The penetration of solar PV in Japan

Innovation and Entrepreneurship in Japan
JFIT-STAJE conference at UC San Diego

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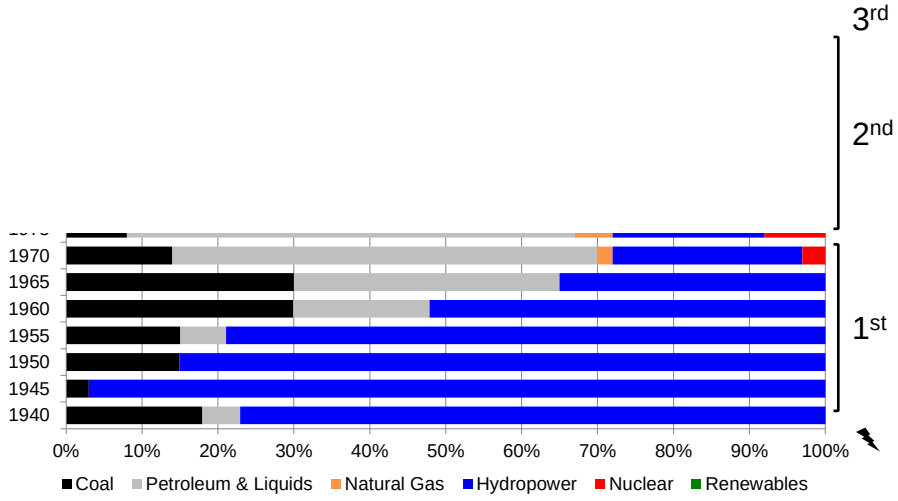
Kanagi Solar Power Project (14MW)

http://www.prnewswire.com/news-releases/pattern-development-and-green-power-investment-complete-14-mw-kanagi-solar-power-project-in-japan-300257485.html

Japan's quest for energy security



Multiple prongs to Japanese policy

- Diversify sources of energy, specifically electricity
  - Develop advanced coal-fired power plants (00s/10s)
  - Pioneer liquefied natural gas development (70s/80s)
  - Strike Faustian bargain with nuclear power (70s/80s)
  - **Develop and deploy renewables**
- Find and help develop liquid hydrocarbon sources
  - Softly "claim" them for Japan (**e.g. Arun**)
  - Strike long-term contracts
  - Diversify exporting countries (**e.g. China**)
- Maintain friendly relations with source countries
- Emphasize energy efficiency

Cautionary notes about what follows

- Not all renewables are equal
  - I will discuss solar PV specifically
  - Different sources pose different institutional challenges
  - Differences between solar, wind, and nuclear striking
- We need to distinguish between
  - Development
    - Research into solar PV technologies
  - Deployment
    - Demonstration in real world conditions
    - Institutional framework development

Solar PV enhances energy security

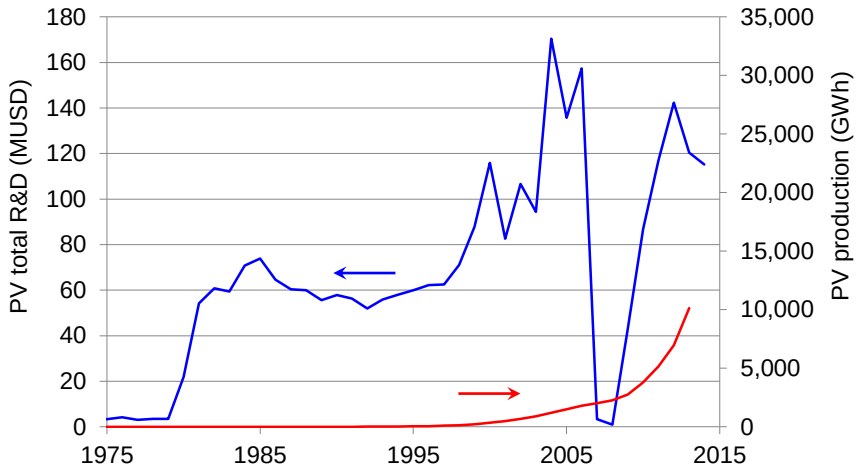
- Opportunities afforded by solar PV
  - Gaining prestige: remaining at the technological frontier
  - Mitigating environmental damage
  - Encouraging electricity market liberalization
  - Creating economic (export) opportunities
  - Developing human capital
  - Enhancing energy security

Why has Japanese PV not swept the world?

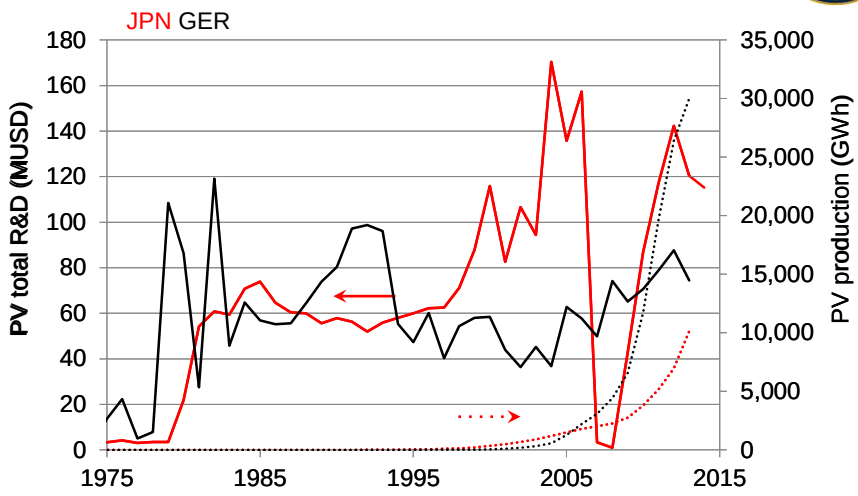
The history of solar PV in Japan

- Checkered history:
  - Government R&D (GERD) into solar photovoltaics (PV) began in earnest after the 1973 oil shock (**Sunshine**)
  - Private industry had been investing in solar PV for at least a decade before the shock
- Institutions only halfheartedly embraced solar PV (if that). Possible reasons:
  - GERD was mainly due to technological novelty
  - Economic prospects were bleak (cost-effectiveness)
  - Existing coalition resisted the technology in favor of fossil fuel and nuclear interests

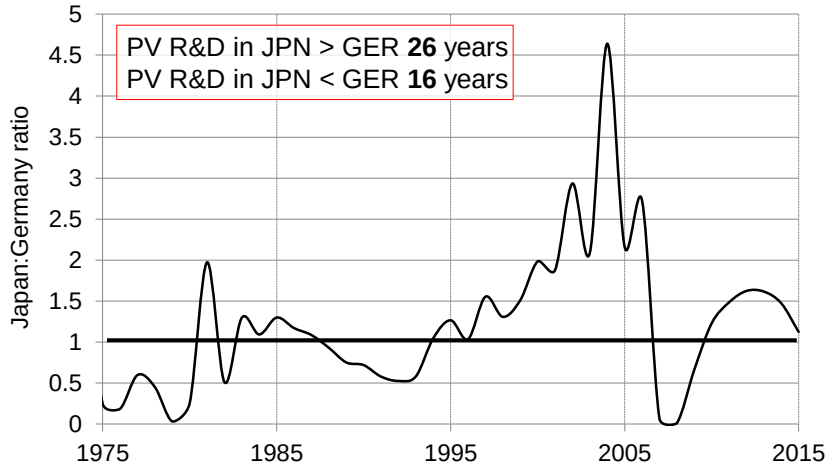
R&D expenditures were non-trivial



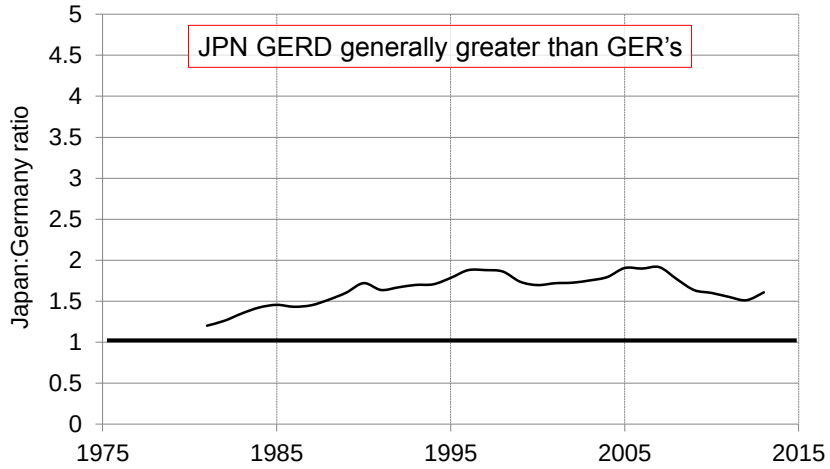
Compare to German PV R&D



Japan:Germany total PV R&D



Japan:Germany GERD

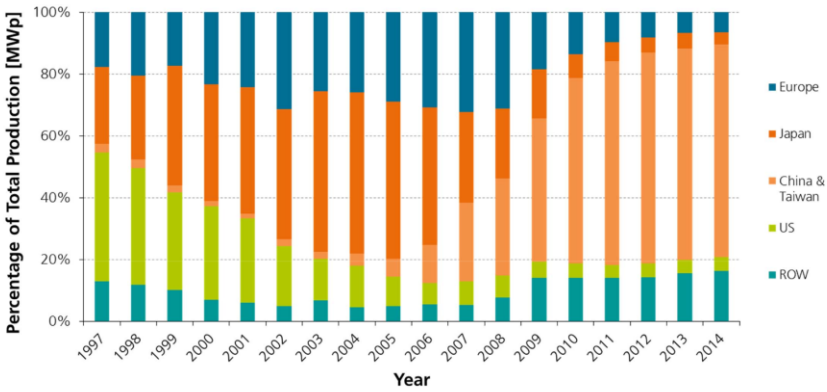


Japan's PV R&D did not deliver results

Despite Japan investing more than Germany in solar PV R&D:

- In 2010, share of Japanese electricity from solar PV: **0.1%**
- In 2010, share of German electricity from solar PV: **2%**
- Market position of Japanese solar PV manufacturers deteriorates despite exploding demand.

PV module production by region



Fraunhofer Institute for Solar Energy Systems
https://www.ise.fraunhofer.de/de/downloads/pdf-files/aktuelles/photovoltaics-report-in-englischer-sprache.pdf

Japan's PV manufacturers biggest losers

	2000	2003	2006	2014	2015
1	Kyocera	Sharp	Sharp	Trina	Trina
2	BP	BP	Hanwha	Yingli	Canadian
3	Sharp	Kyocera	Kyocera	Canadian	Jinko
4	Shell	Shell	Suntech	Hanwha	JA
5	AstroPower				Hanwha
6	RWESchott				First
7	Photowatt	Sanyo	RWESchott	Sharp	Yingli
8	Isofoton	Isofoton	Motech	ReneSola	SFCE
9	Sanyo	Hanwha	BP	First	ReneSola
10	Mitsubishi	Photowatt	SunPower	Kyocera	SunPower
	35%	**50%**	**42%**	**< 4%**	**NA**

Industry protection through inspection standards = high module costs

RE World; IHS; PV Tech

R&D did not translate into deployment

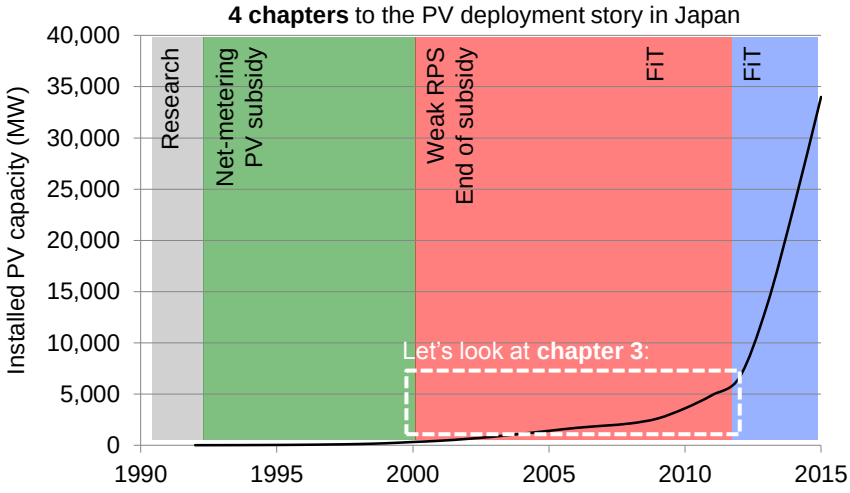
Possible reasons:

- Support for tech. *development* does not automatically translate to support for tech. *deployment*.
  - You need dedicated policy instruments for solar PV deployment. Japan's were weak until 2012.
- Japan chose the wrong areas of solar PV R&D to explore
- Japan was nurturing PV strictly for export market
  - National energy strategies emphasized
    - Energy security
    - Development of new energy technologies
    - Sustainable development

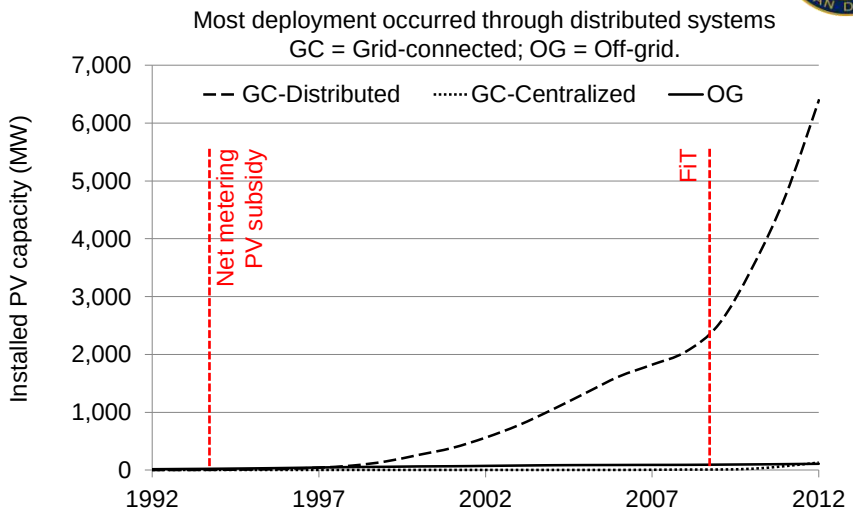
Japan solar PV deployment incentives

- 1974: Sunshine Program
  - Long-horizon, multi-technology effort to enhance energy security and end fossil fuel dependence
  - Solar thermal → solar PV
- 1992-1994: Net metering and New Sunshine Program
  - Deployment of grid-connected distributed systems
  - Subsidy tapers off. Ends in 2004 by design
  - **Good idea poorly implemented (steep taper)**
- 2003: Weak Renewable Portfolio Standard
- 2009: Reinstatement of PV subsidy + Feed-in-Tariff (TiF)
- 2012: More aggressive FiT structure

Let's explore the first hypothesis



2000-2012: Distributed PV deployment



The argument in brief

- Japan spent more money on solar PV R&D than Germany
- Japan had the industrial base, economies of scale, and human capital to maintain its dominance in PV manufacture
- Domestic deployment would have: **1)** enhanced energy security; **2)** mitigated emissions; **3)** buoyed Japanese PV industry; and **4)** catalyzed innovations in system optimization and grid integration
- **But,** domestic deployment tracks govt. incentive structure
  - Poor showing due to poor institutional and policy design
  - It took Fukushima to catalyze widespread deployment
  - Japan now has 3rd largest PV capacity (>24GW), 70% of it installed after Fukushima
  - Fukushima made utilities interested in centralized PV

We are exploring the following at GPS

- Expanding on the above story
  - Estimating loss to Japan of letting its PV industry falter
    - Economic; environmental; human capital
- What are the implications of a Japanese nuclear phase-out?
  - Both economic and environmental
- Mapping the resources available to Japan for expanding biomass, solar, wind, and geothermal
  - Detailed GIS mapping

~ End ~