



Appropriate Technology

Now:

Two Examples

Paul Arveson

ASA Annual Meeting, 2005

Two Underutilized Technologies that are Ready Now

- Solar Cookers –
 - Appropriate for underdeveloped countries
 - Especially in rural equatorial regions
- Hybrid Cars –
 - Appropriate for developed countries
 - especially in urban regions



Underutilized Technology 1: Shiny Stuff for Solar Cookers



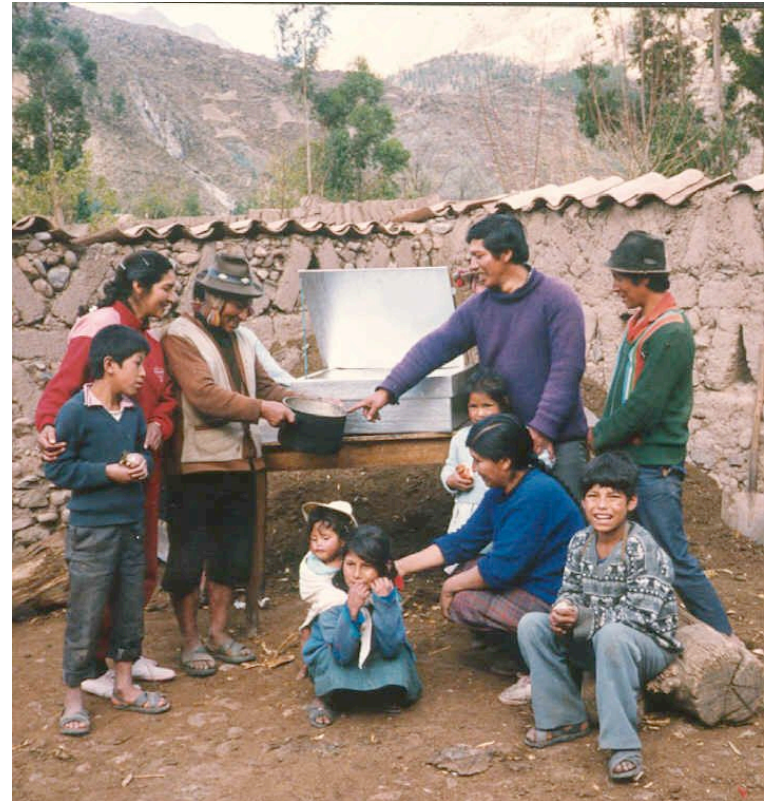
- Shiny materials are relatively new to the world
 - Aluminum foil
 - Metallized plastic film
- But now they are cheap and plentiful
 - Est. \$100 *an acre*
- Consequence: an underutilized solution waiting for cultural acceptance

The Cookit: A Simple but Effective Solar Cooker



Benefits of Solar Cooking

- Consumes no fuels, replaces wood
 - No loss of trees & habitat
 - Trees sequester carbon
 - No loss of soil and watershed
 - Wood is often in short supply now



More Benefits of Solar Cooking

- Eliminates work
 - No daily search for firewood
 - No risks to women and children
 - Frees time for other activities
 - No need to stir food
 - Helps to liberate women



Two Billion People rely on Wood for daily cooking fuel





More Benefits of Solar Cooking

- Reduces costs
 - No fuel to purchase (many poor families spend 25% of their income on fuel)
 - No fuel storage required
 - No fuel transportation required
- Provides business opportunities
 - Making solar cookers
 - Preparing foods: bakeries, restaurants
 - Food processing: rice, honey etc.
 - Dying fabrics
 - Sterilizing instruments for doctors & vets

More Benefits of Solar Cooking

- Generates no air pollution
- Generates no greenhouse gases
- Produces no smoke
- Eliminates fire dangers



Cooking Smoke: An Unrecognized Source of Disease and Death

- Cooking smoke kills over 1.6 million people each year, mostly women & children, according to a recent report
 - Acute lower respiratory infection
 - Chronic bronchitis
 - Lung cancer
 - Asthma, TB etc.



A quadruple tragedy: cooking smoke, malnutrition, child orphaned by AIDS, unused sun rays

Source: Smoke – the Killer in the Kitchen, H. Warwick & A. Doig, ITDG
http://www.itdg.org/?id=smoke_index

More Benefits of Solar Cooking

- Can sterilize water
– 65 deg. C
- Can pasteurize milk
- Can cook high-protein legumes that require many hours to cook



More Benefits of Solar Cooking

- Cooks foods slowly and thoroughly
- Preserves nutrients
- Foods will not burn
- Pots are easy to clean; less clean water is needed
- Use for canning vegetables
- Use for dried fruit
- Kill insects in dry grains



More Benefits of Solar Cooking

- Solar cooking frees up valuable space inside the home for other uses
- Moving cooking outside reduces heat buildup in home





Issues Limiting the Use of Solar Cooking

- Requires clear sky; on cloudy days some other fuel must be used
 - Appropriate for many regions such as India, China, and Saharan Africa
- Lifestyle adjustments are required
 - Change in timing of meals and work
 - Hot food storage
 - Cooking outside
 - Home design
 - Possible changes in taste of food



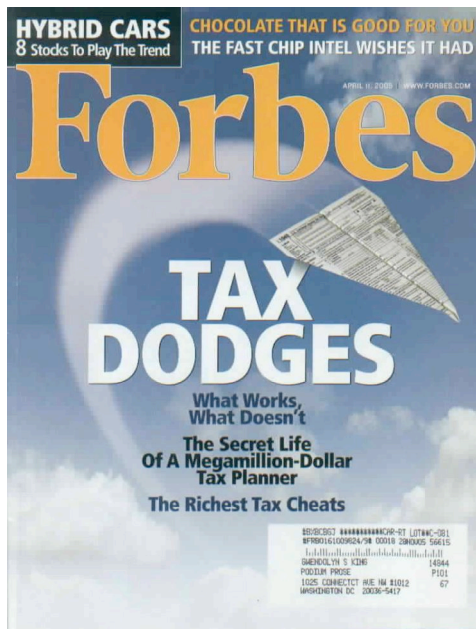
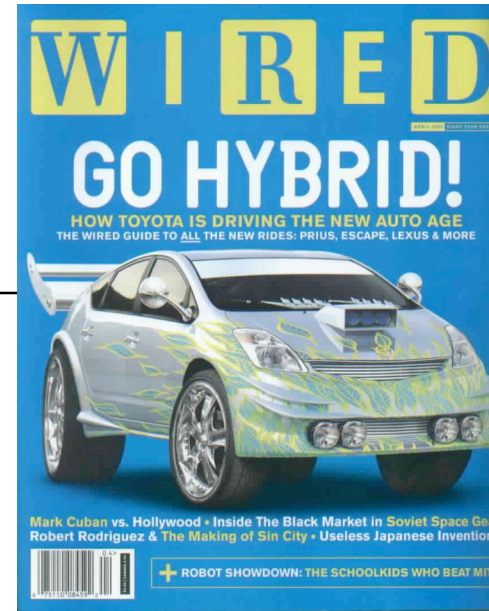
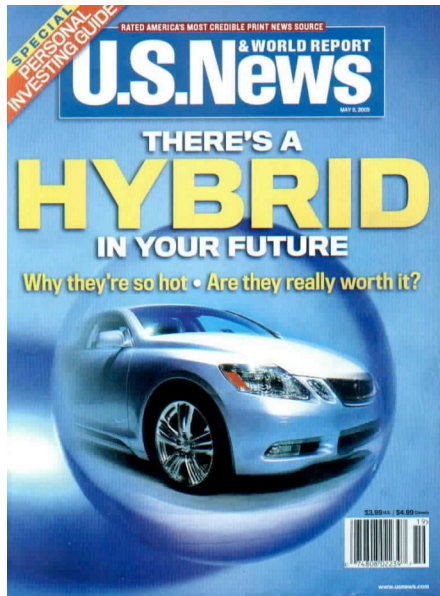
What Can We Do to Promote Solar Cooking?

- Become aware of information sources, e.g. www.solarcooking.org
- Approach mission agencies and individuals working in developing countries
- Develop specific strategies for adapting to local cultures
- Contribute: www.solarcookers.org

Underutilized Technology 2: Hybrid Cars



- Prius introduced in US in 2000
 - Designed by Toyota ~ 1995
 - Little or no marketing
 - Federally-funded research in US stopped early 2001
 - Demand rapidly increased when gasoline prices increased 2004
 - Won a long list of auto awards
 - US began promoting “hydrogen economy”
 - US car companies began anti-hybrid propaganda (“Auto Alliance”) 2005



Toyota 2005 Models vs. MPG



The Prius: A “Real” Hybrid





Other “Real” Hybrids for 2005:

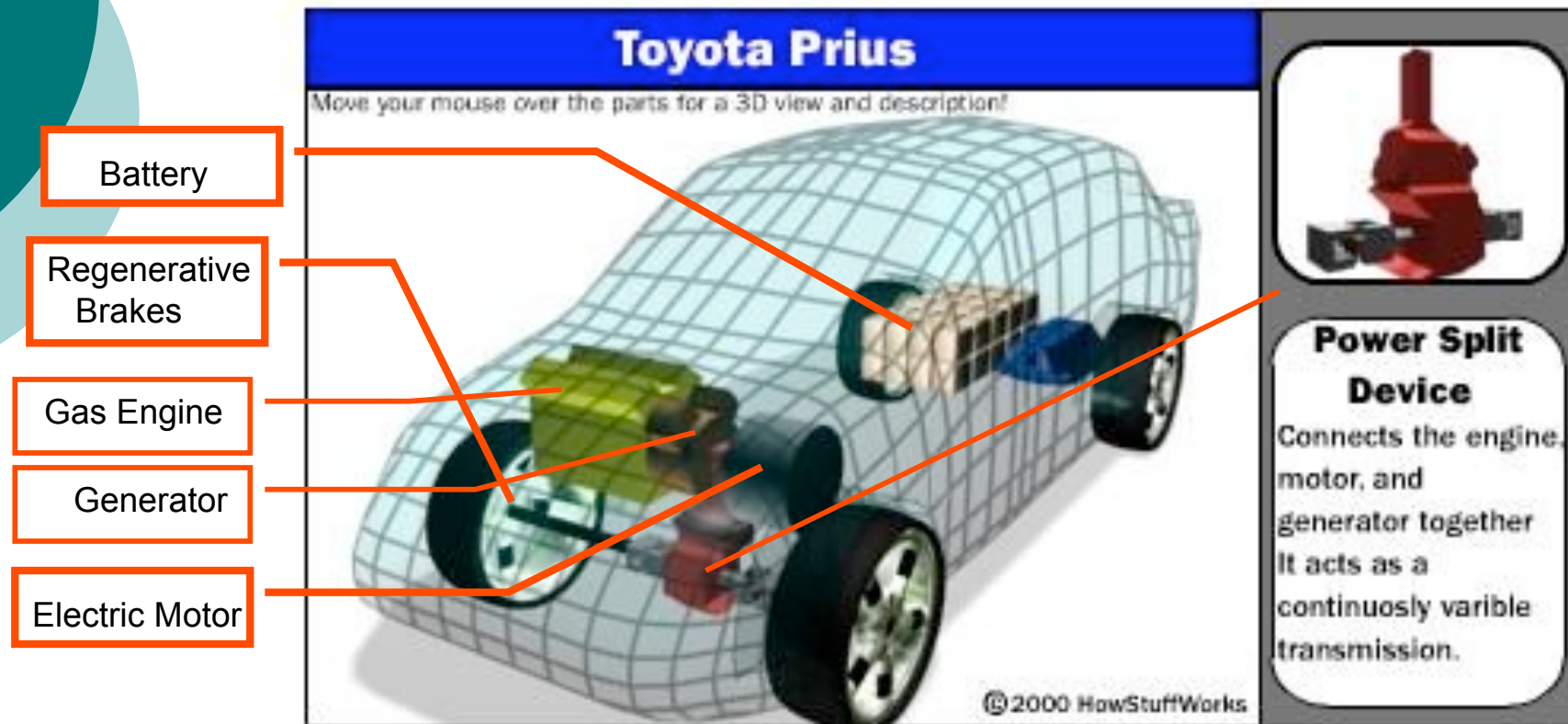
- Honda Civic Hybrid 48/47 mpg
- Honda Insight 61/66 mpg
 - small, 2-seater
- Ford Escape Hybrid 36/31 mpg



More Hybrids Coming in 2006


- Toyota Highlander Hybrid 33/28 mpg (2006)
- Nissan Altima Hybrid
 - To be built in Miss. or Tenn.
- Hyundai Accent Hybrid
 - Fall 2006

How Does the Prius Work?



You don't plug it in!

My 2001 Prius Sticker


TOYOTA

STANDARD FEATURES

MECHANICAL & PERFORMANCE

- 1.5L, 4CYL. TWIN-CAM, 16VALVE ENGINE
- TOYOTA HYBRID SYS., INCLUDES HYBRID TRANSAXLE, INVERTER & HV BATTERY
- 2 PERMANENT MAGNET MOTOR GENERATORS
- FRONT WHEEL DRIVE
- ELECT. CONTROLLED CONTINUOUSLY VARIABLE TRANSMISSION (CVT)
- POWER RACK AND PINION STEERING
- POWER FRONT DISC BRAKES
- INDEPENDENT FRONT SUSPENSION
- MACPHERSON STRUT TYPE
- 175/65R14 RADIAL TIRES

SAFETY

- REGENERATIVE ANTI-LOCK BRAKE SYSTEM (ABS)
- DRIVER/PASSENGER AIR BAG (SRS)
- 3-POINT SEAT BELTS WITH PRETENSIONERS & FORCE LIMITERS

- KEYLESS ENTRY AND SECURITY SYSTEM W/ ENG IMMOBILIZER

EXTERIOR

- ALUMINUM ALLOY WHEELS (4)
- REAR SPOILER
- COLOR-KEYED BUMPERS, DOOR HANDLES, AND DUAL POWER OUTSIDE MIRRORS

COMFORT & CONVENIENCE

- AUTOMATIC CLIMATE CONTROL
- LIQUID CRYSTAL VEHICLE INFORMATION DISPLAY
- POWER WINDOWS AND DOOR LOCKS
- AH/FH CASSETTE W/4 SPRKS
- FRONT CUPHOLDER
- CABIN FILTRATION SYSTEM
- CENTER CONSOLE BOX
- INTERMITTENT WINDSHIELD WIPERS
- ADJUSTABLE FRONT HEADRESTS
- REAR WINDOW DEFOGGER W/TIMER

*** FULL TANK OF GAS ***

PRIUS 4-DOOR

VIN: JT2BK1L
COLOR: ELECTRIC BLUE


MANUFACTURER'S SUGGESTED RETAIL PRICE

FE 50 STATE EMI
CF. CARPET FLOOR
PS. COMPACT DISC

Compare this vehicle to others in the **FREE FUEL ECONOMY GUIDE** available at the dealer.

CITY MPG

52



HIGHWAY MPG

45

Actual Mileage will vary with options, driving conditions, driving habits and vehicle's condition. Results reported to EPA indicate that the majority of vehicles with these estimates will achieve between

44 and 60 mpg in the city, and between

38 and 52 mpg on the highway.

2001 PRIUS

4-CYL., 1.5 LITER DISP., VVT-I, DOHC, EFI ENGINE, AUTOMATIC VARIABLE GEAR RATIO TRANSMISSION.

Estimated Annual Fuel Cost:

\$ 421

For Comparison Shopping, all vehicles classified as

COMPACT

have been issued mileage ratings ranging from

11 to 52 mpg city and

16 to 49 mpg highway.

WWW.FUELECONOMY.GOV

DEALER NAME/ADDRESS:

JIM COLEMAN TOYOTA, INC.,
10400 AUTO PARK AVENUE
BETHESDA MD20817

SHIP TO:

PORT/PLANT: BALTIMORE

19045

Manufacturer's suggested retail price. Includes manufacturer's recommended pre-delivery service. Gasoline, license and title fees, applicable federal, state and local taxes and dealer and distributor installing options and accessories are not included in the manufacturer's suggested retail price.

DELIVERY, PROCESSING AND PREPARE

TOTAL

TOYOTA'S LIMITED WARRANTY
HYBRID COMPONENTS 8
3/36,000; POWERTRAIN
SEE WARRANTY INFORMATION

An extended service contract
Ask dealer for details.



My Bill of Sale

JIM COLEMAN TOYOTA
10400 AUTO PARK AVENUE • BETHESDA, MARYLAND 20817 • (301) 460-7100

PURCHASER'S NAME Kathleen Ruth ARVESAN (PRINT OR TYPE)

BUYERS ORDER

NAME _____

STREET ADDRESS 6902 Breeze Wood Terr.

CITY, STATE N. Bethesda Md. **ZIP** 20852

BUS. PHONE (301) 984-6227 **RES. PHONE** (301) 816-9459 **DATE** 4-30-01

☐ NEW ☐ USED ☐ DEMONSTRATOR AS FOLLOWS: 1222

YEAR	MAKE	MODEL OR SERIES	BODY TYPE	COLOR	TRIM
<u>2001</u>	<u>Toyota</u>	<u>Primer</u>		<u>Electric Green</u>	

BASE: _____

DEALER INSTALLED EQUIPMENT: _____

DAMAGE DISCLOSURE ☐ AMOUNT: \$ _____

ANY NEW VEHICLE OVER 7500 MILES IS A USED CAR ☐

ANY VEHICLE OVER 500 MILES IS A DEMONSTRATOR ☐

THIS VEHICLE IS A DEMONSTRATOR VEHICLE. IT IS A VEHICLE WHICH HAS BEEN USED BY THE EMPLOYEES, OFFICERS OR PRINCIPALS OF THE DEALER, MANUFACTURER OR DISTRIBUTOR OR FOR CUSTOMER ROAD TESTING. FEDERAL LAW REQUIRES A BUYER'S GUIDE TO BE ATTACHED TO THE SIDE WINDOW OF THIS VEHICLE. YOU ARE WELCOME TO INQUIRE AS TO THE SPECIFIC USAGE OF THE VEHICLE FROM THE DATE OF ITS MANUFACTURE. YOU ARE ALSO WELCOME TO CONDUCT WHATEVER INSPECTION YOU DEEM APPROPRIATE PRIOR TO ENTERING INTO AN AGREEMENT TO PURCHASE THE VEHICLE.

TOTAL 20855.00

(NOT REQUIRED BY LAW) PROCESSING FEE _____

LUXURY TAX 185.00

REGISTRATION 21060.92

TOTAL CASH DELIVERED PRICE 21060.92

CASH DEPOSIT SUBMITTED WITH ORDER		ALLOWANCE FOR TRADE-IN AS APPRAISED		LESS BALANCE OWING - TO - CUSTOMER RESPONSIBLE FOR PAYOFF ACCURACY		NET EQUITY	

YEAR	MAKE	MODEL	TYPE	ODOMETER READING	LICENSE NO.	TITLE NO.	UNPAID CASH BALANCE DUE ON DELIVERY

The front and back of this Order comprise the entire agreement affecting this purchase and no other agreement or understanding of any nature concerning same has been made or entered into, or will be recognized.

I have read the matter printed on the back hereof and agree to it as a part of this order the same as if it were printed above my signature. I certify that I am 18 years of age, or older, and hereby acknowledge receipt of a copy of this order.

I hereby acknowledge receipt of a copy of the statement and approve and accept the same as a correct presentation of my or our agreement with Jim Coleman Toyota. I understand and agree that the accuracy of the information furnished to Jim Coleman Toyota is not guaranteed by the same or any of its employees, although every effort is made to ascertain the information accurately. It is understood and agreed that Jim Coleman Toyota may make subsequent proper adjustments in the event any information and/or items on the contract furnished to it proves incorrect, or other funds prove insufficient and I agree to pay and/or reimburse to Jim Coleman Toyota any further sums thus found to be due since all computations and adjustments are subject to final audit.

SALES REPRESENTATIVE 351 [Signature]


PURCHASER [Signature]

THIS ORDER IS NOT VALID UNLESS SIGNED AND ACCEPTED BY DEALER OR HIS AUTHORIZED REPRESENTATIVE

APPROVED _____ **DEALER OR AUTHORIZED REPRESENTATIVE**

Emissions Comparison

Prius vs. Camry (2004)

	Fuel* (estimated per year)		Vehicle emissions (estimated, per year in pounds)			
	Con- sumption	Cost	<u>Carbon dioxide</u>	<u>Carbon monoxide</u>	<u>Nitrogen oxides</u>	<u>Hydro- carbons</u>
2004 TOYOTA PRIUS (55.6 mpg, BIN 3) 12,500 miles/year	225 gal	\$452	4,363 lb	208.3 lb	6.1 lb	4.3 lb
2004 TOYOTA CAMRY (25.4 mpg, BIN 5) 12,500 miles/year	493 gal	\$952	9,566 lb	307.3 lb	8.5 lb	6.9 lb

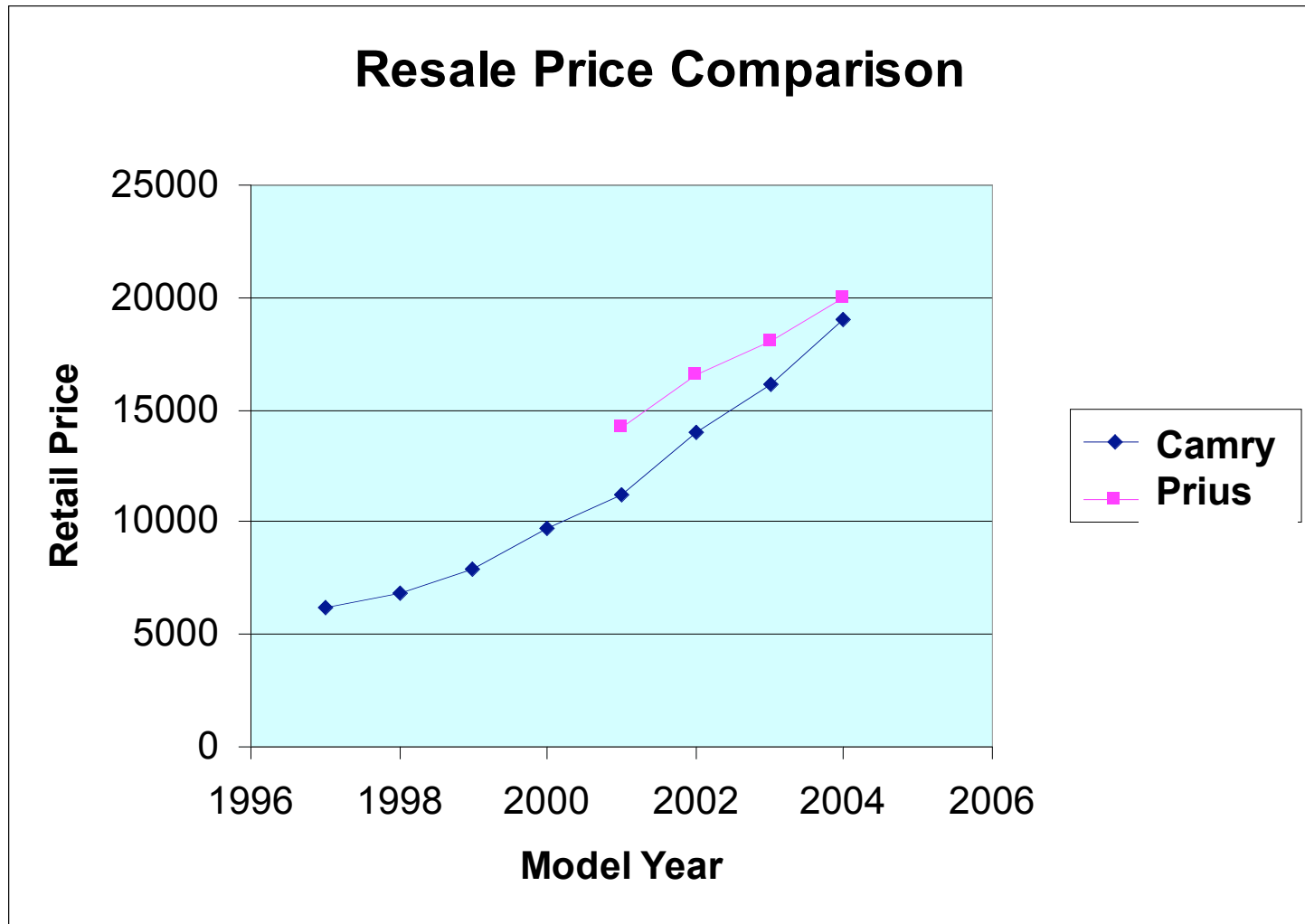
* Actual fuel consumption and emissions will vary depending on the specific vehicle configuration, how well the vehicle is maintained, and your driving habits. (See [methodology](#) for details.) Fuel cost is based on a national average fuel price of \$1.93 (as of June 21, 2004, from the Energy Information Administration).



My Experience with 2001 Prius

- Purchased Aug. 2001 for \$21,040
 - Waited 3 months (now available off the lot)
 - No sales tax in Maryland; your state may differ
 - Federal tax deduction \$1500; now \$2000
- Maintenance
 - Warranty covered most needs
 - Battery 8 yrs/100k miles
 - Other 3 yrs/30k miles
 - Purchased new tires
 - One recall for vibration fix
 - Current mileage 56,000
 - Fuel economy: about 47 mpg average

Prius vs. Camry – Resale Prices



Prius vs. Conventional Car Costs

Car Cost Comparison:		
Avg. price of gas per gallon	\$1.60	
Miles driven	56000	
mpg, car 1	47	01 Prius
mpg, car 2	26	01 Camry
Fuel Cost, car 1	\$1,906.38	
Fuel Cost, car 2	\$3,446.15	
Fuel Cost difference	\$1,539.77	
Tax incentives, car 1	\$1,500.00	
Tax incentives, car 2	\$0.00	
New car price, car 1	\$21,040.00	01 Prius
New car price, car 2	\$17,000.00	01 Camry
Car price difference 1-2	\$4,040.00	
Total cost, car 1	\$21,446.38	
Total cost, car 2	\$20,446.15	
Cost difference, car 1 - car 2	\$1,000.23	



Clean Fuel Tax Deduction For Hybrid Vehicles

“If you are the original (first) owner of a qualifying hybrid vehicle — one that combines an electric motor with a gasoline-powered engine — you may be eligible to claim a one-time tax deduction on your federal income tax return.

Under the Working Families Tax Relief Act of 2004, the deduction amount is limited to \$2,000 for cars first put into use in 2004 and 2005. The deduction will be limited to \$500 for vehicles placed in service in 2006, and no deduction will be allowed after that year.”

IRS Tax Tip 2005-57, March 22, 2005



Energy Policy Act of 2005:

- "... the Administrator of the National Highway Traffic Safety Administration shall initiate a study of the feasibility and effects of reducing **by model year 2014**, by a significant percentage, the amount of fuel consumed by automobiles."

(from Section 744 on Hybrid Vehicles)

So I Bought a 2005 Prius



- Sale price: \$22,978 complete
 - EPA ratings 60 mpg city, 51 hwy
 - Hatchback; more inside space
 - Many minor improvements
- Trade-in of 2001 Prius: \$9500
- 2005 Federal tax relief: approx. \$600
 - Many states have additional tax breaks
- Net cost of 2001 Prius: \$12,878
- Net cost per month: \$268



Prius Conclusions

- Is this car a solution now?
 - **Yes!**
- Is this car the cheapest form of transportation?
 - *No!* Try a bicycle.
- Is this car a good value?
 - ***Definitely – especially in 2005!***



Hybrid Car References

- <http://www.fueleconomy.gov/>
- <http://auto.howstuffworks.com/hybrid-car.htm>
- <http://www.kbb.com/>
- <http://www.iea.org/>
- <http://www.eia.doe.gov/emeu/efficiency/definition.htm>
- <http://www.eia.doe.gov/emeu/steo/pub/tabppt.html>
- <http://www.cleancarcampaign.org/resources.shtml>
- <http://www.hybridcenter.org/hybridcenterindex.cfm>
- http://hybridblog.typepad.com/my_weblog/2005/05/hybrid_hov_waiv.html

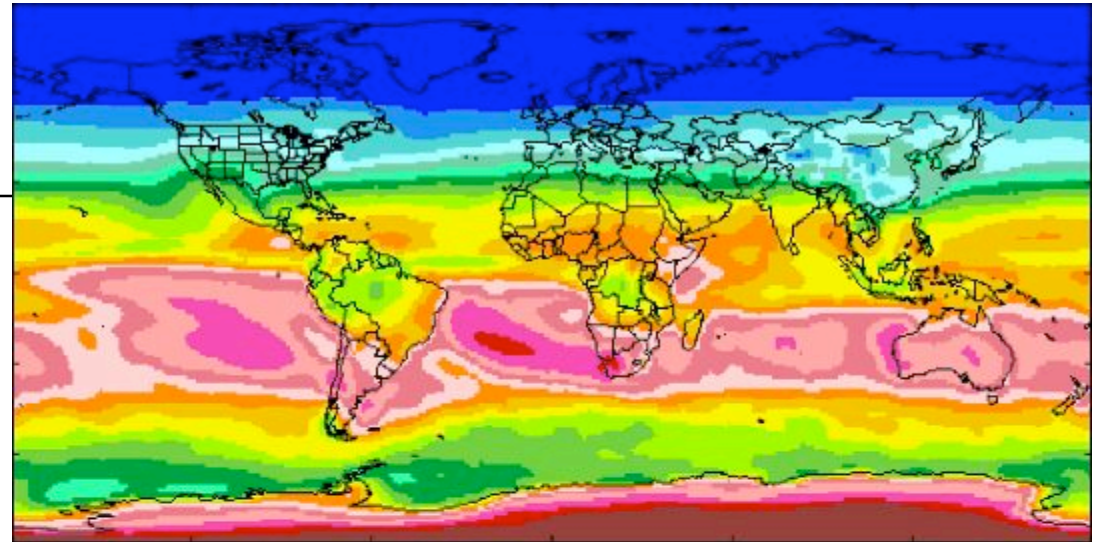


More Hybrid Car References

- http://www.ucsusa.org/clean_vehicles/advanced_vehicles/page.cfm?pageID=213
- http://iwarrior.uwaterloo.ca/?module=displaystory&story_id=1960&format=html
- <http://news-service.stanford.edu/news/2005/july13/hydrogen-071305.html>
- <http://www.world-nuclear.org/sym/2002/ballard.htm>
- http://chemed.chem.purdue.edu/genchem/topicreview/bp/ch7/ie_ea.html
- <http://john1701a.com/prius/prius-history.htm>
- <http://priusonline.com/>
- <http://www.priuschat.com/forums/>
- <http://www.hybridcenter.org/hybridcenterindex.cfm>

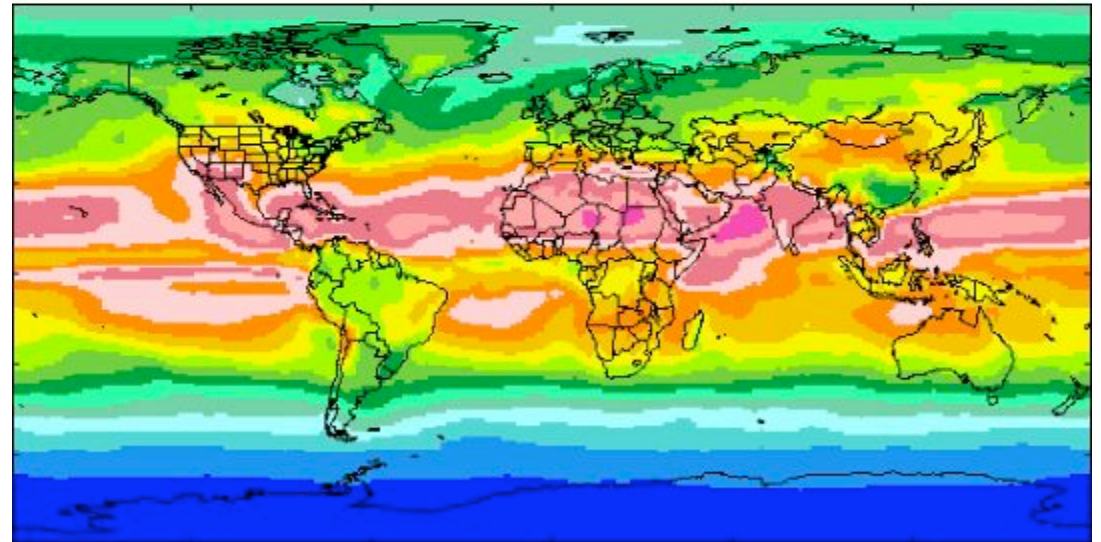
Insolation

January



January 1984-1993

April



April 1984-1993

Graphs show total solar power input in kWh/m²/day

