MITHŪN

Outcome-based Energy Budget Proposal for Washington State—

A Road Map to Achieve Carbon Neutral by 2030

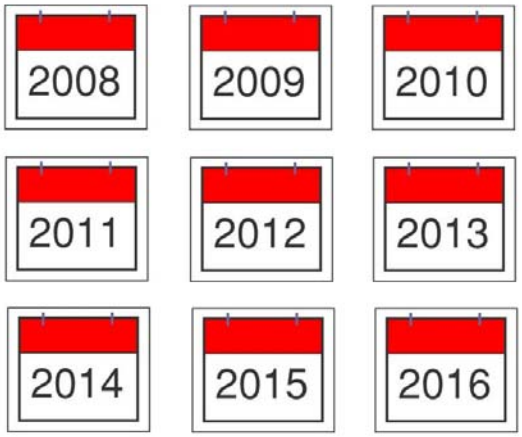
Mike Fowler, AIA

MITHUN
Seattle, WA
San Francisco, CA

Getting to Zero National Forum
Denver, Colorado

October 13, 2016

Take the last 9 years —



Condense into 15 minutes.

STAKEHOLDERS—

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COMPANIES / ORGANIZATIONS—

- Architecture 2030 (New Mexico)
- Cascadia Green Building Council
- David Suzuki Foundation (Canada)
- Development Center for Appropriate Technology (Arizona)
- EMERGE Leadership Project
- Hammer and Hand
- International Living Future Institute
- Kreigh Architecture Studio
- Miller Hull Partnership
- Pacific Press International
- Passive House Northwest
- Perkins + Will – Seattle
- Small Planet Workshop
- Vulcan Real Estate
- WSP Group

INDIVIDUALS—

- Brenna Davis, Director of Sustainability Virginia Mason Medical Centers
- David Eisenberg, DCAT
- Dr. Judy Tingley, Sustainable Bainbridge
- Elizabeth Willmott, Climate Solutions
- Jason Lear, Batt and Lear
- John Gaines, Freehold Group
- Katherine Morgan, EcoMentor
- Kathleen O'Brien, Emerge Leadership
- Michael Niall, Ecova
- Michelle Shafagh, Real Estate agent
- Senator Christine Rolfes, Washington State Legislature
- Sloan Ritchie, Cascade Built
- Teresa Burrelsman, Site Story

2015 Outcome-based Energy Budget proposal—
Washington State Energy Code

- ❑ Add as a 4th compliance option to the state commercial (non-res) energy code
- ❑ Sets a maximum yearly energy use budget for 11 occupancy types
  - Focused on the use types with the most data and research
  - ASHRAE 90.1-2010 / IgCC 2012 / City of Seattle 2012
- ❑ Creates a future code roadmap to 2030 with site EUI/sf reduction every 3 years, ultimately achieving a 70% energy use reduction per WA RCW 19.27A.160 and Executive Order 14-04 (early + widespread deployment of high performance)
- ❑ Multifamily residential energy budget site EUI per person (bedroom)
- ❑ Envelope and Air Tightness requirements as a Backstop
- ❑ 35 page overview information paper with research backup

2015 Outcome-based Energy Budget proposal— Washington State Energy Code

- Requires ability to add future PV generating minimum 40% of the energy budget
- Over a three-year timeframe show minimum one continuous 12-month period with energy use below the energy budget.
- Over the energy budget up to 20% - purchase Green Power
- Over the energy budget more than 20% - purchase Green Power and install PV or make an energy efficiency retrofit or tune up
- Meeting the energy budget releases a performance bond or line of credit.
- Allow buildings under budget to participate in a Cap and Trade program or tradable White Certificate market for an income source.
- Certify compliance every 5 years

2015 Washington State Energy Code - PROPOSAL

WASHINGTON STATE OUTCOME-BASED ENERGY BUDGET: ZONE 4C

TABLE C410		SITE EUI	BASE	PAST	CURRENT	FUTURE	FUTURE	FUTURE	FUTURE	FUTURE
Building Occupancy / Use		Per SF Per Yr	2003	2012	2015	2018	2021	2024	2027	2030
A-3	Library	kWh	30.5	17.4	16.0	14.6	13.3	11.9	10.5	9.1
		kBTU	104	59.3	54.6	49.9	45.3	40.6	35.9	31.2
B	Office / Bank	kWh	19.7	9.7	9.1	8.5	7.8	7.2	6.6	5.9
		kBTU	67.3	33.2	31.0	28.9	26.7	24.5	22.4	20.2
	Medical Office	kWh	14.8	8.4	7.7	7.1	6.4	5.8	5.1	4.4
	(non-diagnostic)	kBTU	50.4	28.7	26.4	24.2	21.9	19.6	17.4	15.1
E	School K-12	kWh	17.1	9.8	9.0	8.2	7.4	6.7	5.9	5.1
		kBTU	58.4	33.3	30.7	28.0	25.4	22.8	20.2	17.5
I-2	Hospital	kWh	51.6	29.4	27.1	24.8	22.5	20.1	17.8	15.5
	(Inpatient)	kBTU	176.1	100.4	92.5	84.5	76.6	68.7	60.8	52.8
M	Grocery/Food Market	kWh	66.6	38.0	35.0	32.0	29.0	26.0	23.0	20.0
		kBTU	227.4	129.6	119.4	109.1	98.9	88.7	78.5	68.2
	Retail	kWh	24.0	14.6	13.4	12.2	10.9	9.7	8.4	7.2
		kBTU	82	49.9	45.7	41.5	37.3	33.0	28.8	24.6
S-1	Parking	kWh	3.8	2.9	2.6	2.3	2.0	1.7	1.4	1.1
	Enclosed Garage	kBTU	13.0	10.0	9.0	8.0	7.0	5.9	4.9	3.9
	Parking	kWh	2.3	1.8	1.6	1.4	1.2	1.0	0.9	0.7
	Open Garage	kBTU	7.8	6.0	5.4	4.8	4.2	3.6	3.0	2.3
S-2	Non-refrigerated	kWh	8.6	4.9	4.5	4.1	3.7	3.3	3.0	2.6
	Distribution/shipping	kBTU	29.2	16.6	15.3	14.0	12.7	11.4	10.1	8.8
R-2	Multifamily (+3 stories)	kWh	29.0	21.9	19.7	17.5	15.3	13.1	10.9	8.7
	Lobby / Common Area	kBTU	99	74.7	67.2	59.7	52.2	44.7	37.2	29.7
		Per Unit Per Yr	2003	2012	2015	2018	2021	2024	2027	2030
	Studio / Micro-unit	kWh	4689	3540	3185	2829	2474	2118	1762	1407
	or additional BR	kBTU	16000	12080	10867	9653	8440	7227	6013	4800
	One Bedroom	kWh	9379	7081	6370	5658	4947	4236	3525	2814
		kBTU	32000	24160	21733	19307	16880	14453	12027	9600
	Two Bedroom	kWh	14068	10621	9555	8488	7421	6354	5287	4220
		kBTU	48000	36240	32600	28960	25320	21680	18040	14400
	Three Bedroom	kWh	18757	14162	12739	11317	9894	8472	7050	5627
		kBTU	64000	48320	43467	38613	33760	28907	24053	19200
ALL	Vertical Fenestration	Non-metal		0.30	0.29	0.28	0.27	0.25	0.24	0.23
	U-value	Metal - Fixed		0.38	0.36	0.33	0.31	0.28	0.26	0.23
		Metal - Operable		0.40	0.37	0.34	0.32	0.29	0.26	0.23
	Air Leakage	CFM50/SF		0.40	0.34	0.28	0.23	0.17	0.11	0.05
	Roof	U-value		0.021	0.017	0.016	0.015	0.014	0.013	0.012
	Wall (above/below grade)	U-value		0.054	0.034	0.031	0.028	0.024	0.021	0.018
	Floors	U-value		0.029	0.026	0.024	0.023	0.021	0.020	0.018
	Slab on Grade	F-value		0.54	0.43	0.41	0.39	0.36	0.34	0.32

2015 Washington State Energy Code - PROPOSAL

WASHINGTON STATE OUTCOME-BASED ENERGY BUDGET: ZONE 5B and 6B

TABLE C410		SITE EUI	BASE	PAST	CURRENT	FUTURE	FUTURE	FUTURE	FUTURE	FUTURE
Building Occupancy / Use		Per SF Per Yr	2003	2012	2015	2018	2021	2024	2027	2030
A-3	Library	kWh	31.9	18.2	16.7	15.3	13.9	12.4	11.0	9.6
		kBTU	108.8	62.0	57.1	52.2	47.3	42.4	37.5	32.6
B	Office / Bank	kWh	20.1	10.6	9.8	9.1	8.3	7.5	6.8	6.0
		kBTU	68.6	36.1	33.5	30.9	28.3	25.8	23.2	20.6
	Medical Office	kWh	15.0	8.6	7.9	7.2	6.5	5.9	5.2	4.5
	(non-diagnostic)	kBTU	51.3	29.2	26.9	24.6	22.3	20.0	17.7	15.4
E	School K-12	kWh	18.3	10.4	9.6	8.8	8.0	7.1	6.3	5.5
		kBTU	62.4	35.6	32.8	30.0	27.2	24.3	21.5	18.7
I-2	Hospital	kWh	48.5	27.6	25.5	23.3	21.1	18.9	16.7	14.6
	(Inpatient)	kBTU	165.5	94.3	86.9	79.4	72.0	64.5	57.1	49.7
M	Grocery/Food Market	kWh	66.3	37.8	34.8	31.8	28.8	25.8	22.9	19.9
		kBTU	226.1	128.9	118.7	108.5	98.4	88.2	78.0	67.8
	Retail	kWh	24.0	16.2	14.7	13.2	11.7	10.2	8.7	7.2
		kBTU	82	55.3	50.2	45.1	40.0	34.8	29.7	24.6
S-1	Parking	kWh	3.8	2.9	2.6	2.3	2.0	1.7	1.4	1.1
	Enclosed Garage	kBTU	13.0	10.0	9.0	8.0	7.0	5.9	4.9	3.9
	Parking	kWh	2.3	1.8	1.6	1.4	1.2	1.0	0.9	0.7
	Open Garage	kBTU	7.8	6.0	5.4	4.8	4.2	3.6	3.0	2.3
S-2	Non-refrigerated	kWh	10.5	6.0	5.5	5.0	4.6	4.1	3.6	3.1
	Distribution/shipping	kBTU	35.8	20.4	18.8	17.2	15.6	14.0	12.4	10.7
R-2	Multifamily (+3 stories)	kWh	29.0	23.9	21.3	18.8	16.3	13.8	11.2	8.7
	Lobby / Common Area	kBTU	99	81.4	72.8	64.2	55.6	46.9	38.3	29.7
		Per Unit Per Yr	2003	2012	2015	2018	2021	2024	2027	2030
	Studio / Micro-unit	kWh	4689	3857	3449	3040	2632	2224	1815	1407
	or additional BR	kBTU	16000	13160	11767	10373	8980	7587	6193	4800
	One Bedroom	kWh	9379	7714	6897	6081	5264	4447	3630	2814
		kBTU	32000	26320	23533	20747	17960	15173	12387	9600
	Two Bedroom	kWh	14068	11571	10346	9121	7896	6671	5445	4220
		kBTU	48000	39480	35300	31120	26940	22760	18580	14400
	Three Bedroom	kWh	18757	15428	13794	12161	10528	8894	7261	5627
		kBTU	64000	52640	47067	41493	35920	30347	24773	19200
ALL	Vertical Fenestration	Non-metal		0.30	0.28	0.25	0.23	0.21	0.18	0.16
	U-value	Metal - Fixed		0.38	0.34	0.31	0.27	0.23	0.20	0.16
		Metal - Operable		0.40	0.36	0.32	0.28	0.24	0.20	0.16
	Air Leakage	CFM50/SF		0.40	0.34	0.28	0.23	0.17	0.11	0.05
	Roof	U-value		0.021	0.017	0.016	0.015	0.014	0.013	0.012
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	Floors	U-value		0.029	0.026	0.024	0.023	0.021	0.020	0.018
	Slab on Grade	F-value		0.54	0.43	0.41	0.39	0.36	0.34	0.32

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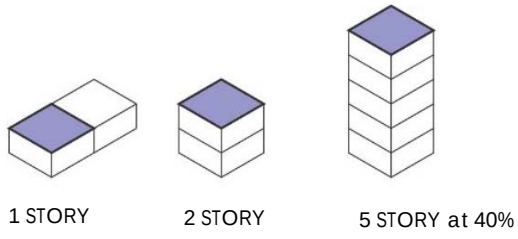
Building Occupancy / Use		**Per SF Per Yr**	**2003**	**2012**	**2015**	**2018**	**2021**	**2024**	**2027**	**2030**
A-3	Library	kWh	30.5	17.4	16.0	14.6	13.3	11.9	10.5	9.1
		kBTU	104	59.3	54.6	49.9	45.3	40.6	35.9	31.2
B	Office / Bank	kWh	19.7	9.7	9.1	8.5	7.8	7.2	6.6	5.9
		kBTU	67.3	33.2	31.0	28.9	26.7	24.5	22.4	20.2
	Medical Office	kWh	14.8	8.4	7.7	7.1	6.4	5.8	5.1	4.4
	(non-diagnostic)	kBTU	50.4	28.7	26.4	24.2	21.9	19.6	17.4	15.1
E	School K-12	kWh	17.1	9.8	9.0	8.2	7.4	6.7	5.9	5.1
		kBTU	58.4	33.3	30.7	28.0	25.4	22.8	20.2	17.5

PV – 40% REQUIREMENT

SEATTLE

36 EUI

1 SF PV = 2 SF BUILDING



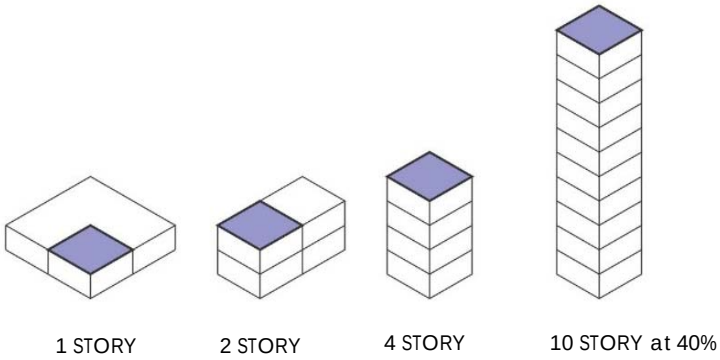
PV – 40% REQUIREMENT

SEATTLE

18 EUI

1 SF PV = 4 SF BUILDING

Code exception:
PV requirement waived in a 2030 District if 2030 energy budget met.

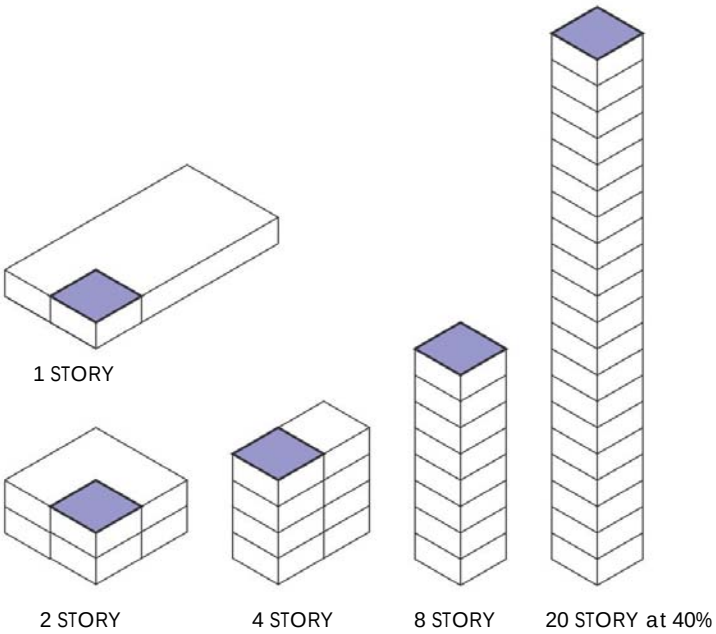


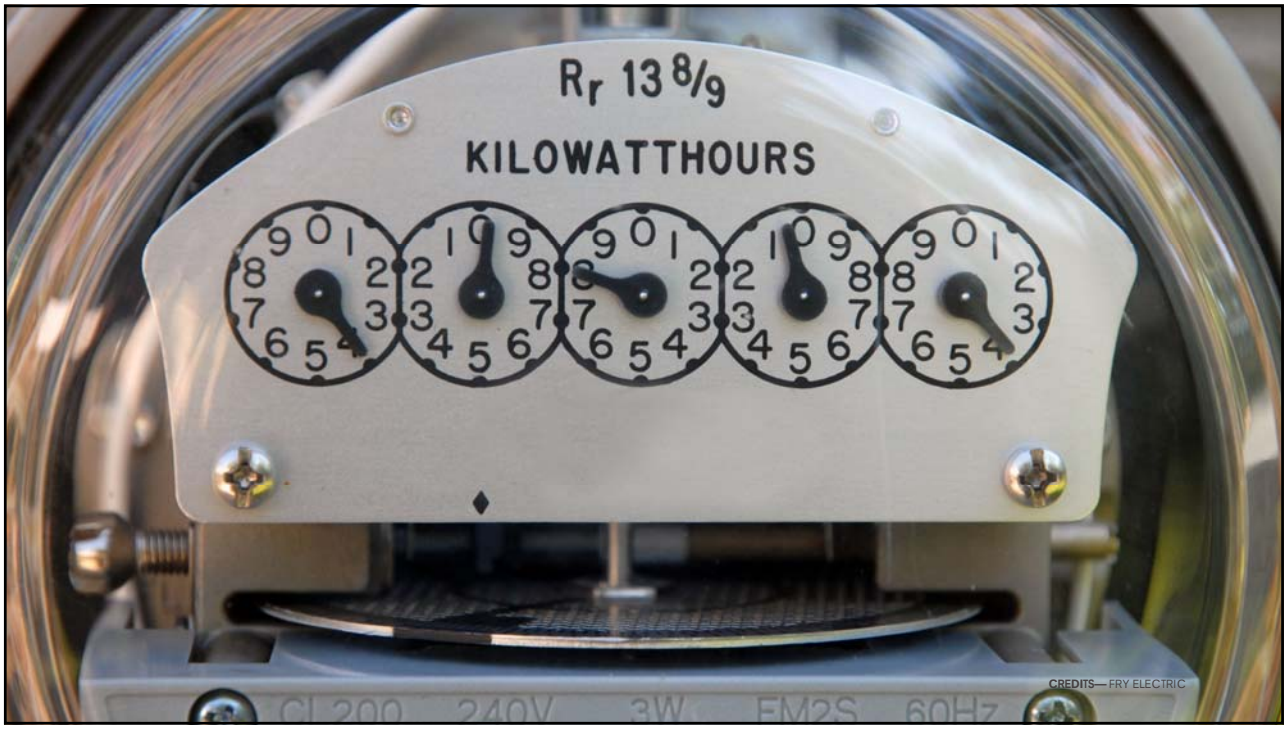
PV – 40% REQUIREMENT

SEATTLE

9 EUI

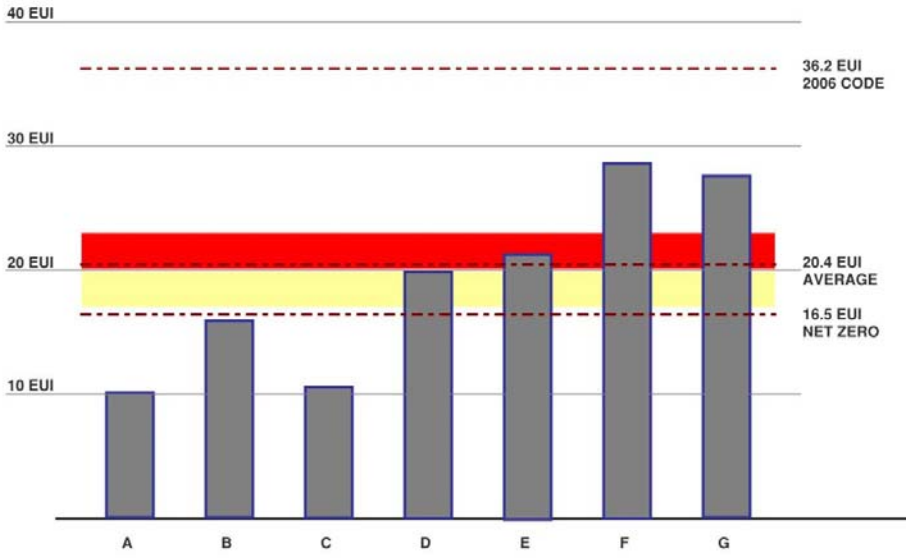
1 SF PV = 8 SF BUILDING



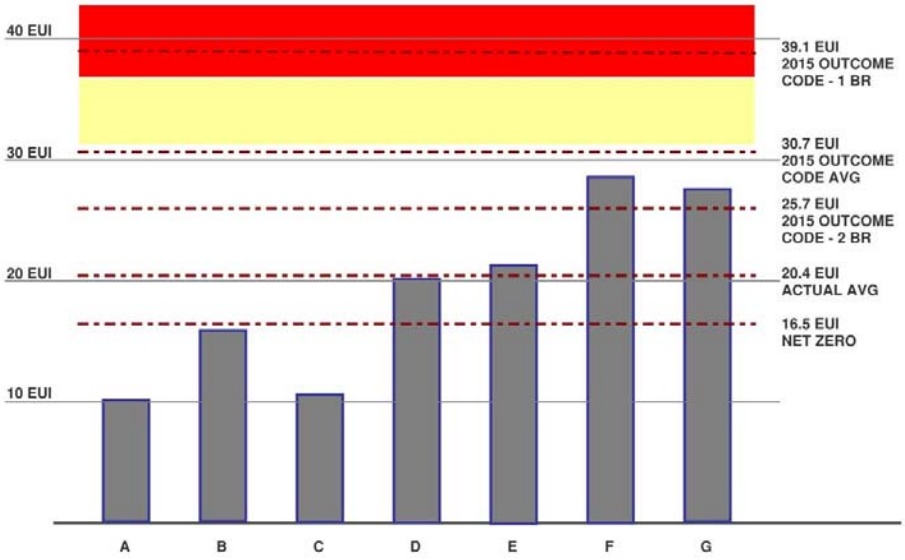

Rr 13 8/9
KILOWATTHOURS
CREDITS— FRY ELECTRIC

LOPEZ COMMUNITY LAND TRUST
COMMON GROUND
16.5 EUI

COMPLIANCE –
LOPEZ EXAMPLE PER SQUARE FOOT



COMPLIANCE –
LOPEZ EXAMPLE PER BEDROOM



Your bill includes charges for electricity and/or natural gas, delivery services, general administration and overhead, metering, taxes, conservation expenses and other items.

Electric Detail Information:

Rate Schedule	Meter #	Start Date Read	End Date Read	Multiplier	Kilowatt Hours (kWh)	Electric Demand (kVA)	Reactive Power (kVAR)	Meter Read Type
Residential 7	719620	7/7 6756	8/5 6817	10	610	—	—	Actual Read

Your Electric Charge Details (29 days)	Rate x Unit		=	Charge
610 kWh used for service 7/8/2016 - 8/5/2016				
Basic Charge	$7.87	per month	$	7.87
Electricity				
Tier 1 (First 600 kWh Used)	0.097543	600 kWh		58.53
Tier 2 (Above 600 kWh Used)	0.116365	10 kWh		1.16
Energy Exchange Credit	−0.006794	610 kWh		−4.14
Other Electric Charges & Credits	0.000074	610 kWh		0.04
Green Power Purchase	0.012500	610 kWh		7.63
Subtotal				71.09
Taxes				
State Utility Tax ($2.75 included in above charges)	3.873%			
Effect of Bainbridge Island City Tax	6.370%	$71.09		4.53
Current Electric Charges			**$**	**75.62**

Definitions

Basic Charge — Covers the costs for meters, meter reading, billing and other costs that do not vary with energy use or the number of days covered by the bill.

Multiplier — Converts the amount of electricity used as measured by your meter into kWh.

kWh — Your use of electricity is billed in units called kilowatt hours. It is a unit of energy that equals 1,000 watts of electricity consumed in one hour.

Energy Exchange Credit — Federal Columbia River Benefits supplied by Bonneville Power Administration from low-cost power generated by federal hydroelectric dams.

Other Electric Charges and Credits — Includes the Conservation Program and Power Cost Adjustment (if any) charges, and the Merger, Federal Wind Power, and Renewable Energy credits.

Schrödinger's Cat

Schrödinger's Cat

Schrödinger's Code

It's optional, no one will ever do it.

What if everyone does it?

2015 Washington State Energy Code - PROPOSAL

FORM C410 - WASHINGTON STATE OUTCOME-BASED ENERGY BUDGET

Building occupancy/use(s): _____

Conditioned floor area SF		
Code maximum site EUI energy budget		
Predicted EUI		
Electric		
Gas		
Propane		
Oil		
Other (source/generation)		
Generation Potential EUI		
Building Integral		
On-site		(combined must exceed 40%)
Offsite		(max 40%)
Purchase		(max 20%)
Percentage better than energy budget		
Percent potential EUI above predicted EUI		

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STAKEHOLDERS—

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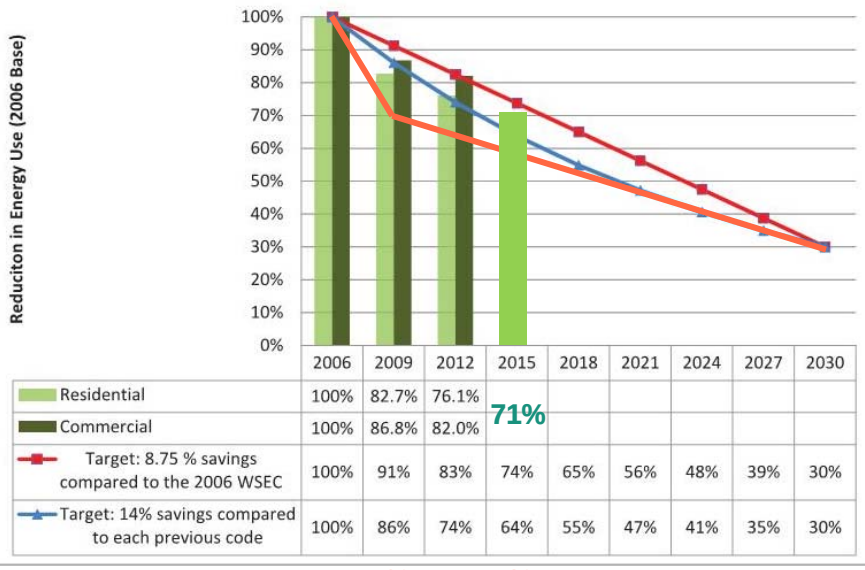
Washington State Energy Code—



	2006	2009	2012	2015	2018	2021	2024	2027	2030
Residential	100%	82.7%	76.1%						
Commercial	100%	86.8%	82.0%						
Target: 8.75 % savings compared to the 2006 WSEC	100%	91%	83%	74%	65%	56%	48%	39%	30%
Target: 14% savings compared to each previous code	100%	86%	74%	64%	55%	47%	41%	35%	30%

WA Climate Action Team 70% 58%

2015 Seattle Energy Code, 2016 call for proposals and public hearings

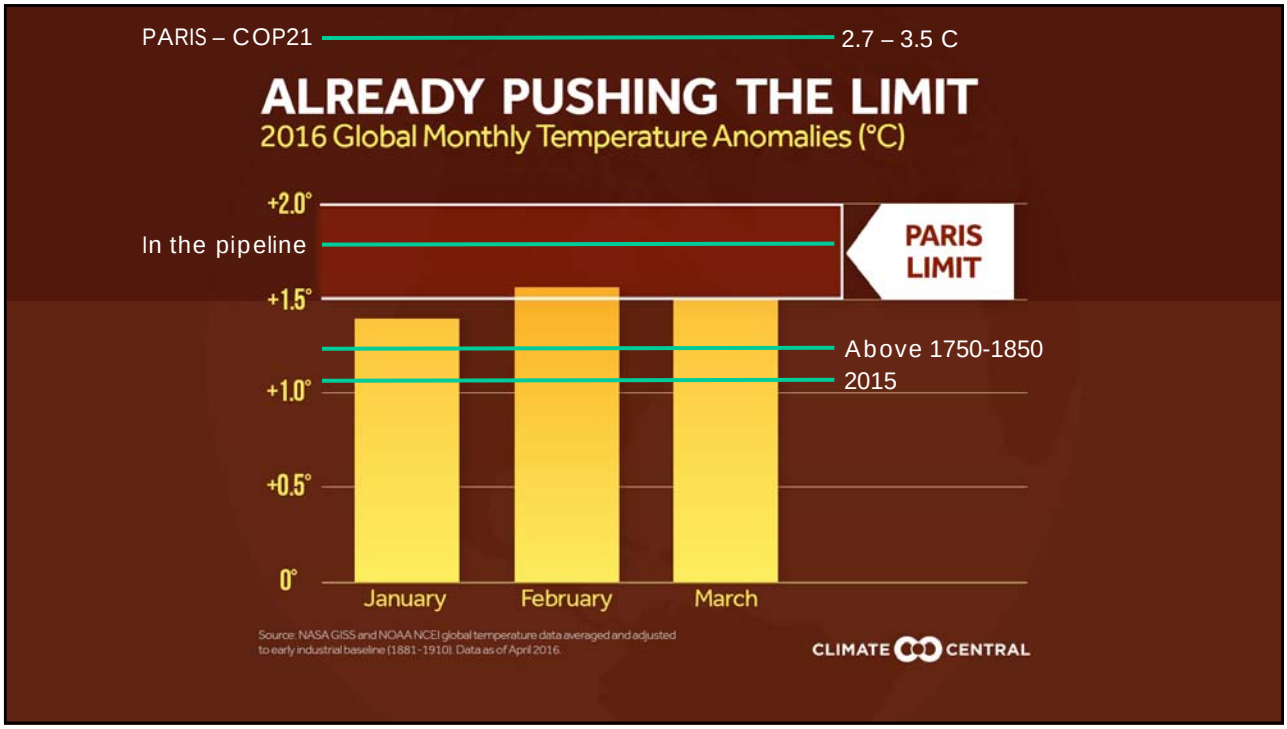
Building Enclosure – more stringent Glazing and Insulation.

- Adopt 2018 values in 2015
- Adopt 2024 values in 2018
- Adopt 2030 values in 2021

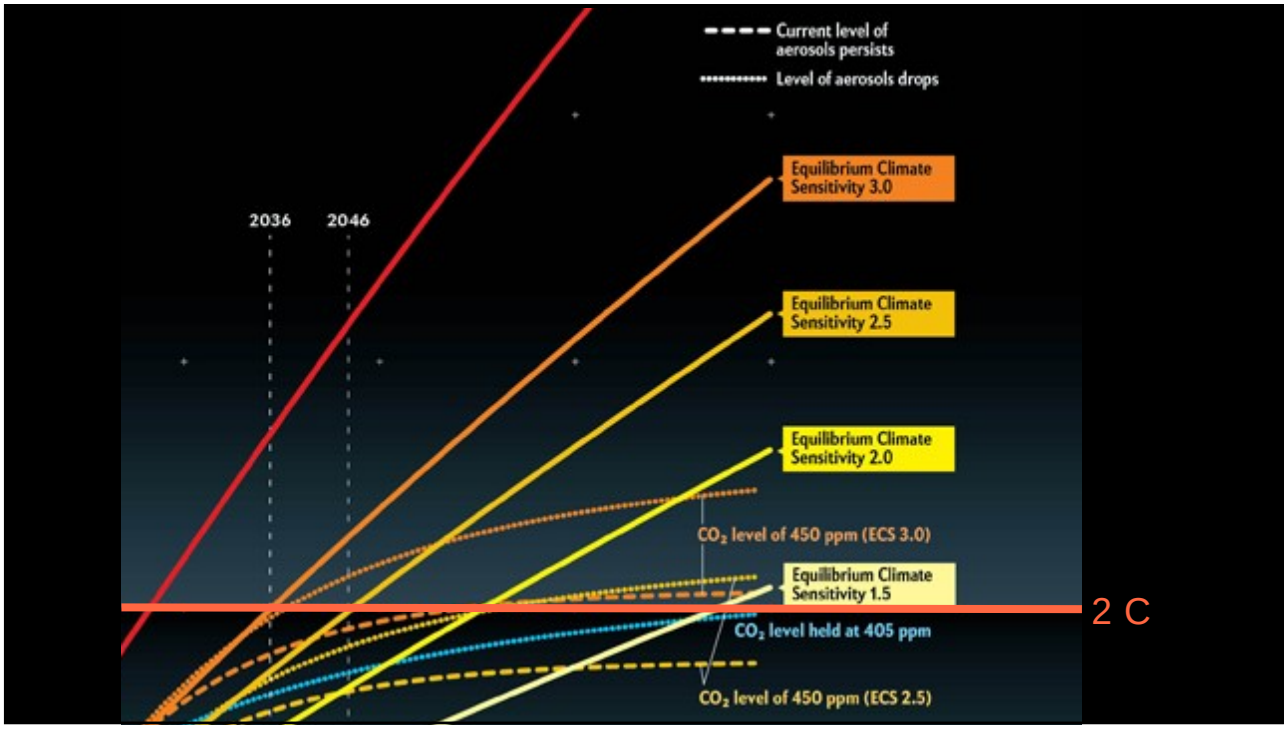
Airtightness:

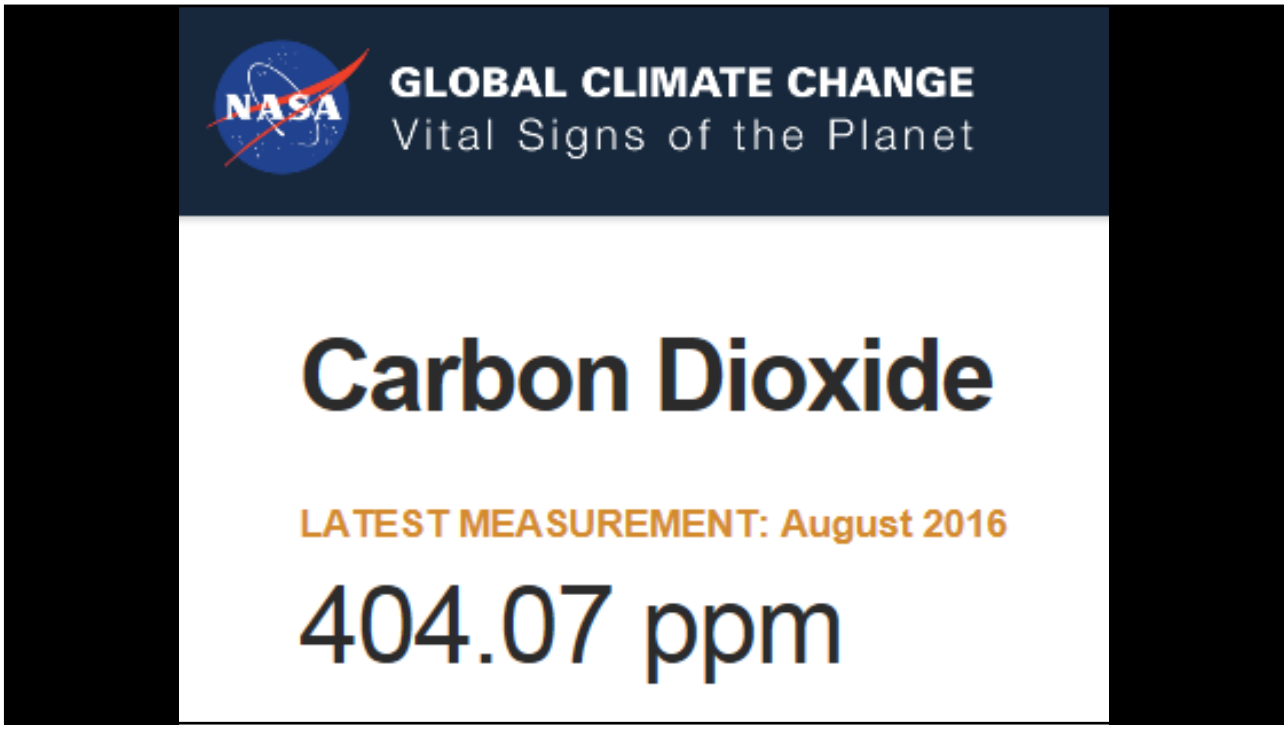
- Change 0.40 CFM75 to 0.25 Final number 0.30
- Change 0.25 CFM75 to 0.15 Final numbers 0.22 and 0.25 for R-2.

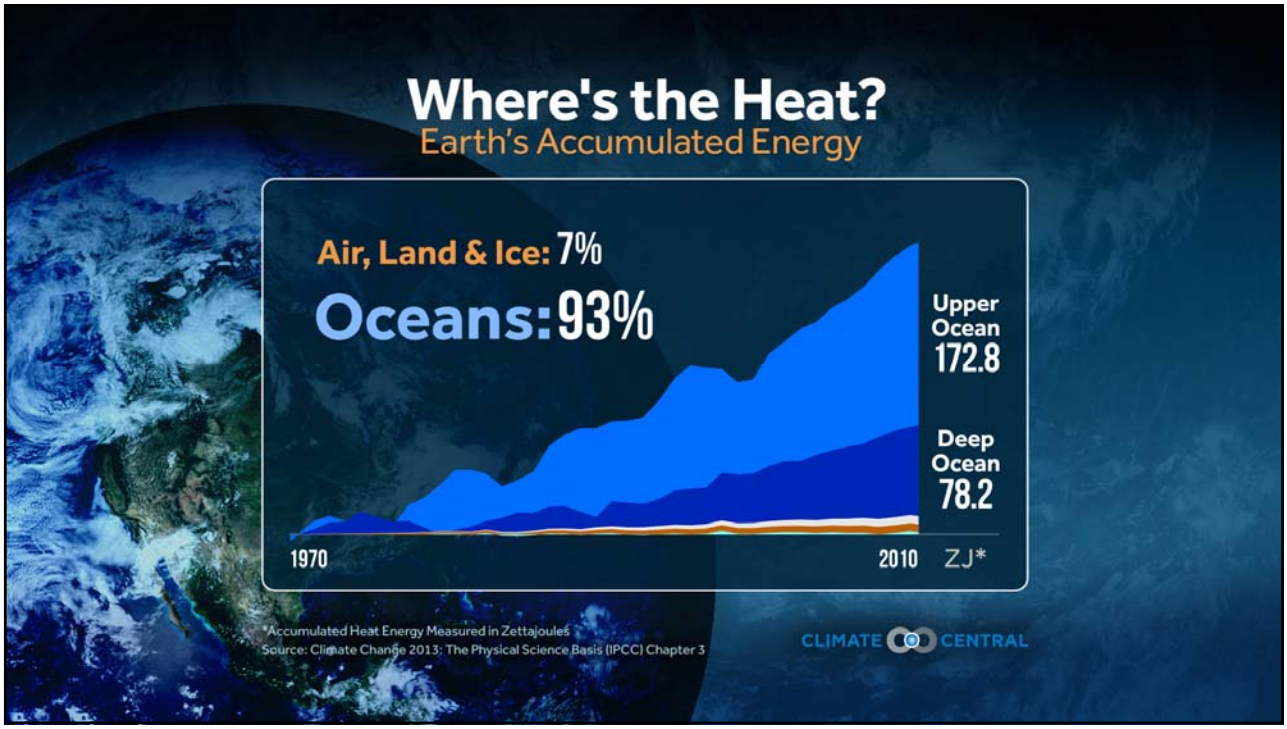
PARIS – COP21
November 30 – December 12, 2015
1.5 DEGREES
Photo - www.internationaleconpolicy.com


PARIS – COP21
2.7 – 3.5 C
ALREADY PUSHING THE LIMIT
2016 Global Monthly Temperature Anomalies (°C)
+2.0°
In the pipeline
PARIS LIMIT
+1.5°
Above 1750-1850
2015
+1.0°
+0.5°
0°
January
February
March
Source: NASA GISS and NOAA NCEI global temperature data averaged and adjusted to early industrial baseline (1881-1910). Data as of April 2016.
CLIMATE CENTRAL

Danger Zone in 22 Years
If the Northern Hemisphere's surface temperatures rise more than two degrees Celsius above preindustrial levels (baseline), human civilization will suffer dangerous harm, scientists say. When will that occur if the world keeps burning fossil fuels at current rates? The answer comes from entering estimates for equilibrium climate sensitivity (ECS)—how sensitive the atmosphere is to the heating effect of greenhouse gases (five solid curves)—into a so-called energy balance model of climate. The estimate that best agrees with recorded data reflecting the sensitivity of the earth's climate (white) indicates that the world will cross the two degrees C threshold in 2036, only 22 years from now (orange). If the reported recent slowdown in the rate of temperature rise, sometimes inappropriately called "the pause," proves to be part of a more persistent pattern, then a different estimate (gold) best fits the past 15 years or so, and it gives the world until 2046 to cross the danger line.
Where to Hold the Line
Scientists and policy makers commonly say that the world has to keep atmospheric CO_2 levels below 450 ppm to avoid two degrees C of warming (the level briefly hit 400 ppm in 2013). Yet if the atmosphere's climate sensitivity is three degrees C (orange), warming can be limited to that amount only if we keep emitting polluting aerosols (particles in the atmosphere that partly block the sun's heat) at current rates (dashed orange). Ironically, the reduction in coal burning needed to lower CO_2 emissions also lessens aerosols, sending temperatures across the danger line (dotted orange). The same is true if the sensitivity is 2.5 degrees C (gold). These data therefore indicate that to reliably avoid two degrees C of warming, CO_2 levels should be held to 405 ppm (blue)—barely above the 393 to 400 ppm levels observed in the past year.
Surface Temperature Change (°C)
4
3
2
1
0
2 °C Danger Threshold
Faux Pause
Historical Mean Annual Temperature (white)
Preindustrial Temperature
2013
2036
2046
1850
1875
1900
1925
1950
1975
2000
2013
2025
2050
2075
2100
Current level of aerosols persists
Level of aerosols drops
Equilibrium Climate Sensitivity 3.0
Equilibrium Climate Sensitivity 2.5
Equilibrium Climate Sensitivity 2.0
CO_2 level of 450 ppm (ECS 3.0)
Equilibrium Climate Sensitivity 1.5
CO_2 level held at 405 ppm
CO_2 level of 450 ppm (ECS 2.5)
Graphic by Pitch Interactive


Current level of aerosols persists
Level of aerosols drops
2036
2046
Equilibrium Climate Sensitivity 3.0
Equilibrium Climate Sensitivity 2.5
Equilibrium Climate Sensitivity 2.0
CO_2 level of 450 ppm (ECS 3.0)
Equilibrium Climate Sensitivity 1.5
CO_2 level held at 405 ppm
CO_2 level of 450 ppm (ECS 2.5)
2 C


GLOBAL CLIMATE CHANGE
Vital Signs of the Planet
Carbon Dioxide
LATEST MEASUREMENT: August 2016
404.07 ppm


Where's the Heat?
Earth's Accumulated Energy
Air, Land & Ice: 7%
Oceans: 93%
Upper Ocean 172.8
Deep Ocean 78.2
1970
2010
ZJ*
*Accumulated Heat Energy Measured in Zettajoules
Source: Climate Change 2013: The Physical Science Basis (IPCC) Chapter 3
CLIMATE CENTRAL

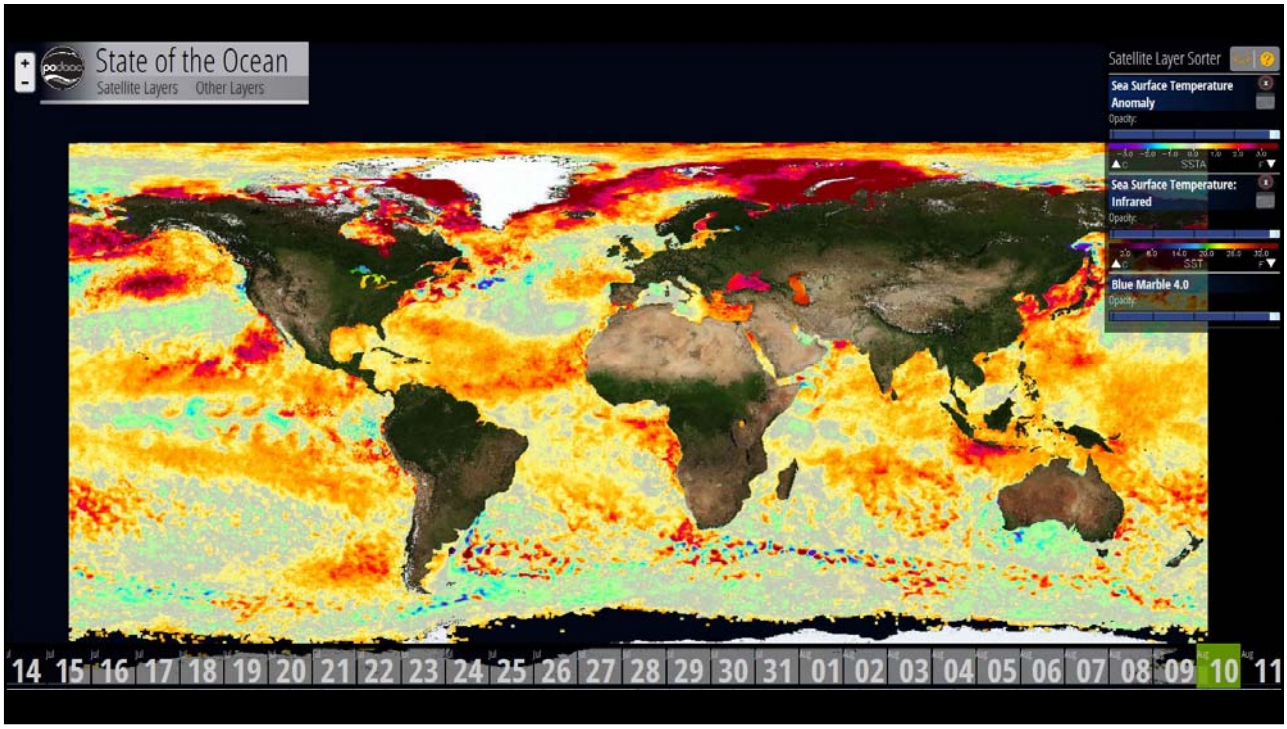
FORECASTED HIGH TODAY IN DENVER

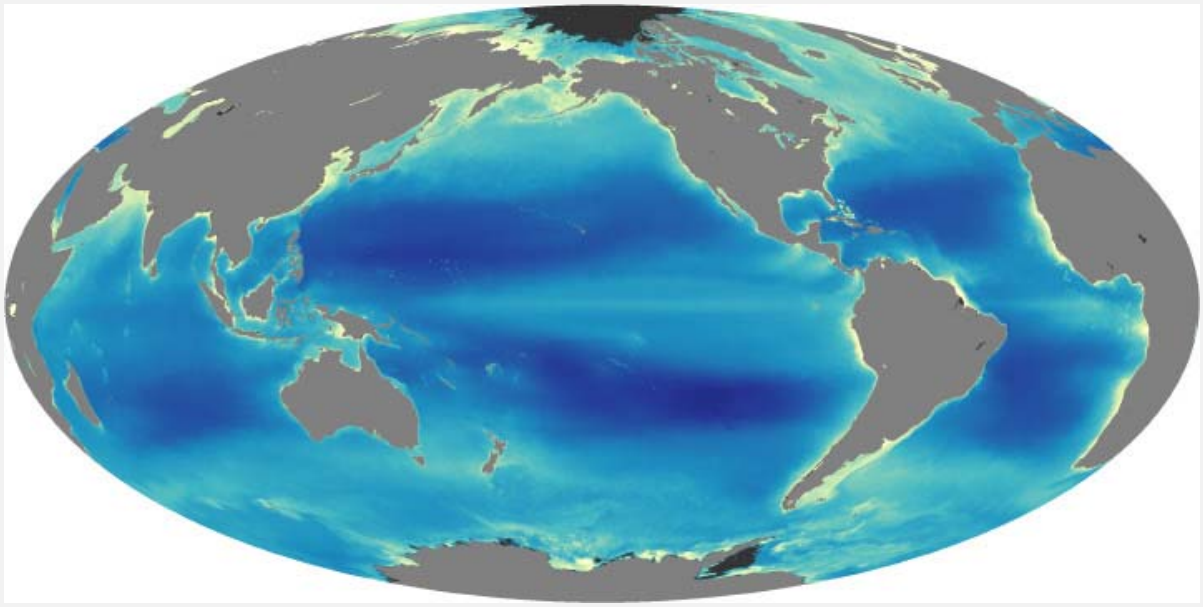
75

FORECASTED HIGH TODAY IN DENVER, WITHOUT THE OCEANS

140

Source: IUCN (International Union for Conservation of Nature)





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Global warming disaster could suffocate life on planet Earth, research shows

Posted by ap507 at Dec 01, 2015 10:50 AM | Permalink

University of Leicester researchers reveal how Earth's oxygen could dramatically fall due to change in ocean temperature of just several degrees

Issued by University of Leicester Press Office on 1 December 2015

Falling oxygen levels caused by global warming could be a greater threat to the survival of life on planet Earth than flooding, according to researchers from the University of Leicester.

A study led by Sergei Petrovskii, Professor in Applied Mathematics from the University of Leicester's Department of Mathematics, has shown that an increase in the water temperature of the world's oceans of around six degrees Celsius – which some scientists predict could occur as soon as 2100 - could stop oxygen production by phytoplankton by disrupting the process of photosynthesis.

Professor Petrovskii explained: "Global warming has been a focus of attention of science and politics for about two decades now. A lot has been said about its expected disastrous consequences; perhaps the most notorious is the global flooding that may result from melting of Antarctic ice if the warming exceeds a few degrees compared to the pre-industrial level. However, it now appears that this is probably not the biggest danger that the warming can cause to the humanity.

"About two-thirds of the planet's total atmospheric oxygen is produced by ocean phytoplankton – and therefore cessation would result in the depletion of atmospheric oxygen on a global scale. This would likely result in the mass mortality of animals and humans."

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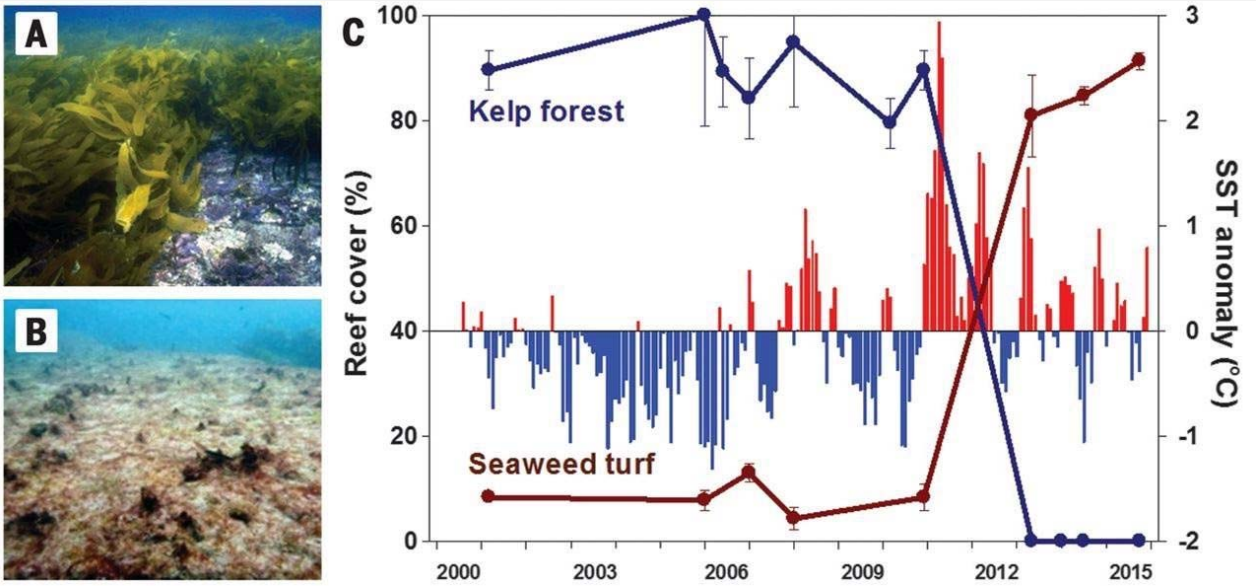

SHIFT OUR THINKING FROM:

Incremental steps to leaps,

Being Green to Being Blue,

Sustainability to Survivability

ENERGY CODE SOLUTION WITH MEASURABLE RESULTS—