NISSAN MOTOR CORPORATION

FCEV Market Creation: H2 Economic Studies at NISSAN MOTOR

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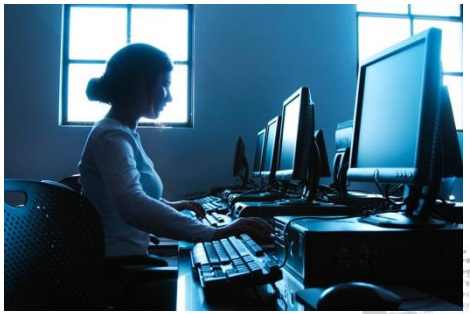
Today's Topic

Energy Supply Responsibility

to future FCEV customers

H2 Business Creation

FCEV Technology Demonstration → FCEV '15-'17 Start of Selling → FCEV Sustainable Business



OEMs

H2 is …

Stable? Vehicle price?

Affordable? Secured? Available?

Safe?

IS H2 PROFITABLE?

INVESTORs

CUSTOMERs

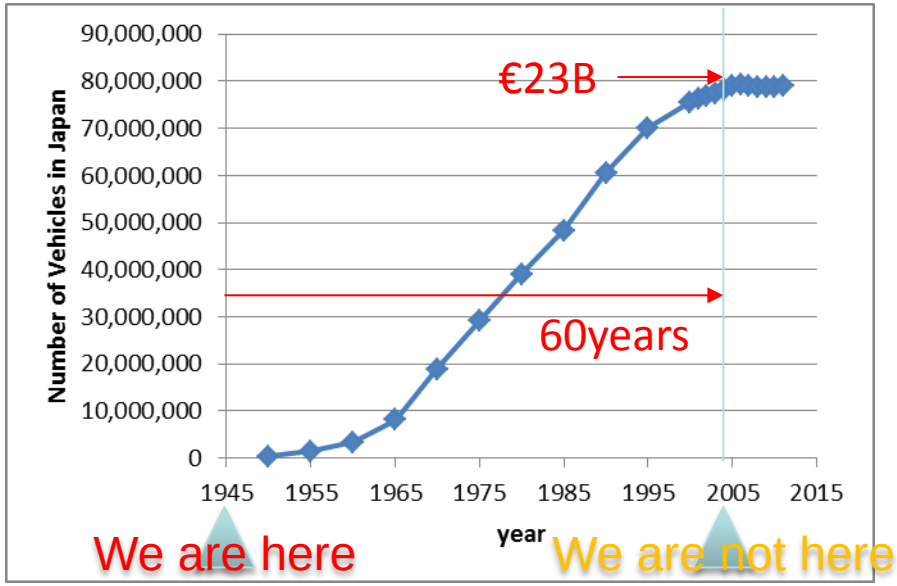
H2 Profitability in the far Future

- **Energy Cost Reduction by <CH2/ICEV→H2/FCEV>**
  - Crude Oil — €33B/y for 75M ICEVs
  - Natural Gas — €10B/y for 75M FCEVs
  - Energy Purchase Reduction — €23B/y (from 2010 Japan's Statistics)

	Japan	USA	Germany	UK	France	Norway
Crude Oil for Gasoline	€33B					
Natural Gas for H2	€10B					
Energy Cost reduction potential	€23B					

H2 Profitability in the near Future

- **The ICEV in Japan from 1945**



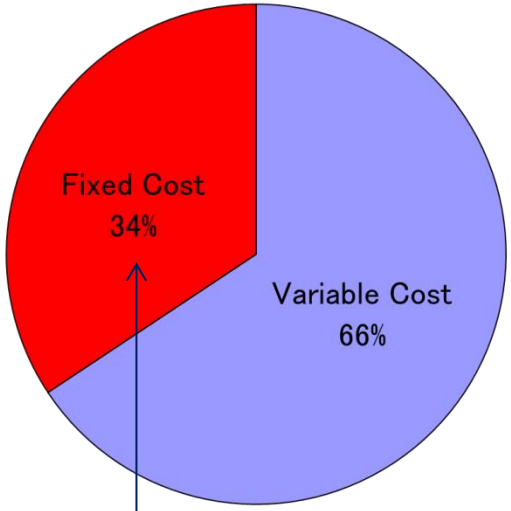
- **It took over 60 years, even for Liquid Fuel (gasoline)**
  - Technology Demonstration → Enough or Moderately needed
  - Economics Demonstration → Highly needed

Energy Cost Structures and the Risk

- **Hydrogen Fixed Cost is twice as volatile as Gasoline Fixed Cost**

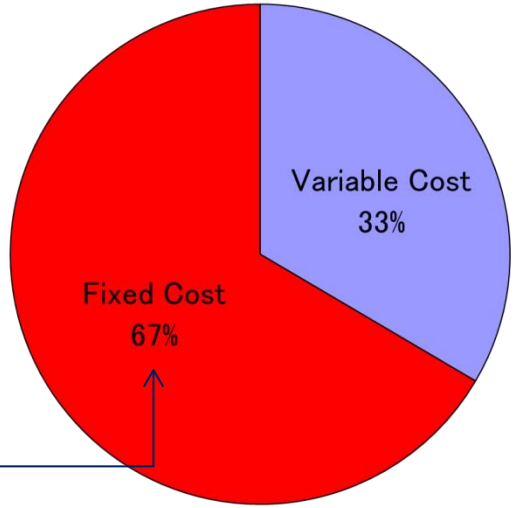
Gasoline

100km → **about €10(price)** w/o tax



Hydrogen*

100km → **about €10(price)** w/o tax



*JHFC 2nd report (2010)

SUPPLY = DEMAND

Only if this equation holds

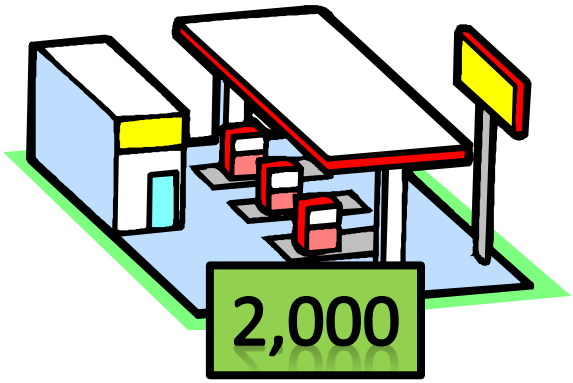
Business Sustainability: GRS Gasoline Refueling Station

- Statistically, the ICEV price range starts from €10k in Japan
- The number of ICEVs per GRS PMA is 2,176 (about 2,000)

SUPPLY

DEMAND

Large GRS



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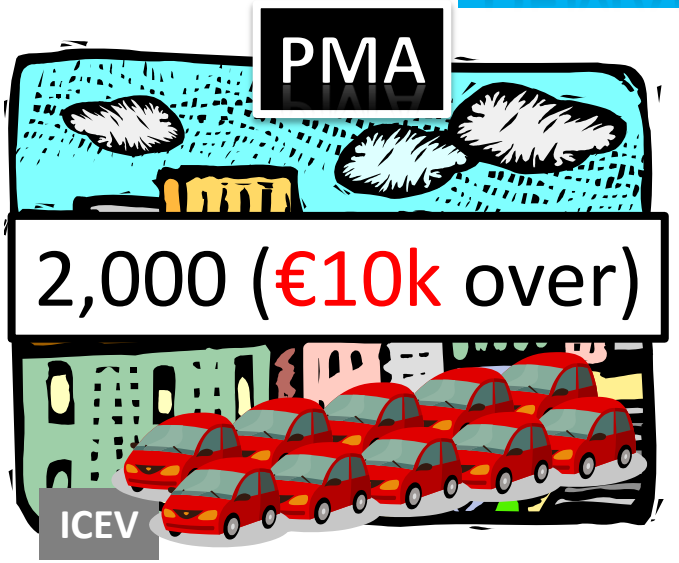
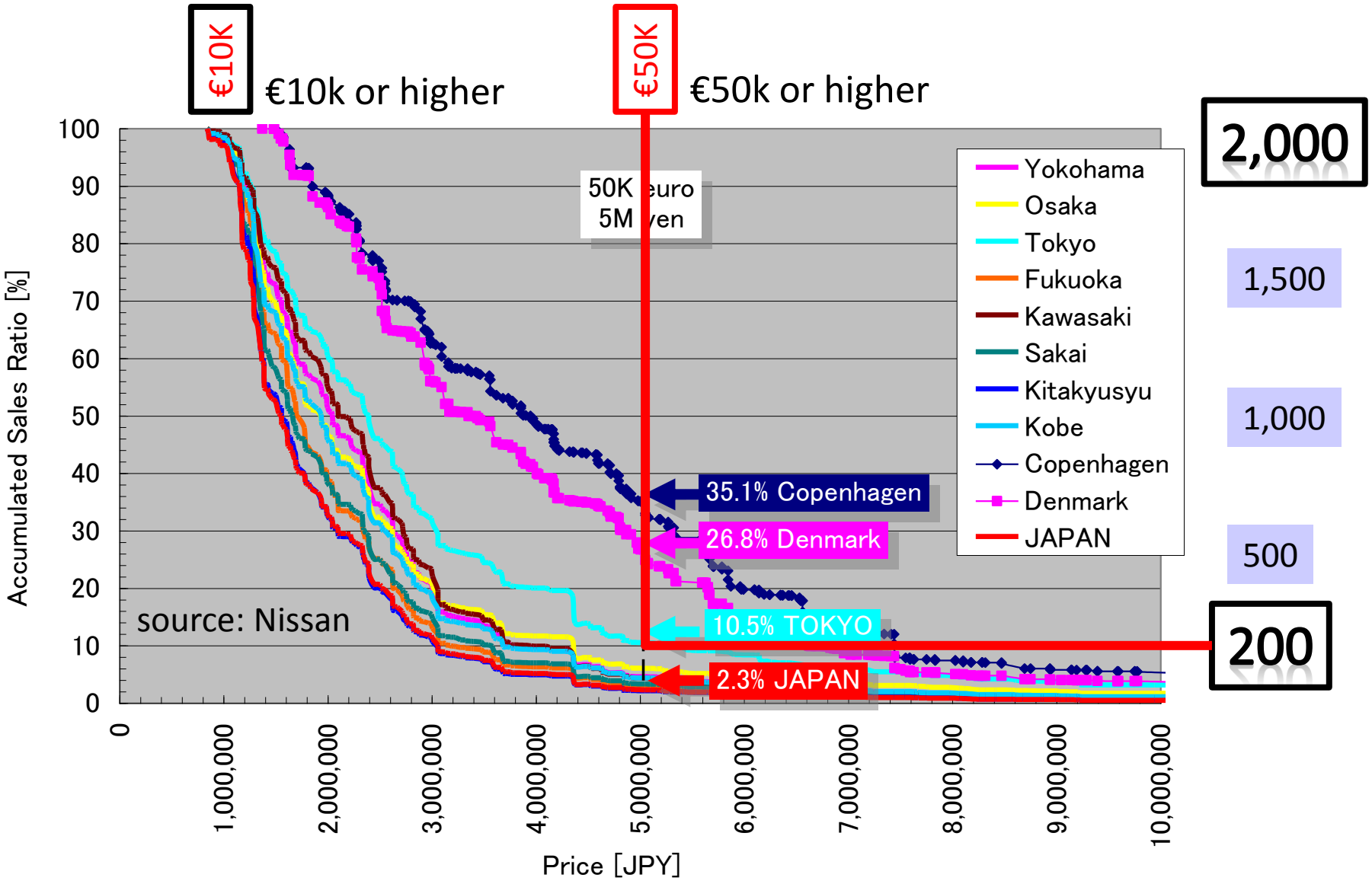
holds



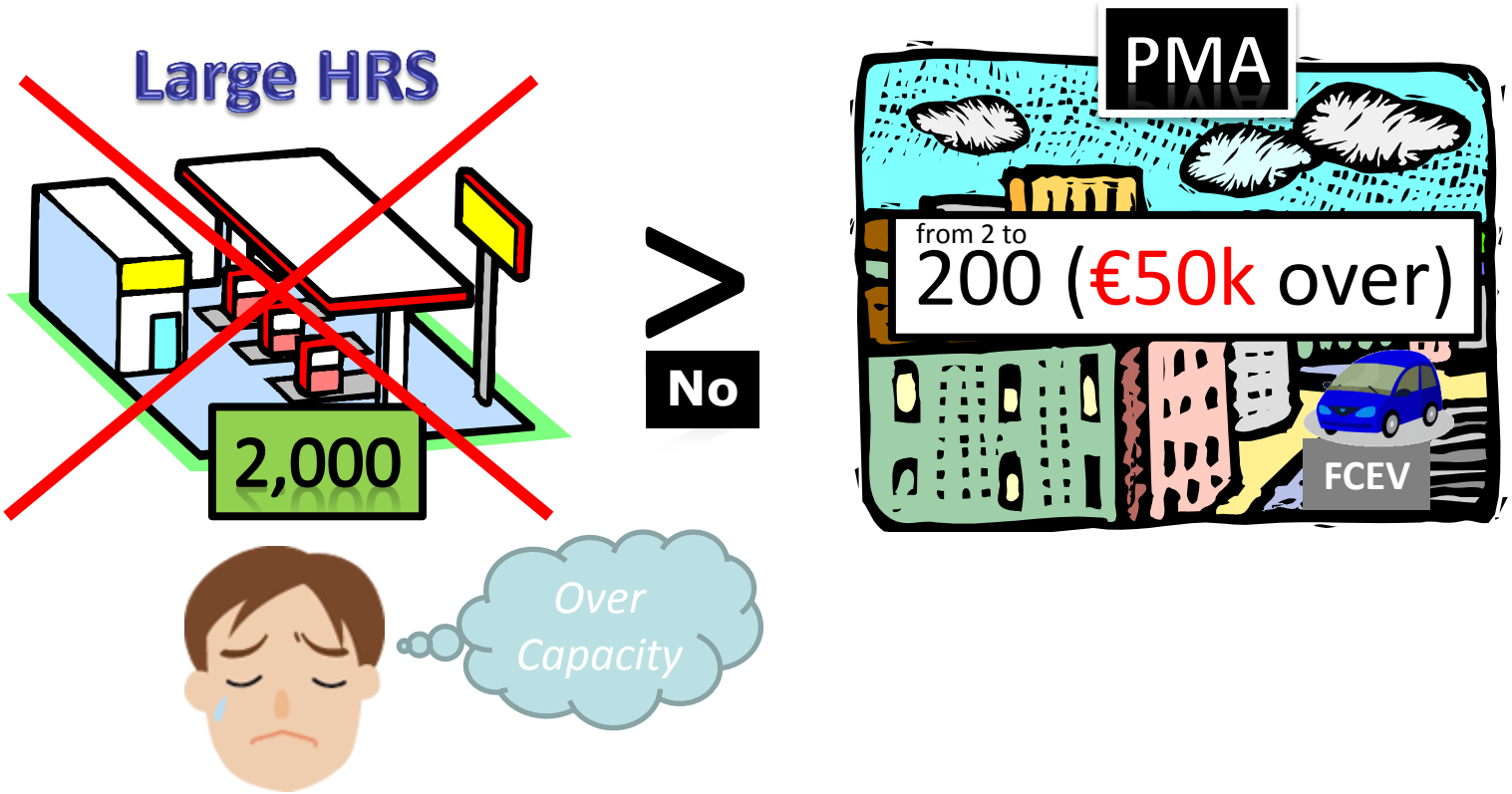
*Primary Market Area:
an area of neighborhood ICEVs
(1-10km2/ST in Japan)

Accumulated Sales Ratio



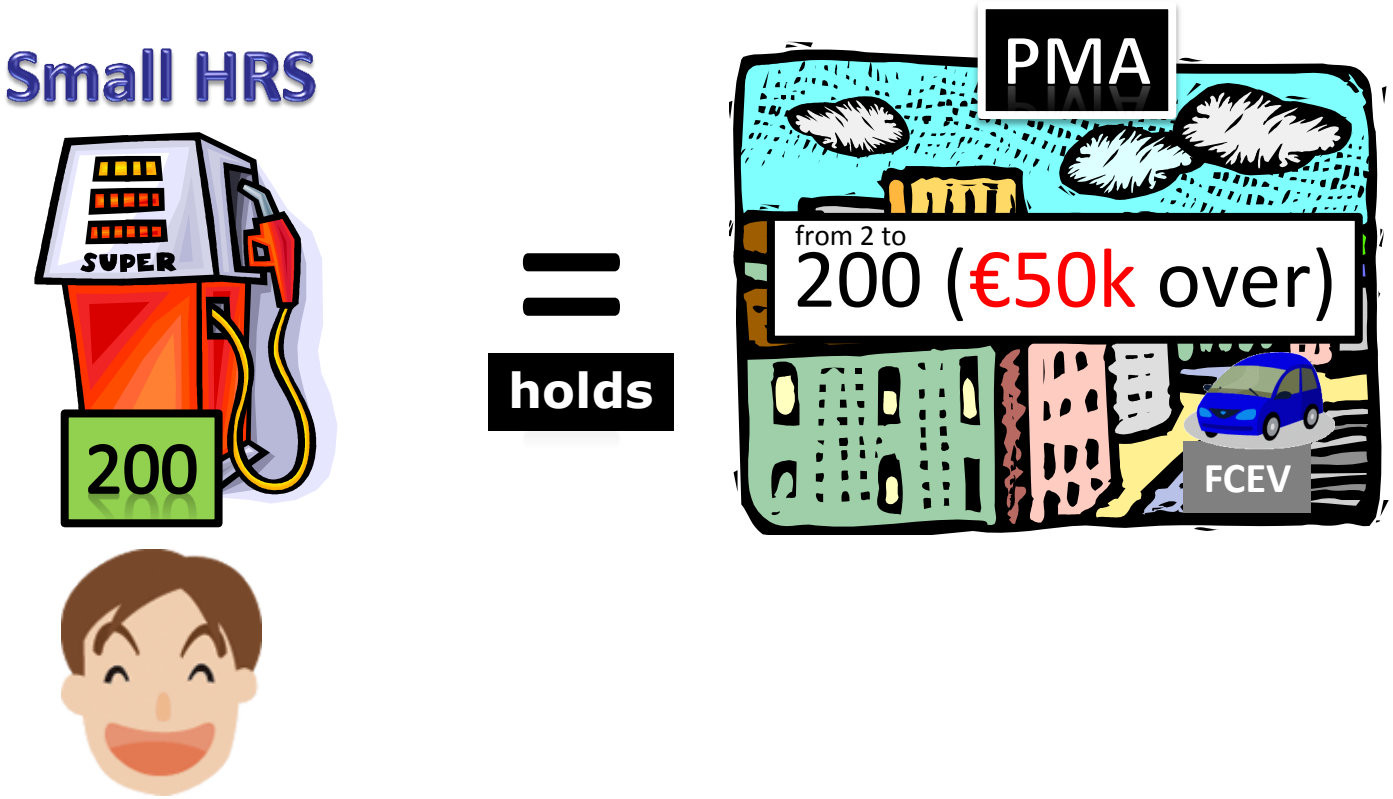
Business Sustainability: HRS Hydrogen Refueling Station

- "€50k or higher" is only 10.5% even in Tokyo (about 200)
- ICEV will be still attractive, FCEV may be 10% or less (about 20)
- "New car" is 8.6% of registered vehicles (about 2 per year)

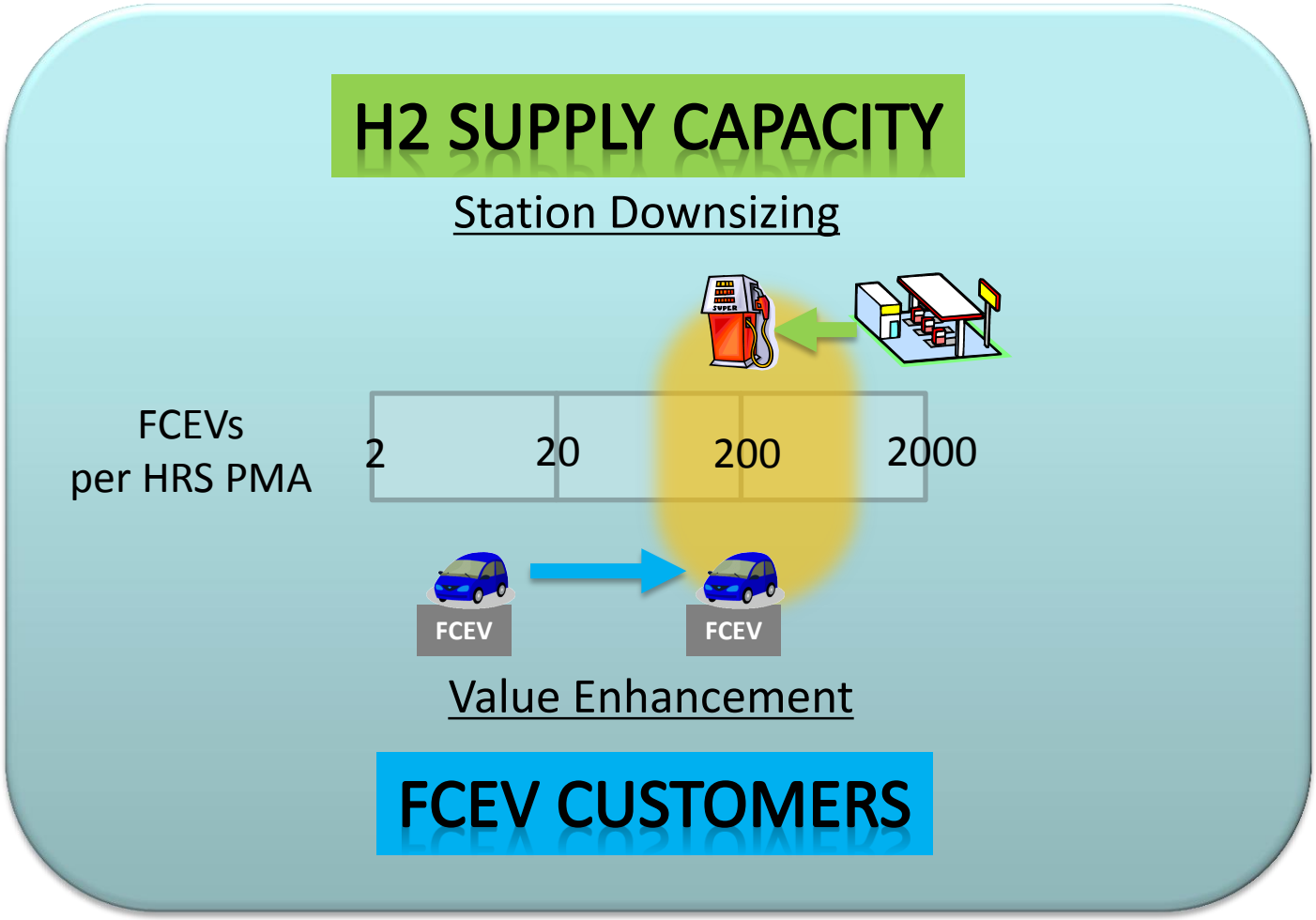


Supply(HRS) and Demand(FCEV)

- Smaller HRSs (2,000→200) are needed to secure “Energy Supply Responsibility” in early business years
- In parallel, the FCEV value needs to be enhanced (20→200) without increasing the FCEV price

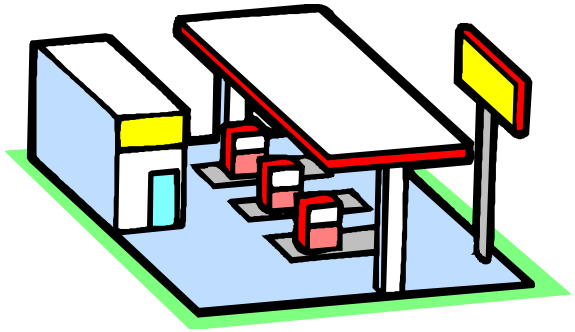


Supply(HRS) and Demand(FCEV)



FCEV Demand Creation by HRSs

A) Large HRS



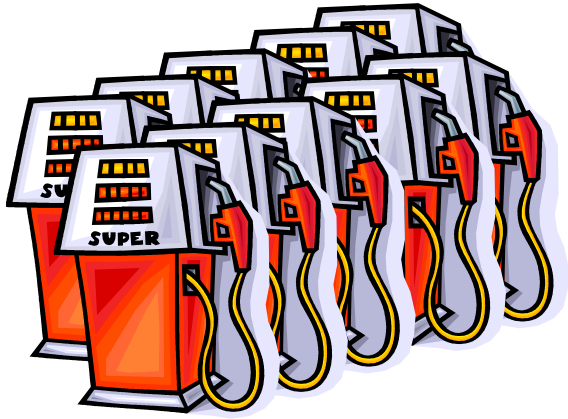
2,000 > 200

@Price	€5M
Stations	x20

@Demand	200
Stations	x20
Demand Creation	4,000

Total Budget €100M

B) Small HRS



200 = 200

@Price	€0.5M
Stations	x200

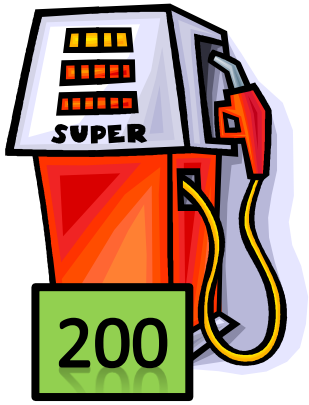
@Demand	200
Stations	x200
Demand Creation	40,000

H2 Price & Investment "Ceiling"

H2

- FCEV running cost target = €0.06/km **same as HEV**
- FCEV fuel consumption = 100km/kg
- **€0.06/km** x 100km/kg = **€6.0/kg** **Price Ceiling**
- Variable Costs = €2.0/kg
- Fixed Costs + Profit = €4.0/kg
  - **Depreciation** = **€2.5/kg**

EXAMPLE

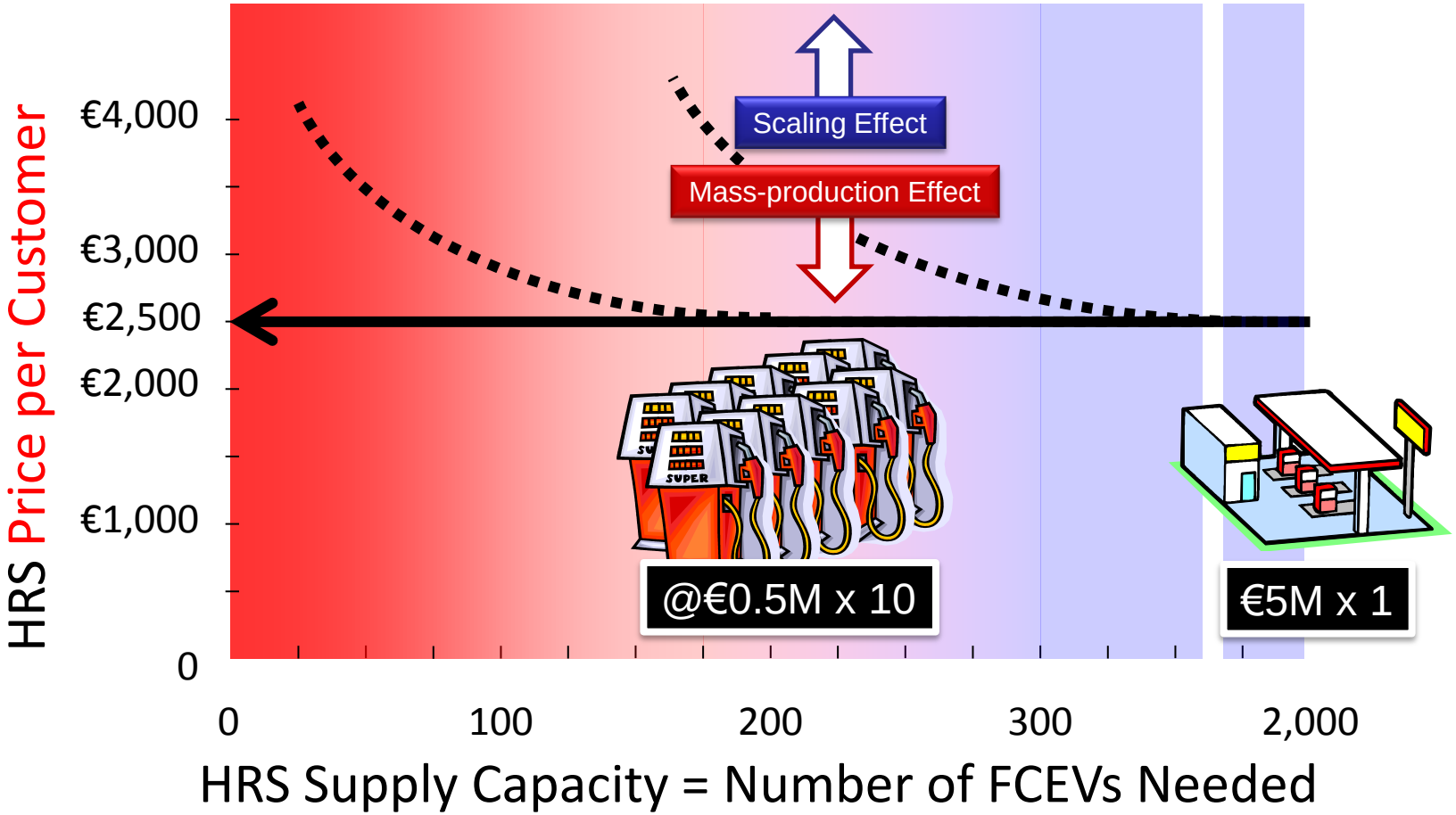


Small HRS

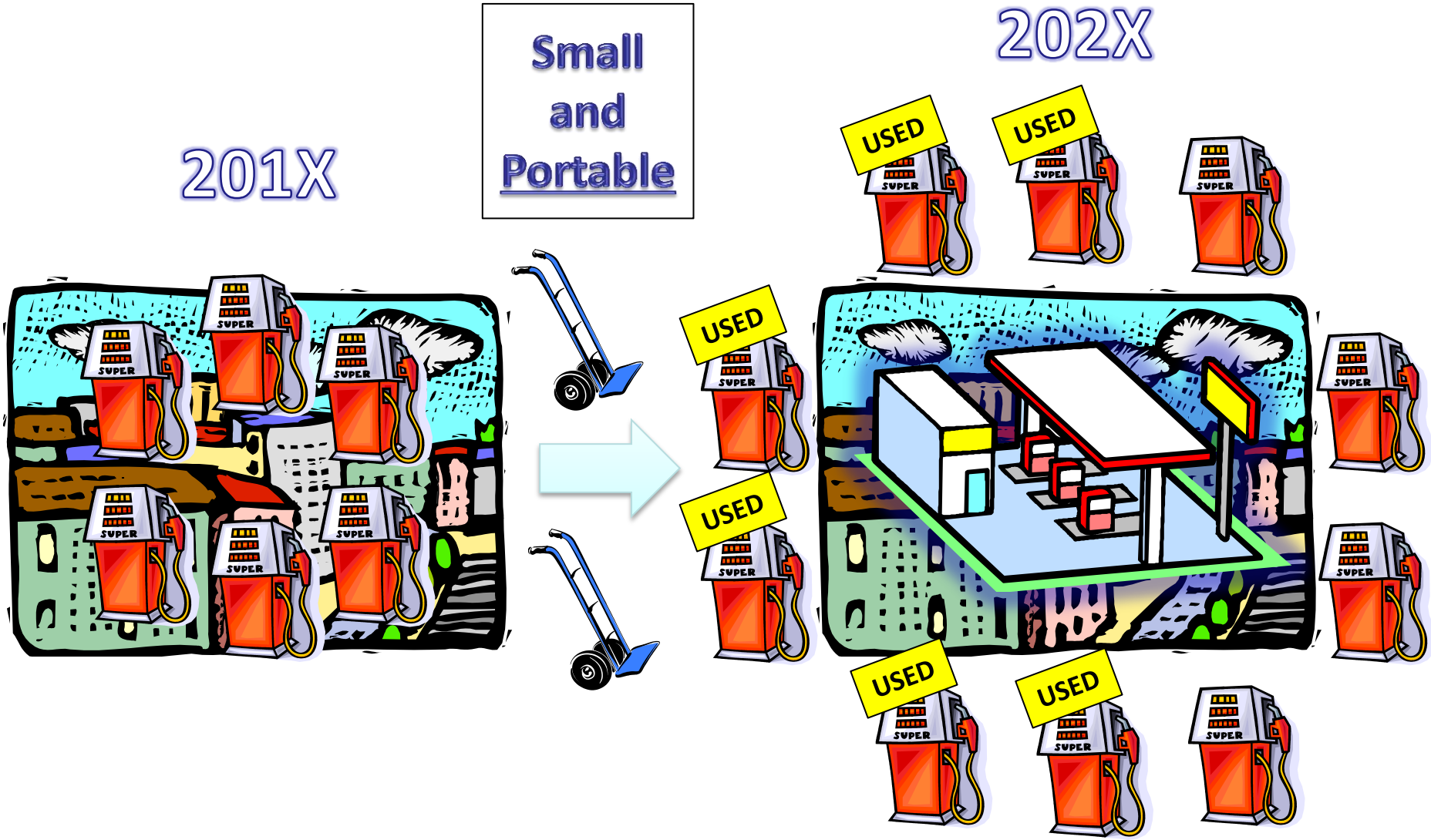
- FCEV Annual Driving Range = 10,000km/y
- Annual H2 consumption = 100kg/y
- 100kg/year x **€2.5/kg** = **€250/y**
- **€250/y** x **10y** x **200** **FCEVs** = **€500k** **Invest. Ceiling**

Price Projection: Small HRSs

- How far can HRS 'Price per Customer' keep constant?
  - Scaling Effect(+) vs. Mass-production Effect(-)



Portable: Rapid Expansion Capability

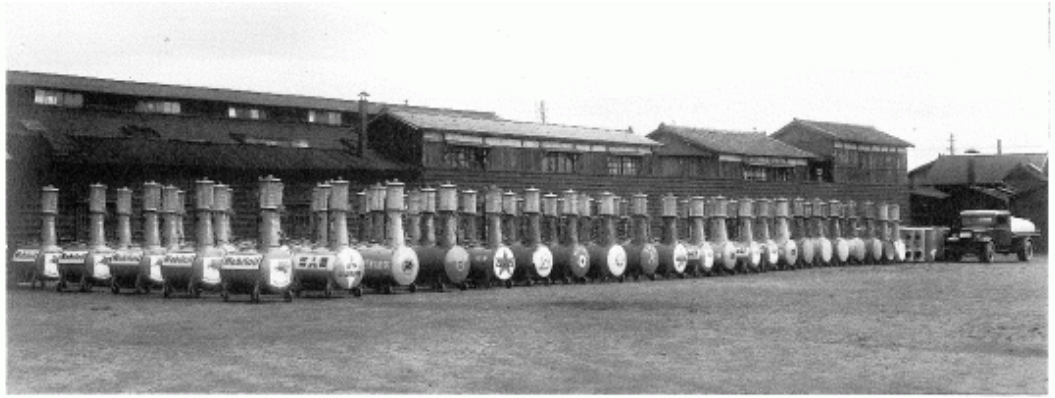


Portable: A Historical Fact in Japan

Number of ICEVs supported by a 600L Portable GRS (1951)

SUPPLY side
- ex. 500L x 40 weeks
- 20,000 L/y

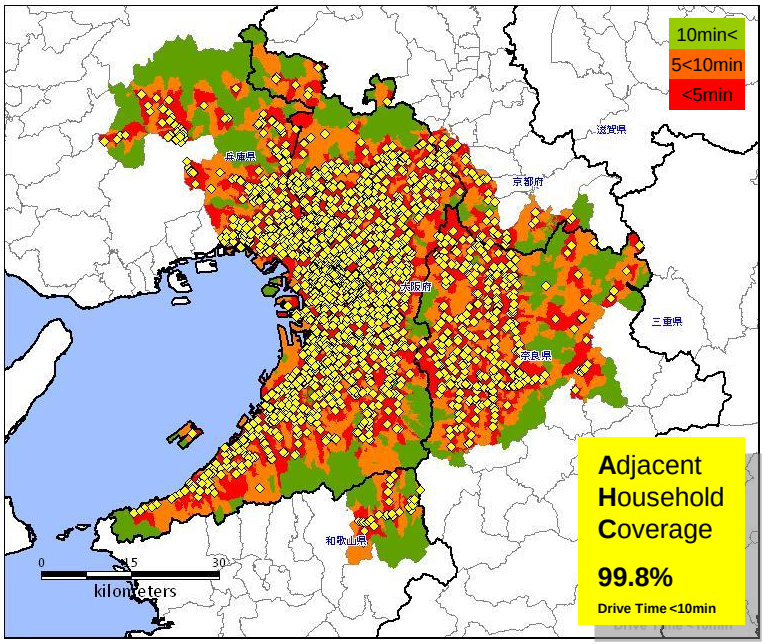
DEMAND side
- 988 L/y-ICEV(1951)
- **20 ICEVs**
- 19,760 L/y



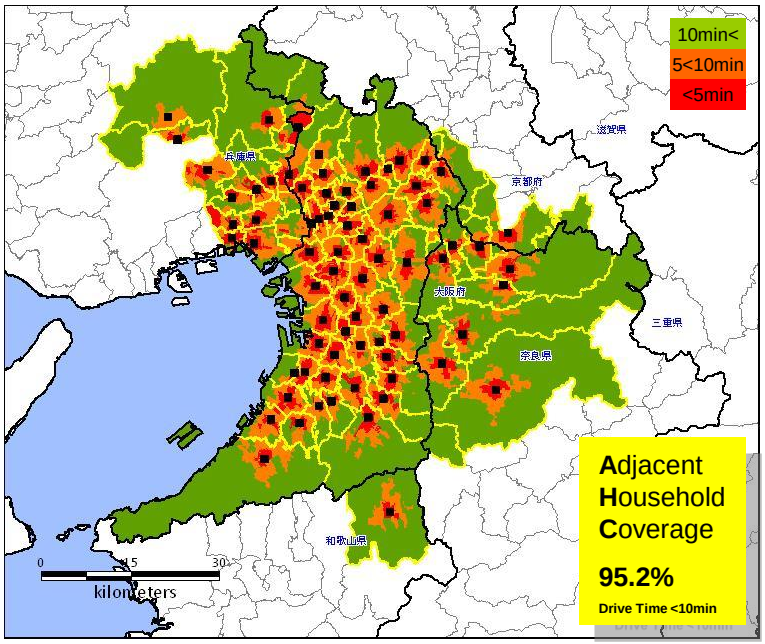
元売各社向けの㊧（ポータブル）計量機（昭和26年）

Source:
「トミナガ100年のあゆみ」
22 rows x 5 columns
= 110 Portable GRSs
Supporting 110 x 20
= 2,200 ICEVs

Usability: Driving Time to Stations



Gasoline Station: 2159



Hydrogen Station: 75

- **'Adjacent Household Coverage' in 10 min is easy to achieve 90%**
- **'Average Statistical Driving Time ' is, however, much shorter than 10 min***
  - Tokyo → $(1.3x\frac{\pi}{2})$ min, Hokkaido → $(2.8x\frac{\pi}{2})$ min

*to be submitted to elsewhere

Energy Supply Responsibility

- 1st scenario can be Subsidy-Sustained
- Next scenario must be Self-Sustained (>X5 subsidy leverage*)
- Full deployment of a business package, consisting of small and portable HRSs and a relevant number of FCEVs, has a strong impact to OEM's business decision in early business years

* P. Devlin, IEA Hydrogen Technology Roadmap North America Workshop, Jan 28th, 2014

Energy Supply Responsibility

to future FCEV customers

Thank you for your attention