Commercializing Hydrogen Technology in the Ports

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Must-haves for commercial success of hydrogen technology in the ports


Customer & Market
Society
Individual Value
Public Value
W
$$$
?
Competitive Advantage
Infrastructure
Product

Customer & Market

Value to the individual

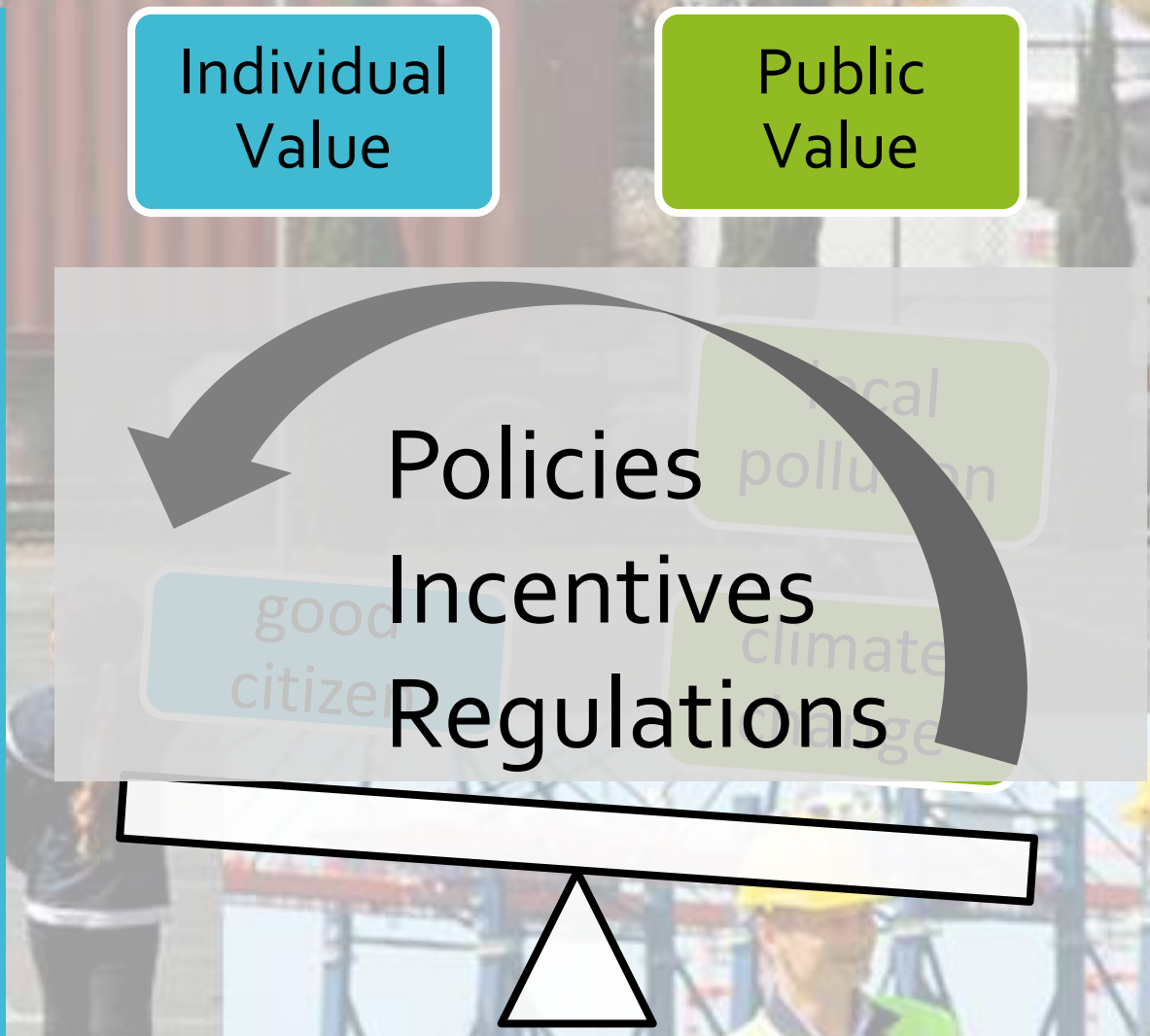
- What are tangible benefits of hydrogen/ zero-emission technology?
  - Clean - good citizen …
- Meet regulatory requirements
- Advantage over competitors
- Emotional appeal ?!

Public Value

local pollution

Individual vs

Public Value



Individual vs Public Value

Individual Value

Public Value

business rationale

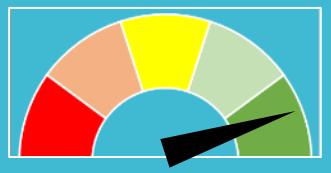
local pollution

good citizen

climate change

Product

- Performance
  - Power
  - Range
  - Refill/recharge time
  - Weight
  - Fuel consumption
- Reliability and durability
  - Mean-Time-Between-Failures
  - Lifetime
- Safety
- Ease of operations
  - What operators are used to
  - No compromises
  - Simple



Compe-titive Advan-tage

- Diesel vs H2
  - $, reliability, ease of operations
  - environmental impact
- LNG vs H2
  - improvement over Diesel, easy transition
  - not zero-emission

- Battery-electric vs H2
  - fuel efficiency
  - range, recharge, weight

Battery vs hydrogen tank

	Tesla	Fuel Cell	Diesel
range	500 miles		
specific energy consumption	2 kWh/mile		0.56 ltr Diesel/mile
total energy consumption	1,000 kWh		280 ltr
energy storage	1,000 kWh battery	60 kg H2	280 ltr Diesel
storage weight	5,000 kg	1,667 kg	280 kg

Reduced payload!

Battery recharging vs hydrogen refueling

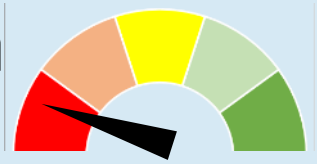
	charge power [kW]	charge time [hr]	[min]
Battery capacity 1000 kWh	1000	1	60
Level 3 charger	7.5	133	8000
Fast charger	50	20.0	1200
Tesla Supercharger	120	8.3	500
Porsche Fastcharger	350	2.9	171
1.5 MW charger	1500	0.67	40
Hydrogen refueling time	n/a	0.5	25

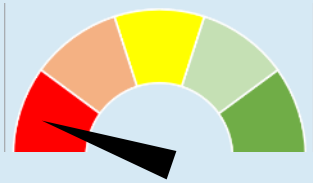
How much is

1.5 MW ?

Infra-structure

- Hydrogen production
- Hydrogen station
- Distribution of hydrogen to the users
- Sector and application coupling





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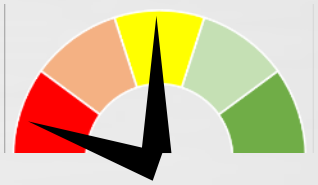
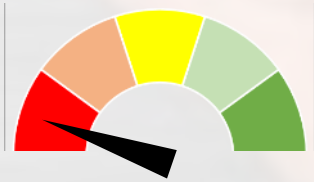
Profitable for customer AND manufacturer

- Customer perspective
  - Purchase price
  - Total cost of ownership
    - purchase price
    - fuel
    - maintenance
    - insurance



- Manufacturer perspective
  - Sufficient (positive !) margin



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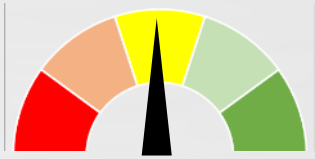
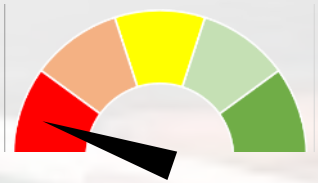
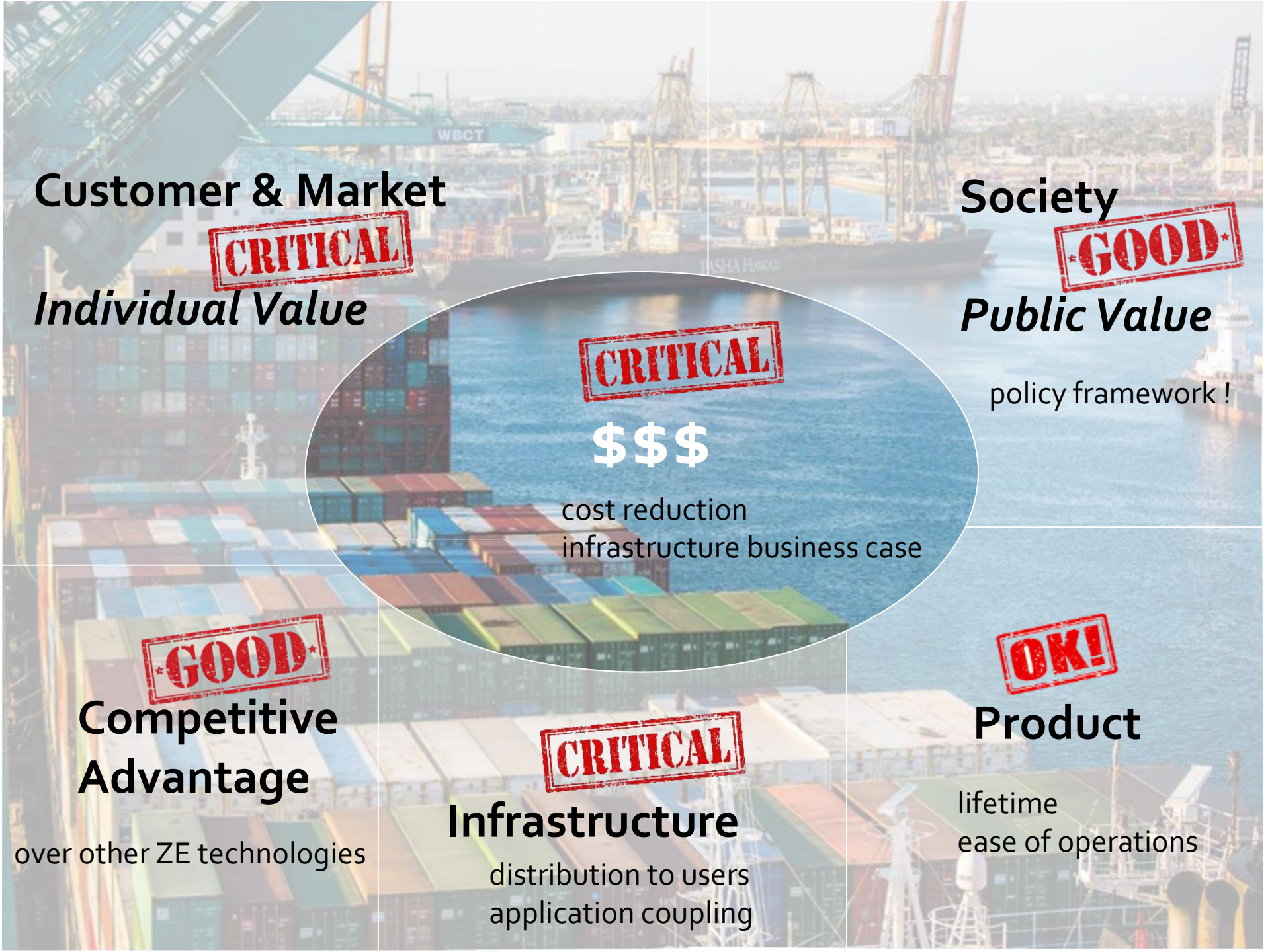
- Policy framework
  - Subsidies
  - Compliance cost
  - Credits
- Infrastructure business case
  - H_2 stations as a profitable business






There is no chicken-and-egg problem:
Infrastructure investments are financially attractive and will happen - if enough vehicles and other hydrogen applications are around !


Customer & Market
CRITICAL
Individual Value
Society
GOOD
Public Value
policy framework !
CRITICAL
$$$
cost reduction
infrastructure business case
GOOD
Competitive Advantage
over other ZE technologies
CRITICAL
Infrastructure
distribution to users
application coupling
OK!
Product
lifetime
ease of operations


WBCT
WBCT
PASHA HAWAII
We are on a good path
BUT
Demos are not enough !

Thank you!

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