

EE-402A

Topics in International Technology Management

Thursday, October 4, 2012



The Greening of Transportation: Will Asia Lead the Way?

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Outline of today's talk



- ◆ **Welcome**
 - ◆ For Stanford students: requirements for credit
- ◆ **Green technologies in transportation**
 - ◆ From materials to systems to usage
 - ◆ The current situation in major Asia markets
- ◆ **Background**
 - ◆ Some areas in which Asia has been taking the lead
- ◆ **Some Asia policies and investment plans**
- ◆ **Discussion**

Welcome to everyone!

- ◆ **Weekly public lecture / panel discussion series presented by the US-Asia Technology Management Center (School of Engineering)**
 - ◆ Every Thursday, through 12/06/2012
 - ◆ Additional support from The Miner Foundation (Thank you!)
 - ◆ See <<http://asia.stanford.edu>> for upcoming session info
- ◆ **Mission: guest speakers bring up-to-date view of how business and technology intersect in an important domain for growth**
 - ◆ Especially: try to bring in fresh information from Asia
 - ◆ Previous: (slides at <http://asia.stanford.edu/?page_id=101>
 - ◆ Mobile Internet businesses and technologies in Asia (2011)
 - ◆ Asia technology management in energy and cleantech (2010)
 - ◆ Technology strategies in Asia business (outsourcing, IP, corporate VC, etc. – 2009)
 - ◆ Global technology development: the changing role of Asia (2008)

Special note



- ◆ **(Depending on how you count) this autumn represents the 20th Anniversary of these seminars**
 - ◆ Autumn 1992: “EE-392A” special seminar series by Prof. Fumio Kodama (then Univ. of Tokyo) on Japanese technology management
 - ◆ Thematic focus each year since autumn 1993 (“Advanced Manufacturing”)
 - ◆ Some highlights:
 - ◆ First North American presentation of blue LED by Shuji Nakamura
 - ◆ First North American presentation of joint Toshiba-IBM reflective LCD projector
 - ◆ Three series later compiled into books
- ◆ **Addition of spring technology survey seminars since spring 1995 (“Flat Panel Displays”)**
 - ◆ Currently morphing into smaller series for first-year Ph.D. students
- ◆ **Addition of EE-402T “Entrepreneurship in Asian High-Tech Industries” from Spring 2003**

Series available for credit to Stanford students



- ◆ **Register for EE-402A
“Topics in International Technology Management”**
 - ◆ **No pre-requisites, open to all undergrads and graduate students**
 - ◆ **May be repeated in future years for credit; each series is separate (different content)**
- ◆ **Casual attendance by students welcome**
- ◆ **Open to the public with no registration requirements**
- ◆ **Light refreshments afterward**
 - ◆ **Meet the speaker, meet each other**

EE-402A Requirements for Credit

- ◆ Obtain **Syllabus** for official statement of credit requirements
 - ◆ These MAY BE DIFFERENT REQUIREMENTS THAN FOR OTHER SEMINARS at Stanford
- A. On-site attendance at seven (7) of nine (9) sessions
 - ◆ Requirement A waived for SCPD students
 - ◆ Today fill out survey, then weekly sign-up sheet at auditorium
- B. Submit a comment / summary each week for eight (8) of the nine (9) sessions
 - ◆ Send comment by email within two weeks of the session
 - To me (Prof. Dasher) <rdasher at stanford dot edu>
 - Always cc to Tiphane <gammond at stanford dot edu>
 - ◆ Comment must provide evidence that you watched the session
- ◆ Contact Dasher by email a.s.a.p. if you may have trouble fulfilling requirements

Request to everyone (visitors and students) for today (10/04)

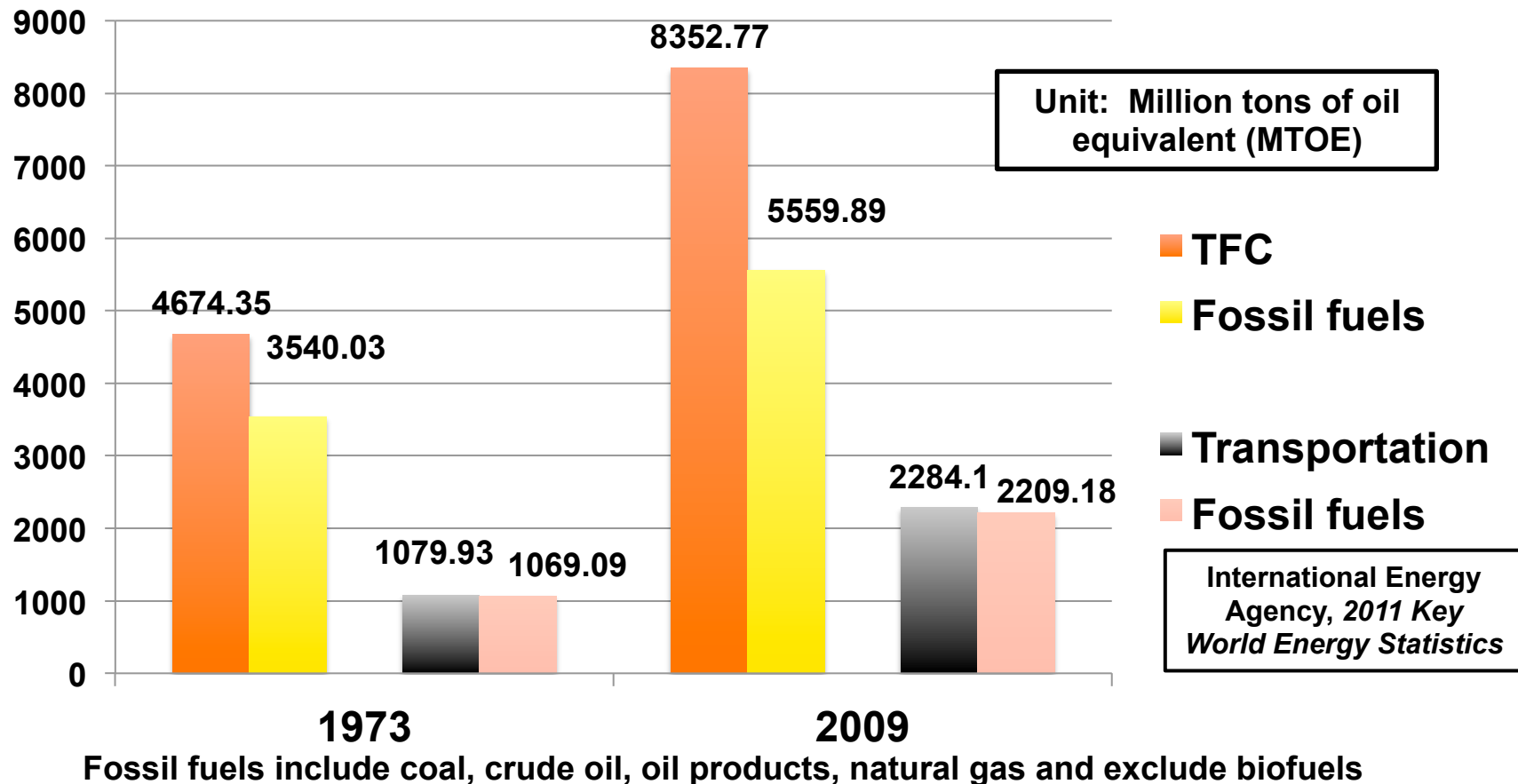


- ◆ **Please fill out incoming-survey and leave with Siejen, Tiphane, or me**
 - ◆ **Even if you have attended our series in the past**
- ◆ **For students registering for credit, the survey is your on-site attendance record for 10/04/2012**
 - ◆ **In addition, you will need to submit your comment / summary about the content of this session within two weeks**



Green technologies in transportation

World energy consumption 1973 vs 2009

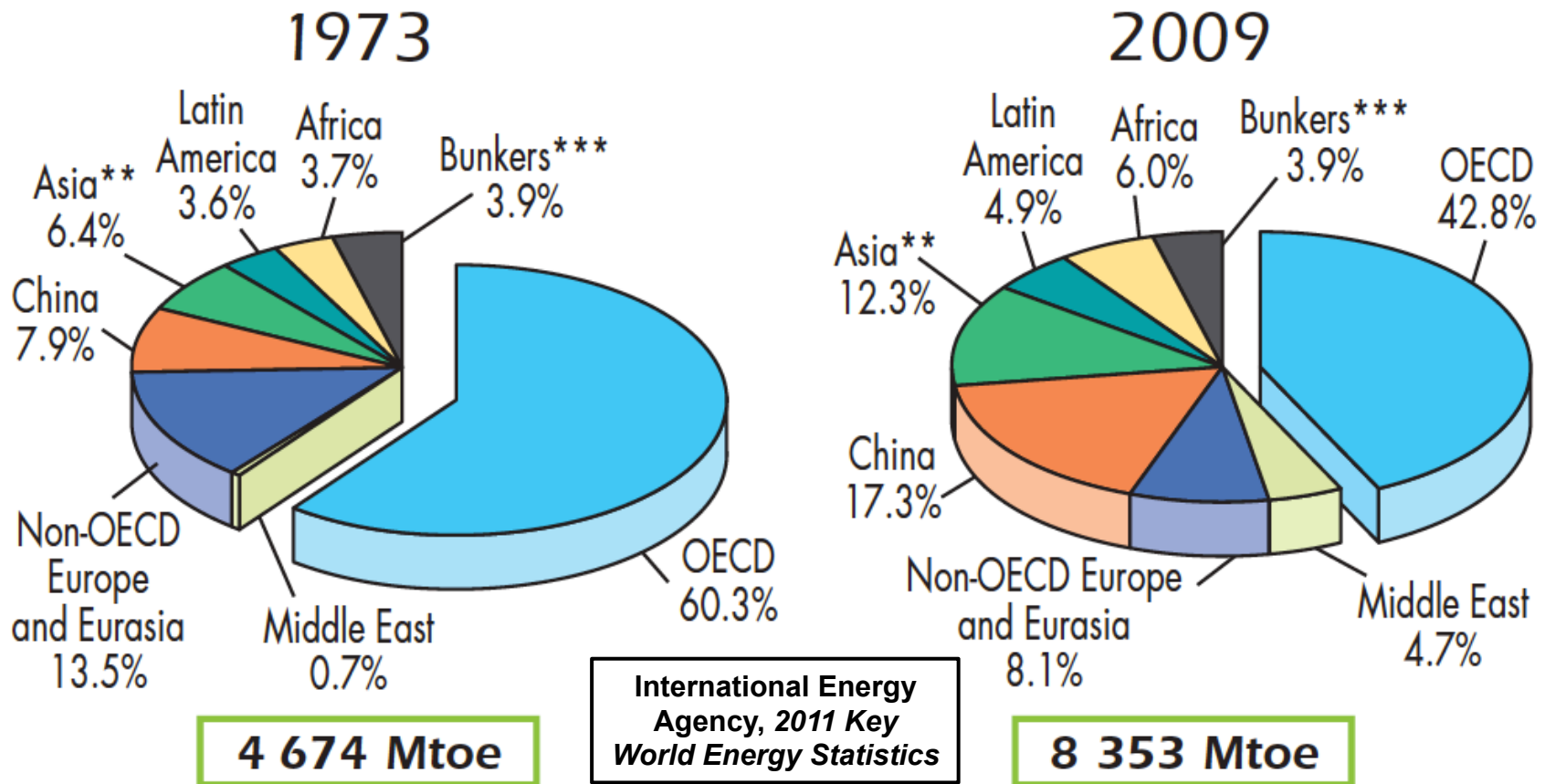


The transportation sector in the growth of energy and fossil fuel consumption



- ◆ **Total final energy consumption (TFC) worldwide grew 78.8% between 1973 & 2009**
 - ◆ **Total fossil fuel consumption grew 57.1%**
- ◆ **Transportation sector final energy consumption worldwide grew 111.5% between 1973 & 2009**
 - ◆ **Fossil fuel consumption in transportation grew 106.6%**
 - ◆ **Transportation accounts for about 60% of all petroleum consumption (including gasoline, jet fuel, diesel, etc.)**
- ◆ **Currently, transportation sector = about 28% of all TFC in U.S.**
 - ◆ **~ about 20% of all TFC in China**

Total final energy consumption (TFC)



*Data prior to 1994 for biofuels and waste final consumption have been estimated.

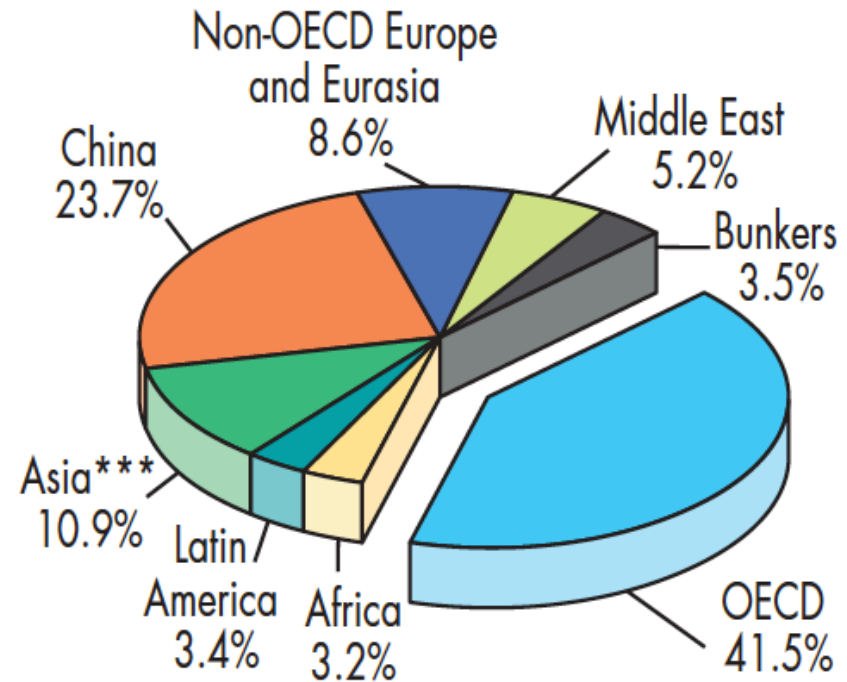
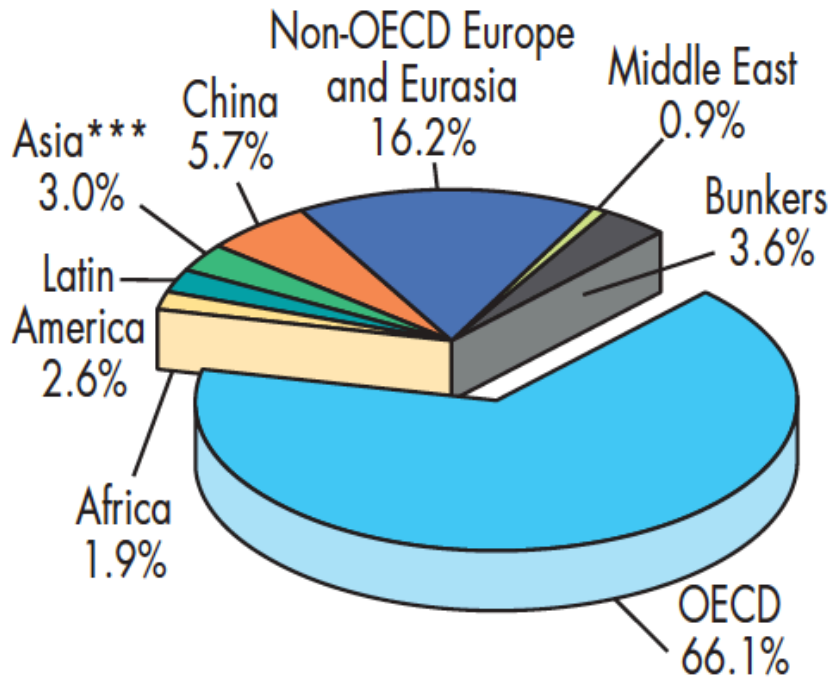
**Asia excludes China.

***Includes international aviation and international marine bunkers.

Regional shares of world CO₂ emissions

1973

2009



15 624 Mt of CO₂

International Energy Agency, 2011 Key World Energy Statistics

28 999 Mt of CO₂

*World includes international aviation and international marine bunkers, which are shown together as Bunkers. **Calculated using the IEA's energy balances and the Revised 1996 IPCC Guidelines. CO₂ emissions are from fuel combustion only. ***Asia excludes China.

China and (other) Asia in energy consumption and CO₂ emission growth

World energy consumption

- ◆ China share grew from 7.9% in 1973 to 17.3% in 2009 (i.e. share grew by 119.0%)
- ◆ Other Asia countries' share grew from 6.4% in 1973 to 12.3% in 2009 (i.e. share grew by 92.1%)
- ◆ In 2009, Asia including China accounted for 29.6% of world energy consumption

CO₂ emissions

- ◆ China share grew from 5.7% in 1973 to 23.7% in 2009 (share grew by 315.8%)
- ◆ Other Asia countries' share grew from 3.0% in 1973 to 10.9% in 2009 (i.e. share grew by 263.3%)
- ◆ In 2009, Asia including China accounted for 34.6% of CO₂ emissions

The rise of transportation in China



- ◆ In 2009, China surpassed the U.S. to become the world's largest automobile producer and market
 - ◆ 170 million automobiles on roads in China (end 2009), expected to **add** 220 million **new** automobiles by 2020
- ◆ Total freight transport (land, sea, air) in China grew from 4,432,050 million ton (metric) - kilometers (2000) to 11,030,049 million ton - km (2008) = **148.9% growth**
 - ◆ Compare: U.S. total freight transport grew from 4,328,750 million ton (U.S.) - miles (2000) to 4,647,112 million ton - miles (2008) = **7.4% growth**

“Green technologies”



- ◆ **A relative term...**
- ◆ **The use of technologies, processes, or approaches (e.g. to supply chain management) that reduce negative environmental impact or improve environmental sustainability in comparison to traditional technologies or approaches**
- ◆ **Compare: environmental technologies, cleantech**
- ◆ **In transportation: major concerns have revolved around greenhouse gas (GHG) reductions and energy reduction**

Green Technologies in Transportation

◆ Vehicles

- ◆ Electric automobiles, buses, bicycles, ships, airplanes ...
- ◆ Improve vehicle efficiency through use of IT, new power train technologies, new materials
- ◆ Emission scrubbing

◆ Fuels and energy storage

- ◆ Also include battery technologies as well as biofuel, fuel-cell (H₂)

◆ Total systems

- ◆ “Intelligent transportation systems” – also may impact “use” below
 - ◆ Networks of sensors on roads & in vehicles, plus advanced computing
- ◆ Logistics for air transport
 - ◆ Improve efficiency on the ground as well as in the air

◆ Systems use

- ◆ Encourage shift from POV to public transportation, reduce traffic jams, suggestion of more efficient transport routes

Asia government policies reflect acute awareness of need for green transportation



A few selected examples

◆ China – by 2020:

- ◆ Increase hybrid and EV autos to 15% of total production
- ◆ Double long-distance high speed rail
- ◆ Beijing metro rail to 660 km by 2015, 1,000 km by 2020

◆ South Korea – by 2020

- ◆ Increase rail share of total transportation from 8.7% to 15%
- ◆ Increase bicycle share from 1.2% to 15%

◆ Malaysia

- ◆ Already in Phase 2 of “EV Roadmap” – with pilot projects by Proton, Mitsubishi, Nissan underway
- ◆ Promoting discussion of standards for EV charging

Some areas in which Asia has already taken the lead: high speed rail service

Country	Service	Service began	Operating speed (current use)	Design speed
Japan	Shinkansen	1964	300 km/hr (N700)	330 km/hr (N700)
France	TGV	1981	300 – 320 km/hr	320 km/hr
U.S.	Acela	2000	241 km/hr	266 km/hr
S. Korea	KTX	2004	305 km/hr	330 km/hr
China	CRH	2007	~ 320 km/hr (CRH380)	380 km/hr (CRH380)
Taiwan	THSR	2007	300 km/hr	300 km/hr

Why is high speed rail “green”? More efficient movement of passengers than automobiles, sources of energy may be greener than for airplanes



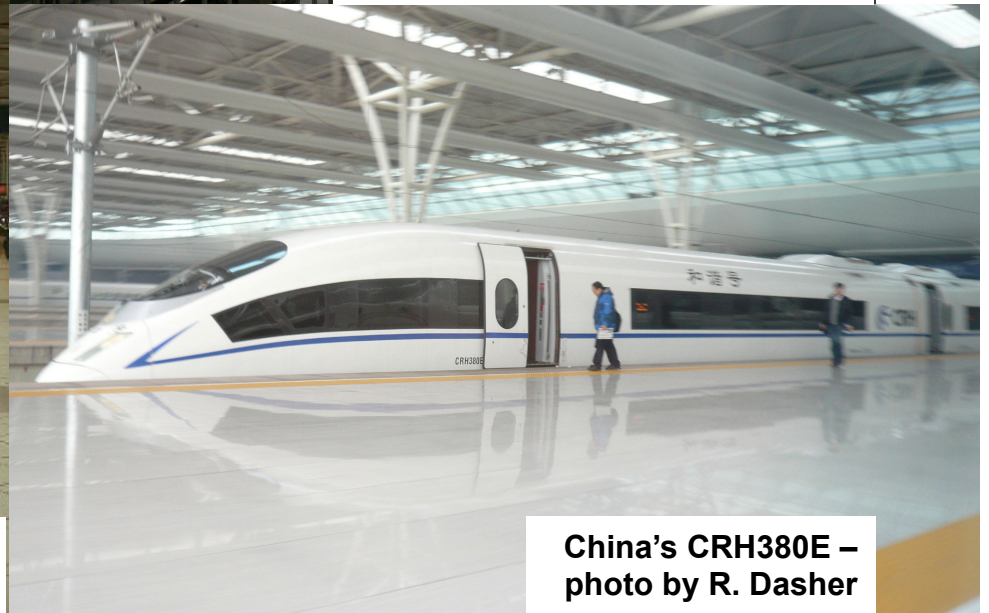
Korea's KTX - photo from Wikipedia



Japan - recent shinkansen models – photo by R. Dasher



Taiwan's THSR - photo from Wikipedia



China's CRH380E – photo by R. Dasher

Some areas in which Asia has taken the lead

– EV technologies



- ◆ **Most automobiles in the 1800's (U.S. and Europe) were electric**
 - ◆ **No infrastructure outside cities**
 - ◆ **Gasoline-powered cars became dominant after self-starter invented (1913)**
- ◆ **GM began production of the EV-1 in 1996**
- ◆ **Toyota unveiled the Prius hybrid at Tokyo Auto Show (1997)**
- ◆ **Nissan unveiled Prairie Joy EV (1997) -- first ever with Lithium ion battery; Leaf went commercial from 2009**
- ◆ **Honda fuel cell hybrid EV (FCHV) from 2008 – available for leasing in L.A.**

Some reasons to watch Asia for green transportation



- ◆ **Acute awareness of the need to “go green”**
- ◆ **R&D strengths**
 - ◆ **Complex hardware-and-software systems, including robotics**
 - ◆ **Materials – e.g. carbon fiber composites, CFRP**
 - ◆ **Battery technologies**
- ◆ **Business experience with new transportation technologies**
 - ◆ **E.g. ANA was first airline to take delivery of Boeing 787**
 - ◆ **Evergreen Lines shipping (orig. base in Taiwan)**
 - ◆ **Maglev commercial line in Shanghai**
 - ◆ **JR development / adoption of Suica paperless ticketing system**

What's important for the U.S. side?



- ◆ **Learn from Asia examples**
 - ◆ What would a high speed rail system look like in the Northeast Corridor?
- ◆ **Watch for early development of technology standards**
 - ◆ E.g. for electric vehicle charging: Europe and Japan are probably more active than U.S. in general
- ◆ **Global market opportunities (in Asia or other regions, with Asia business or technology partners, etc.) and global competition**
 - ◆ How will the EV market in China change as domestic production increases
- ◆ **Look to future (next generation beyond current cool things)**
 - ◆ Maglev, radically new freight transport ideas, etc.

A few upcoming sessions



- ◆ **October 11 Mr. Osamu Onodera, Silicon Valley representative of NEDO: Japanese government policies and investments in green transportation (e.g. EV to smart grid)**
- ◆ **October 18 Prof. Hiroshi Shimizu, CEO of SIMDrive: a new in-wheel electric motor for EVs and also existing vehicle conversion**
- ◆ **October 25 Prof. Lin Zhang, Tsinghua University: intelligent transportation systems research for Beijing**
- ◆ **November 1 Mr. Toshiyuki Kondo, CEO of Toray Composites America: carbon fiber materials for aircraft and automobile applications**
- ◆ **Subsequent sessions will discuss emissions scrubbing, maritime transportation, air transportation systems, etc.**