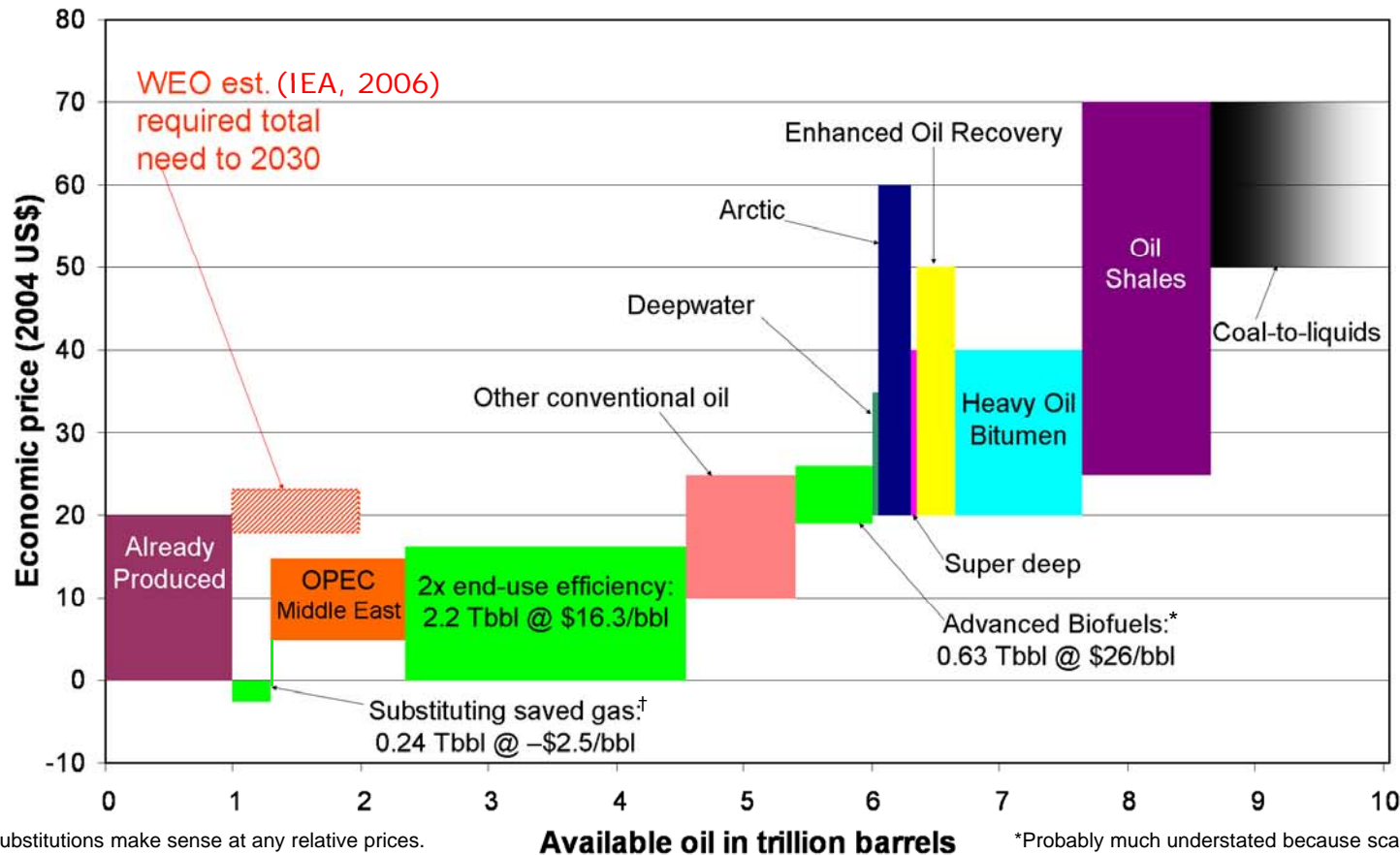


How that supply curve stretches ~3 Tbbbl if the U.S. potential shown in *Winning the Oil End-game* scales, very approximately, to the world



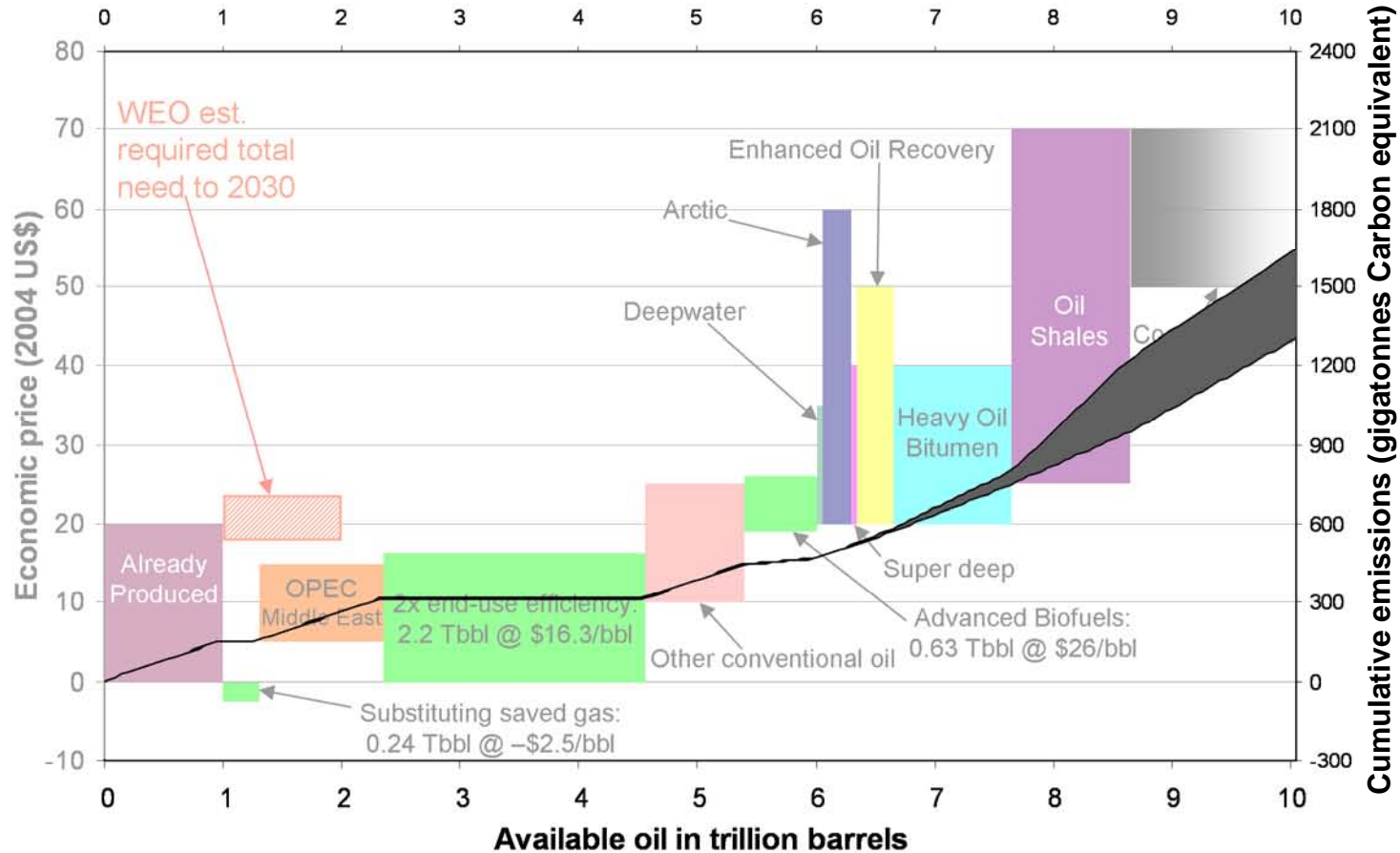
†These substitutions make sense at any relative prices. Depending on future prices, additional such substitutions several- to manyfold larger than shown are also available

*Probably much understated because scaling from U.S. to world should count abundant tropical cane potential; also, the estimate does not include emerging major options like algal oils

To scale from U.S. alternatives-to-oil potential in Mbbbl/d achievable by the 2040s (at average cost \$16/bbl in 2004 \$: www.oilendgame.com) to world potential over 50 y, multiply the U.S. Mbbbl/d × 146,000: 365 d/y × 50 y × 4 (for U.S. → world market size) × 2 (for growth in services provided). Obviously actual resource dynamics are more complex and these multipliers are very rough, so **this result is only illustrative and indicative.**



Stretching oil supply curve ~3 Tbbl averts >1 trillion tonnes of carbon emissions and saves tens of trillions of dollars



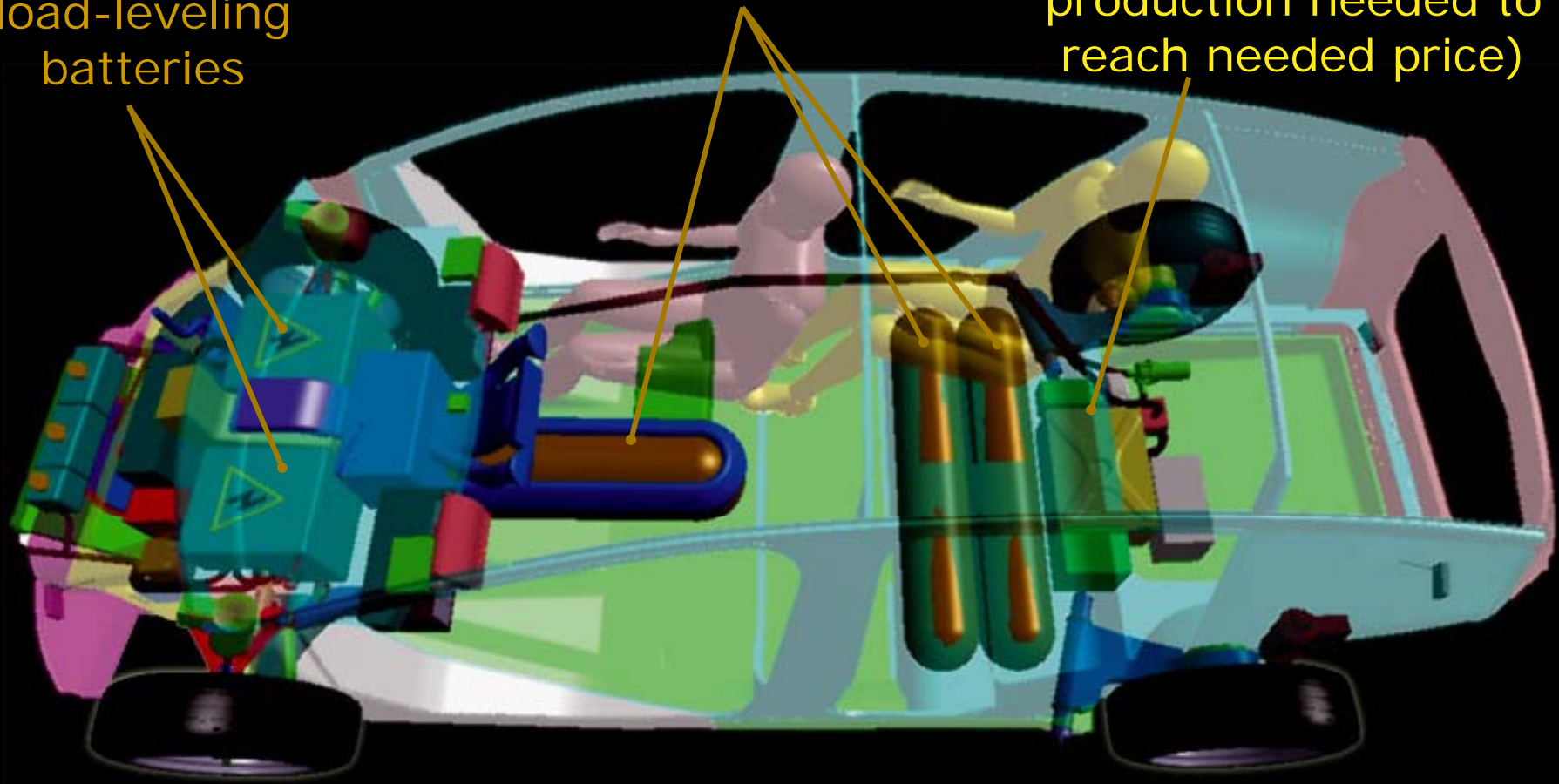


**857-kg curb mass ($\div 2$), low drag, load $\div 3$,
so 89 km/h on same power as normal a/c,
so ready now for direct hydrogen fuel cells**

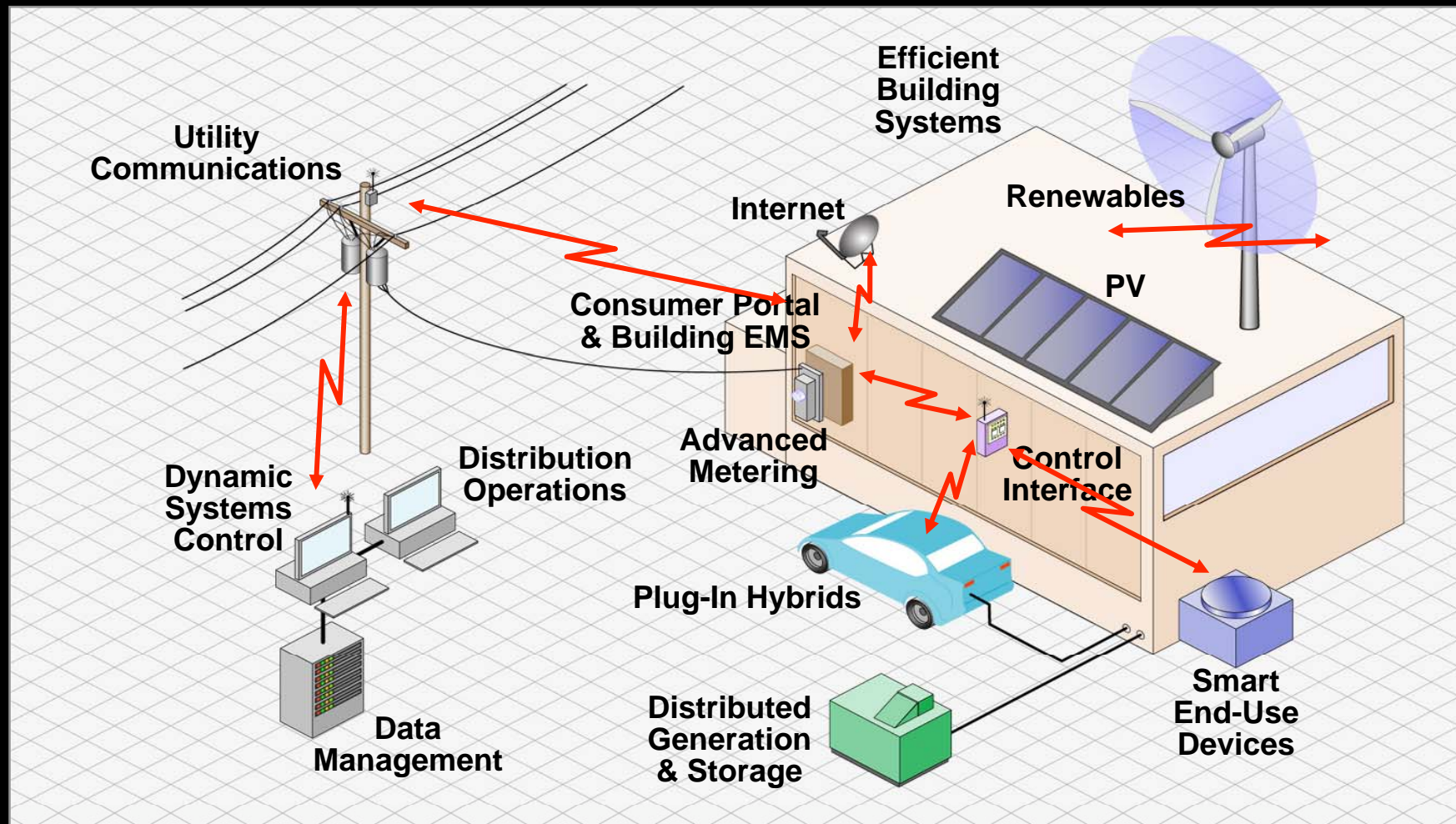
137-liter 5000-psi H₂ storage
(small enough to package):
3.4 kg for 530-km range

35-kW fuel cell (small
enough to afford early:
~32x less cumulative
production needed to
reach needed price)

35-kW
load-leveling
batteries



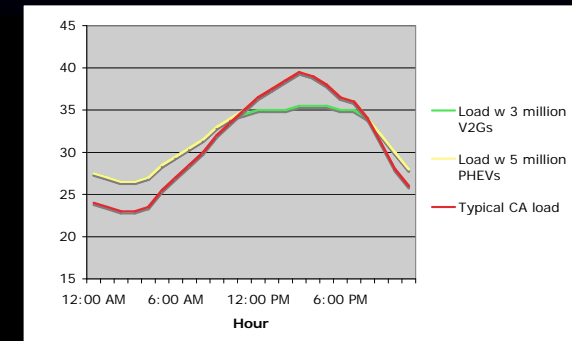
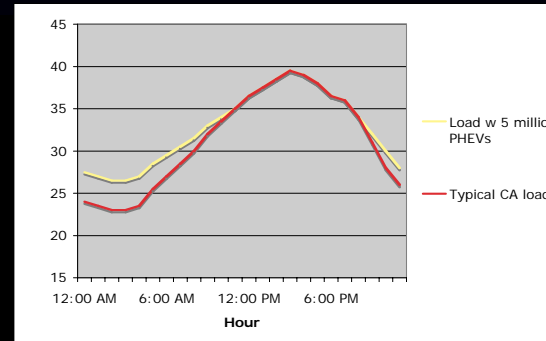
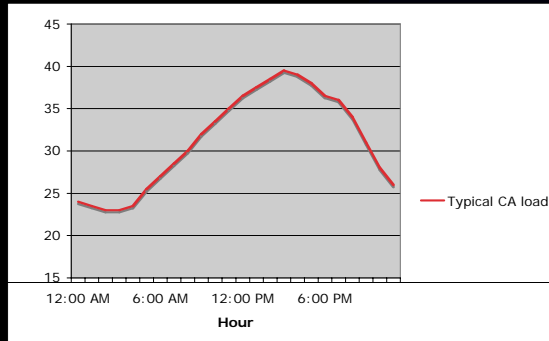
Utilities' emerging distributed-resources portfolio (EPRI vision)



Graphic by Hank Courtright, Senior VP, Electric Power Research Institute, courtesy of Johnson Controls



Smart vehicle-to-grid (V2G) interface could be important



The grid could recharge PHEVs with previously spilled night windpower, then lop daytime peak

- ◇ Cars are parked ~96% of the time
- ◇ PHEV batteries or FCEV fuel cells in a superefficient U.S. light-vehicle fleet have ~6–12× total U.S. electric generating capacity, so even modest V2G *displaces all coal and nuclear plants*
- ◇ First ~2 million US drivers selling that capacity back to utility where/when most valuable could earn back entire car cost
- ◇ Utilities love G2V: offpeak el. sales, ratebasing grid expansion, el.→transport GHG shift, battery finance, hi-tech customer bundle
- ◇ RMI and Tier One partners are engaged in a serious effort to bring profitable PHEVs, then “smart garages,” to the U.S. market soon



Japan's energy achievements and opportunities

- ◇ Industrial efficiency ranges from #1 to more ordinary; even the best can improve markedly
- ◇ But 1970– transport & residential energy use more than doubled; trucks 2×, passenger cars >6×
- ◇ Car/truck fleet efficiency far below best exports; another $\geq 2\times$ is available quickly at no extra cost
- ◇ Building efficiency unimpressive; needs mass retrofits, fully integrated new equipment & design
- ◇ Some excellent policies like “Top Runner”, but need comprehensive barrier-busting, not just price
- ◇ Key: reward energy distributors not for selling more energy but for cutting customers' bills
- ◇ Japan is poor in fuels but rich in energy
- ◇ Biggest barrier: not realizing that opportunities for both efficiency and renewables are very large



Five heresies about implementation

- ◇ “It isn’t happening—why not?” ignores the data
 - Total U.S. oil, coal, and energy use *fell* in 2005–06. Nobody noticed. Far more *could* happen if we paid attention and fixed the 60+ well-known market failures in buying en. efficiency
- ◇ Solutions must await global agreement (why?)
- ◇ Public policy isn’t the only or the strongest key
 - Innovative competitive strategy, technology, and design, all from *business* coevolving with civil society, are more dynamic
- ◇ Public policy = taxes, subsidies, and mandates
 - Other instruments, such as car feebates and utility decoupling-and-shared-savings, seem more effective and attractive
- ◇ Pricing carbon will be valid and helpful—but not necessary, sufficient, or (probably) important
 - *Ability to respond* to price (“barrier-busting”) matters more: see RMI’s 1997 “Climate: Making Sense *and* Making Money”
 - Efficient carbon markets will clear at low or negative prices, because climate protection is generally *profitable, not costly*

We are the people we have been waiting for

***“Only puny secrets need protection.
Great discoveries are protected
by public incredulity.”***

—Marshall McLuhan



www.rmi.org, www.oilendgame.com,

www.rmi.org/stanford, www.natcap.org,

www.smallisprofitable.org

ご静聴ありがとうございます