Mobilizing Business for the Low Carbon Economy

Robert Yang, PhD

Durban, South Africa
December 8, 2011

Key Considerations for the Implementation of Climate Change Mitigation

- **The huge costs of climate change mitigation**
  - **International Energy Agency (IEA): 0.5 to 1.1 percent of world GDP in the next 20 years …**
  - **and the total extra cost for mitigation would be $ 45 trillion from now to 2050**
- **The huge market opportunity**
  - **HSBC: to grow to annually $ 1.0 trillion in 2020**
- **Cost vs. Opportunity**
  - **How to manage this "cost vs. opportunity relationship" is, by far, the most significant consideration for any GHG reduction strategy.**

Lessens from the Best Practice Economies

- To them, the huge costs of GHG reduction are huge "business opportunities ".
- They treat these business opportunities as valuable "resources" for the development of their green energy industries.
- With that they are able to set very aggressive targets for GHG reductions.
- This kind of strategies allow them to achieve effective GHG reductions and build world-competitive green energy industries at the same time.

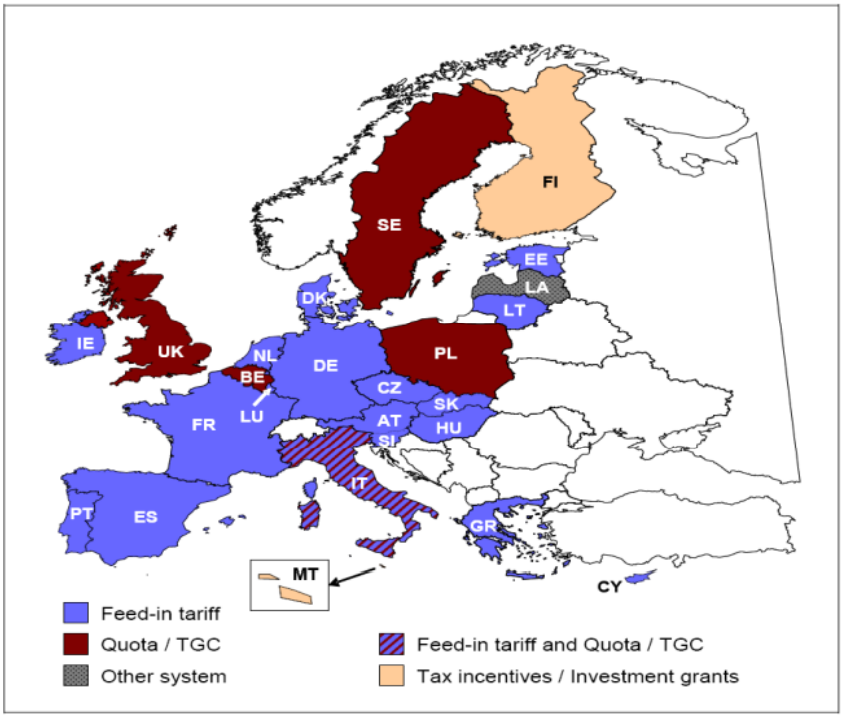
The Formula
for Climate Change Mitigation

- **The three essential components**
  - Set aggressive GHG reduction targets
  - Grow green energy industries
  - Invest in technology
- **Mobilizing business is the key**
  - The bulk of mankind's execution capabilities resides with the businesses of the world
  - Implementation of climate change mitigation wouldn't be possible without business moving proactively
  - Competition is the key to fast technological advances

Taiwan's GHG Reduction Plans

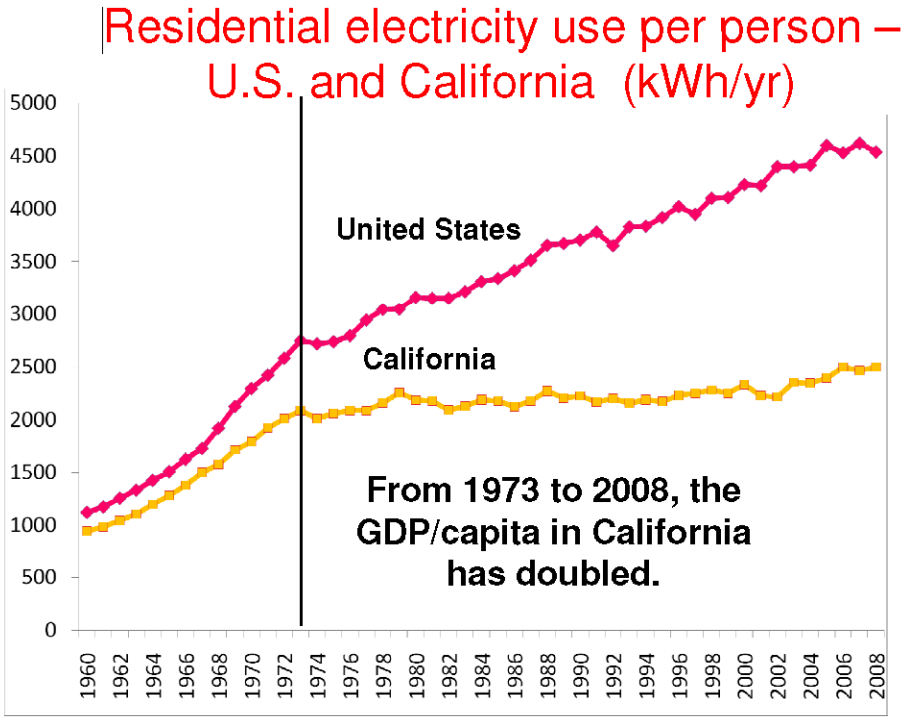
- **Set aggressive targets to reduce GHG emissions**
  - **2020 back to 2005 levels (peaking before 2020) …**
  - **Institute the necessary laws, pricing policies, market mechanisms, and especially incentive policies to convert these targets to business opportunities**
- **Build green energy industries**
  - **Photovoltaic and LED already world-class players**
  - **Strategy to encompass offshore wind, smart grid infrastructure, green buildings and its assorted components, electric vehicles, biofuels, advanced energy storage, ultra-low-power electronic appliances …**
- **Expand energy technology R&D investment substantially**
  - **ITRI to expand its industrialization-driven energy R&D efforts to close to 3,000 man-years (out of 6,000)**
  - **Launched major academic research program to build R&D excellence for the long haul**

Sample Market Making Strategy:
EU's Feed-in-Tariff (FIT) Systems



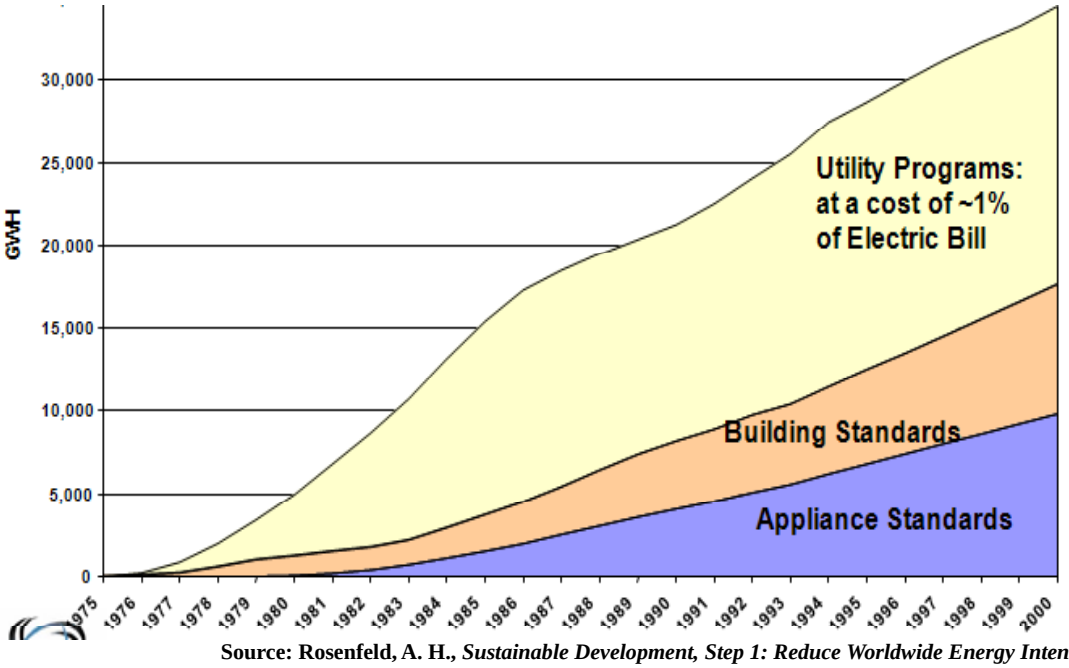
Source：Klein et al., 2006, Evaluation of different feed-in tariff design options", Fraunhofer Institute Systems Innovation Research (ISI) and Energy and Economics Group (EEG), funded by the Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), p87.

Energy Efficiency Best Practice: California



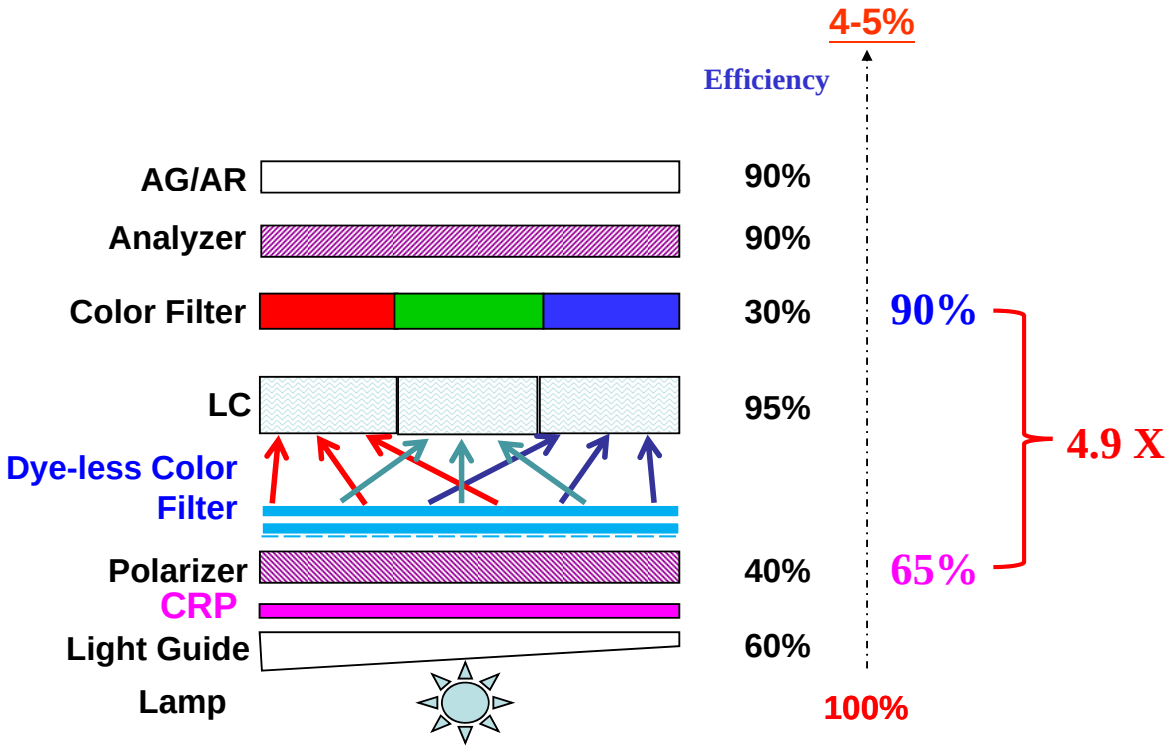
Source: Chu, Stephen, *Driving Global in Clean Energy*, Clean Energy Ministerial, July 2010

Energy Efficiency Best Practice: Essential Policies in California



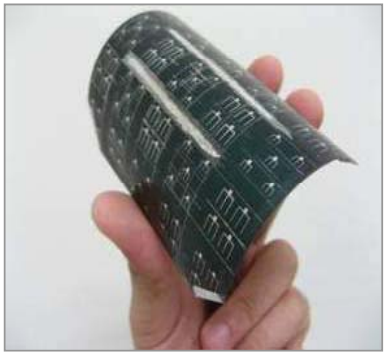
Source: Rosenfeld, A. H., *Sustainable Development, Step 1: Reduce Worldwide Energy Intensity by 2% Per Year,* November 2003

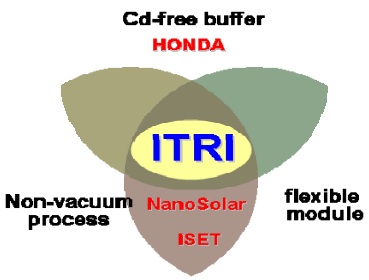
Ultra-efficient Flat Panel TVs
Power Consumption Down ~ 5 Times



Low-cost Non-vacuum Flexible CIGS

- **Core Technology**
  - New nano-metal oxide ink increase material utilization rate to 95%
  - Uniform selenization process to modify the surface between buffer and absorber layers.
- **Targeting $ 0.40 per watt module cost**
- **3E Benefits**
  - Easy to deploy
    - ➢High PCE* with light weight
    - ➢Capable of high efficiency flexible module
  - Easy to maintain
    - ➢Tolerance to defect
    - ➢Tolerance to tough environment
  - Easy to expand market
    - ➢Printed CIGS = low cost equipment
    - ➢Flexible module = supreme applications
    - ➢Cd-free buffer = no environmental Issues





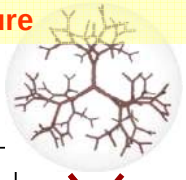
*PCE = Performance of cost to efficiency

Safe Li-ion Battery Technology

2009 R&D 100

STOBA
(self terminated oligomers with hyper-branched architecture)
cross-link @abuse temperature

Thermal setting technology



Potential Runaway Conditions

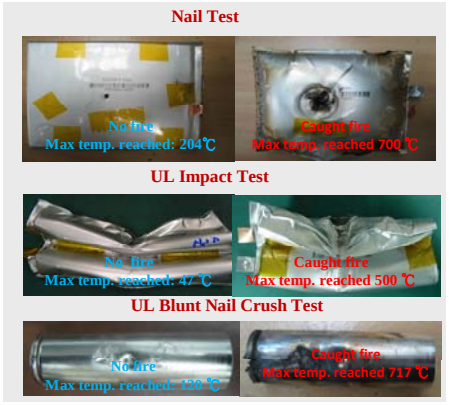
- Internal Short
- External Short
- Over Charge
- Charge after Over Discharge

→ Electronic Protection

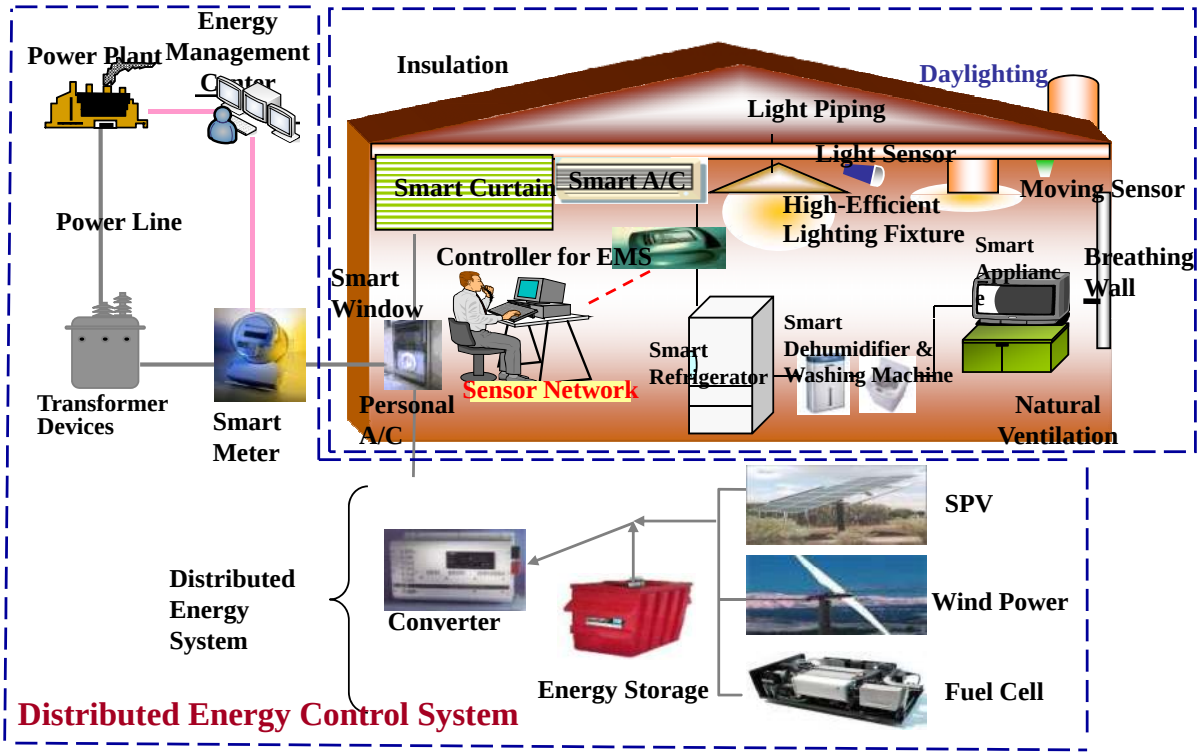
→ Mechanical Protection

→ Material Protection ~130℃

→ Damage: Fire, Explosion

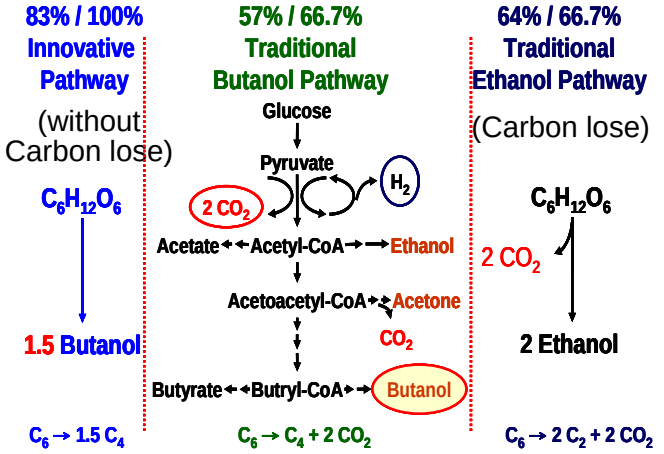


Smart Green Buildings



A New Reaction Pathway
that Increases Biofuel Yield by 50%

- Ethanol was called as "Half-Burn Fuel" since ~50% weight loss during fermentation due to CO_2 release
- Petro-based butanol dominates the market as solvent but not a renewable fuel
- ITRI's Carbon Loss-Free Pathway
  - Theoretical maximum carbon yield is 100%
  - 1.5X yield of traditional process



	Carbon Yield (%)		microorganism
	Current	Theoretical maximum	
ITRI's Process	83	100	Acclimatized Bacteria
Literature*	45-57	66.7	GMO (*E. coli*)
Ethanol Process	64	66.7	Yeast

*(a) Nature, 2008, (b) Nature Chemical Biology 2011

Thank You