

“All you ever do since we got this car is
drive around and show it off.”

Kyle Broflovski, South Park

Conspicuous Conservation: Green Signaling and WTP for the Prius Halo

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VPC Workshop :: 21 May 2012

Motivation

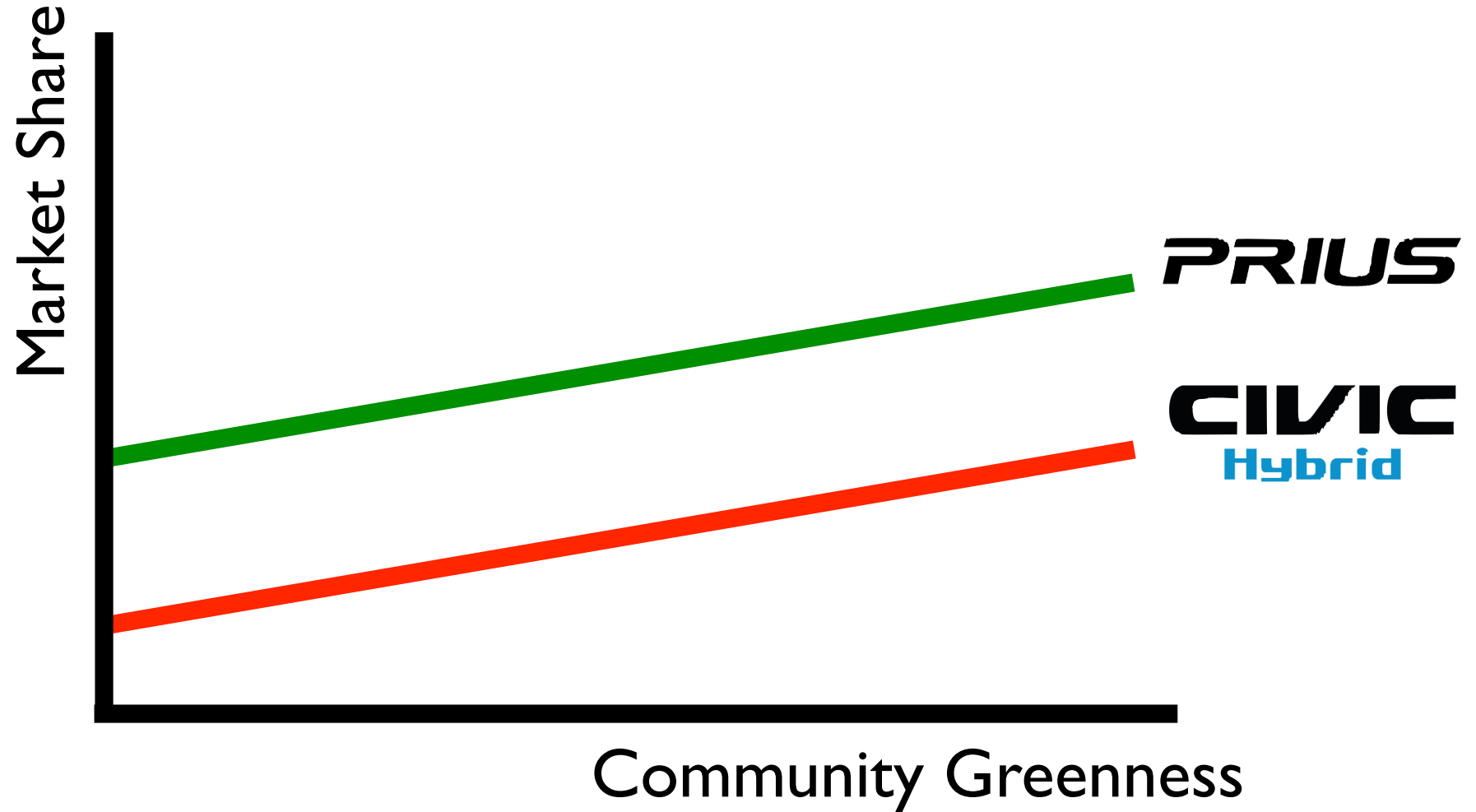


Whole Foods in Berkeley, CA

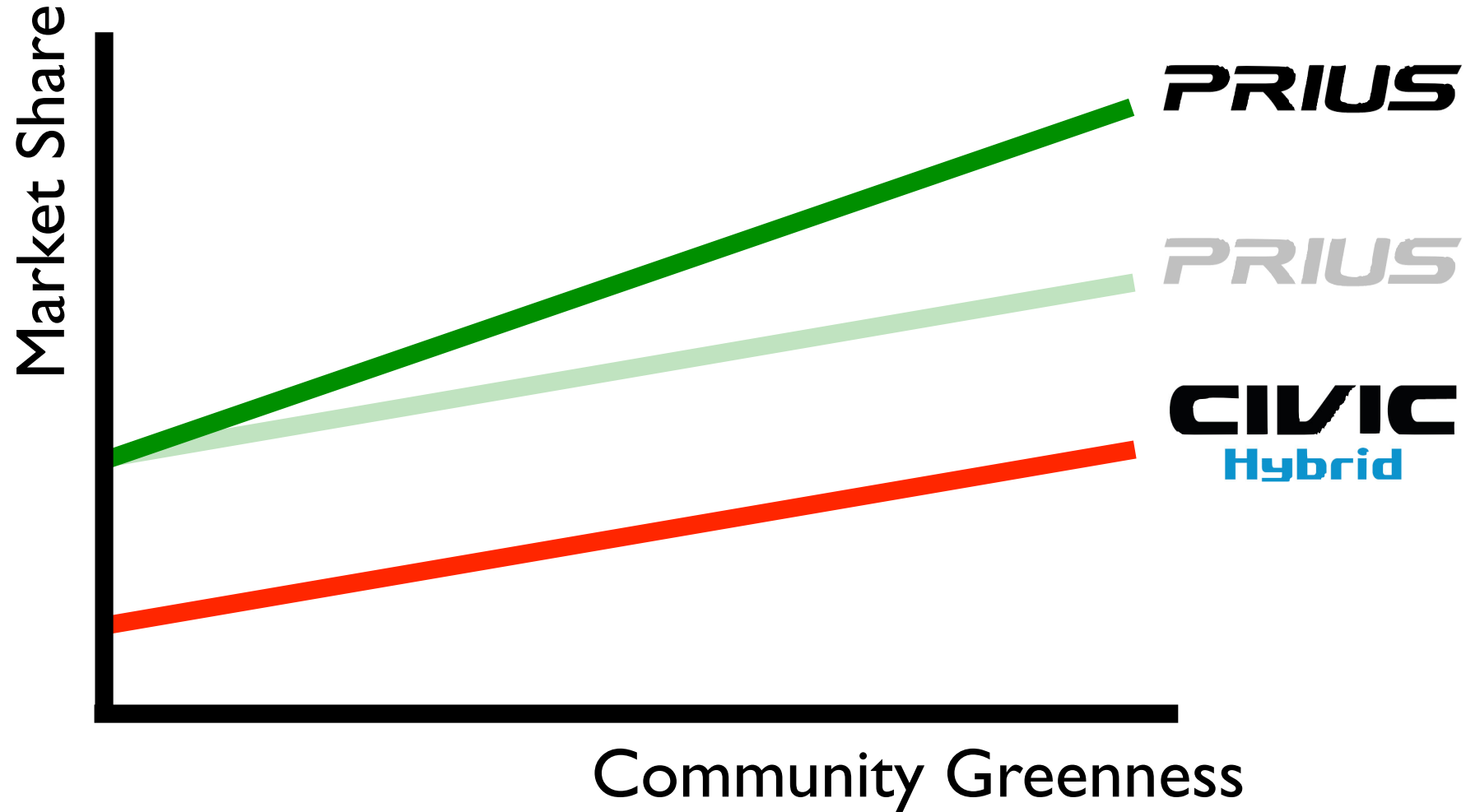


Civic Hybrid	Prius
\$23,800-\$27,000	\$22,800-\$28,070
40 city / 45 hwy	51 city / 48 hwy
51 Superior	52 Superior
★★★★★	★★★★

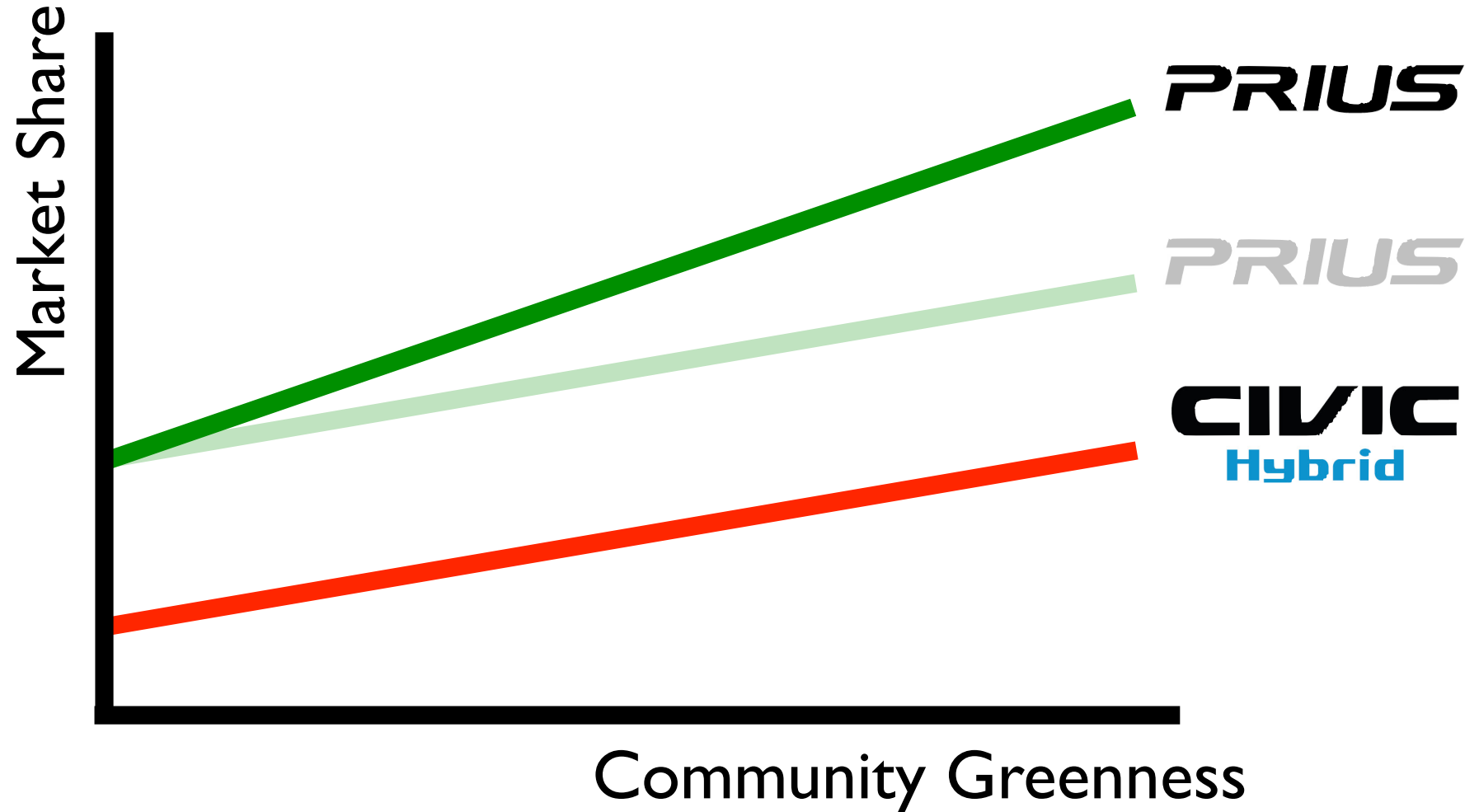
Altruism



Altruism



Conspicuous Conservation



Conspicuous Consumption

- “The wealth or power must be put in evidence, for esteem is awarded only on evidence.” - Veblen 1899.
- Signaling as an explanation for luxury brands (e.g. Leibenstein, Frank, Ireland)
- Charitable contributions as a signal of wealth (Glazer and Konrad 1996)

Conspicuous Conservation

- Anomalies in green markets cannot be explained by altruism alone
- “Esteem” from austerity that minimizes environmental impact of consumption, i.e. green goods.



Signaling Theory

- Behavior must be observable
- And signal (net-)cost must be negatively correlated with desirable trait (to allow partial revelation)

Green Signaling

- Value of the signal depends on the distribution of preferences of those who receive it
- Warm glow
- Identity conformance (Akerlof and Kranton 2000)

A Separating Equilibrium

- One receiver: Society (S)
- Two types of signalers: Green (g) and Brown (b):
- Signal: Own Prius (G), CivicH (H), or std. car (B)
- utility over:
- status: $s_G^*(\hat{\theta}) > s_H^* = s_B^* = 0$
- ID: $ID_{G,H}(g) = ID_B(b) > 0 > ID_B(g) = ID_{G,H}(b)$
- warm glow: $w_{G,H}(g) > w_{G,H}(b) = w_b(g) = w_b(b) = 0$
- hybrid cost premium: $c_G > c_H > c_B = 0$

A Separating Equilibrium

- Perfect revelation of types (ICC):

- ICC_G :

$$s_G^*(\hat{\theta}) + ID_G(g) + w_G(g) - c_G > ID_H(g) + w_H(g) - c_H$$

$$s_G^*(\hat{\theta}) + ID_G(g) + w_G(g) - c_G > ID_B(g)$$

- ICC_B :

$$ID_B(b) > s_G^*(\hat{\theta}) + ID_G(b) - c_G$$

$$ID_B(b) > ID_G(b) - c_H$$

A Separating Equilibrium

- Sufficiency for PBE:

$$s_G^*(\hat{\theta}) < ID_B(b) + c_G + \|ID_G(b)\|$$

Conspicuous

- Only hybrid with std. amenities and a design unique to the model (pre-2011)
- “Look at me design,” “polarizing,” “instantly recognizable to the masses.”
- Toyota wanted it that way



Inconspicuous



Honda Civic: Find the Hybrid

Inconspicuous



Ford Escape: Which is “green”?

The Prius Halo

“I felt like the Camry Hybrid was too subtle for the message I wanted to put out there. I wanted to have the biggest impact that I could, and the Prius puts out a clearer message.”

--Prius owner in NYT 7-4-07

The Prius Halo

“It makes a statement about me.”

--Number one reason for Prius purchase among 57% of owners. (NYT 7-4-07)

The Prius Halo

- Heffner, Kurani, and Turrentine 2007: symbolism important to hybrid owners:
 - Prius “made a statement”
 - “...a symbol of preserving the environment ...”
 - “only a basic understanding of environmental issues or ecological benefits of HEVs ...”

Revelation

- Hybrid system costs ~\$4-5,000
- Tradeoff of driving performance for environmental performance:
 - “... acceleration will just seem slow--2.5 seconds more lethargic than the dawdler in our sedan pack.” --Cars.com
 - “... a penalty box to drive.” -- Automobile Mag
 - “... humble, humming people pod ...” - LAT

Revelation

“... but anyone who buys the Prius as fashionable, commodious transportation will likely be annoyed by the car's efficiency-related quirks and will probably never realize the full value of the exotic technology.”

--Cars.com

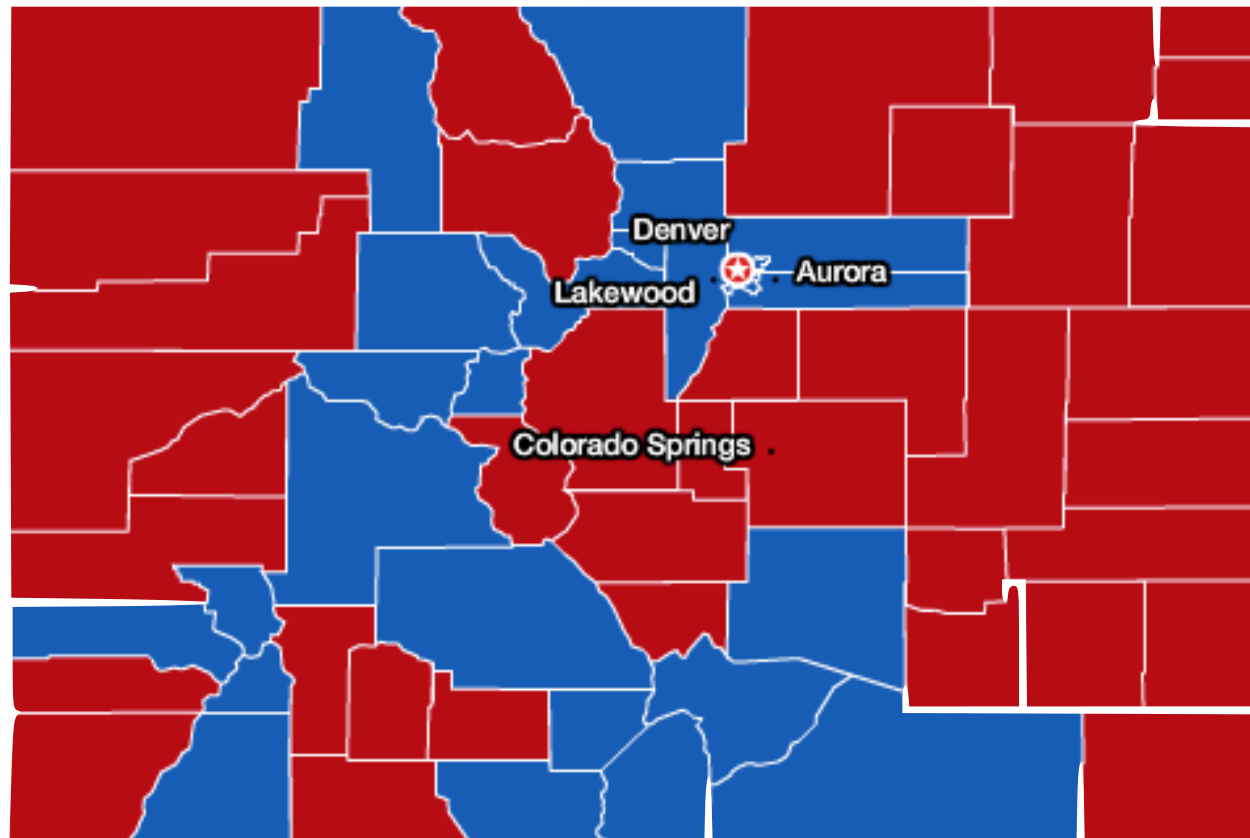
Data

- VIN by zip code in CO and WA
 - 3.9M and 4.2M cars, respectively
 - 511 and 412 5-digit zips
- Vehicle characteristics from proprietary data (make, model, MPG, weight, etc.)
- Limit attention to Acura, Cadillac, Chevrolet, Ford, GM, Honda, Lexus, Mercury and Toyota brands to reduce dimensionality
- Model greenness: ratings from ACEEE “Green Book” (and MPG)
- Demos from Census 2000

Measuring community 'greenness'

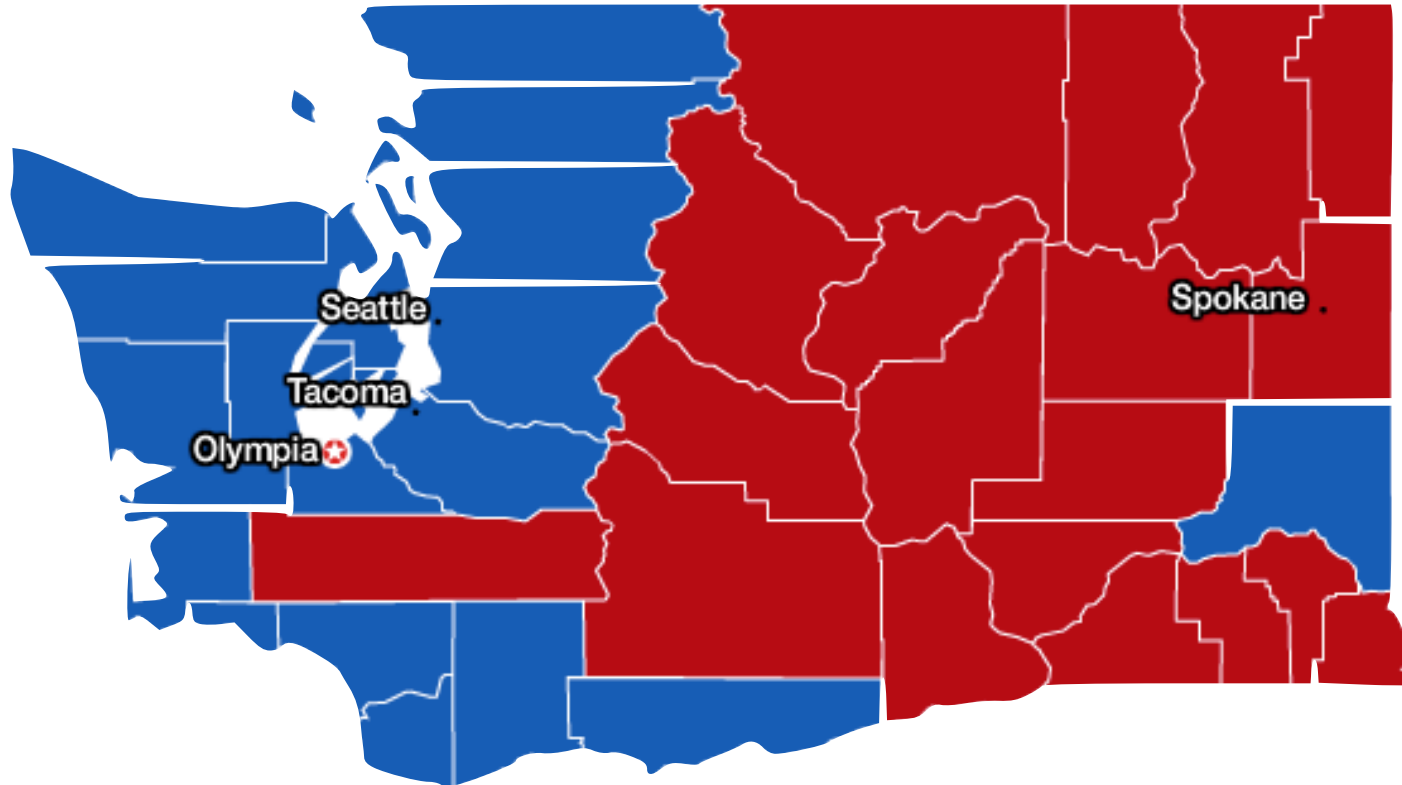
- Kahn (2007) introduces electoral measures of greenness in “Hummers vs Hybrids”
- Strategic voting concern and preference for Dem party measures
- Dems exhibit preferences for the environment: Costa and Kahn (2010) home energy; Loewenstein (2009) energy demand and global warming concern; political science literature on congressional votes, victorious candidates exhibit strong green preferences among Dems relative to Reps.

Measuring community 'greenness'



Colorado Presidential 2008

Measuring community 'greenness'



Washington Presidential 2008

Empirical Model Intuition

- Consider simple Diff in Diff
- 2 identical communities except one is green and one is brown
- 2 identical green cars, except one is conspicuous (Prius) and one is not (CivicH)

$$\hat{\beta} = (S_G^T - S_B^T) - (S_G^H - S_B^H),$$

Estimating equation

$$s_{ij} = \delta_j D_j + \xi_i V_i + \gamma GREEN_j * VOTE_i + \beta PRIUS_j * VOTE_i + \varepsilon_{ij}$$

- i denotes zip; j denotes product
- $GREEN$ is ACEEE “Green Score” for product
- $VOTE$ is vote share in zip (Dem, Obama)
- $PRIUS$ is dummy
- D is zip FE; V is product FE

Marketing

- Toyota undertakes at national, regional, dealer level
- Generate marketing areas by matching each zip to nearest dealer
- Interact product dummy with marketing area dummy to control for dealer-level marketing

Income and density

- Hybrid ownership correlated with income and educ; correlated with Dem?
- Dem correlated with pop density; is Prius better in city or suburb?
- Interact product dummy with median household income and pop density

On prices ...

- Instantaneous arbitrage condition likely precludes price discrimination (consumers can shop outside their communities)
- Dealer price discrimination => positive correlation b/n price and community greenness => smaller shares in green communities => attenuation bias

Results

Table 3: Conspicuous Conserv. Effect on Prius Market Share: Full Model

Dependent Variable: Product Market Share		
	(1) Colorado	(2) Washington
Product-specific Marketing Area Effects		
PRIUS*VOTE	0.0052*** (0.0024) [24.3]	0.0113*** (0.0023) [18,4]
Product-specific Marketing, Income, and Population Density Effects		
PRIUS*VOTE	0.0052*** (0.0014) [32.9]	0.0062*** (0.0026) [10.1]

Robust standard errors in parentheses

Mean conspicuous consumption effect as percent of share in brackets

*** p<0.01, ** p<0.05, * p<0.1

Falsification Tests

Table 4: Conspicuous Conserv. Effect on Civic Hybrid and Camry Hybrid Market Shares

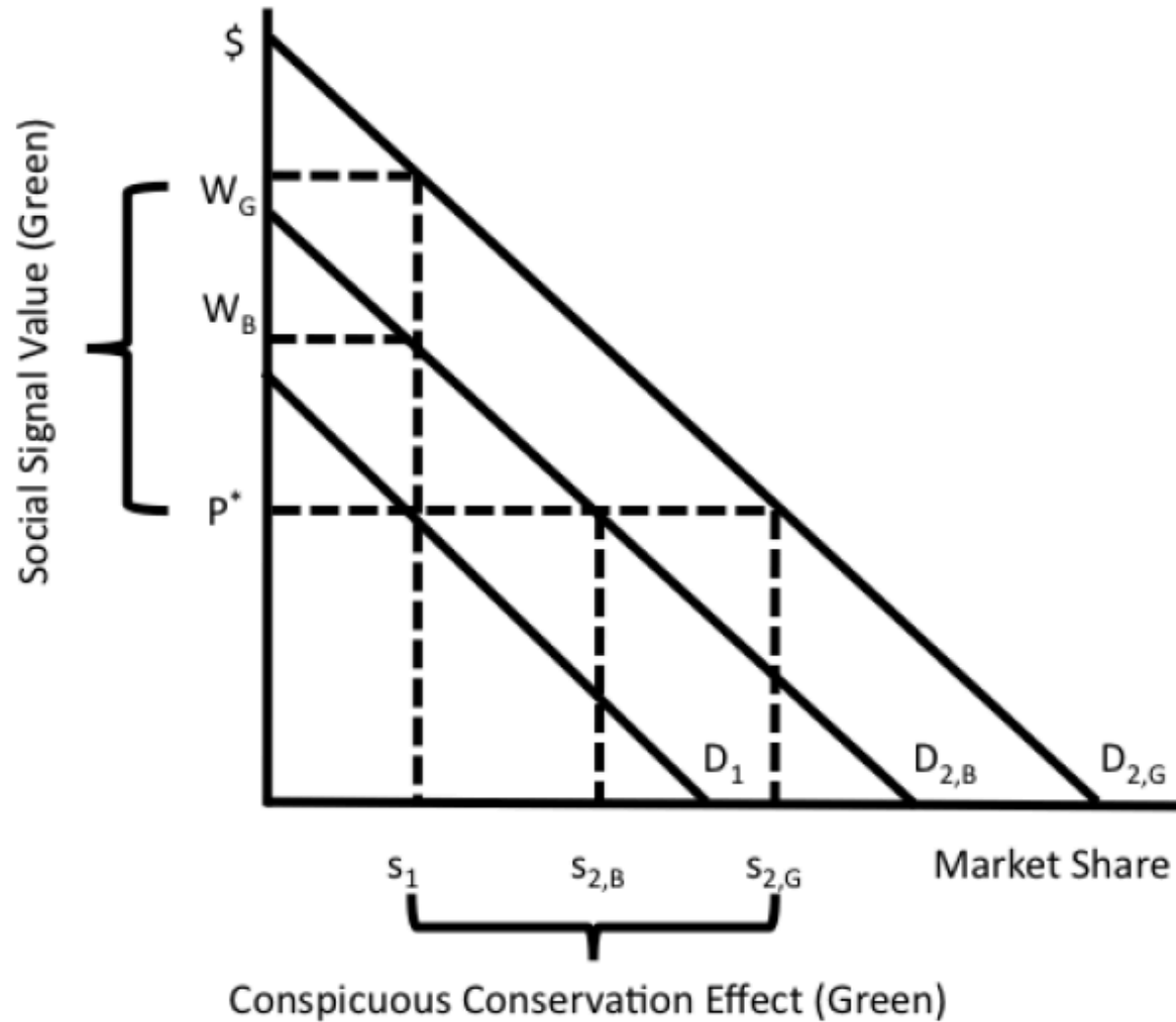
Dependent Variable: Product Market Share		
	(1) Colorado	(2) Washington
Honda Civic Hybrid		
CIVIC_HYB*VOTE	-0.0046*** (0.0009) [-87.3]	-0.0047*** (0.0013) [-90.4]
Toyota Camry Hybrid		
CAMRY_HYB*VOTE	-0.0036*** (0.0012) [-45.5]	0.0028* (0.0014) [-44.4]

Robust standard errors in parentheses

Mean conspicuous consumption effect as percent of share in brackets

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Estimating WTP



WTP Estimates

Table 5: Estimated Mean Willingness to Pay for the Prius Halo (in dollars)

Percent Change in Share	Price Elasticity		
	-1.6	-2.0	-4.8
10.1 (WA)	1,291.34 [229.94, 2,352.73]	1,033.07 [183.95, 1,882.19]	430.45 [76.65, 784.25]
32.9 (CO)	4,208.53 [1,987.72, 6,429.34]	3,366.83 [1,590.18, 5,143.48]	1,402.84 [662.57, 2,143.11]

95% confidence interval is reported in brackets holding elasticity constant

Benefit to Toyota

- Toyota pricing decisions involve fleet considerations and CAFE.
- Back of envelope:
 - Most comparable: Corolla LE: \$15,615
 - Toyota Hybrid System: \$3,960-5,175
 - => Corolla Hybrid: \$19,575-20,790
 - \$ Prius - \$ “Corolla Hybrid” => mark-up of \$710-1,925
- If linear demand, and constant MC, seller gets 1/2 WTP for demand shift

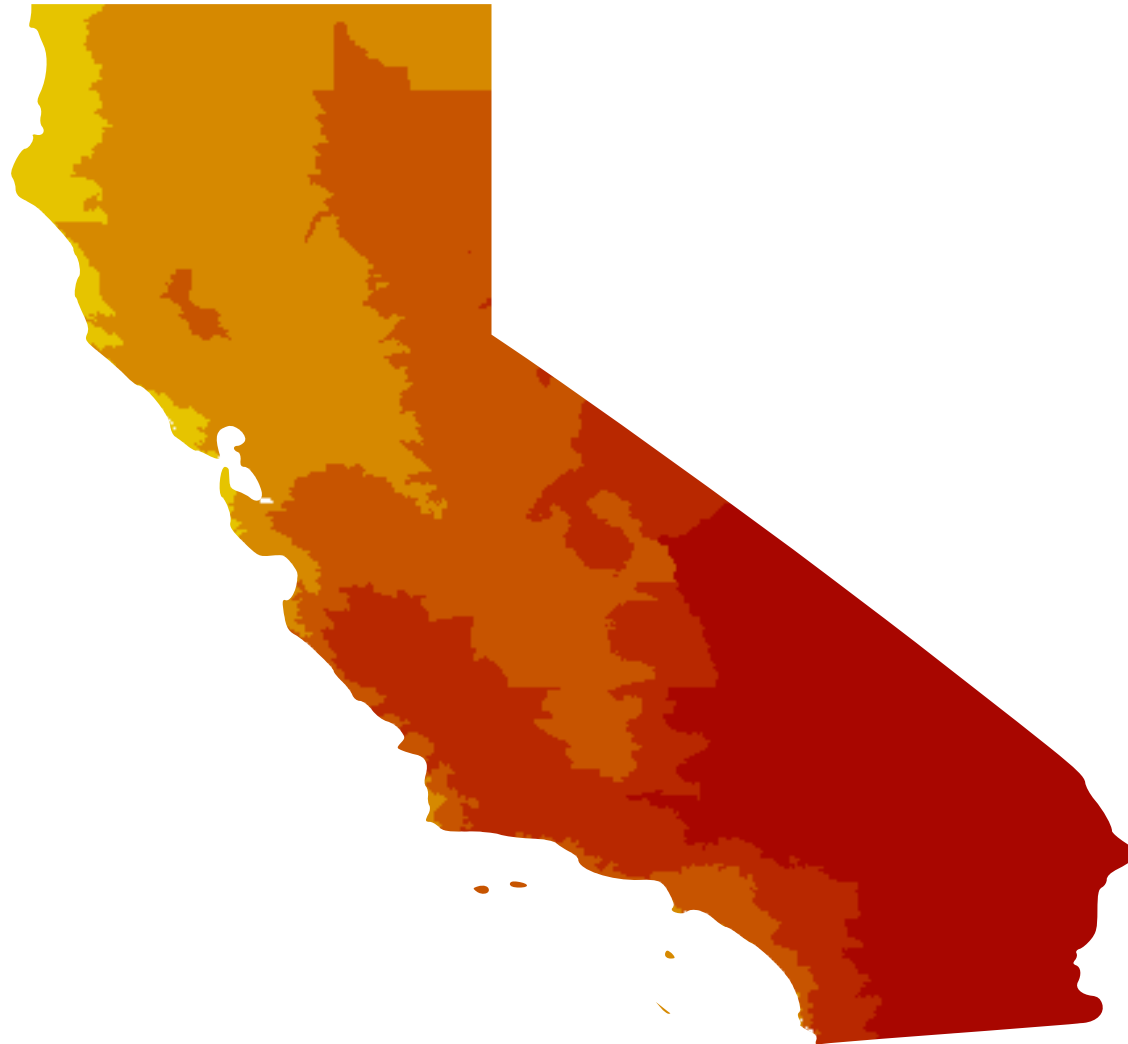
Implications

- Conspicuous conservation can induce private provision of public goods
 - Policy: make green behavior conspicuous
 - Firms: 2nd-degree price discrimination / product differentiation
- Conspicuous *consumption* leads to wastefulness and welfare losses; Conspicuous *conservation* can lead to welfare *gains*
- BUT, inefficient conservation investment:
 - Crowd out?
 - “low hanging fruit” passed over for visible green projects

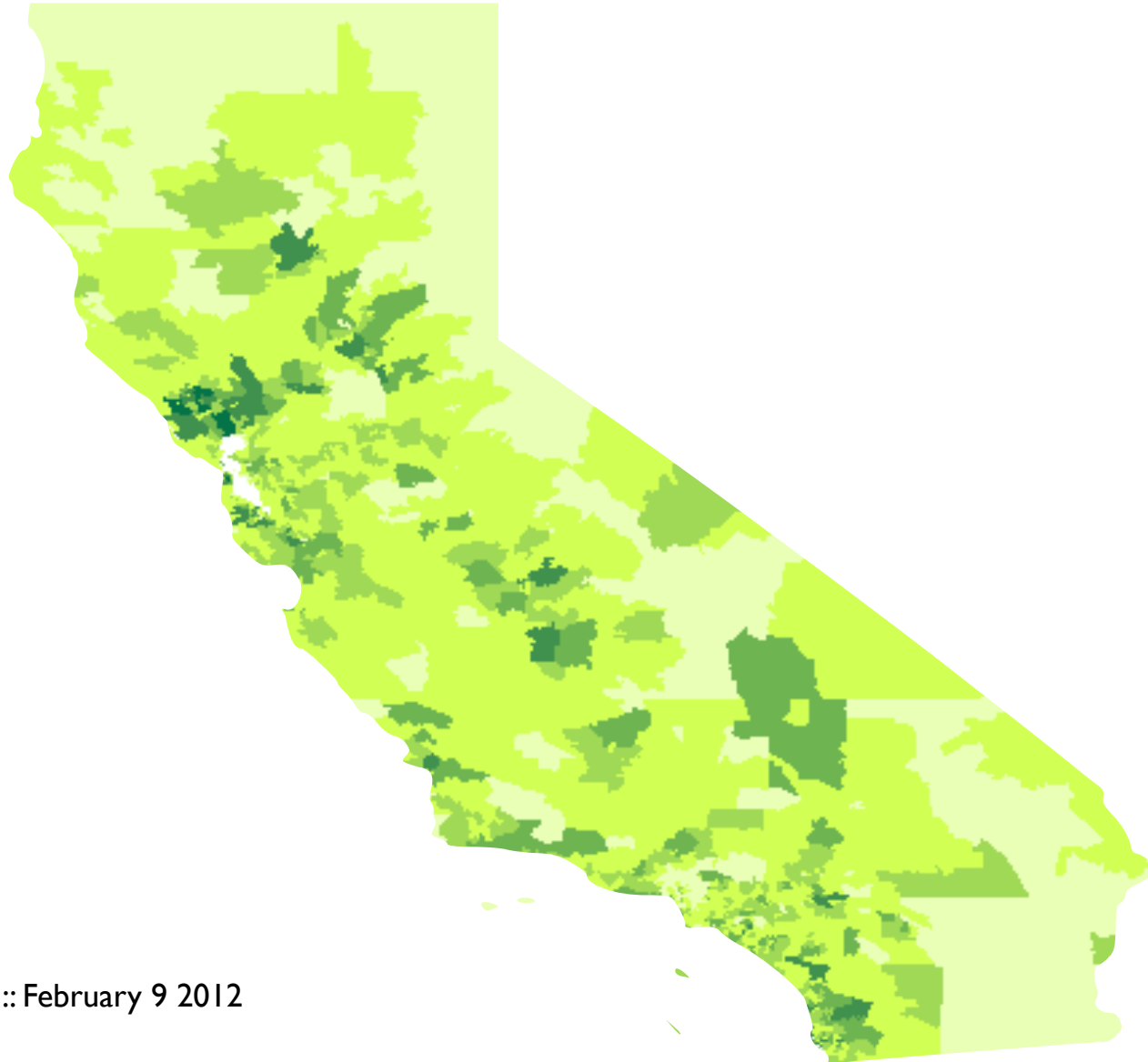
thank you

and thanks to
University of California Giannini Foundation, and
Energy Biosciences Institute

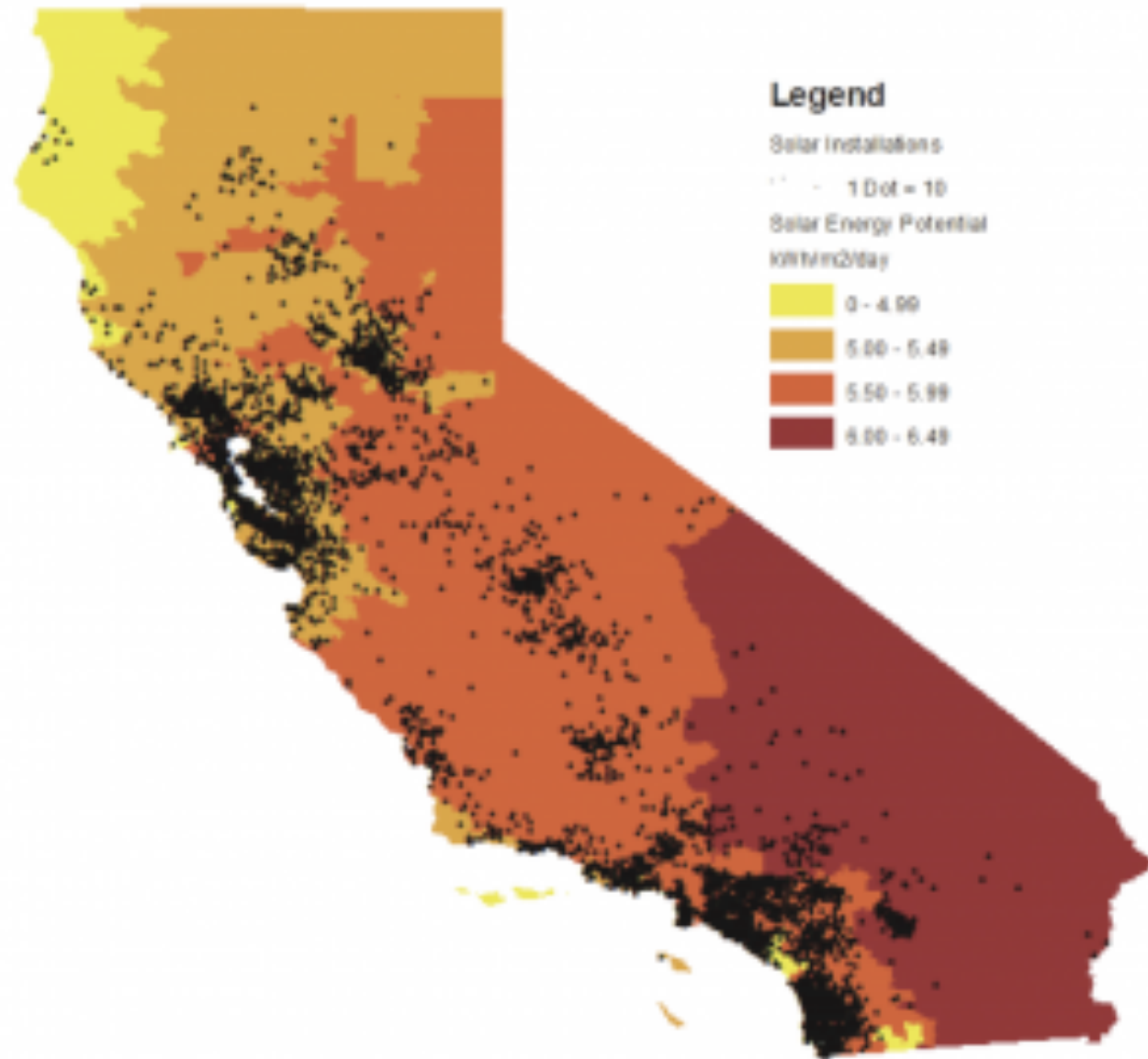
Solar potential



Resid. solar density



Solar potential



Conclusions

- Identified significant conspicuous conservation effect
- WTP for “Green Halo” on the order of several thousand dollars.
- Suggested role for policy to ensure efficient mix of conservation projects / maximizing PPPG
- Ongoing work:
 - efficiency of decentralized energy conservation effort
 - signaling theory / identity

thank you

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Energy Biosciences Institute

On Social Contagion

- one's adoption behavior is a function of exposure to others' adoption behavior
- Four causal mechanisms (Van den Bulte and Lilien 2001):
 1. normative pressures
 2. competitive concerns
 3. network effects
 4. information transfer