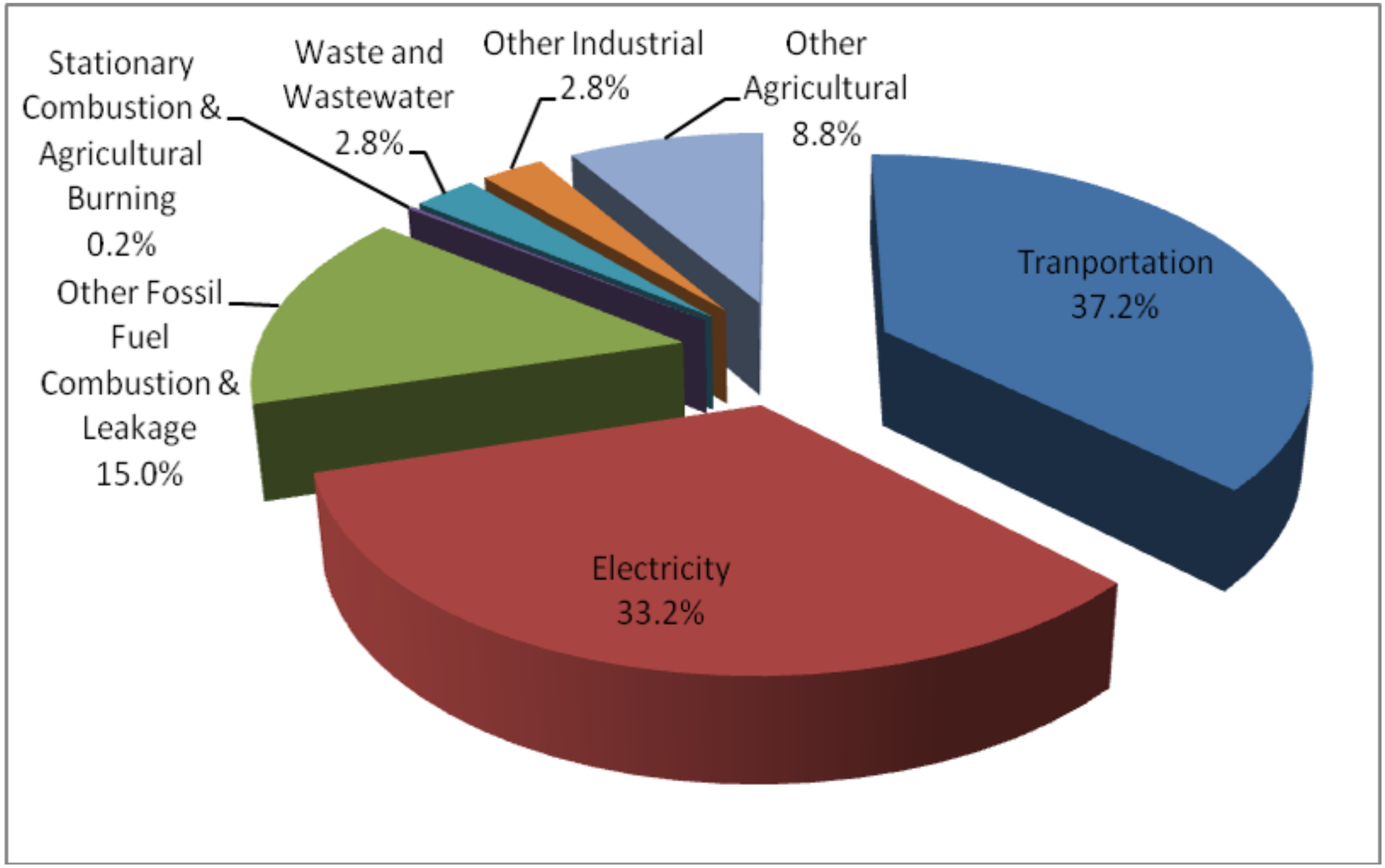


Mote and Salathé, 2010

Seasonal changes

- Changes in precipitation equivocal fall, winter, spring
- More warming (and drier) in summer
- Likelihood of more extreme precipitation

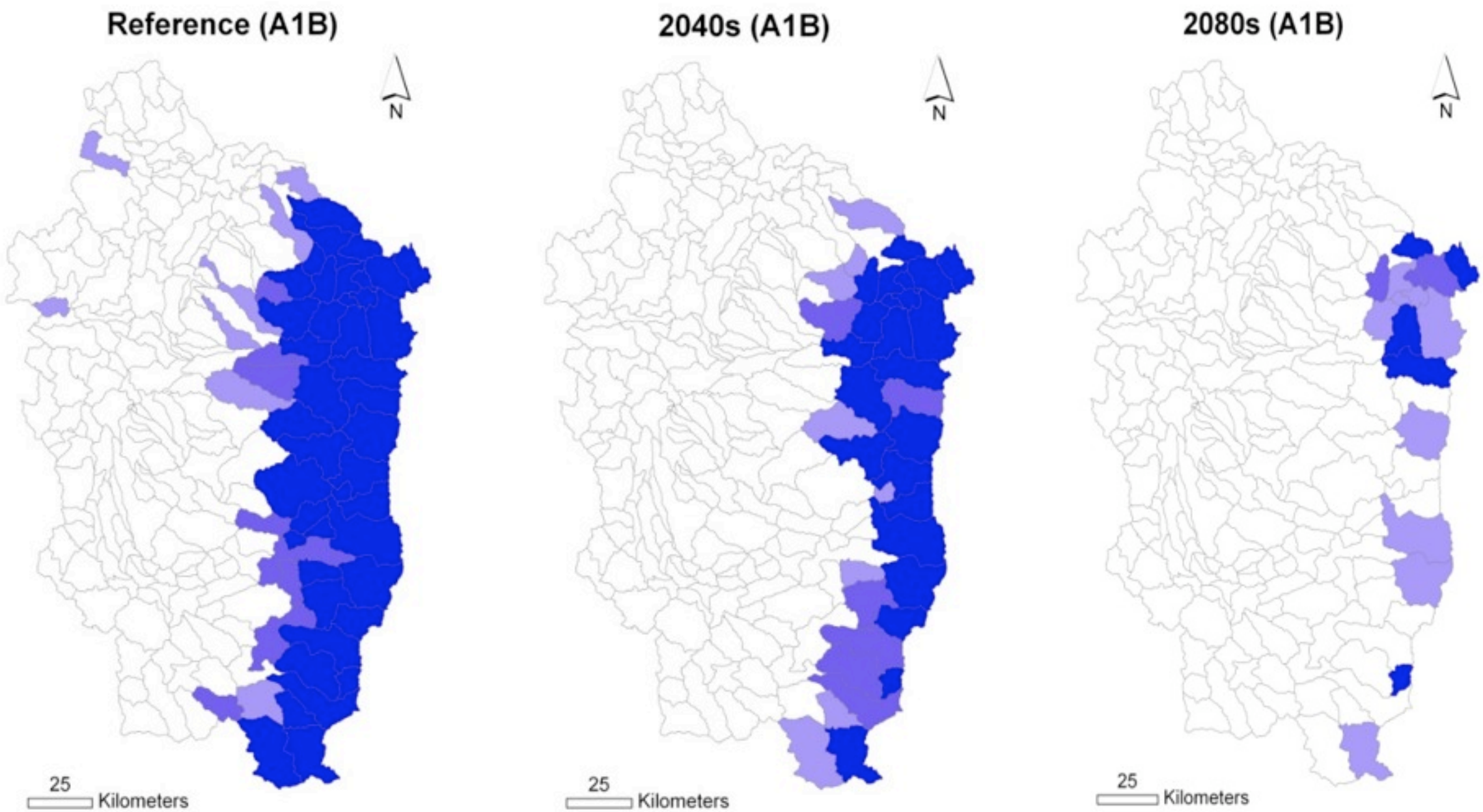
Ch. 2



Oregon Greenhouse Gas Inventory, 2010

Ch. 3

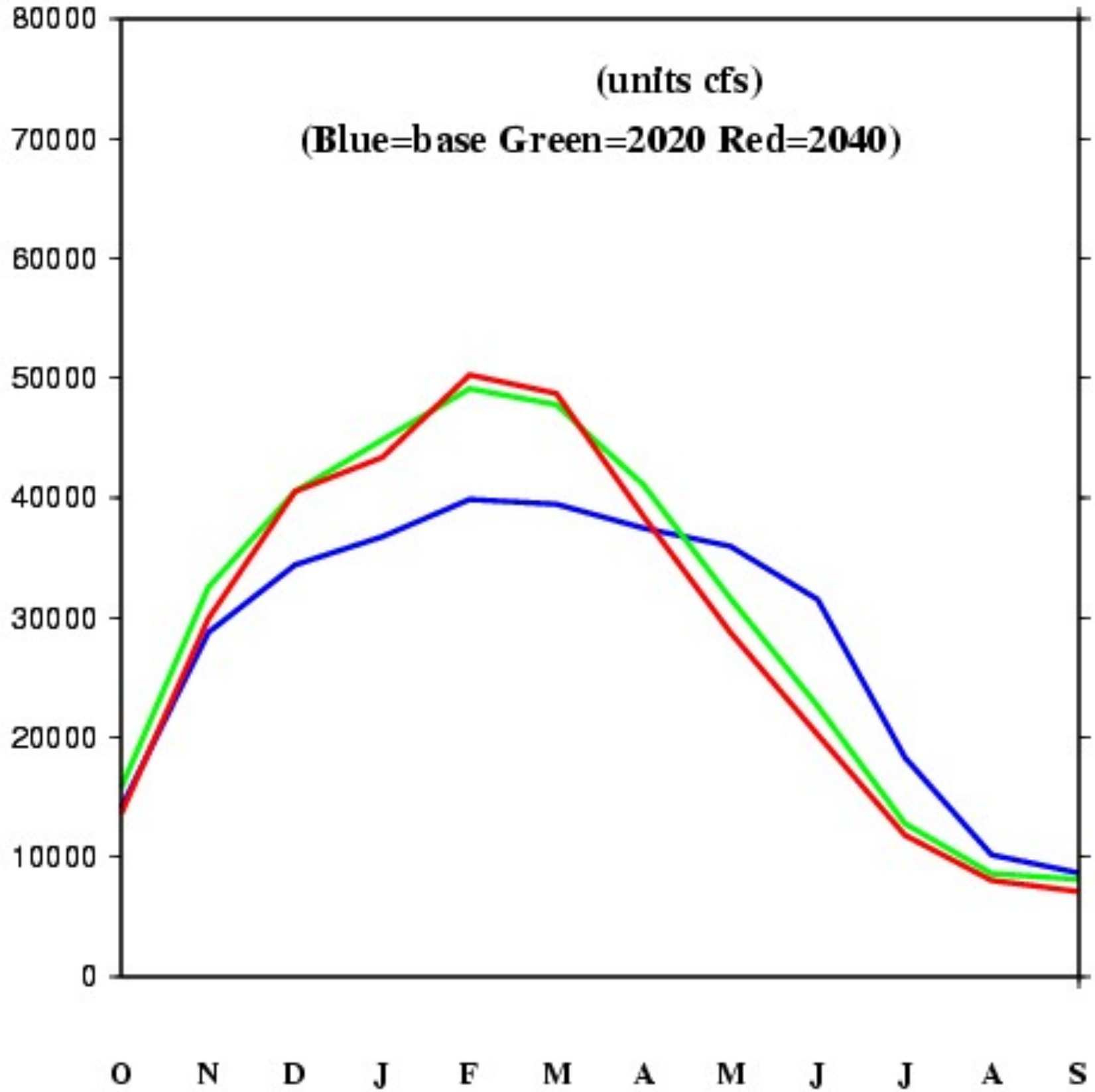
April 1 snow water equivalent in Willamette Basin



Chang and Jung 2010

Ch. 3

Simulated Natural Flow in the Willamette River at the Columbia

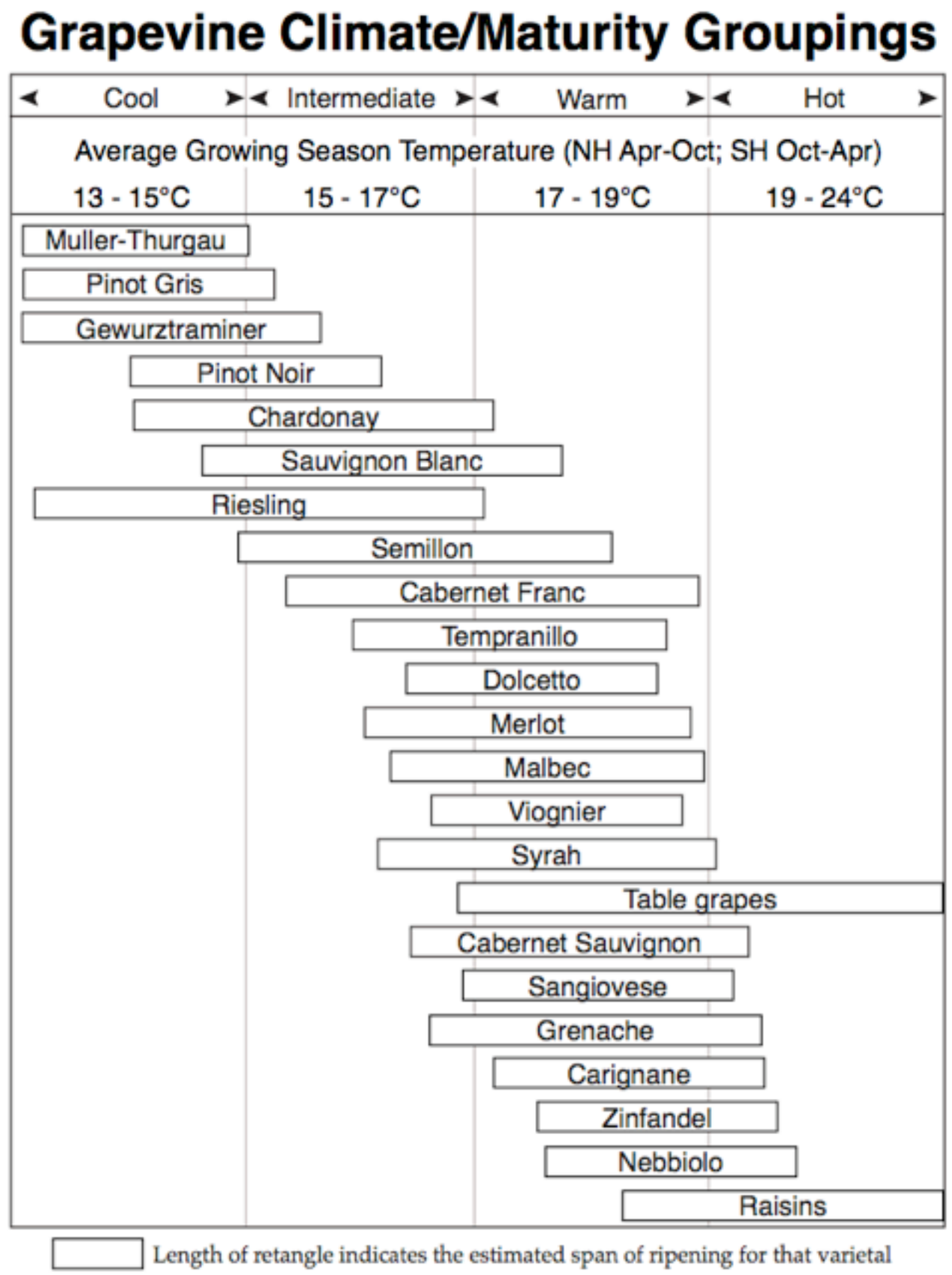


Modeling: Alan Hamlet
Analysis: Kathie Dello

agriculture in OR

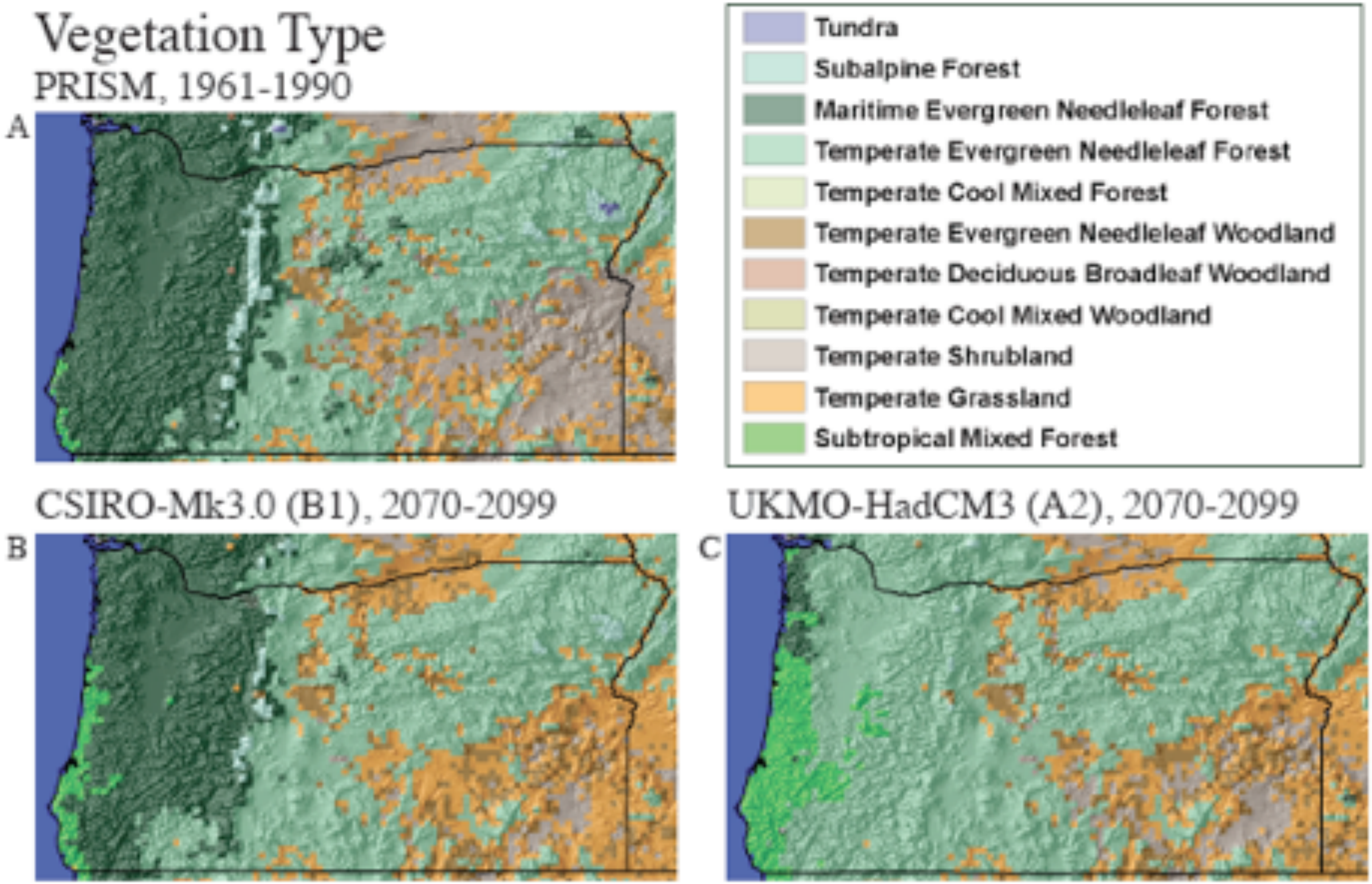
- state is top producer of 15 US commodities
- agriculture makes up about 9% of OR ghg emissions
- Concerns: availability of water; weeds, insects
- Plus: longer growing season, more wine varieties

Ch. 4



Jones et al. 2004

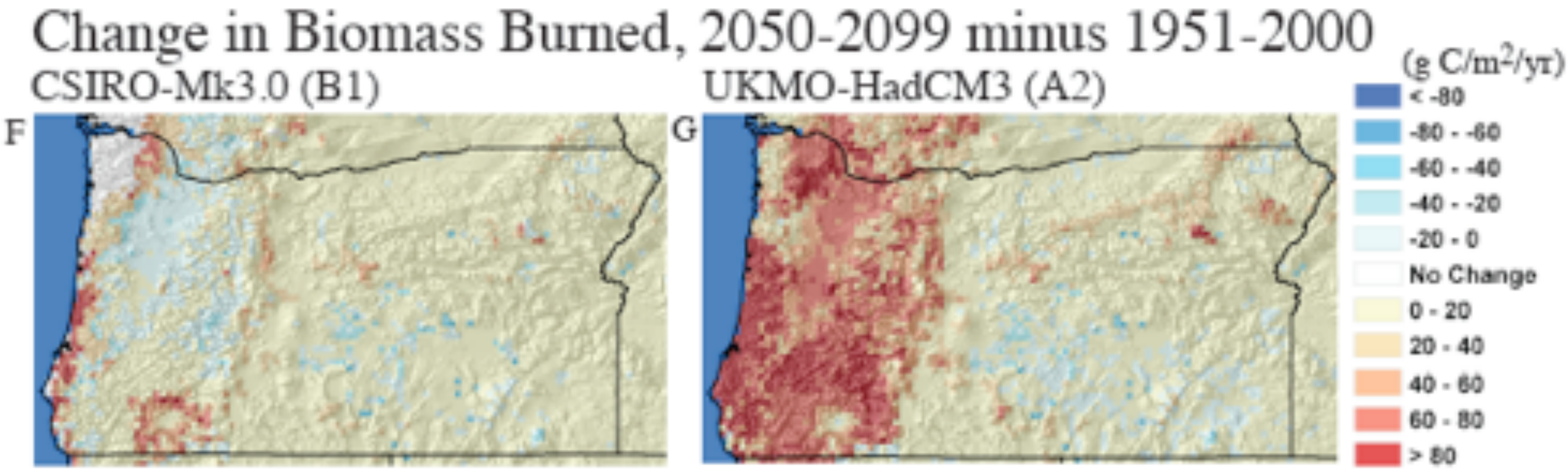
Ch. 5 Future Projections of Vegetation Type



MAPSS, R. Neilson

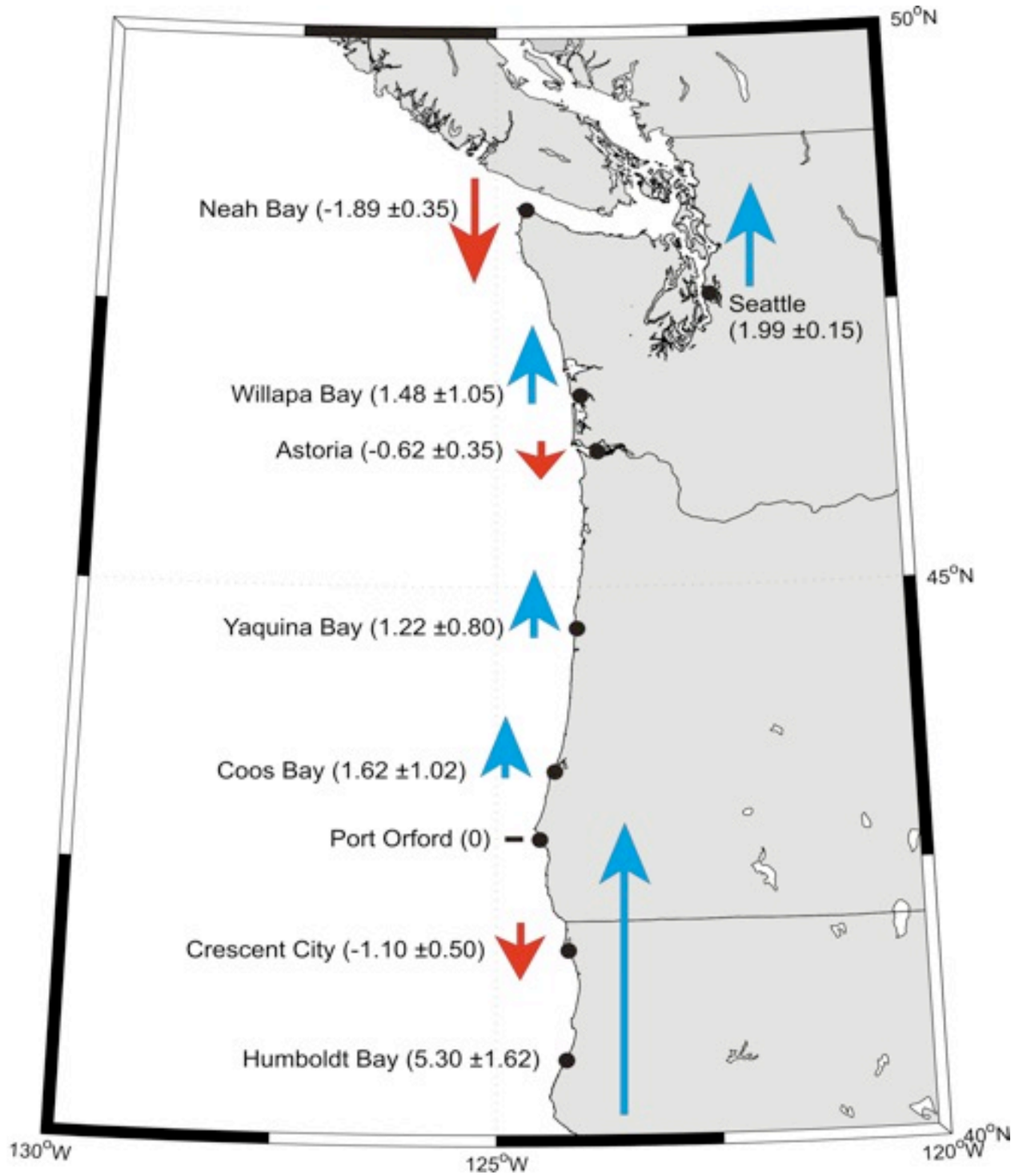
Ch. 5

changed in biomass burned



MAPSS, R. Neilson

Ch. 6



after Komar et al., 2010 (in press)

Ch. 6

Shoreline retreat and armoring, Rockaway

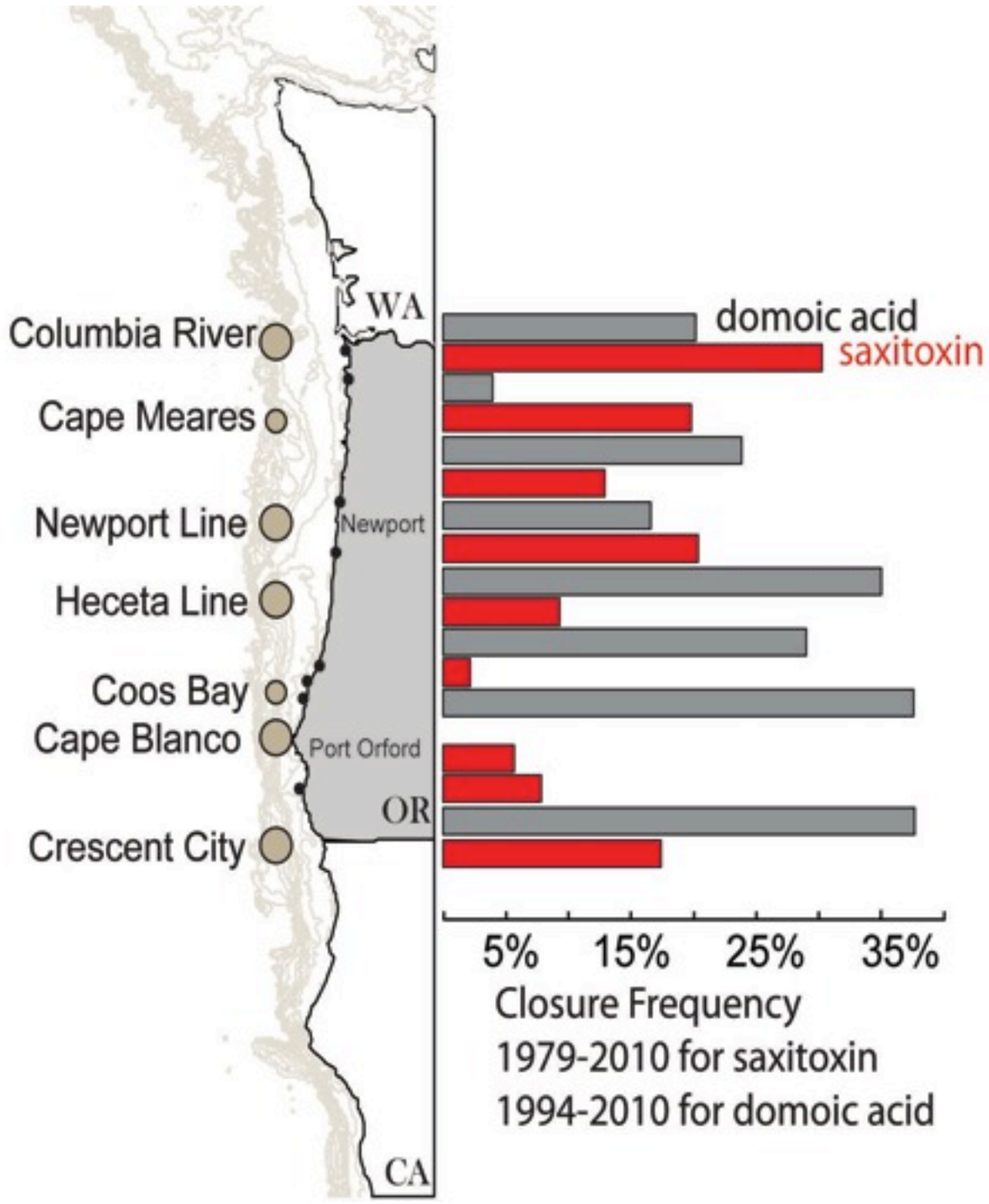
photo: Don Best

observed species changes

- Could be natural variability or climate change
  - insects moving in from south of Oregon
  - frogs reproducing earlier in the year
  - land birds are shifting their distributions northward
  - freshwater fish losing habitats
  - humboldt squid appearing off OR coast

Ch. 7

algal blooms



Hixon et al., 2010

Economic risks

Global estimates of costs 1-5% GDP

- Oregon: Reductions in snow and water supply
- Energy
- Agriculture: crop yield, water supply
- Forestry: Wildfire, insects, shifting species
- Riverine and coastal flooding
- Salmon, Health, Recreation (CLI report)

Ch. 9

Recently there has been much discussion about climate change and global warming due to years of human use of fossil fuels such as petroleum and coal. Some have called for the development of renewable energy sources—such as wind, solar, wave and geothermal—to reduce our reliance on fossil fuels. In general, which of the following views best describes your opinion in this area?

Statement	% respondents agreeing
1. Do not know	1.6%
2. Climate change is not a problem; existing energy policies should be maintained.	25.6%
3. Climate change is a minor problem; only minor energy policy changes are needed to encourage the development of renewable energy sources.	9.4%
4. Climate change is a moderate problem; moderate energy policy changes are needed to encourage the development of renewable energy sources.	30.3%
5. Climate change is a serious problem; significant energy policy changes are needed to encourage the development of renewable energy sources.	33.2%
	N=1,480

Borberg et al. 2009

key findings

- increases in annual temperature, warmer drier summers
- summer water supply will decrease
  - reduced snowpack, drier summers
- Oregon's most ghg intensive sector is transportation
- availability, quality and cost of water will be a limiting fact

key findings

- potential opportunities in the ag sector
- wildfire is projected to increase
- frequency and magnitude of coastal flooding events may increase
- many plant and animal species on land, freshwater and sea will shift their distributions
- changes to the marine environment, increased temps

moving forward

- we call for a more complete economic analysis of the impacts of climate change on Oregon's economy
- we're already experiencing impacts now
- measures for adaptation should be taken now
- OR Climate Change Adaptation Framework

Oregon Climate Change Adaptation Framework

Land Conservation and Development Commission

January 12, 2011

Presentation at a glance:

- Purposes of the framework
- Climate risks
- Short-term priority actions
- Recommendations for implementation

Framework Context

<u>Previous effort</u>: The Oregon Climate Change Integration Group's *Framework for Addressing Rapid Climate Change*, January 2008

<u>Starting point</u>: LCDC direction to develop a climate change strategy in July 2009. October 2009 meeting of Governor Kulongoski, agency directors and representatives of the university system: Develop a framework for organizing how Oregon should prepare for changes to our climate

<u>Parallel effort</u>: Practical steps to apply the OCCRI state of the science report (*Oregon Climate Assessment Report)*

<u>Resources</u>: Declining revenues focus efforts on low or no cost (low hanging fruit) ways to get started

Purposes of the Framework

- Identify future climate conditions that pose major risks for Oregonians
- Provide a framework to help state agencies, local governments and citizens to begin to prepare for the effects of changes in Oregon's climate
- Assess our current capacity to address climate-related risks to people, communities, infrastructure, and natural resources
- Identify next steps: short-term, low-cost priority actions to begin helping Oregon to prepare

Principal framework elements:

- Summary of climate risks (11 major areas)
- Short-term priority actions
- Recommendations for improving the Framework (Version 2.0)

Risks that are *very likely* to occur

- Increase in average annual air temperature and likelihood of extreme heat events

- Changes in hydrology and water supply; reduced snowpack and water availability in some basins; changes in water quality and timing of water availability

Risks that are *likely* to occur (slide 1 of 2)

- Increase in wildfire frequency and intensity
- Increase in ocean temperatures with potential for changes in ocean chemistry and increased ocean acidification
- Increased incidence of drought
- Increased coastal erosion and risk of inundation from increasing sea levels and increasing wave heights and storm surges

(continued)

Risks that are *likely* to occur (slide 2 of 2)

...

- Changes in abundance and geographical distributions of plant species and habitats for aquatic and terrestrial wildlife
- Increase in diseases, invasive species and insect, animal and plant pests
- Loss of wetland ecosystems and services

Risks that are *more likely than not* to occur

- Increase incidence and magnitude of damaging floods and frequency of extreme precipitation events
- Increased incidence of landslides

Short-term Priority Actions

Risks that are very likely to occur	
1.	**Increase in average annual air temperatures and likelihood of extreme heat events**
	❑ Enhance and sustain public health system (state and local) capacity to prepare for and respond to heat waves and smoke emergencies, and improve delivery of information on heat events and cooling centers, especially for isolated and vulnerable populations.
2.	**Changes in hydrology and water supply; reduced snowpack and water availability in some basins; changes in water quality and timing of water availability**
	❑ Maintain the capacity to assist landowners to restore wetlands, uplands and riparian zones to increase the capacity for natural water storage.
	❑ Improve real-time forecasting of water delivery and basin yields to improve management of stored water.
	❑ Improve capacity to provide technical assistance and incentives to increase storage and to improve conservation, reuse, and water use efficiency among all consumptive water uses.

Short-term Priority Actions

Risks that are likely to occur	
3.	**Increase in wildfire frequency and intensity**
	❑ Improve integration of wildfire risk into planning to reduce vulnerability to natural hazards.
	❑ Restore fire-adapted ecosystems to withstand natural recurring wildfires.
	❑ Develop short- and medium-term climate change adaptation strategies for forests and other fire-prone habitats, and improve development standards to reduce exposure to fire risk at the urban-wildland interface.
	❑ Improve the capabilities of public health agencies to plan for and respond to the public health and safety risks of wildfire emergencies.
4.	**Increase in ocean temperatures, with potential for changes in ocean chemistry and increased ocean acidification**
	❑ Increase research on the impacts of changes in ocean temperature and chemistry on estuarine and near-shore marine habitats, including commercial and recreational fisheries.

Short-term Priority Actions

Risks that are likely to occur	
5.	**Increased incidence of drought**
	❑ Improve capacity to provide technical assistance and incentives to increase storage capacity and to improve conservation, reuse, and water use efficiency among all consumptive water uses.
6.	**Increased coastal erosion and risk of inundation from increasing sea levels and increasing wave heights and storm surges**
	❑ Inventory and map coastal shorelands that are at risk of erosion or inundation, or are barriers to shoreline migration, and develop long-term state and local adaptation strategies for shorelands.
7.	**Changes in the abundance and geographical distributions of plant species and habitats for aquatic and terrestrial wildlife**
	❑ Work with private, local and federal partners to identify ways to manage ecosystems to improve their resilience to changes in climate conditions.

Short-term Priority Actions

Risks that are likely to occur	
8.	**Increase in diseases, invasive species, and insect, animal and plant pests**
	❑ Increase monitoring, detection and control measures for pest insects and plant and wildlife diseases.
	❑ Increase surveillance and monitoring for climate-sensitive infectious diseases to humans.
	❑ Increase outreach and community education about disease and invasive species prevention measures.
	❑ Seek new means of securing resources to detect and combat diseases and invasive species.
9.	**Loss of wetland ecosystems and services**
	❑ Support implementation of priority actions for Risks 2, 5, 6, 7, and 10 related to hydrologic changes, drought, coastal erosion and inundation, habitats, and flooding.

Short-term Priority Actions

Risks that are more likely to occur than not	
10.	**Increased frequency of extreme precipitation events and incidence and magnitude of damaging floods**
	❑ Inventory past flood conditions and define and map future flood conditions.
	❑ Improve capability to rapidly assess and repair damaged transportation infrastructure, in order to ensure rapid reopening of transportation corridors.
11.	**Increased incidence of landslides**
	❑ Develop public education and outreach on landslide risks and how to adapt to landslide risks.

Recommendations for Implementation

- Ongoing working group
- Work with OCCRI to identify research priorities
- Agency program assessments
- Integrate economic analysis into next round of adaptation planning
- Mainstream adaptation considerations into existing planning
- Work to integrate local, private and federal entities into next round of adaptation planning
- Communication and outreach – taking adaptation planning to the local level

Oregon Climate Change Adaptation Framework

For more information:

http://www.oregon.gov/LCD/

KeepOregonCool

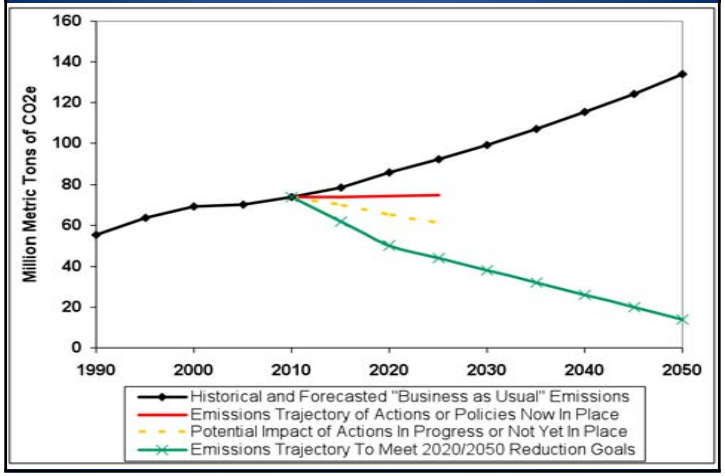
Oregon Global Warming Commission

www.KeepOregonCool.org

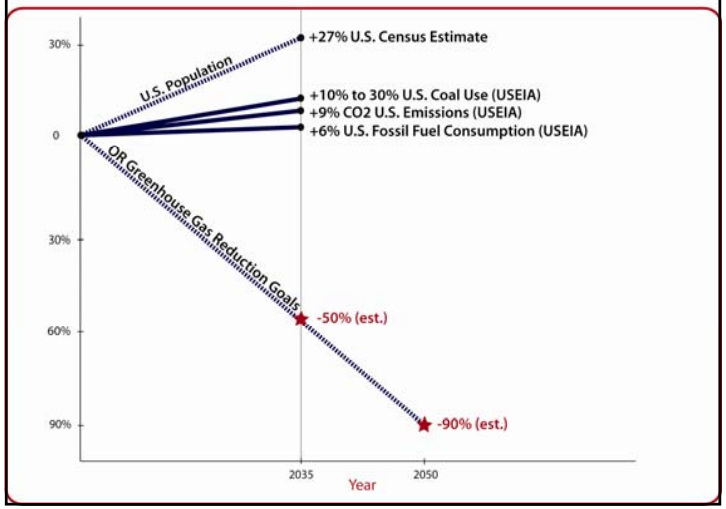
HB 3543 – 2007 Legislature Sets Goals

1. By 2010 Oregon shall have arrested the increase in greenhouse gas emissions and shall begin real reductions.
2. By 2020, Oregon's greenhouse gas emissions shall not exceed a level 10% below 1990 levels.
3. By 2050, Oregon's greenhouse gas emissions shall not exceed a level at least 75% below 1990 levels.

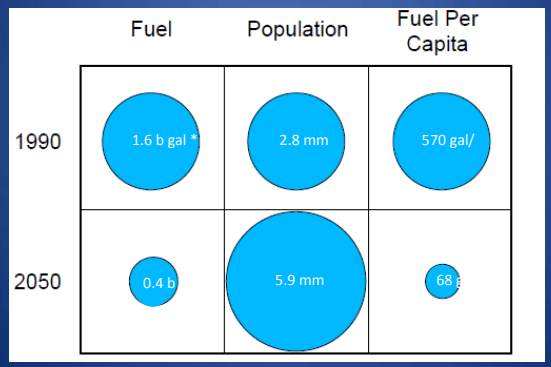
Oregon GHG Goals/Trends



Oregon / U.S. Trends 2005-2035



What does a 75% reduction in GHG emissions mean in terms of (vehicle) fossil fuel consumption?



* 2010 ODOT Data for on-road vehicle travel; US Census population growth projections

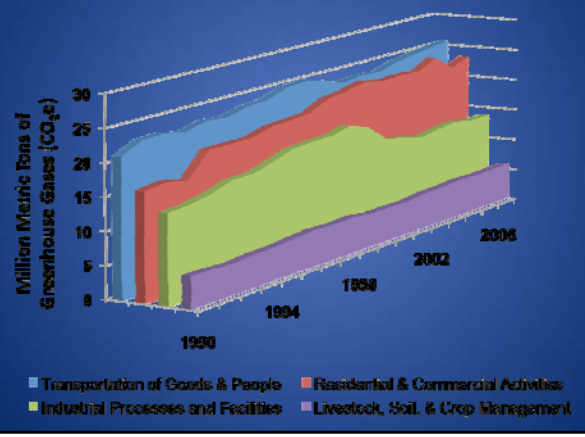
Roadmap to 2020 Recommendations by Sector

- Commission "Integrating" Recommendations
- Energy/Utilities
- Industrial Emissions
- Materials/Waste Management
- Agriculture
- Forestry
- Transportation/Land Use

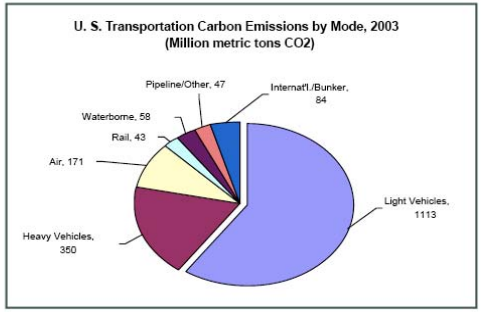
Roadmap to 2020: *Big Ideas*

1. Vehicle Fuels: Out: gasoline/diesel
   In: electricity, gas, biofuels
2. Cities: "Growth" inside existing UGB's
3. Electricity: Ramp down coal generation
4. Public Revenues: Charge for carbon emissions
5. New Buildings: Net Zero Emissions designs
6. Existing Buildings: Retrofit code applied at point-of-purchase
7. Industry: Sell Oregon-branded low carbon products
8. Consumption-Based Carbon Accounting

Greenhouse Gases by Sector over Time



Highway Vehicles Account for 82% of Transportation CO2 Emissions – and 23% of all U.S. CO2 **



**37% of all OR GHG

AASHTO FTA

OR Transportation GHG Emissions: Recent History

1990 - 2000

- OR Population +20%; GHG+15% (Pd GHG +4%)
- OR VMT +24% (Pd VMT +17%)
- OR VMT/capita +4%

2000 - 2007

- OR population +12%; GHG +6% (Pd emissions -2%)
- OR VMT -3% (Pd VMT -7%)
- OR VMT/capita -8% (Pd –14%; Metro -4%; national +5%)
- OR Freight GHG emissions +7% (mostly medium/heavy duty diesel trucks)

- *Metro pop +30% (1990-2004); UGB expanded by 12%;*
- *Pd Metro average commute 16% shorter than national average; saves drivers $2.5 B/year and 1.4 mm tons CO2*

Transportation/Land Use Tier One Recommendations

- Change funding strategies/increase funding
- Expand Urban, Intercity Transportation Options/
- Create compact neighborhoods with accessible services *within existing urban growth boundaries*
- Enable lower-carbon freight movement (Industrial zones and transport corridor design/operations)
- Embed climate change in transportation planning
- Demand reduction
- Manage/price parking
- Low Carbon Fuel Standards/Electric/Alt Fuels Vehicle market uptake, infrastructure

T + LU + GHG Planning Underway

- ODOT STIP recommends "GHG reduction be considered and discussed" in 2012-15 submissions (required thereafter)
- HB 2001 (2009): ODOT will develop Transportation *Least Cost Planning*
- SB 1059 (2010): MPO's begin GHG planning
- Metro: SB 1059 compliance + RTP

Least Cost Planning

- Used in utility planning since ±1980
- Costs/benefits compared across multiple attributes and goals
- Qualitative and quantitative evidence
- Internalized + externalized costs
- Risk and uncertainty explicitly recognized, and quantified if possible
- Question: applied at system level or project level?

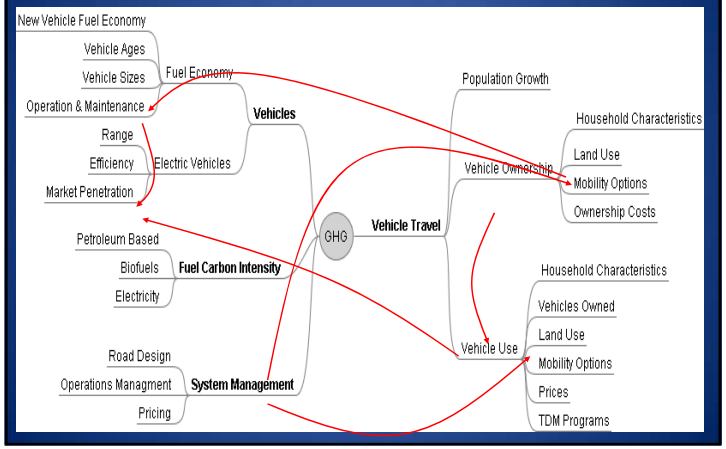
The GreenSTEP model

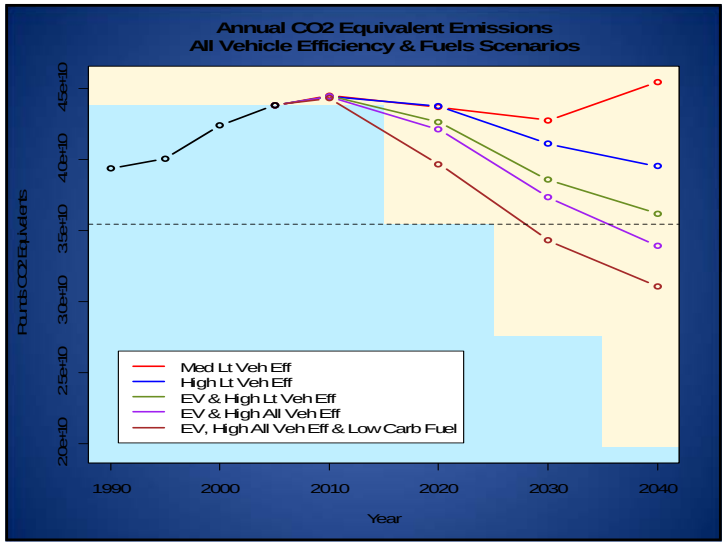
- GreenSTEP = Greenhouse gas State Transportation Emissions Planning model
- Work started (2008) at the request of the Oregon Global Warming Commission (OGWC) for a model to evaluate a broad range of GHG policies
- Integral to both SB 1059 and LCP processes

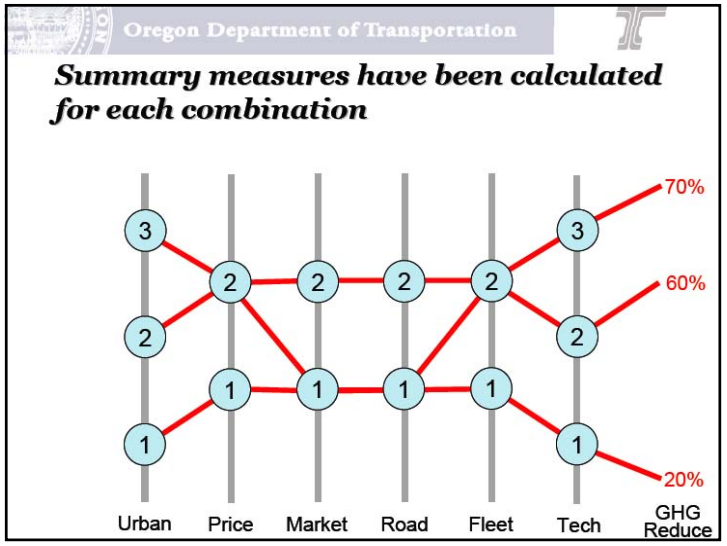
GreenSTEP addresses a large number of factors affecting GHG emissions

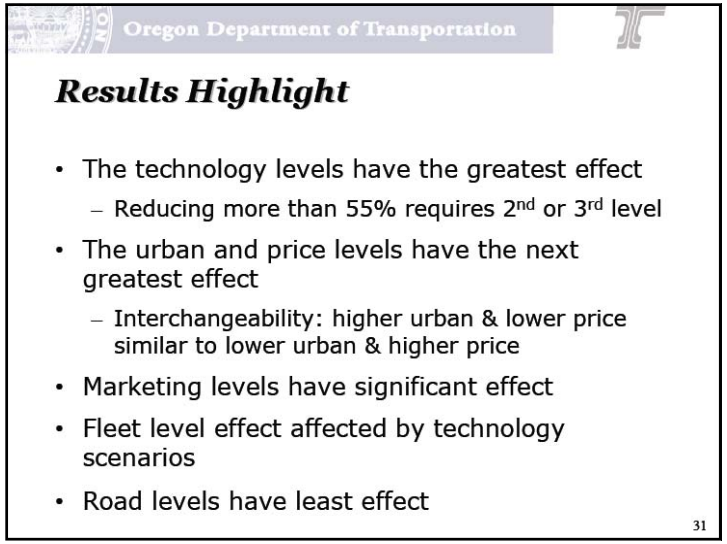
- Demographic and income changes
- Relative amounts of development occurring in urban and rural areas
- Metropolitan and other urban area densities
- Urban form (i.e. mixed-use)
- Amounts of metropolitan area public transit service
- Highway capacity
- Vehicle proportions: autos, light trucks, EVs, PHEVs
- Vehicle ages
- Vehicle fuel efficiency
- Pricing of fuel, carbon, VMT, parking
- Use of bicycle & other light-weight vehicles
- TDM and eco-driving
- Effects of congestion on fuel economy
- Lifecycle carbon content of fuels
- CO2 production from electrical power use for transportation

Factors are interconnected









Energy/Utilities Tier One Recommendations

- Develop State Energy/Climate Policy & Benchmarks
- Energy Efficiency Codes, Standards, Incentive
- New Transmission
- OUS Research Priorities
- Gas Infrastructure
- Smart Grid/Resource Integration
- Ramp down coal

Industrial Emissions

- Sector-targeted efficiency, e.g. boilers served from pipeline gas contracts
- State assistance for finance, technology access; staff training; "best practices" sharing
- Leadership Initiative: "Top Twentieth" percentile in plant carbon/output – State brands, markets (like Oregon Country Beef)
- (see also Transportation/Land Use industrial siting and freight recommendations)

Materials/Waste Management

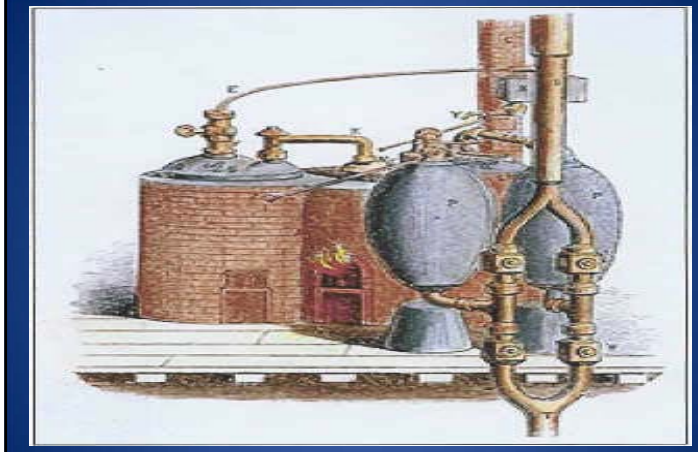
- Consumption-based GHG inventory
- Carbon footprinting; carbon content labeling; consumer information (e.g., food choices)
- Upstream "stewardship" responsibilities for manufacturers
- "Net zero" life cycle carbon footprint buildings
- Reduce food waste
- Research organic waste disposition for optimum carbon outcomes

Agriculture

- Increase nutrient use efficiency, information transfer to farmers
- Identify and incent tools for carbon sequestration in soils and permanent vegetation
- Develop, deploy manure-to-energy technologies
- Develop adaptation strategies to cope with expected water constraints

Forestry

- Develop forest carbon inventory/tracking tools
- Leave west-side (moist) forests alone to accumulate carbon
- Manage and reduce fuel loading in east-side (dry) forests (result: near-term carbon release)
- Rely upon private forest holdings for product
- No net conversion of forest to non-forest uses



Savery Steam Engine – 1698

"Global warming is not just another environmental issue."

Oregon Strategy for Greenhouse Gas Reductions

Governor's Advisory Group on Global Warming, December 2004

The Good News

The good news, in the six years since that line was written in an earlier state climate *roadmap* report, is that Oregon is on a greenhouse gas (GHG) emissions trajectory to meet its 2010 goal – to arrest GHG emissions growth and put us on the road to real reductions. The 2010 emissions goal, and subsequent goals for 2020 and 2050, were recommended by the Governor's 2004 Advisory Group on Global Warming, and adopted by the 2007 Legislature in HB 3543.

There is other encouraging news. By 2020 we will close our only in-state coal plant at Boardman. Wind energy now contributes 4.4% of Oregon's electricity, up from <1% in 2004. Megawatt-sized solar systems are proposed or under construction. Oregon has a Renewable Portfolio Standard and our utilities are on their compliance paths. New technologies and ideas for managing the power grid are creating opportunities to re-imagine the electricity system as one in which high reliability service, reasonable cost and low carbon peaceably co-exist.

New energy efficiency finance and delivery tools (like Portland's CleanEnergyWorks) are being deployed to capture deep residential and commercial sector savings. Oregon has become the national leader in green building techniques and their application in both new structures and retrofits. The Northwest Power and Conservation Council projects some 6000 average megawatts (aMW) of additional regional electric energy conservation savings in the next 20 years, to go with the nearly 4000 aMW already realized since 1980 – in aggregate, about five Grand Coulee Dams' worth of avoided new energy generation.

In 2004 "low carbon vehicle fuels" seemed synonymous with bio-diesel in Oregon. Such fuels still figure in our strategies, but by 2010 Oregon had become one of the favored markets in the U.S. for deployment of electric vehicle technologies by car companies across the globe.

Portland and Multnomah County were among the many Oregon local governments taking the initiative to curb GHG emissions. Oregon's most populous city and county have reduced their emissions back to and even below 1990 levels despite a 24 percent population gain over the period, and while maintaining a vigorous economy (at least until all economies sagged in the current global slump). State and local government transportation and land use planning efforts are paying off, with more compact urban areas that require less energy per person while accommodating economic growth and individual choice. These outcomes have won recognition for Oregon nationally and globally.

EXHIBIT: 8 AGENDA ITEM: 3
LAND CONSERVATION & DEVELOPMENT COMMISSION
DATE: 1-12-11
SUBMITTED BY: Angus Duncan

The 2020 Challenge

Getting to our 2010 goal wasn't easy, and it wasn't accomplished by operating the state on autopilot. We have mobilized in many ways over the last six years. The Renewable Portfolio Standard, auto tailpipe emissions standards and other initiatives from state and local governments, utilities, businesses and private citizens were all essential.

Getting to our 2020 goal – 10 percent below 1990 levels – is a heavier lift still. It's the equivalent of a nearly 30 percent reduction from today's (2010) emissions levels. And since some choices made in 2011 may not generate carbon savings for years – closing a coal plant in 2020, for example – Oregon can't delay choosing the actions and investments that will be needed. Infrastructure investments – in transportation and in electric and gas transmission – have lengthy lead-times to construction before savings can begin to accumulate.

It would also be myopic to not acknowledge the thin revenues with which the State begins this decade.

The Oregon Global Warming Commission's (OGWC) *Roadmap to 2020* recognizes both of these considerations – lead-time and cost -- by offering recommendations that mix near-, mid- and long-term action time lines, that include research and regulatory as well as investment actions, and that propose new funding mechanisms. Six work groups, comprised of technical and policy experts in their fields, developed recommendations in the areas of energy; transportation and land use; industrial emissions; agriculture; forestry; and materials management. For example, the OGWC supports shifting transportation infrastructure funding to a *utility* model that charges users commensurate with their use of the system including both physical infrastructure and environmental effects (e.g., airshed pollutants and greenhouse gas emissions). Another low-cost recommendation is for Oregon to recognize, co-brand and co-market products of Oregon companies that deliver their goods with fewer carbon emissions and less energy consumed than their competitors elsewhere.

The 2050 Challenge

Each OGWC workgroup was asked to begin its process by envisioning its subject area in a Year 2050 in which Oregon's emissions goal, set back in 2007, had been achieved. Each group's report begins by reaching for this 2050 outcome with only existing technologies – no magic bullets or potions. In all cases workgroups found this task doable, although confidence in achieving the outcomes was paired with a realistic assessment of the challenges in doing so.

We asked for this step for two reasons. First, we wished to avoid recommendations that might get Oregon more easily to its 2020 goal but make getting to 2050 harder. An example: the one-for-one displacement of conventional coal plants with conventional gas to generate electricity might get us to 2020 but in doing so could lock us into forty more years of fossil fuel dependence.

The more important reason was to recognize that getting to 75 percent below 1990 levels (or nearly 90 percent below 2010 levels) will not be achieved by *incremental* thinking and actions. We can't count on having 200 mpg gasoline-

powered cars in forty years, so what are our alternatives with today's technologies? We can put just so many inches of insulation in existing walls and attics; then what?

Some of our answers will have to be *transformational* ones; comparable to how, in the 1970's, we re-conceived "energy efficiency" as comparable to a new electricity generating plant because it directly displaced the need for that plant's output. The consequence of that idea has been regional efficiency investments displacing almost 4000 aMW of electric energy annually by 2010 and saving regional ratepayers some $2.3 billion annually in avoided energy costs.

The Next Big Ideas

What are some of these next Big/Transformational Ideas? Here's the Commission Chair's short list of candidates, all drawn from the adopted Roadmap:

- **Vehicles and Fuels:** (K18, K19): Electric and/or gas-fueled light vehicle and fleet vehicle market penetration targets in Oregon should be *at least double* national levels; Oregon government and utility policies should align with this goal.
- **Cities: Hold the Urban Growth Boundary Line in Oregon's Larger Urban Areas** (K12): With limited exceptions for flexibility adjustments, Oregonians in our six largest urban communities should grow within existing UGBs; no net expansion. This will require greater creativity in urban design, transportation, distribution of goods and services, and development of *brownfields* and other infill opportunities within UGBs.
- **Electricity: Ramp Down Coal; Replace with "Flexible" Grid and Resource Mix** (K2, K3, K4, K7): To achieve "substantial reductions" by 2020 (e.g., closing out PGE's Boardman coal operations) and make "deliberate, continuous progress" thereafter toward the 2050 GHG goal, we should be replacing the coal generation that now serves Oregon electricity loads with a flexible combination of resources (e.g., renewables, efficiency and gas to integrate) that will lower carbon counts while preserving system reliability.
- **Public Revenues: Charge For Carbon** (K2, K8, K9, K17): Shift Oregon revenue models to charging for consumption of (1) infrastructure, (2) airshed, and (3) carbon. Phase out the gas tax and adopt a "utility" revenue model for funding transportation infrastructure, including congestion charges and per-vehicle-mile charges that vary with vehicle carbon efficiency. Shift from taxing real estate property value to taxing energy consumption and carbon emissions by dwelling.
- **New Buildings: Build to net zero energy/emissions target** (K2): Oregon already has a national reputation for sustainable buildings and building design, being leveraged by Oregon companies to sell their products and services. But we can't slack off and hold our competitive edge. The next big thing for buildings is *net zero* carbon emissions and energy consumption (even better: net zero environmental footprint: energy, emissions, water, waste management). Oregon incentives and aspirational codes need to target *net zero* outcomes.

- **<u>Existing Buildings</u>: "Retrofit" Building Code and Code Compliance at Point of Sale** (K2): There are different costs and physical opportunities to retrofit buildings for optimum energy and carbon efficiency. Recognizing these differences in building energy codes while requiring all cost-effective upgrades at point-of-sale could accomplish more efficiency investments in those buildings sooner, and in a manner that is more cost-efficient.
- **<u>Oregon Industry</u>: Sell Oregon Low Carbon Products** (K20, K21): Oregon can go further to leverage its national reputation for environmental values in transportation, green buildings, agriculture (e.g., Oregon Country Beef) and other economic sectors. If Oregon industry – likely starting with food processors and high-tech products – can show added value in energy and carbon-efficiencies, ranking in the top 20% of their competitors nationally, the State could recognize those accomplishments, brand them and co-market those companies' products.
- **<u>Consumption-based carbon accounting</u> (and carbon-labeling)** (K33): With the exception of electric utilities, the carbon emissions we hold Oregonian's responsible for are those originating inside the state. We don't count emissions resulting from producing the goods we choose to import from out of state (except for electricity); we do count emissions from producing goods in Oregon even when we export those goods for outside consumption. A "consumption-based" inventory gives us a better handle on how our choices affect global emissions. It could also benefit Oregon producers by excluding emissions associated with what they produce and export for out-of-state consumption.

Note that there are no "magic bullet" technologies in this list; no "X-Factor" solutions. We don't discount the emergence of such technologies. Indeed we believe they will be critically needed; we call for increased funding of focused research regionally and nationally, as well as a national carbon "cost" signal to stimulate innovation. But none of the ideas in this list is waiting around for any new technology. Instead they are creating the framework within which such technologies can emerge, take root, and grow into industries and jobs as well as carbon savings.

Climate Change Impacts and Preparation

Strategies to reduce Oregon's emissions are the primary focus of the Oregon Global Warming Commission, but we work in partnership with many other entities. Two of these – the Oregon Climate Change Research Institute (OCCRI) at Oregon State University, and the State Agency Directors' Adaptation Work Group – each delivered critical reports in December, 2010.

The OCCRI *Oregon Climate Assessment Report* is the work of over 100 researchers across the Oregon University System. Its *key findings* should surprise no one: likely impacts to Oregon's weather patterns, water supplies, agricultural production, forest health, fish and wildlife species and ecosystems, public health, transportation infrastructure and coastal communities.

The *State Adaptation Framework* takes that list of impacts and identifies near-term, low cost and high benefit actions Oregon can undertake to cope with the

effects and cushion their costs to Oregonians, to their communities and livelihoods, and to the environmental values we hold dear in this state.

The OGWC has been involved in both efforts, and commends the researchers and authors for their contributions. Taken together with the *Roadmap to 2020*, these comprise a carefully considered and systematic response by Oregon to the pending threat of climate disruption, while taking responsibility for our share of the state's GHG emissions that contribute to climate change.

Principles

This introduction to the Roadmap begins with one quote from the 2004 Advisory Group report and recommendations. It ends with the Principles adopted by that Group for proceeding into our uncertain climate future. They are as exactly pertinent today as they were six years ago.

A. Oregon's greenhouse gas reduction goals and solutions must be meaningful, firmly grounded in science, and lead to effective reductions in Oregon's greenhouse gas emissions, commensurate with the state's share of the larger global problem.

B. Oregon should first begin with the most cost-effective solutions.

C. To the fullest extent possible, Oregon's actions should be designed to serve both the long-term economic well-being of the state and the goal of climate stabilization.

D. Recognizing that there are always tradeoffs between a long-term investment strategy and near-term costs and cash flow, the Advisory Group believes Oregon can and should be a leader – but the State can't get so far ahead that Oregon's businesses are not competitive in the short term. The State will need some safety valves to relieve short-term competitive pressures if others aren't living up to their responsibilities along with Oregon.

E. Oregon creates long-term economic well-being with an "investment strategy" that buys efficiency savings, new technologies, energy price stability and a competitive edge in marketing – and profiting from—the tools developed and the lessons learned.

F. Oregon will take no actions that impair energy reliability.

G. Oregon will look for ways to support innovation, especially if it leads to marketable products and services.

H. Oregon will partner with other states, Canadian provinces, tribal nations and other nations, where doing so will enhance the effectiveness of state-level actions and their co-benefits for Oregonians.

I. Reducing the state's greenhouse gas emissions won't eliminate the need to adapt to the warming climate that will result from changes already fixed in the atmosphere. Oregon must next develop an adaptation strategy.

J. Oregon is committed to equity in allocating both costs and benefits of this enterprise.

Next Steps

The Commission, OCCRI and the State Agency Directors are submitting their findings and recommendations to the Governor and Legislature, but also generally to the citizens of Oregon. Our conclusions are only meaningful if they are communicated effectively to, and resonate with, a majority of Oregonians.

In 2011 the Commission will be undertaking that communications effort – a *Roadshow* for the Roadmap – across the state. We will employ different channels and media to reach individuals, opinion leaders and stakeholder groups. We hope Oregonians will make it a true two-way conversation, letting us hear a full range of ideas and opinions. And while we encourage all to communicate their ideas directly to the Governor and your legislators, we'll ensure as well that they find their way into State policymaking circles.

Later in 2011 the Commission will reconsider the Roadmap in light of what we hear, as well as what we may have learned since from advances in science and technology. We'll consider actions undertaken by communities, agencies and in the legislative session. The "roadmap" process is in a sense always "interim" as we learn by doing and listening both. We urge all Oregonians to engage with us, to speak up and speak out.