Sweden-China Bridge
Collaborative Academic Platform for the Electrification of Transportation Systems

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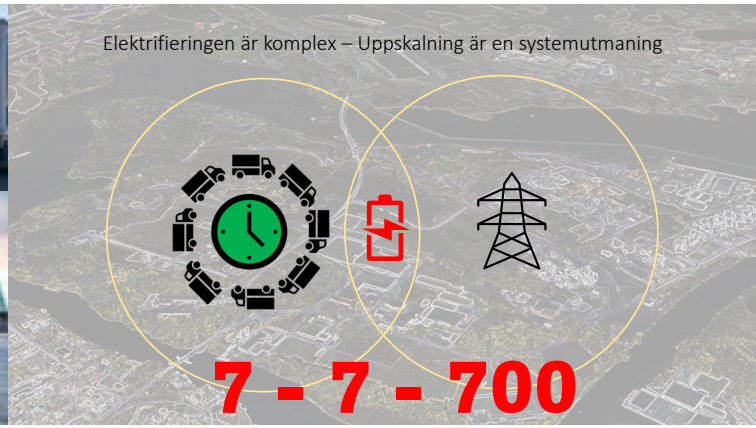

Agenda

- Tillbakablick– 2021-2024
- **Om projektet Sweden China Bridge**
- En inflygning till Kina
- "Exploratory tour"
  - Den kinesiska utvecklingsmiljön
  - Tekniken för battery swapping
  - Entreprenadverksamheten
  - Batteriteknik och utveckling
- Batteribyte i en nordisk kontext
- Frågor, svar, diskussion

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Sweden-China Bridge: A Collaborative Academic Platform for the Electrification of Transportation Systems

International research program funded by
The Swedish Transport Administration (Trafikverket, TRV)

Pilot project with TRV, 2017 – 2018
Sweden-China Bridge 1.0, 2020 – 2022
Sweden-China Bridge 2.0, 2023 – 2026

vti · HALMSTAD UNIVERSITY · TRAFIKVERKET · LUND UNIVERSITY

MIKE DANILOVIC

- Professor of Industrial Management at Halmstad University focusing on Innovation and Technology Management.
  - Linköping University, 1986-2000
  - Jönköping International Business School, 2000-2010
  - Halmstad University, 2010 – now
- Visiting Professor at Johannesburg University, South Africa in 2002 & 2003.
- Distinguished Overseas Professor at Shanghai Dianji University in Shanghai, China, 2011 –
- Affiliated researcher at Lund University.
- Action & Grounded Theory Research Approaches – Research & Business development
  - Conducted real-life innovation and technology management projects with industry: Saab Aerospace, Saab Automobile, Scania Trucks, Volvo, AUDI, Whirlpool, ISS Fascility Management, Swedish Defence HQ, ABB Robotics, Elfa, Roxen, Thule … Goldwind & ZPMC (China) …

JASMINE LIHUA LIU

- B.Sc. In Business Administration, Marketing.
- M.Sc. of Industrial Psychology.
- Ph.D. in Innovation Sciences from Halmstad University in 2019.
- Senior lecturer of Marketing at Shanghai Dianji University.
- Senior researcher at Lund University working on a project funded by the Swedish ministry of transportation (TRV) focusing on the electrification of transportation in China.
- 12 years experience of studying and working in Sweden.
- Experiences of working with industry: Goldwind & ZPMC, Varberg Energy.

Can China innovate? Perceptions from 2014 to 2021. Where is China going?

Predictions about China, 1990 – 2023

The Rhodium Group's predictions will never go out of fashion. They never have.

1990. China's economy has come to a halt. The Economist
1996. China's economy will face a hard landing. The Economist
1998. China's economy's dangerous period of sluggish growth. The Economist
1999. Likelihood of a hard landing for the Chinese economy. Bank of Canada
2000. China currency move nails hard landing risk coffin. Chicago Tribune
2001. A hard landing in China. Wilbanks, Smith & Thomas
2002. China Seeks a Soft Economic Landing. Westchester University
2003. Banking crisis imperils China. New York Times
2004. The great fall of China? The Economist
2005. The Risk of a Hard Landing in China. Nouriel Roubini
2006. Can China Achieve a Soft Landing? International Economy
2007. Can China avoid a hard landing? TIME
2008. Hard Landing In China? Forbes
2009. China's hard landing. China must find a way to recover. Fortune
2010. Hard landing coming in China. Nouriel Roubini
2011. Chinese Hard Landing Closer Than You Think. Business Insider
2012. Economic News from China: Hard Landing. American Interest
2013. A Hard Landing In China. Zero Hedge
2014. A hard landing in China. CNBC
2015. Congratulations, You Got Yourself A Chinese Hard Landing. Forbes
2016. Hard landing looms for China. The Economist
2017. Is China's Economy Going To Crash? National Interest
2018. China's Coming Financial Meltdown. The Daily Reckoning.
2019. China's Economic Slowdown: How worried should we be? BBC2020. Coronavirus Could End China's Decades-Long Economic Growth Streak. NY Times
2021. Chinese economy risks deeper slowdown than markets realize. Bloomberg
2022. China Surprise Data Could Spell R-e-c-e-s-s-i-o-n. Bloomberg.
2023. No word should be off-limits to describe China's faltering economy. Bloomberg

China Leads the Way in Electrifying the Road

How well do we know and understand China?

Western leaders and technology experts have a long history of underestimating China.

- Kings College London professor Kerry Brown wrote in The Diplomat in 2014 that Beijing could pour all the money it wanted into R&D parks and churn out legions of engineers, but would stumble in creating globally innovative companies. *"The system that China currently has still rewards conformity,"* he wrote.
- And former Hewlett Packard CEO Carly Fiorina said: *"Although the Chinese are a gifted people, innovation and entrepreneurship are not their strong suits. Their society, as well as their education system, is too homogenised and controlled to encourage imagination and risk-taking."*

Harvard Business Review on understanding China:

*"Many people have **wrongly assumed** that political freedom would follow new economic freedoms in **China** and that its economic growth would have to be built on **the same foundations as in the West**. The authors suggest that those assumptions are rooted in three essentially **false beliefs about modern China**:*

(1) economics and democracy are two sides of the same coin;
(2) authoritarian political systems can't be legitimate; and
(3) the Chinese live, work, and invest like Westerners

But at every point since 1949 the Chinese Communist Party—central to the institutions, society, and daily experiences that shape all Chinese people—has stressed the importance of Chinese history and of Marxist-Leninist doctrine.

Until Western companies and politicians understand this and revise their views, they will continue to get China wrong".

(Rana Mitter, and Elsbeth Johnson, Harvard Business Review, 2021)

Published reports, 2021-2023

Exploring global development of battery swapping for BEH

Business models for battery-swapping for BEH

Dynamic system simulation of one harbor context operating five tractors 24/7

In the pipeline:
- Intelligentization of transportation systems in China
- Intelligentization of Chinese heavy trucks
- State of the art of transportation systems in China
- State of the art of hydrogen energy solutions for heavy trucks in China
- Dynamic system approach to optimal charging infrastructure for transport systems based on the integration of cable charging and battery swapping – The case of Varberg

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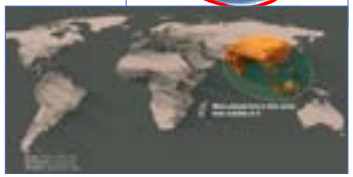
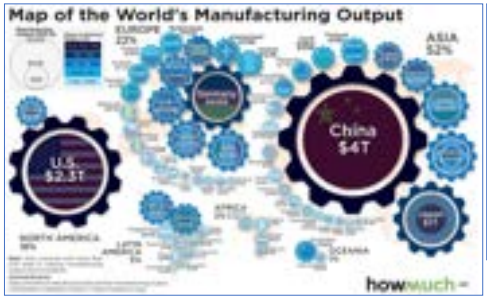
Who is driving the global growth in 2023?
Asia &Pacific is the global economic engine in years to come

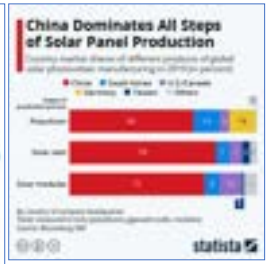
- World Bank data showed that China's contribution to global economic growth averaged 38.6% from 2013 to 2021, making it the most significant contributor.
- China's GDP grew by 6.6% annually from 2013 to 2021, higher than the global average of 2.6% and the 3.7% of other developing economies during the same period.

China achieved 5,2% GNP growth in 2023 and it is expected to be 5,4% in 2024.



HOW DO WE DECOUPLE THE COUPLED WORLD?



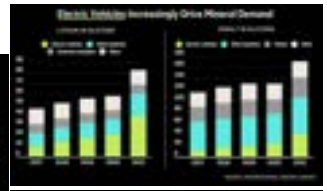


Top 5 Countries with the Biggest Manufacturing Output
1. China: $4T (28.37% of world total)
2. United States $2.3T (16.65% of world total)
3. Japan: $1T (7.23% of world total)
4. Germany: $806B (5.78% of world total)
5. South Korea: $459B (3.29% of world total)

In 1930s, USA's industry capacity = Soviet's + Germany's + UK's

Now, China's industry Capacity = USA's + Japan's + Germany's

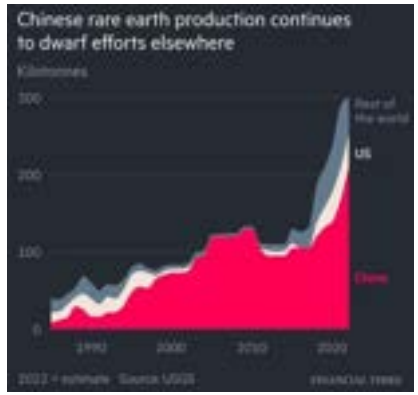
Electrification of transportation system from a helicopter perspective



How can we minimize the use of minerals, rare earth metals and batteries?

How can battery swapping support environmental efficiency, minimize use of minerals and metals and extend the battery life cycle?

Chinas grip on rare earth metals



China's exports of germanium and gallium fell sharply in August, after Beijing imposed new controls on exports of the two metals used for chip production.

China exported no wrought germanium products last month, down from 8.63 metric tons in July, when shipments more than doubled year-on-year, as overseas buyers rushed to lock in shipments ahead of the restrictions.

There were also no exports of wrought gallium products in August.

In July, exports were 5.15 tons and 7.67 tons in the same month in 2022, the data showed.

In July, China announced export restrictions on eight gallium and six germanium products, which came into effect on August 1.

Critical Technology Race - Seven key technology areas

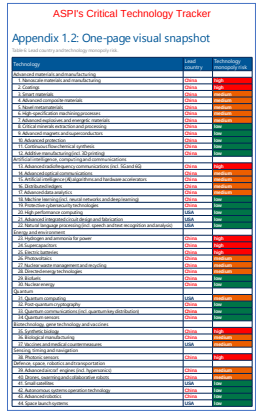
- Advanced materials and manufacturing
- Artificial intelligence, computing and communications
- Energy and environment
- Quantum
- Biotechnology, gene technology and vaccines
- Sensing, timing and navigation
- Defence, space, robotics and transportation

List of critical technologies

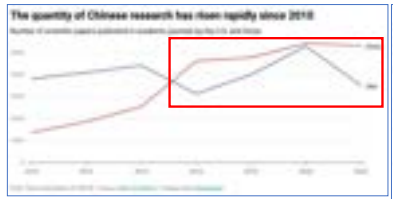
China has the lead in
37 out of 44 technologies

USA has the lead in
7 out of 44 technologies

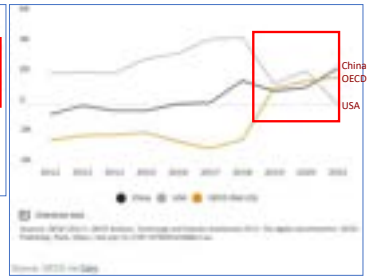
There's a large gap between China and the US, as the leading two countries, and everyone else.
The data indicate a small, second-tier group of countries led by India and the UK: other countries that regularly appear in this group—in many technological fields— include South Korea, Germany, Australia, Italy, and less often, Japan.



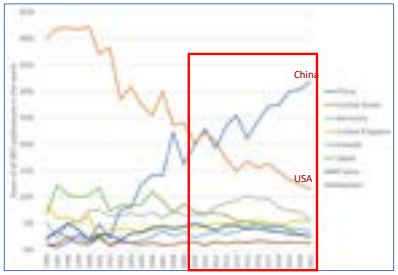
The quantity of Chinese research, 2010 – 2022

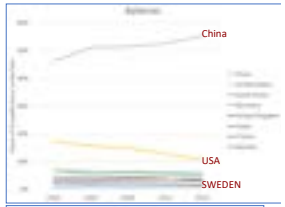


China takes the global lead in research publications, 2012-2021



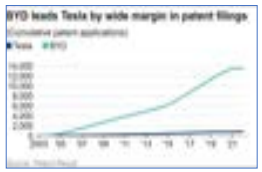
The global share of publications in electrification of vehicles area, 1996 – 2022





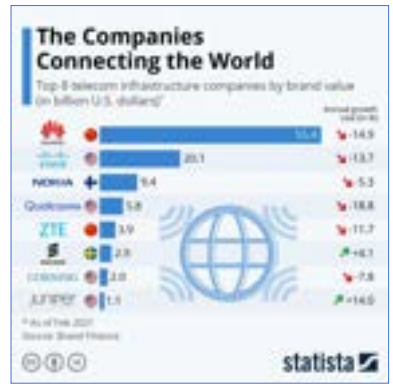
Research leads to knowledge, that leads to new solutions & technologies, that leads to patents and innovations and the wealth of people!

Patents in 36 fields are based on research and publications
-
China tops 29 fields
USA tops 4 fields
Japan tops 3 fields

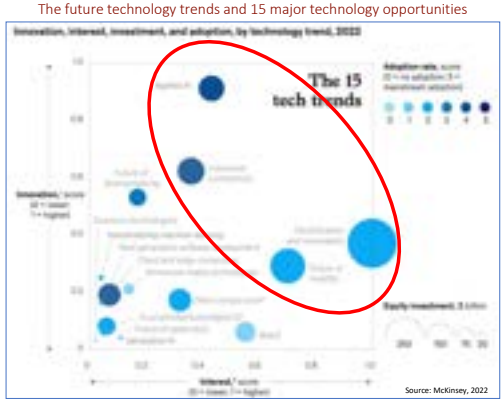


From electrification of transport to smart city and community –
China leads the implementation of 5G and development of 6G patents

Huawei global positioning



The future technology trends and 15 major technology opportunities



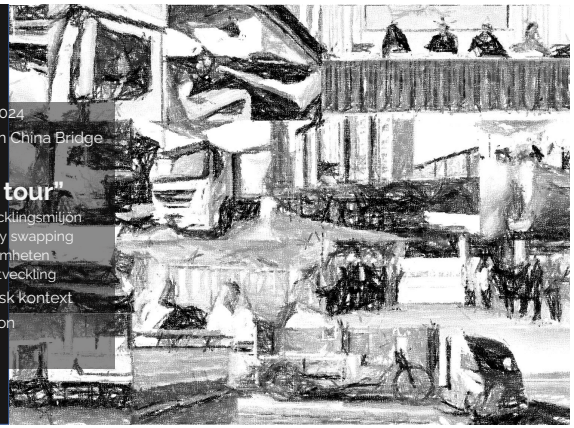
China and USA has the lead!

Euroopean automotive crises? Collaboration for the future?

Success factors for China & Chinese industry

- China is a 5000-6000 years old civilization.
- Meritocratic nation for 2500 years, since Confucian time.
- China does not have a national religion. China is influenced by Confucianism in the past 2400 years.
- Strong emphasis on technology, R&D, publications, patents, and commercialization
- Focus on integrated R&D, manufacturing, and commercialization since the end of the 1990s
- Development of a complete value chain from minerals and materials to final products
- Determinant decision-makers
- Decisiveness in decision-making and actions
- Action-oriented mindset
- Business minded – No business, no actions!
- Speed in decision-making and actions
- Learning and absorbing capacity
- Experimental orientation & experimental approach in the society and in the industry
- Technological leap, jump and bypass the old dominant technology!
- System perspective & System solutions (not salami slicing)
- A collective, collaborative & complementary approach to development and business, i.e. swarms!

Agenda



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Electrification exploratory tour 2023

Visited

- Shanghai Dianji University (SDJU) & Lingang municipality
- Research centers
- Test drive facilities
- Vehicle manufacturers
- Battery manufacturers
- Battery-swapping system developers and manufacturers

Visitors

- Vehicle industry
- Transportation company
- Transportation buyer
- Consultancy
- Academia
- VTI, Logistikia, Sweden China Bridge

We need to address two major challenges to the electrification of transport:

1. The lack of charging infrastructure &
2. The lack of value chain for R&D and manufacturing of EV in Europe.

Those can only be handled through strategic collaboration between China and Europe.

"Volkswagen hesitates to go all the way in the electrification process for two main reasons. The first reason is although customer demands are there, the value chain is not in a place that can fully support Volkswagen's transformation. The second reason is the charging infrastructure is not in place and is not well developed to support the large-scale transformation to electric vehicles."
(Mr. Herbert Diess, a former CEO of Volkswagen Group)
(Source: The Financial Times Event "Future of the car," May 9th to 12th, 2022)

"The roof is on fire" … "we are letting the costs run too high in many areas"
(Mr. Schäfer, CEO VW, *Source:* Autocar).
He further indicated that the coming weeks and months will be *"very tough"* for the company.

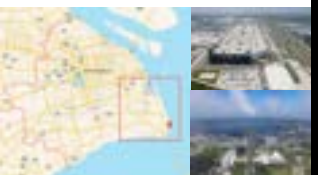
World's largest charging station in Shenzhen powers all-electric taxi, bus and truck fleet

Battery swapping is a mature technology and solution

Zhiliwulian 3rd generation battery-swapping system

Lingang-The epicenter for NEVs and chips industry

- The Lingang Special Area of China (Shanghai) Pilot Free Trade Zone (FTZ) aims to become an epicenter of new-energy vehicles (NEVs), integrated circuits (ICs) and high-end equipment manufacturing by 2025, when its gross regional product will double the 2018 level, an annual average growth rate of about 25 percent.
- The direction is to develop three giant industrial clusters for NEVs, ICs, and high-end equipment manufacturing worth 100 billion yuan ($15.44 billion).Over 40 integrated circuit companies have invested in the area. Tesla Gigafactory is located in Lingang.
- Lingang plans more investments in biopharmaceuticals, artificial intelligence, and civil aviation, cross-border financial services, modern shipping services and digital information services.
  At least 10 top scientific laboratories will be set up in Ligang, with at least 100 top-caliber experts brought into the area. The addition of high-tech firms will hit about 1,000.
- In 2022, the region's industrial output totaled 170.3 billion yuan while its fixed-asset investment hit 61.82 billion yuan.



Intelligent transportation system solutions

WindRose

DeepWay

Battery energy storage
Hydrogen energy storage
Battery-swapping as standard
Autonomous driving as standard
Intelligent technologies
Intelligent transport systems
Intelligent infrastructure

Batteribytessystem – Teknisk beskrivning

Konceptet – ett ekosystem

Battery Swapping-konceptet bygger på flera komponenter och aktörer i samverkan.

I samverkan tekniskt och i affärsmodeller

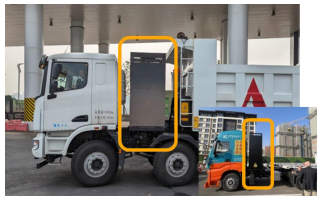
På vår resa har vi besökt och intervjuat dessa aktörer för att lära, förstå och försöka översätta konceptet till en europeiskt kontext.

Intuizio

Batteribytessystem – Teknisk beskrivning

Fordonet

Bakom hytt



- Transportsystem; lokala transporter
- Hög tyngdpunkt
- Traditionellt drivsystem
- Hög digitaliseringsgrad och kommunikation med Batteribytessystemet

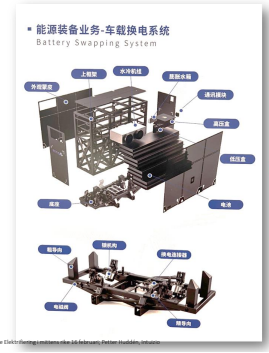
Kassett under chassi

- Transportsystem; lokala och långväga transporter
- Låg tyngdpunkt
- Kräver e-axel. (Axelmonterad elmotor), endast Daimler i Europa har det idag
- Hög digitaliseringsgrad och kommunikation med Batteribytessystemet
- Just denna är dessutom 100% autonom/självkörande

Intuizio

Batteribytessystem – Teknisk beskrivning

Batteriet & Infästning

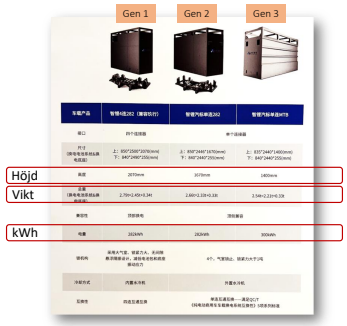


Modulär uppbyggnad
Iterativ strategi - uppdateringsbart
LFP-batterier
800-volts system
Vädertestat i olika transportsystem (IP67)

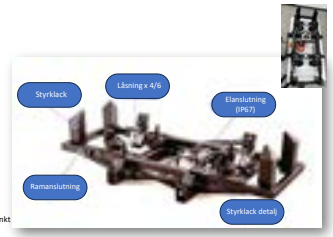
Intuizio

Batteribytessystem – Teknisk beskrivning

Batteriet & Infästning



Höjd — Lägre tyngdpunkt
Vikt — Lägre totalvikt/kWh
kWh — Högre energitäthet



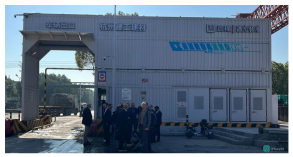
Reflektioner:
- Viss kompatibilitet mellan generationer
- Hög uppgraderingsmöjlighet i jämförelse med europeiska lösningar.
- Finns i olika storlekar men vi såg att en batteristation = En batteristorlek

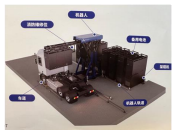
Intuizio

Batteribytessystem – Teknisk beskrivning

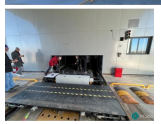
Batteribytesstationen & Elnät

Bakom hytt = Byte uppifrån





Kassett under chassi = Byte underifrån



Varianter
1 Laddare = 1 Batteri
Elnätsanslutning; 1,5-4MW

Placering; Tar liten plats jämfört med utrymmeskrävande sladdladdningsdesign/ Laddpark.

Mark är dyrt i Kina

Intuizio

Batteribytessystem – Teknisk beskrivning

Batteribytesstationen & Elnät

Fakta:

Plats:	Byggelementfabrik, Hangzhou
Utrymme BS-stationen:	60kvm (plus transformatorer)
Elnätsanslutning:	1,5-2,5 MW
Antal batterier:	7+1
Batteristorlek:	285kWh
Batterikemi:	LFP.
Antal byten per dag:	125
Försörjer antal fordon:	50 st

Digitalt eco system. Fordon /Station/Elnät/(TMS?)

Intuizio

Batteribytessystem – Teknisk beskrivning

Batteribytesstationen & Elnät

Intuizio

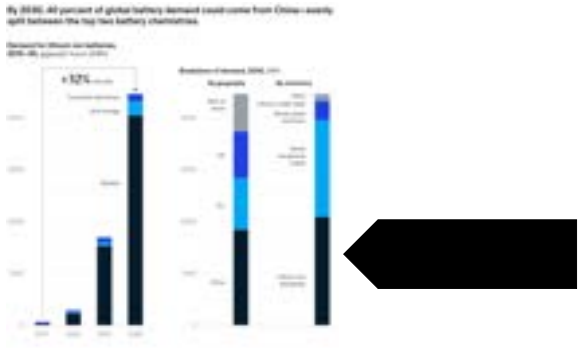
Kinesiska Entreprenader – Skillnader och likheter

- Projekt av en annan storlek
  - Antalet enheter
  - Beläggningsgrad
  - Förutsättningar för Batteryswappingsystem

BATTERY PACKS FOR SWAPPING



LI-ION BATTERY MARKET



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Batteribytesteknik i en nordisk kontext

- Åkeriperspektivet
- Transportköparna
- Fordon
- Batteribytesstationerna
- Effektbrist
- De europeiska fordonstillverkarna
- Standards
- Skalbarhet
- En affärsmodell i nordisk kontext

	POSITIVA	NEGATIVA
INTERNA	STYRKOR	SVAGHETER
EXTERNA	MÖJLIGHETER	HOT

Scenario, Battery Swapping i Europa

1. Noll – BS kommer inte in på marknaden. Laddinfra och fordon etableras så starkt att det inte är värt ansträngningen på vår lilla marknad
2. Kina 1 - Lokala brofästen, Kinesiska lösningar importeras av svenska aktörer och implementeras i lokala, avgränsade system
3. Kina 2 – Kinesisk aktör går in på marknaden med avsikt att bygga en nationell infrastruktur (jmr Nio)
4. Kina 3 – Europeiska fordonstillverkare utvecklar partnerskap med kineser och kommer till marknaden i befintliga kanaler
5. Väst goes BS – Europeiska OEM byter strategi och utvecklar egna BS-lösningar

Utvecklingskontext, scenario

- Effektbrist, lönsamhet och andra uppskalningsproblem - Elektrifieringen går långsammare än prognos
- Utslagning/konsolidering bland OEM
- Nya aktörer på transportmarknaden – Einride, Northvolt, Volta, investerare, kinesiska energiaktörer

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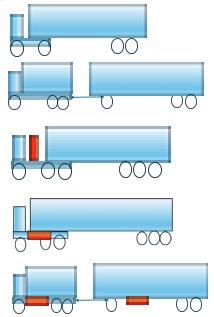
Fordonskombinationer i en nordisk kontext



Artist: Per Haugland

- **2 axlad dragbil med 2 eller 3 axlad trailer**
- **2 eller 3 axlad lastbil med 2 eller 3 axlat släp**
- **3 axlad dragbil med 2 eller 3 axlad trailer Bytesbatteri**
- **Alternativ placering av batteri**
- **2 eller 3 axlad lastbil med 2 eller 3 axlat släp. Bytesbatteri , altenativ på både bil och släp**

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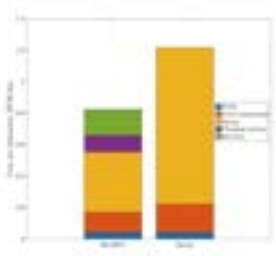
- 68 ton HDV
- Route: Joutseno – Luumäki – Hamina
- 4 times per day back and forth with 4 vehicles
- 32 spare batteries at Luumäki BSS



Agenda

- Tillbakablick– 2021-2024
- Om projektet Sweden China Bridge
- En inflygning till Kina
- "Exploratory tour"
  - Den kinesiska utvecklingsmiljön
  - Tekniken för battery swapping
  - Entreprenadverksamheten
  - Batteriteknik och utveckling
- Batteribyte i en nordisk kontext
- **Frågor, svar, diskussion**

Diskussion, frågor, synpunkter

VAD HÄNDER HÄRNÄST?

- ***Examensarbete*** *Renall, Returpack och LiU. "Uppskalad elektrifiering" Q1-Q2*
- *Godsöverflytt till* ***järnväg****, 19e april*
- ***ÖTKS-*** *Östergötland Transporterar KlimatSmart*
- *"**Ladda Händelö**" – Laddningsbehov vs elnätskapacitet*

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Tack för idag!

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