Northwest Power and Conservation Council

June 27, 2011

MEMORANDUM

TO: Council Members

FROM: Terry Morlan

SUBJECT: Presentation on Oregon's Road Map to 2020 Greenhouse Gas Reduction Goal and Utility System Implications – Angus Duncan, Chair, Oregon Global Warming Commission

In 2007 Oregon adopted a goal of reducing greenhouse gas emissions levels to about 30 percent below current levels by 2020. The Oregon Global Warming Commission was created in 2007 by the Oregon Legislature through House Bill 3542. The Commission's general charge is to recommend ways to coordinate state and local efforts to reduce Oregon's greenhouse gas emissions consistent with Oregon's goals and to recommend efforts to help the state, local governments, businesses and residents prepare for the effects of global warming. Members of the Oregon Global Warming Commission include representatives of industries, environmental organizations, agriculture concerns, faith-based organizations and utilities. Ex officio members include representatives of state agencies and the state legislature.

The Commission developed a roadmap for reaching the state's goals. Angus Duncan, the Chair of the Oregon Global Warming Commission will discuss the Commission's findings and recommendations. The recommendations are divided into those affecting "sectors" of the state, including energy, transportation and land use, industry, agriculture, and forestry. Summary materials and a PowerPoint presentation are attached. In addition, the link below will take you to the website of the Commission where you can research its process, findings, and recommendations.

http://www.keeporegoncool.org/content/oregon-global-warming-commission

Attachments

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An aerial view of the flooded Interstate 5 overpass looking south in Chehalis, Wash. A storm that battered the Pacific Northwest left behind flooded homes, fallen trees and washed-out roads, including the region's largest highway, which was covered with 10 feet of muddy water.

Photo by Bruce Ely

Chehalis I-5 Interchange December 2007

Oregon Adapting to Changing Climate

Very Likely

- Hotter; more extreme heat events
- Reduced snowpack, shifting precipitation, runoff, water availability
- Wildfire
- Increased ocean temperature, acidity

Likely

- Increased coastal erosion
- Redistribution of plant/animal species/habitat; wildlife at risk
- Increased disease, invasive species

More Likely than not

- Wetland loss
- Increased flooding frequency/magnitude
- Increased landslide frequency

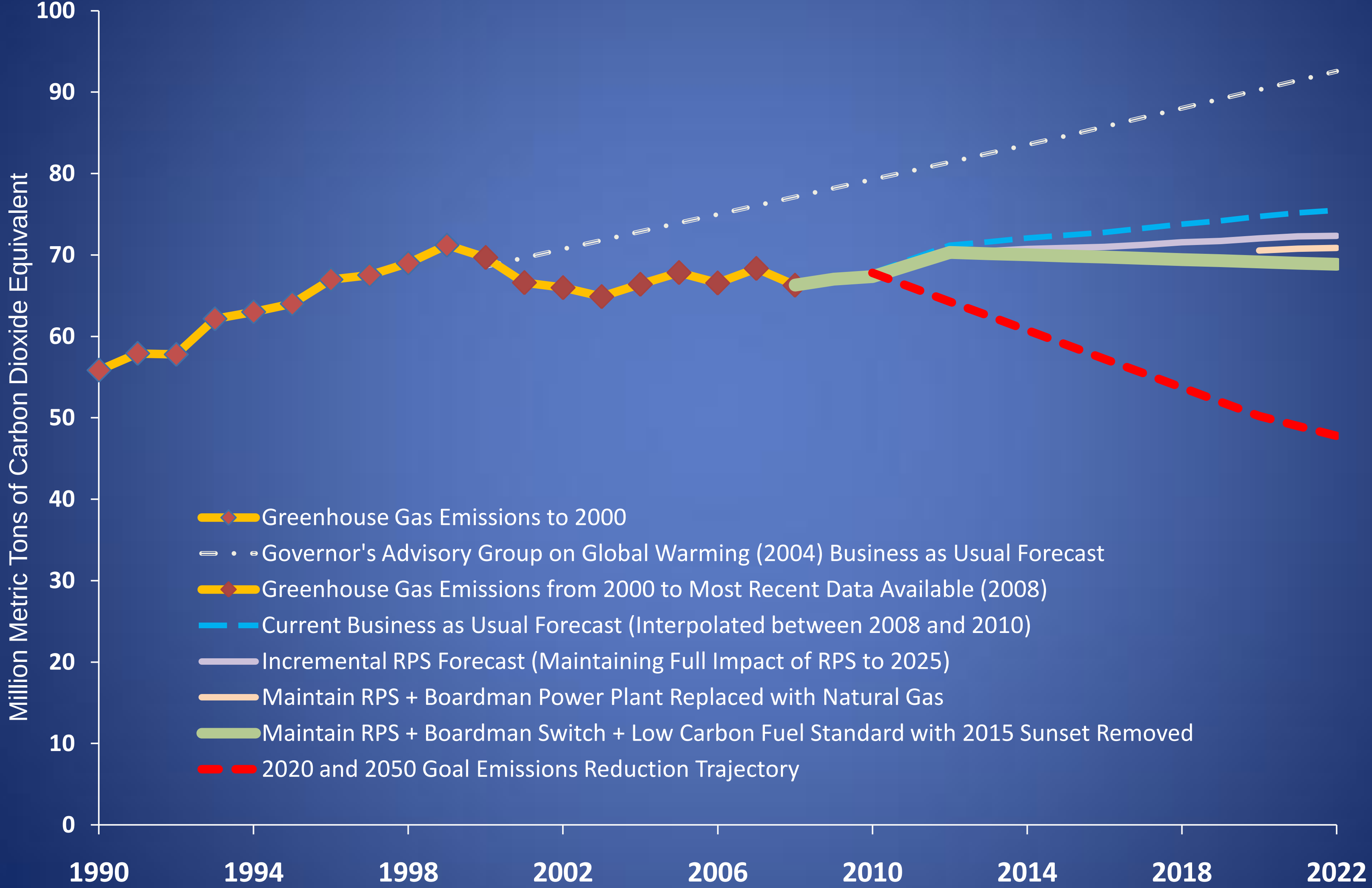
HB 3543 – 2007 Legislature Sets Goals

1. By 2010 Oregon shall have arrested the increase in greenhouse gas emissions and shall begin real reductions.

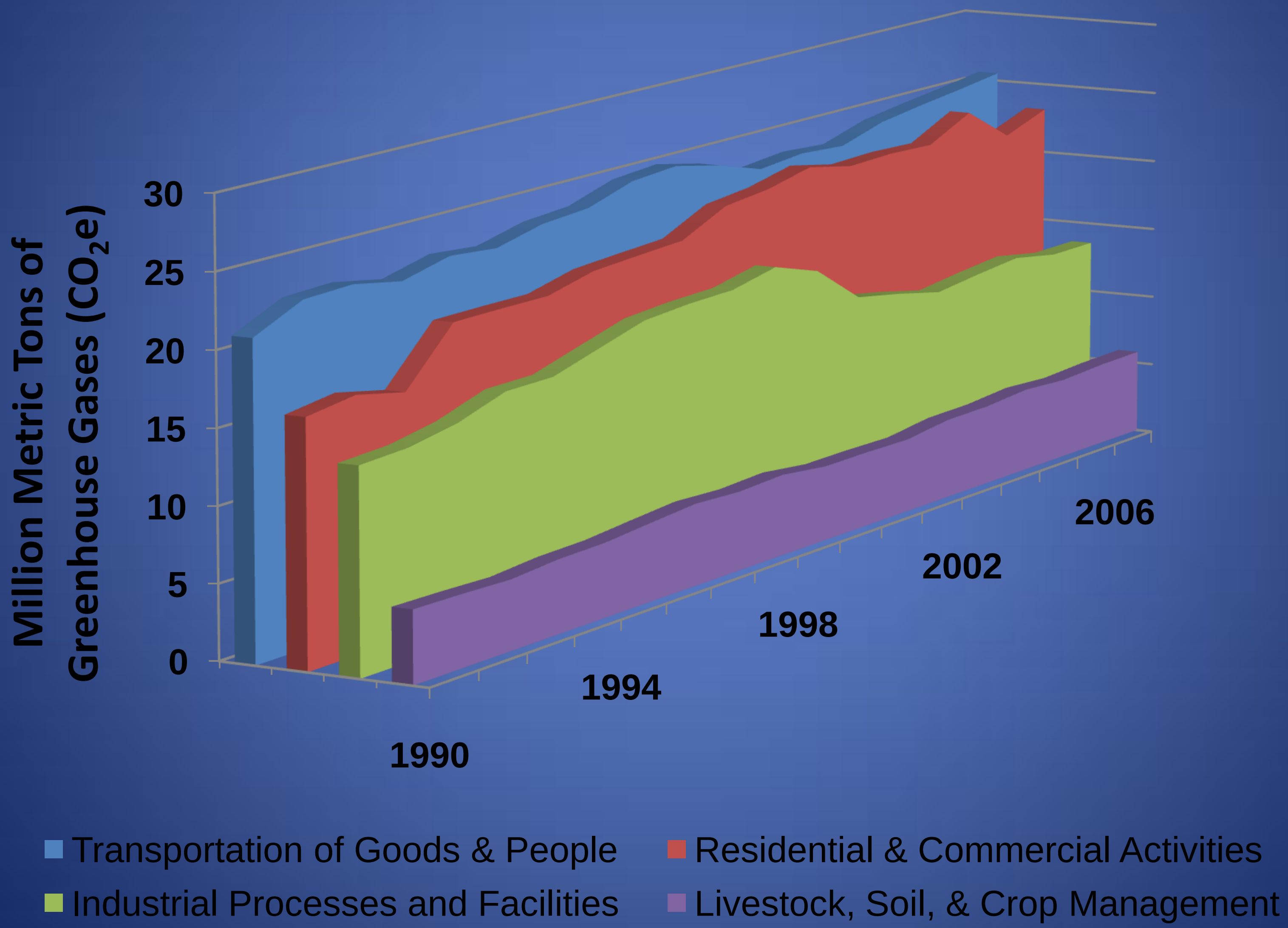
2. By 2020, Oregon's greenhouse gas emissions shall not exceed a level 10% below 1990 levels.

3. By 2050, Oregon's greenhouse gas emissions shall not exceed a level at least 75% below 1990 levels.

Progress Toward Oregon's Greenhouse Gas Reduction Goals



Greenhouse Gases by Sector over Time



OGWC Roadmap to 2020 Recommendations Adopted by Sector

- Energy/Utilities
- Industrial Emissions
- Materials/Waste Management
- Agriculture
- Forestry
- Transportation/Land Use

Roadmap to 2020
Seven Propositions

Embed carbon in the planning process

Leverage efficiency of cities

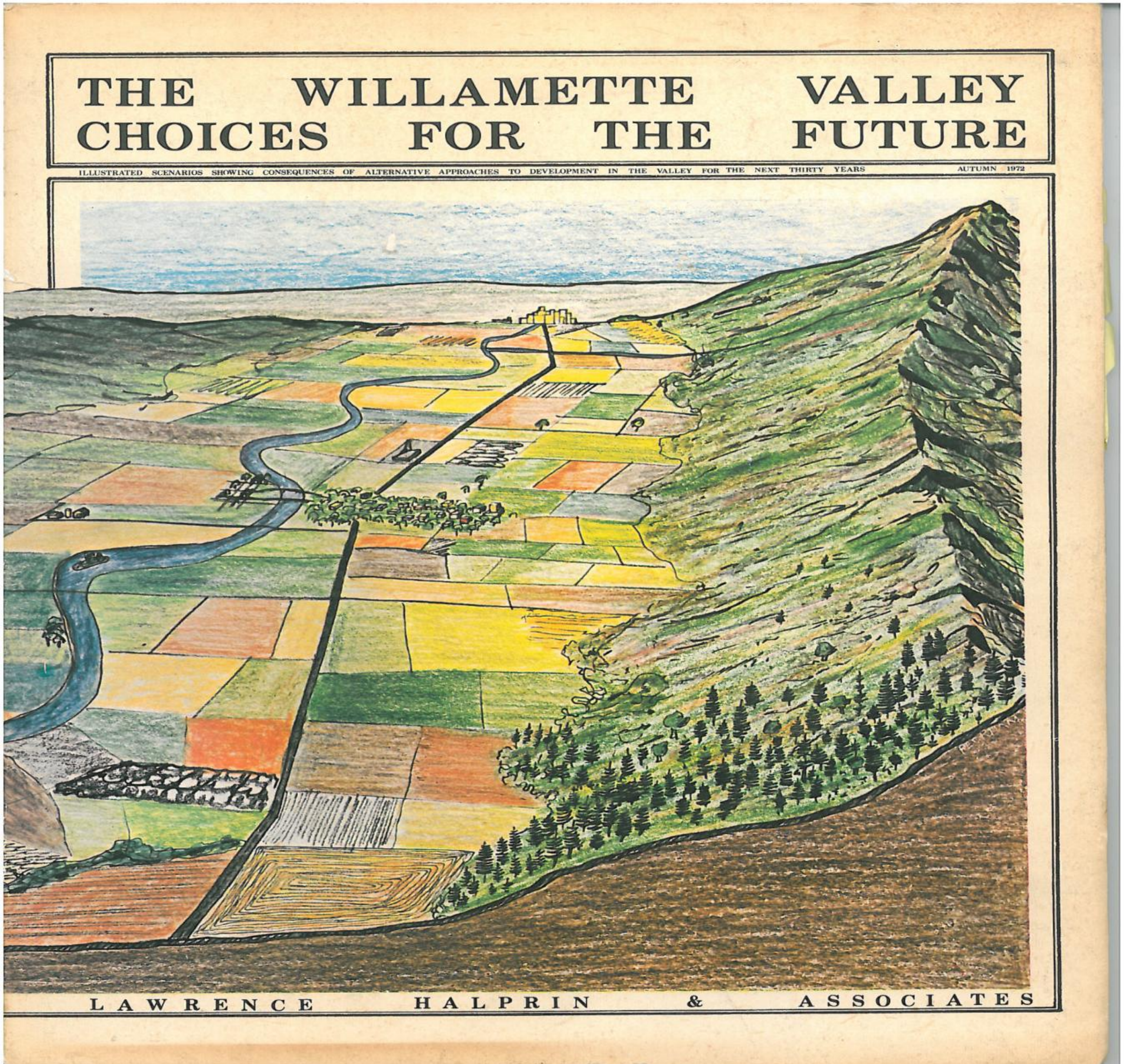
Leverage efficiency of buildings

Shift transportation fuels

Ramp down coal emissions

Capture carbon across the board

Embed carbon in energy prices



Governor Tom McCall -- 1972

Why couldn't we rethink how we plan our communities, industrial parks, roads and transit, energy and water systems, so carbon makes a difference?

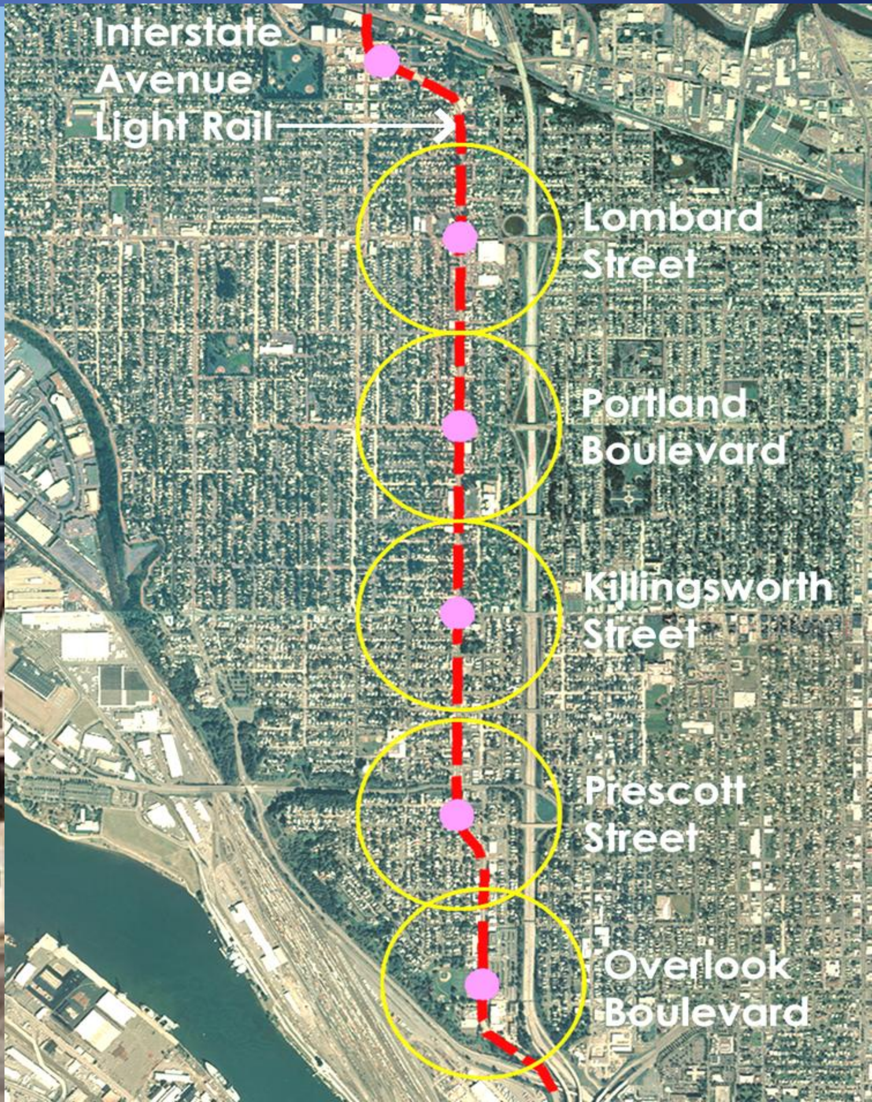
Roadmap to 2020 – Propositions

Embed carbon in the planning process

- State and local transportation/land use plans should target 2020* greenhouse gas goals
- OR utility planning should meet GHG goals
- "Consumption-based" GHG Inventory

* = about 30% below today's levels

Why couldn't we design and build cities that are energy and carbon efficient?



Roadmap to 2020 – Propositions

Leverage Efficiency of Cities

- Stay within present UGB’s (larger cities)
- Redesign neighborhoods for walking access to schools, services, shopping, transit
- More & more accessible public transit
- Shift longer freight hauls from truck to rail
- Smarter roadways; priority to emergency, freight, multi-passenger users

Why couldn't we create tomorrow's buildings, and rebuild today's, for superior energy and carbon performance?

[Portland, OR Health Sciences solar south façade]

Roadmap to 2020 – Propositions

Leverage Efficiency of Buildings

- New buildings: “near-zero-emissions” designs
- Existing buildings: Retrofit building energy code applied to existing buildings at point-of-purchase
- Smart Building systems for energy, water efficiency
- Fuel-blind space/water heating (gas + electric)

Why couldn't we shake the oil habit, and move full speed ahead to electric and other new vehicles and fuels?

Roadmap to 2020 – Propositions

Shift Transportation Fuels/Modes

- Fleet turnover to electric and gas at double the national rate
- Deploy public, private recharging infrastructure
- Integrate plug-in EV’s with Smart Grid to add vehicle flexibility, grid energy storage
- Modal shift from cars/trucks to transit/rail; extend reach, accessiblity of transit

Where else can we go digging for carbon reductions? Industry? Farms? Forests? Stuff?

Roadmap to 2020 – Propositions

Capture Carbon Across the Board

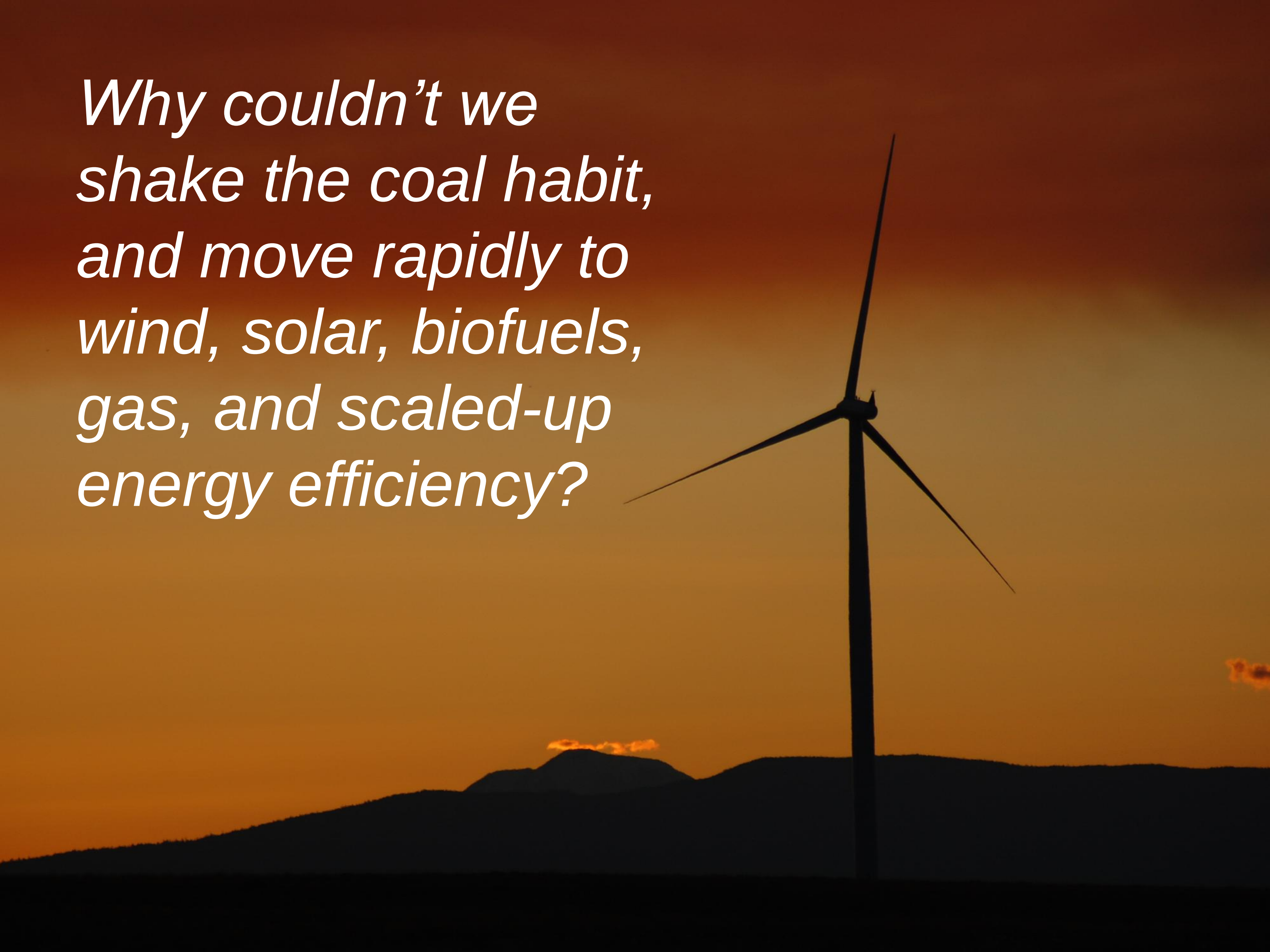
- Align forest practices for conservation, fire management, carbon capture/storage
- Align agricultural practices (1) to reduce soil disturbance and fertilizer overuse; (2) to capture and use methane
- Support industrial efficiencies with access to finance, technical support
- Reduce, reuse, recycle “stuff”

Can we imagine taxing carbon inefficiency instead of taxing income or property values?

Roadmap to 2020 – Propositions

Embed carbon in energy prices

- Eliminate gas tax; replace with fee for “vehicle efficiency *X* miles traveled”
- Charge extra for using roadways at choke points to reduce highway congestion
- Charge for parking at workplaces
- Key property tax to “building efficiency X full time residents”, not market value


Why couldn't we shake the coal habit, and move rapidly to wind, solar, biofuels, gas, and scaled-up energy efficiency?

Roadmap to 2020 – Propositions

Ramp Down Coal; Ramp Up Efficiency, Renewables

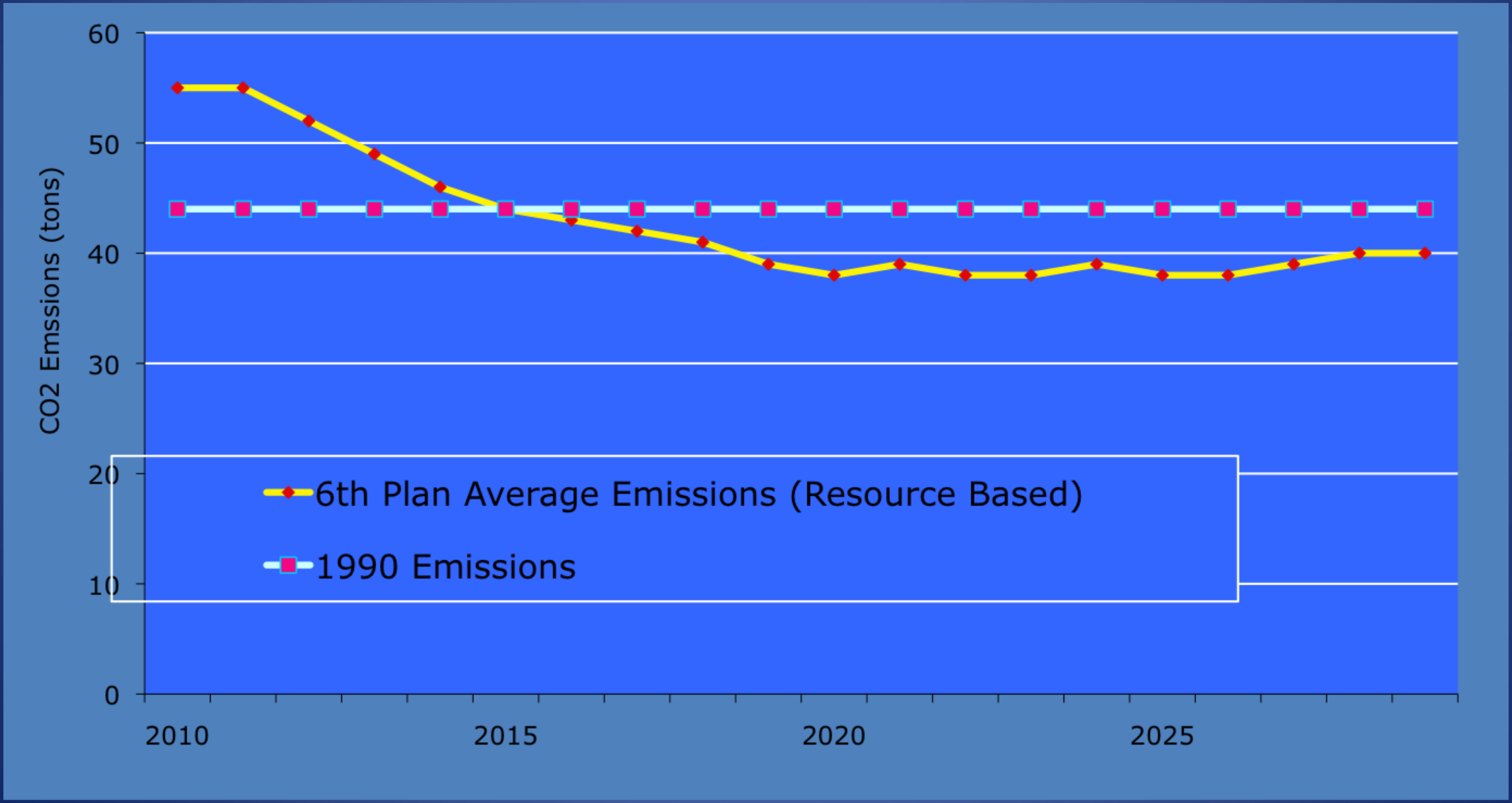
- Meet load growth w/ energy efficiency
- "Substantial reductions" in coal generation by 2020 and thereafter
- Replace with renewables + gas
- New transmission (and storage?)
- Integrate generation with "smarter" homes, businesses and electric vehiclesefficiency +

Sixth Plan: Four Regional Actions to Meet OR/WA Carbon Goals

1. Save 6000 aMW more by 2030
2. Fully implement Renewable Portfolio Standards
3. Shut down or back down coal generation by 50%
4. Preserve and leverage hydro system

Adds ± 15% to wholesale costs of "current policy" scenario; or ±4% consumer rate increase/2.2% consumer cost increase

Four Actions Dropped PNW Electric Utility Carbon Emissions 15% Below 1990 Levels by 2020



NW Conservation and Power Planning Council Sixth Power Plan

6th Plan Meet's 90% of Load Growth with Energy Efficiency

The Disconnect:
Resource Acquisitions to 2030
(% reliance - estimated)

	NW Power Council	**NW Utilities**
Efficiency	68	45
Wind/Renewables	17	25
Gas	13	30
Other	2	

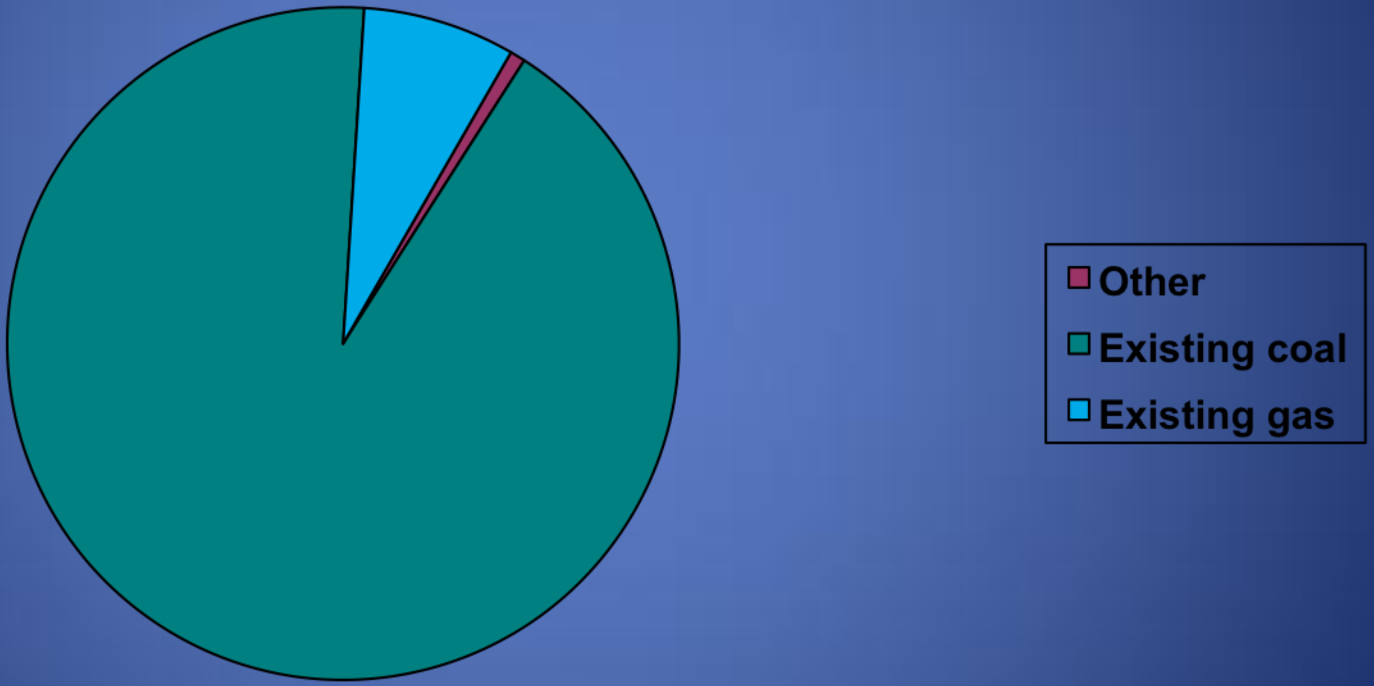
NCPPC Sixth Power Plan; PNUCC Sum of PNW Utility Plans 2010

“Willie, why do you rob banks?”

“. . . because that’s where the money is.”

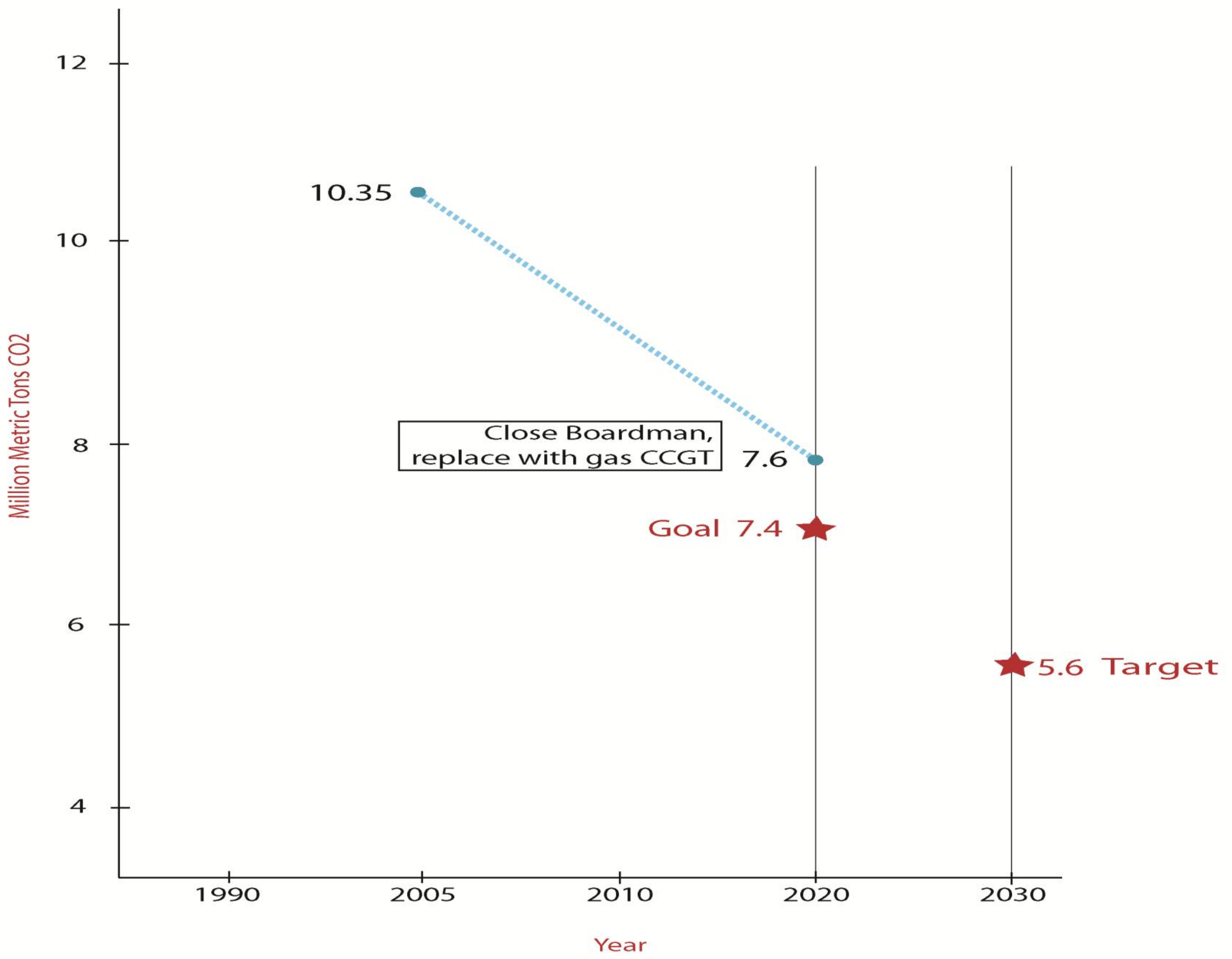
Willie “The Actor” Sutton (1901 – 1980)

Coal plants account for 88 percent of PNW power system CO_2 emissions



. . . and roughly one-third of overall GHG emissions

Portland General Electric



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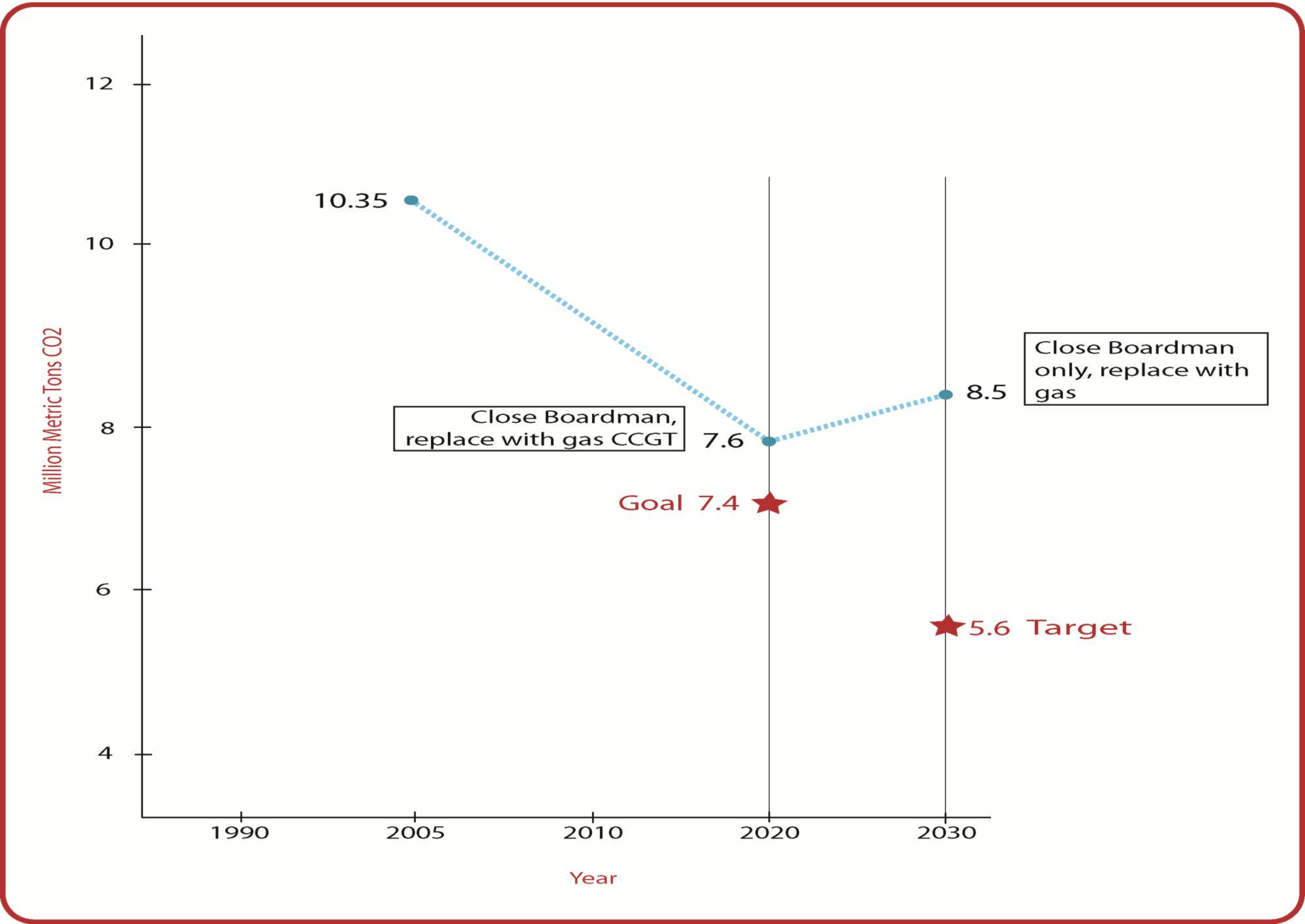
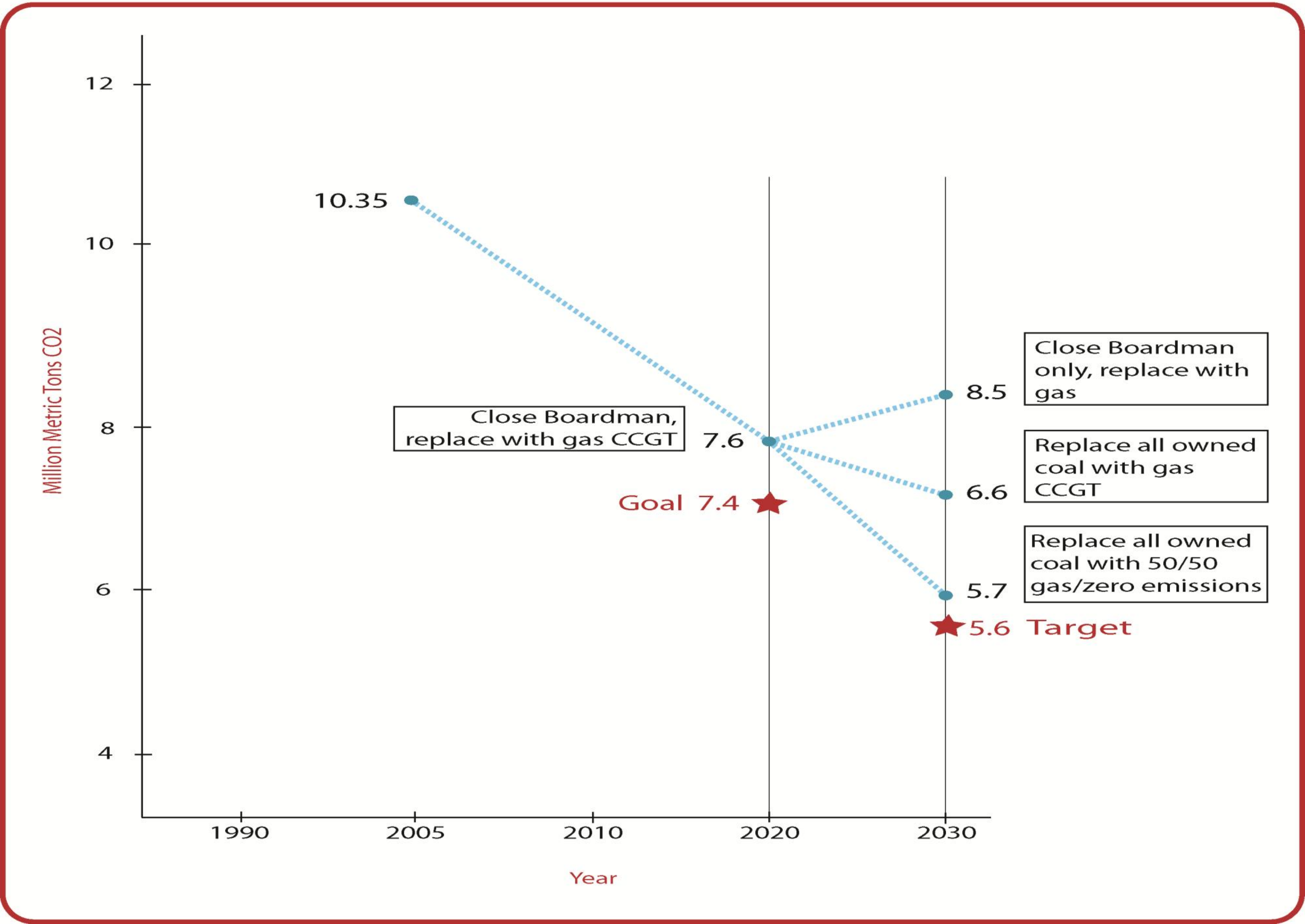
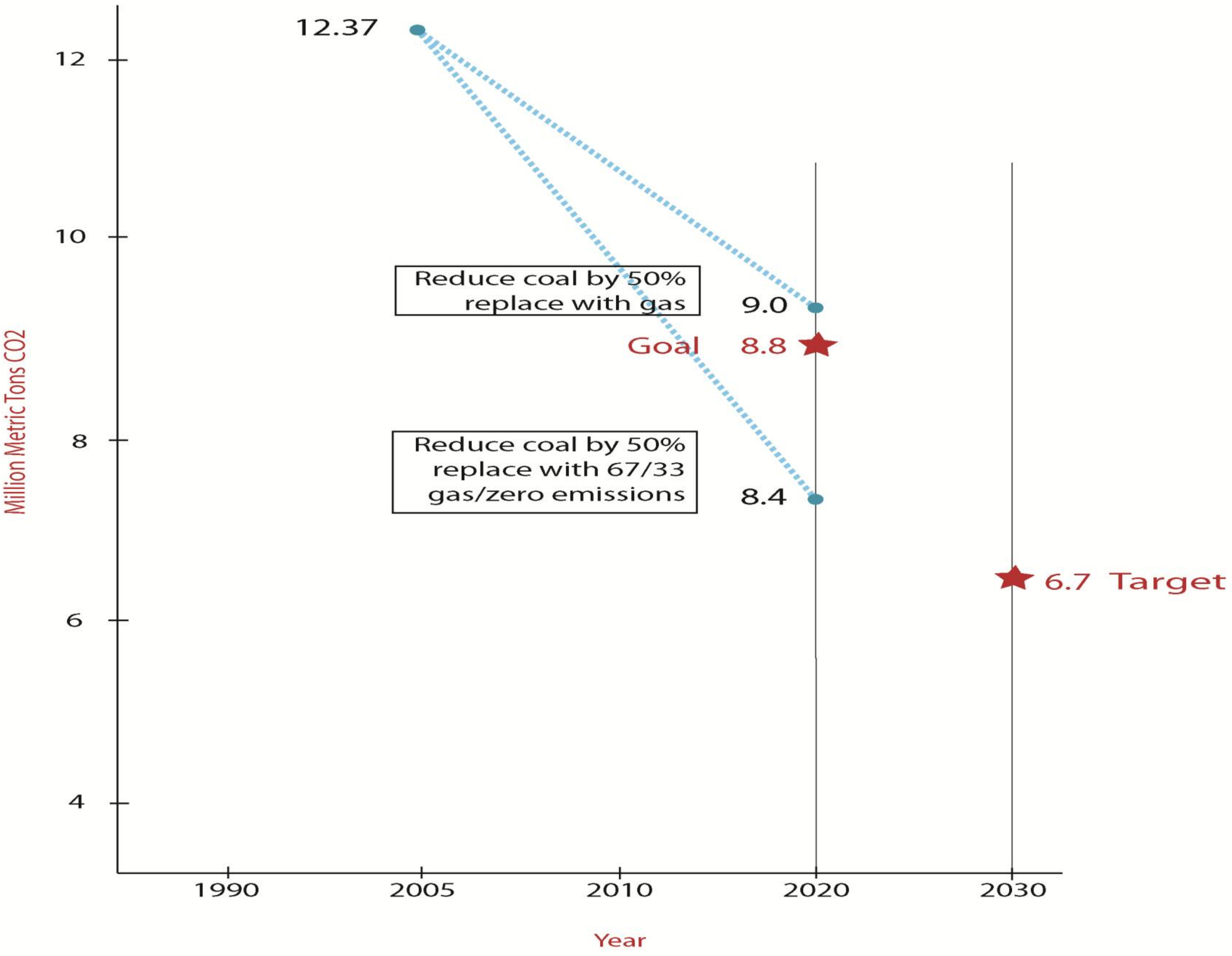


Portland General Electric



Pacific Power



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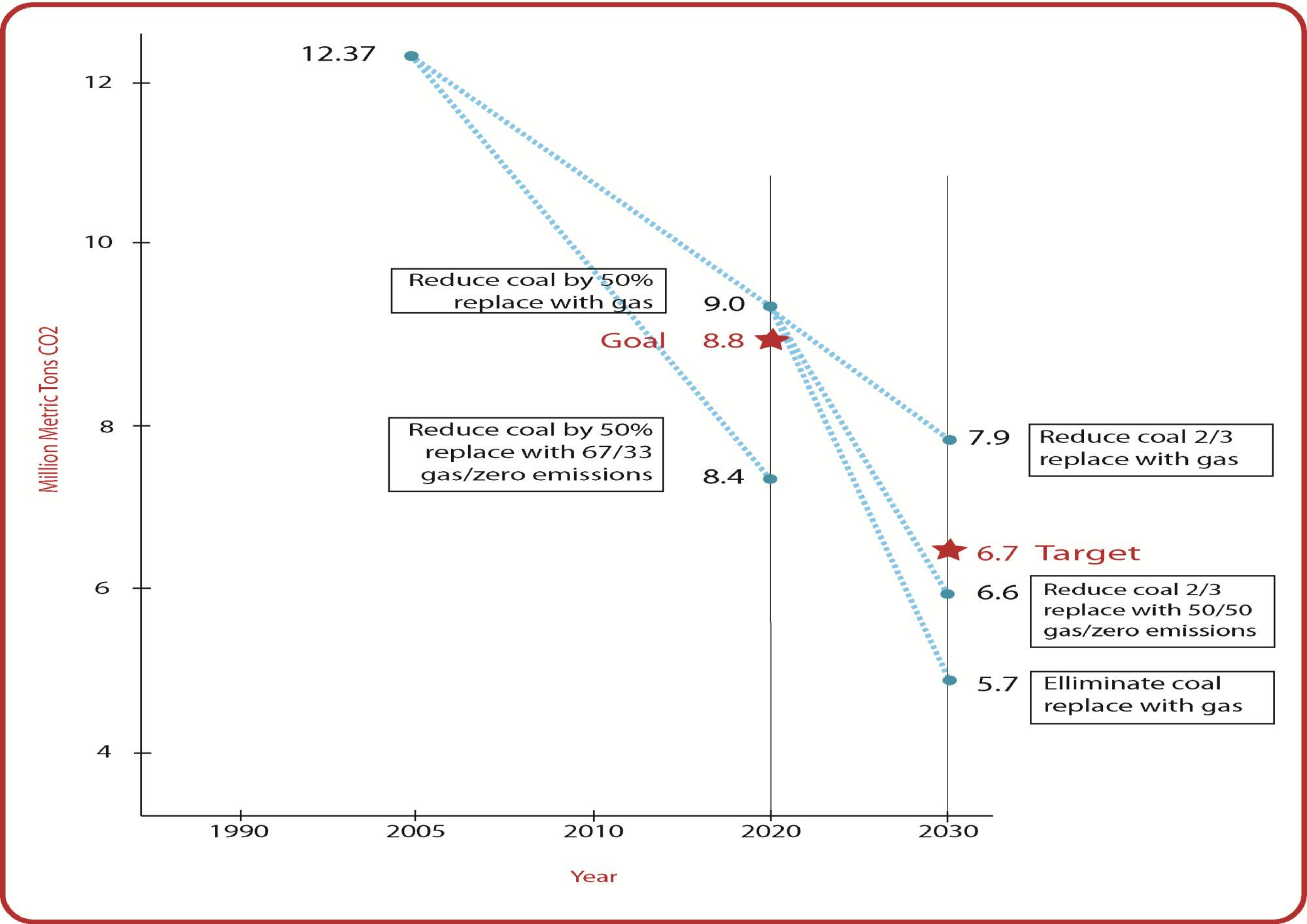
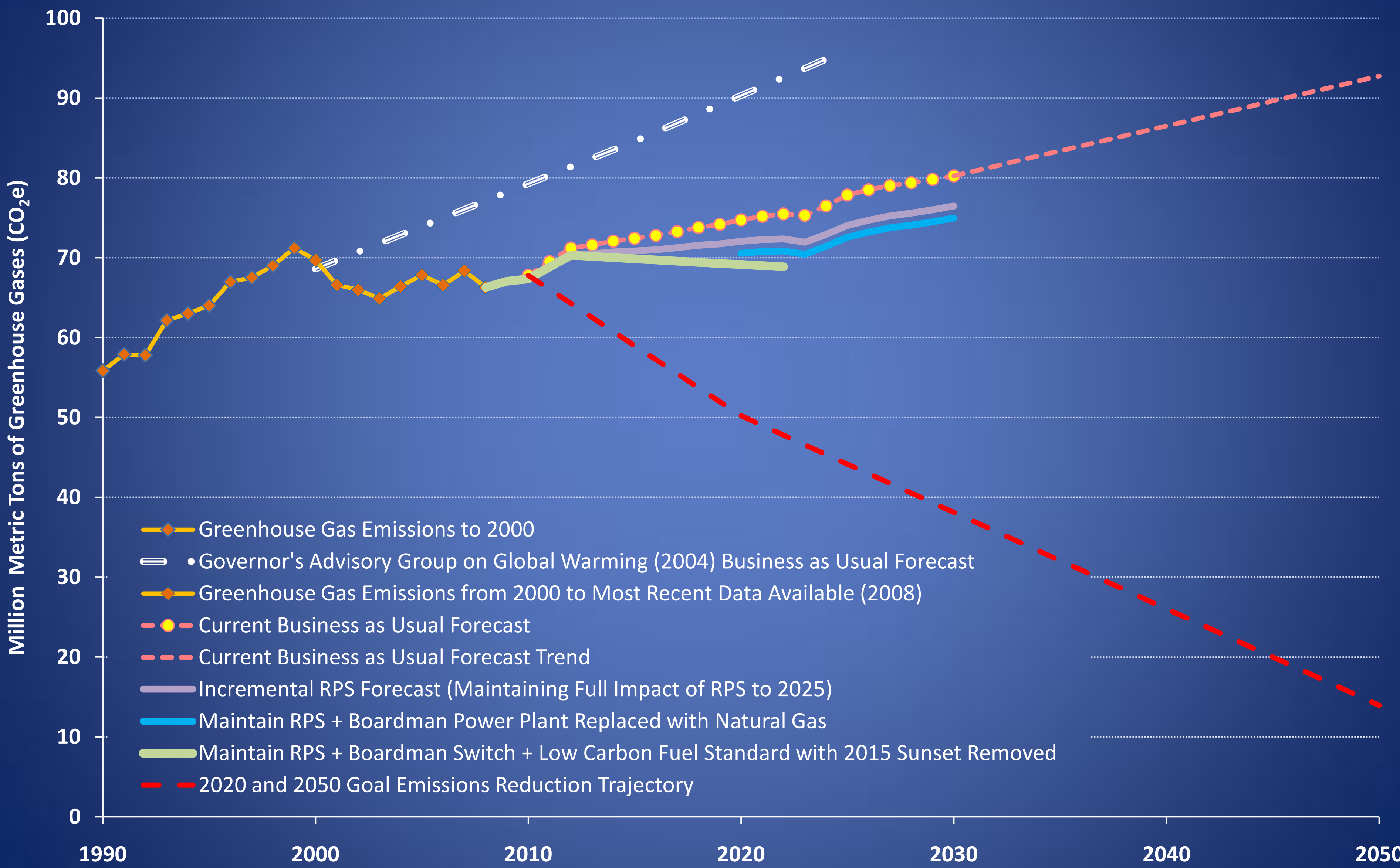


“You can’t rob a bank on charm and personality.”

Willie “The Actor” Sutton (1901 – 1980)

Progress Toward Oregon's Greenhouse Gas Reduction Goals



KeepOregonCool

Oregon Global Warming Commission

From:

OREGON GLOBAL WARMING COMMISSION
ROADMAP TO 2020

Adopted October 29, 2010

FUTURE (2050) STATEMENT – Energy/Utilities

We cannot predict in detail how energy and capacity will be produced, delivered and consumed in 2050, we can propose scenarios that, relying on existing and emerging technologies only, could plausibly meet our aggregated goals of reliability, affordability, and low greenhouse gas and other emissions. It is likely that the architecture and operations of such an evolved system will be as different from today's as today's is from that of the mid-20th century. We can expect it to be reshaped by emerging technologies and evolving values, both reflected in the public policies and market forces of 2050; rearranging the basics – production, storage, transmission, distribution, and use of energy – and perhaps introducing new factors we can't anticipate. In one possible future, carbon capture and sequestration breakthroughs give new life to coal; in another, a policy preference for nuclear technologies prevails. What follows is one future scenario among the many possible; perhaps not even the most likely scenario, but one that can help illuminate the choices we face in reaching our greenhouse gas reduction goals while maintaining system reliability, quality and cost management.

Energy System Architecture and Operations

This 2050 system is more decentralized, contains more – and more diverse – resources, and relies heavily on Intelligence Technology (IT) for dynamic management and integration. It places a higher value on system flexibility, and the resources that supply flexibility. "Integration" is not primarily across generating plants but also between demand and supply sides, and even from customer to customer -- the energy flowing not just downhill from plant to user but uphill as well, from user back into the utility system; and sideways, from user to user. The battery in my plug-in electric vehicle (PEV) powers your toaster in the morning, and may even supply backup capacity when the central grid goes down.

Communities are fully integrated as well. The farm on the corner supplies renewable gas to homes while waste heat from the industrial plant is fed into an efficient district system.

The priority energy resource of this 2050 system is energy efficiency (as it was in 2010, when it was the third largest source of electricity in the Pacific Northwest after hydro and coal) integrated into a modernized electricity grid. New homes and commercial buildings are energy and carbon high performance building, with consumption and related emissions >80% less than in 2010. This is achieved by virtue of their passive energy efficient designs, tight building envelopes, high-efficiency LED lighting (that produces lower heat loads for the air conditioning required by 2050's more frequent heat waves), heat pump or direct gas space and water heating (water preheated with rooftop solar thermal systems), and solar photovoltaic building skin elements (siding, windows, roofs).

The priority capacity resource in this scenario is also found on the customer side of the meter. Those buildings with excess power or thermal energy (or other "distributed" resources) may store it onsite (in a PEV battery or a fuel cell), or return it to the electric grid or gas supply system for storage or redistribution. "Smart" appliances talk to the utility "smart grid," buying and selling stored energy or capacity (from appliances that can be cycled on and off remotely) according to schedules mutually agreed to by the customer and utility.

Gas appliances in both residential and commercial uses can also be programmed to respond remotely to shortages of supply or weather-related spikes in demand (they might also support distributed electrical generation that could be called upon during peak power demand).

In 2050, electric and gas systems are also information systems. Achieving the benefits that Smart Grid technologies offer will require that we think and plan simultaneously for the electric and gas service system and the integrated role the data system will play in supporting these benefits

This active role for customer-side electricity resources has enabled faster progress toward a power grid that is more flexible than today's system; that can respond more quickly and efficiently to changes elsewhere across the system, whether it is following loads or reacting to variable renewable resources ramping up and down. Most of the conventional coal and gas facilities that served as baseload resources in 2010 have been replaced by newer technologies that operate efficiently over a range of load factors, (pulverized coal plants were nearly all retired by 2030, freeing up east-west transmission that now brings High Plains wind to both West Coast and Mid-west markets). New gas turbine technology that can ramp up and down rapidly serves primarily as integrating resource for a grid that contains wind (in diverse wind regimes), solar, ocean, hydro[1], biomass and some geothermal renewable resources.

Wind and solar operate as "predictable" rather than "dispatchable" resources; the difference is that while system operators can't call on a wind-farm to increase generation when loads increase, they will know with higher probability than was the case in 2010 the level of output at which that wind-farm can continue to generate for the next hour, or day, or week ahead. IT systems will monitor and predict (1) changing loads, (2) dispatchable demand-side resources, and (3) available "predictable" resources. It will automatically dispatch (4) integrating resources – hydro plus new storage plus gas turbines – to backfill holes. Wind generators also can contract to reduce output to prevent over-generation and thereby preserve system balance.

Transmission, Storage and Controls

Such a system design relies on its transmission grid nearly as heavily as did the old architecture. But today's transmission grid is an intensively monitored and far more resilient, responsive, reliable and efficient system that can remotely diagnose and often repair its rare malfunctions. Transmission facilities are more strategically located and interconnected to be internally reinforcing, linking together and permitting efficient integration among loads, generation and storage while respecting environmentally sensitive landscapes and ecosystems. Siting new transmission facilities has become easier as communities realize its importance in a strategy of lower carbon emissions and greater energy independence.

Storage facilities are located both at the supply end (pumped storage, compressed air, advanced batteries, etc.), at load centers (batteries, fuel cells) and within loads (PHEV batteries, remotely-dispatched appliance cycling). Sophisticated control systems optimize flows and reduce congestion. The wide distribution of storage capability across the grid also strengthens system regulation and stability.

Electricity Generating Resources

[1] Includes some new hydro capability resulting from efficiency investments in existing facilities.

In 2050, hydro still supplies + 50% of the region's electrical energy supply (and a significant share of the integrating services for wind and solar). That hydro is complemented by a mix of new wind, solar and other renewables, which together comprise >80% of electrical generation[2] Energy efficiency standards and investments have held overall load growth to + 0, excluding shifted transportation load (electric vehicles are estimated to have added 10% to 12% to overall energy load[3] – assuming 60% of the light duty vehicle fleet is electrically-powered in 2050 – but has actually moderated the need for new electrical generating capacity by providing flexible load-center storage to the system). The entire system – supply, delivery and demand components -- is planned and operated for optimum cost-effectiveness within hard reliability and carbon emissions constraints.

Gas

Natural gas supplies for both direct space and water heat, and for electricity generation as described above, are supplied domestically from both conventional and unconventional (e.g.,shale gas) resources, and from renewable gas. This renewable gas may come from anaerobic digestion (animal waste, waste water treatments plants, landfills) or gasification of biomass. Between this supply, and robust US research, development, demonstration and commercialization of other renewable and energy efficiency products – and the shifting of most vehicles to electricity, gas and biofuels – the long-sought achievement of energy independence has been largely attained. To the extent energy products are still imported, whether equipment or fuels, our capability to replace imports with domestically-sourced products assures the US of price and supply leverage in global energy markets.

Oregon policies support, and utilities invest in, combined-heat-and-power (CHP) facilities to retrofit or displace boilers at industrial plants requiring substantial quantities of process heat. Oregon land use policies encourage co-location of such plants (which also enable industrial district heating systems) to reduce stranded investment risks.

Financing and Affordability

Early on, Oregon developed a State-sponsored energy financing platform that made use of State and local bonding authority, State revenues (including user assessments tied to carbon emissions), a strengthened and extended public purpose charge, and regulatory support for efficient utility access to capital markets to provide consistent financing support for realizing this energy future. The State's efforts were supported by BPA and utility investments in transmission capacity and control infrastructure. This financing was particularly important in effectively extending energy efficiency assistance to low-income households (including rental housing efficiencies captured through combined code requirements and loans secured by the properties). The model was not dissimilar to the public financing that created so much essential 20th century infrastructure, from dams and transmission lines to interstate highways.

Research

National and Oregon energy research agendas and budgets have received vigorous support over the last forty years, achieving gains in low- or zero-carbon fuels, energy

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[2] The "Western Wind and Solar Integration Study" (NREL/SR-550-47781) published by the National Renewable Energy Laboratory (NREL) in May, 2010, estimated that a wind/solar (30%/5%) system penetration rate on the WestConnect Grid was technically and operationally feasible even without the hydro system flexibility available to the PNW grid. WestConnect includes utilities in AZ, NV, NM, CO and WY.

[3] See "Electrification Roadmap", The Electrification Coalition, November, 2009, p 99: estimates 10% to 12% increase in electricity load nationally from 60% LDV market penetration.

efficiency (including building and appliance design, and behavioral response tools), supply and demand side controls, and low-carbon generating technologies. A reinvigorated research program will be pursued by the state in partnership with the federal government. Cost-effective carbon capture and storage (CSS) for fossil fuel plants remains elusive; while new energy storage technologies have combined with sophisticated control systems and wind/solar resource prediction capabilities to integrate a greater diversity of resources across larger geographic control areas. Conventional nuclear power plants have been deployed elsewhere in the US, while development interest in the Pacific Northwest focuses on the "pocket" nuclear designs with passive safety systems, standardized design elements and shorter development lead times, that were refined at Oregon State University

Regulatory Predictability

Looking back from 2050, it's clear that the adoption of a mandatory national carbon emissions reduction policy (cap, cap and trade, tax or other device) proved essential to achieving Oregon – and national – GHG reduction goals. This single action provided homeowners, businesses and utilities with the predictability that both incented and enabled them to make carbon reduction investments at the scale required for deep emissions cuts. The required reductions were ramped in over time, while price ceilings and floors flattened out the spikes and dips that unnerve investors and lenders. The reduction curve encouraged innovation in carbon-reducing technologies and strategies (and created marketing opportunities for Oregon entrepreneurs).

The Oregonian

Flexible Power System a Must To Meet the Region's Demands

Angus Duncan -- Sunday, May 22, 2011

Fact: Portland General Electric has committed to ending coal burning at Oregon's only in-state coal-fired power plant.

Fact: The Bonneville Power Administration now has 3000 megawatts of wind generation on its power grid, an amount that could double in the next two years.

Fact: Governor Kitzhaber has committed Oregon to developing a 10-year energy strategy that can meet reliability, cost and environmental quality goals

These are three promising benchmarks. Their promise can be redeemed or lost by the choices we make in the next few years; the wrong choices could block our path forward to the kind of future the Governor seeks.

To understand why, we need to understand a little more, technically and historically, about the power system.

Back when we relied primarily on hydroelectricity, we could use the same dams to meet two kinds of consumer demand: "base load", or the amount of power we needed most of the time, daily and over the course of the year; and "peaking load" or the rise and fall in demand that occurs when we all shower in the morning, or when our heating demand rises in the winter and subsides in the spring. When we had excess reservoir storage and generating capacity in our hydroelectric system, hydropower flexibility served both functions.

We finished the last large Columbia River hydro project in the 1970's, and since have increasingly relied for base-load service on coal, nuclear and now gas generators. These operate most efficiently when they operate at full power, so the role of hydro shifted increasingly to providing the flexibility in the system to meet those daily and seasonal variations. Over the last twenty years that system flexibility has been constrained by river flow requirements; while at the same time, growing demands have been placed upon it to help integrate new generation from wind power (generation from wind can vary significantly from hour to hour as winds fluctuate).

We can stretch hydropower only so far, while overall demands on the electricity system continue to grow. Of course if we didn't have greenhouse gas (GHG) reduction goals to meet, along with other important air pollution limits, we could just build more base-load coal and gas plants, and not need to deal with a variable resource like wind.

Or, if we could just relax after reaching Oregon's 2020 GHG goal (reducing emissions by about 30% from today's levels), we could just *replace* base-load coal with base-load gas (which emits less than half the GHG per kilowatt), and do without more wind in the system.

But meeting the 2020 GHG goal is only a first step; we have a *30-year* reduction pathway beyond that. Our emissions in 2050 will need to be almost 90% below today's levels, while our population in 2050 is likely to be half again what it is today. Electricity will be meeting more and more of our energy needs – think electric vehicles in place of today's gasoline engines. And our growing dependence on computers and other information technologies will require that it be highly reliable electricity. .

If PGE simply replaces Boardman coal operations with a new base-load gas plant by 2020, it will temporarily lower the state's ten-year-out GHG emissions. That's good news as far as it goes, and a good first step for PGE.

But in 2030 (by PGE's own projections) the utility's overall GHG emissions could be *higher* than they are today, as the utility also stretches to also meet load growth and replace some expiring hydro contract resources. Shut down coal operations at Boardman and watch emissions rise? When they need to be almost *50% lower* for the state as a whole by 2030? We need a better strategy.

Instead of just exchanging coal for gas, we need a lot more wind, solar and other renewables, and a lot more energy efficiency. Not just 6000 megawatts of wind on the regional grid, but 12,000 or 16,000 megawatts. And solar and other renewables as well.

Can we do this? We can, but not by trying to squeeze wind and solar into yesterday's arrangement of hydro and thermal, base-load and peaking.

BPA, the region's utilities and the rest of us have to be thinking creatively about a system in which the operations *flexibility* of a plant is no less important than how much bulk power it puts out, and sometimes more. We need gas generating plants that are designed to ramp up and down rapidly, without losing much efficiency, so they can follow both variable electricity demand and variable generators like wind.

We need tools that better predict when demand and supply are likely to rise and fall.

We need the ability to manage the system not just with power plants that can ramp up and down, but also with buying flexibility back from willing customers who can accommodate temporary service interruption. There are many options for doing this with both large industrial users and individual, residential loads such as hot water heaters.

Governor Kitzhaber's Ten Year Plan can lead the way to this future, but only if it starts with the 2050 future we must have and then thinks backward to the choices we must make today.

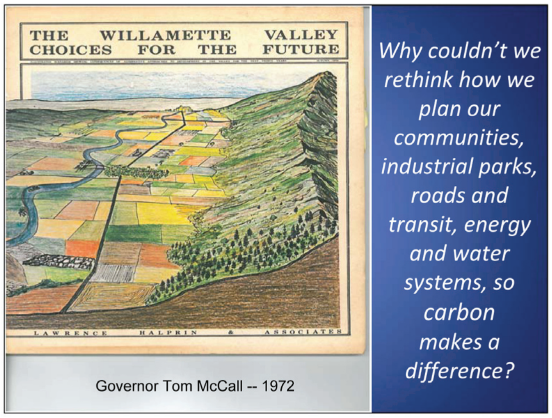
It can work if our technology and system design choices don't solve short-term problems while making the long-term ones, like GHG reduction, more intractable.

Of course the best planning can be trumped by new technologies or other unforeseeable shifts. But a flexible power system is likely our best friend for coping with surprises, happy or not.

Roadmap to 2020 — Seven Propositions

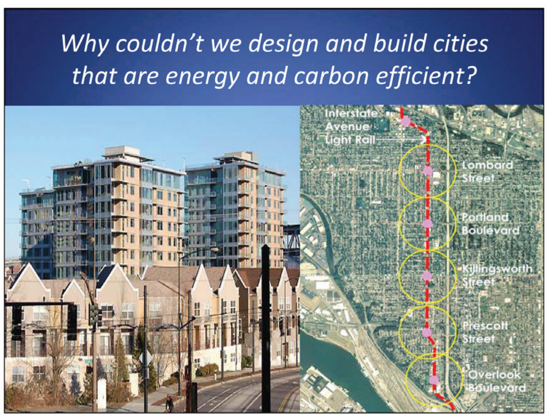
Spring 2011

The State of Oregon has set ambitious greenhouse gas (GHG) emissions reduction goals: a 10% reduction from 1990 levels by 2020 and a 75% reduction from 1990 levels by 2050. Carbon dioxide is the most prevalent GHG; others include methane, ozone, and other heat-trapping gasses. Meeting our reduction goals will require all our efforts.



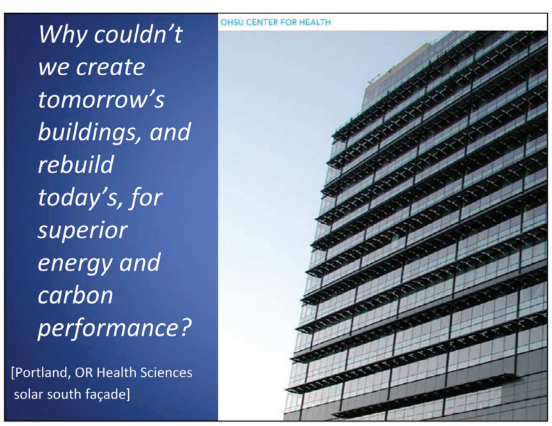
1 Embed Carbon in the Planning Process

- Include carbon generated by local transportation and land use decisions in the community planning process.
- Incorporate meeting Oregon's GHG reduction goals into State transportation and land use planning.
- Set 5 to 10 year benchmarks to meet ultimate GHG reduction goals.
- Incorporate State GHG goals into gas and electric utility planning.



2 Maximize the Energy Efficiency of Cities

- Redesign neighborhoods so schools, services, and shopping are easily accessible by walking, biking or transit.
- Maintain existing Urban Growth Boundaries through 2050.
- Make public transit more convenient, frequent, accessible, affordable.
- Transport more freight by rail, less in trucks.
- Create "smarter" roadways to manage traffic flow and to boost efficiency.



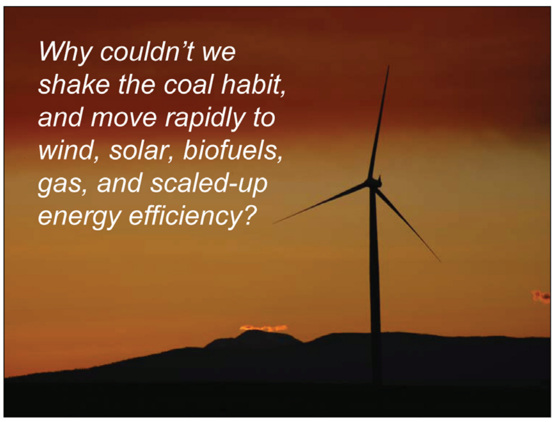
3 Increase Efficiency of Buildings

- Achieve zero total GHG emissions for new buildings.
- Require existing buildings to meet retrofit efficiency standard.
- Require the most carbon-efficient fuel for heating and cooling of new buildings.

Roadmap to 2020 — Seven Propositions (continued)

4 Shift to Lower Carbon Transportation Fuels

- Increase investment in infrastructure for electric vehicles such as recharging stations.
- Introduce electric, gas, and other low emissions vehicles in Oregon at double the national rate.
- Support vehicle biofuels production, requiring that biofuels result in a net reduction in GHG emission over their life cycle.

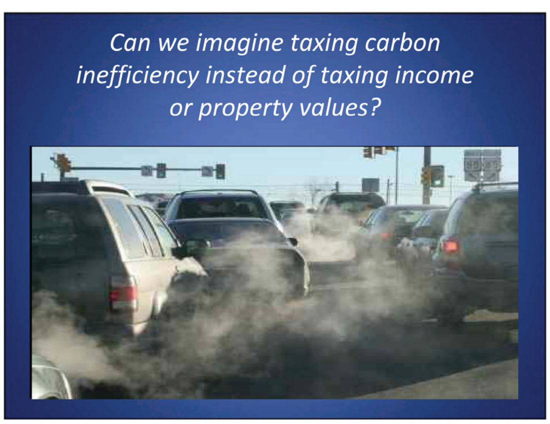


5 Ramp Down Coal Emissions Ramp Up Efficiency, Renewables

- Build a smart grid to integrate new energy generation and distribution technologies with new homes, machines, and vehicles designed to save and store energy.
- Replace coal generation with increased efficiency, renewable power sources (wind, solar, other), and gas turbines.

6 Reduce and Capture Carbon Across the Board

- Strengthen community programs to reduce, reuse, recycle materials.
- Label goods with their carbon content across their full lifecycle from manufacture to disposal.
- Align forest management practices to reduce and store carbon, e.g. conservation, harvest, fire management.
- Align agricultural practices with carbon reduction and storage, e.g. soil disturbance, fertilizer use, methane generation.
- Support industrial efficiency improvements.



7 Embed Carbon in Energy Prices

- Replace property taxes based on market value with tax based on carbon inefficiency of buildings.
- Implement fees for using highways at rush hour.
- Replace gas tax with a fee for miles traveled, discounted for more fuel efficient vehicles.
- Charge for parking.

For more information:

www.keeporegoncool.org