Business from technology

Integrating transport energy supply with the energy system of the future

Juhani Laurikko, VTT

MOBILITY: TECHNOLOGY PRIORITIES AND STRATEGIC URBAN PLANNING

IEA-EGRD Workshop

22-24 May 2013, Finland

Of the Future and Forecasting

What is the Future?

- ***The Future is***, according to the linear concept of time, the ***portion of the timeline that has not yet happened***
- The portion that has already taken place is called ***the Past***
- The phase that in on-going at the moment is called ***the Present***

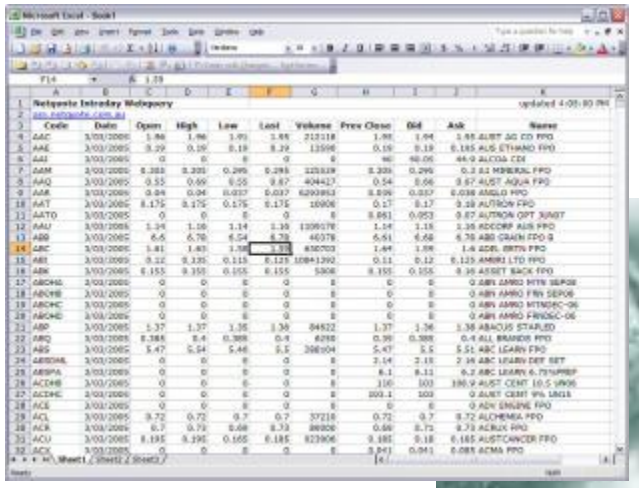
Why Do We Have Interest in the Future?

- Our interest in the Future is often linked with:
  - ***Desire to plan and prepare for the changes*** in the operating environment that may threaten your business or activity and its continuum
  - ***Find new, arising possibilities*** that may support growth or development of new business.

How Can We Forecast the Future?

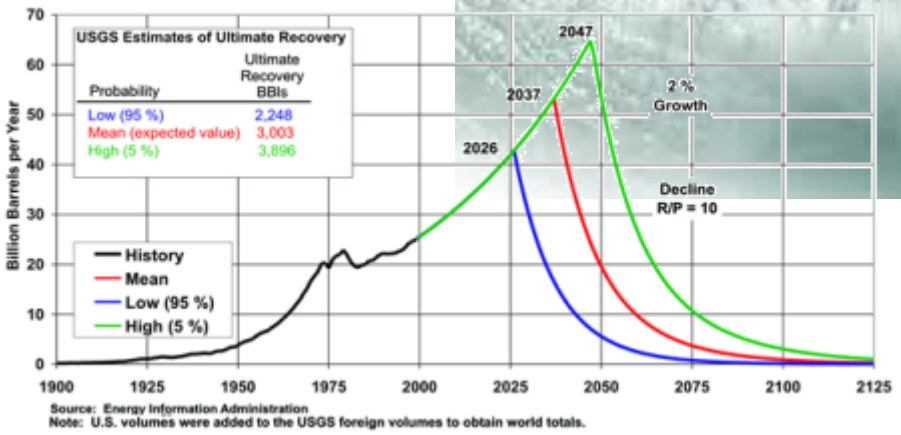
- ***Forecasting*** is presenting an estimate of the Future, based on **interpretation of the omens that convey future trends**.
- ***We cannot predict the future***, but is possible to explore it with a systematic method, and to present **alternative images of the future called *Visions*.**
- ***Visions arise from*** the construction of time-phased and logically progressive **development paths called *Scenarios***

In the Past...



...Now!

Figure 2. Annual Production Scenarios with 2 Percent Growth Rates and Different Resource Levels (Decline R/P=10)



Source: Energy Information Administration
Note: U.S. volumes were added to the USGS foreign volumes to obtain world totals.

“Listen to the Visioneers”

FISITA World Automotive Congress 1998

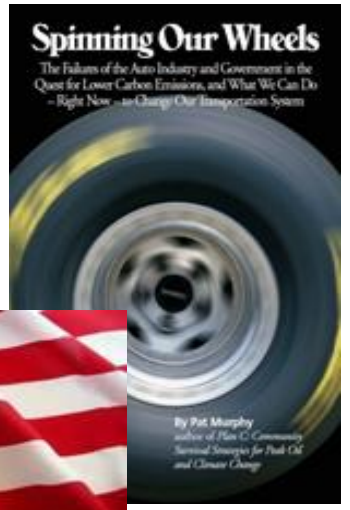
”Many parts of the future are already here now, but in an embryonic state”

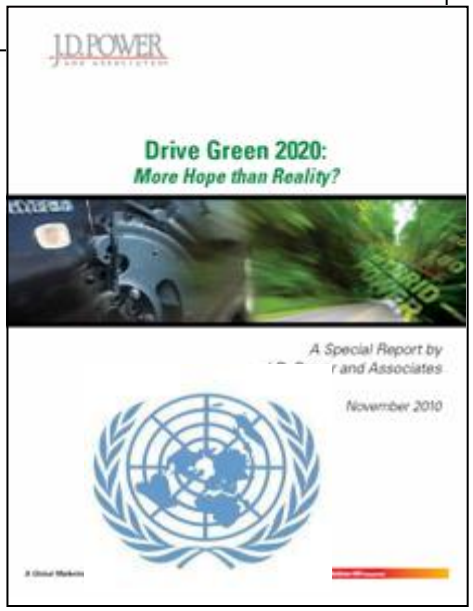
Carlos Ghosn
Chairman, CEO Renault-Nissan

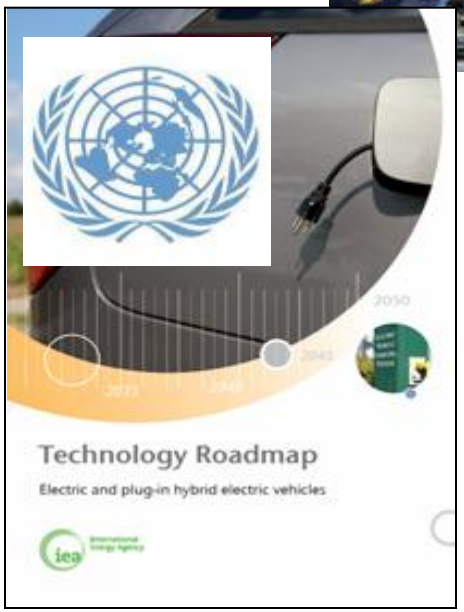

s for Europe:
H_2
The role of Battery Electric Vehicles, Plug-in Hybrids and Fuel Cell Electric Vehicles

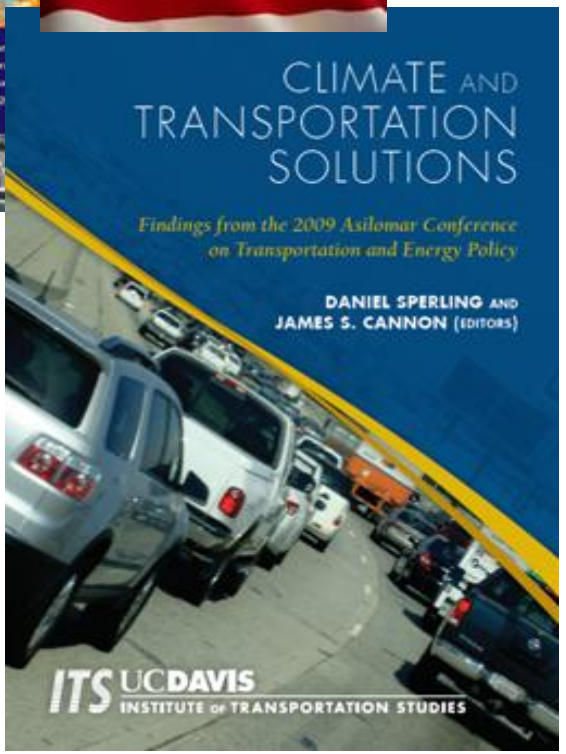

UNDERSTANDING ELECTRIC VEHICLE TECHNOLOGY
– ENVIRONMENTAL BENEFITS
ELECTRIC VEHICLE CHARGING STATION


On the Road in 2035
Reducing Transportation's Petroleum Consumption and GHG Emissions
Anup Bandivadekar
Kristian Bodek
Lynette Cheah
Christopher Evans
Tiffany Groode
John Heywood
Emmanuel Kasseris
Matthew Kromer
Malcolm Weiss
MIT


Spinning Our Wheels
The Failure of the Auto Industry and Government in the Quest for Lower Carbon Emissions, and What We Can Do – Right Now – to Change Our Transportation System
By Pat Murphy


J.D.POWER
Drive Green 2020:
More Hope than Reality?
A Special Report by
November 2010


Technology Roadmap
Electric and plug-in hybrid electric vehicles
iea

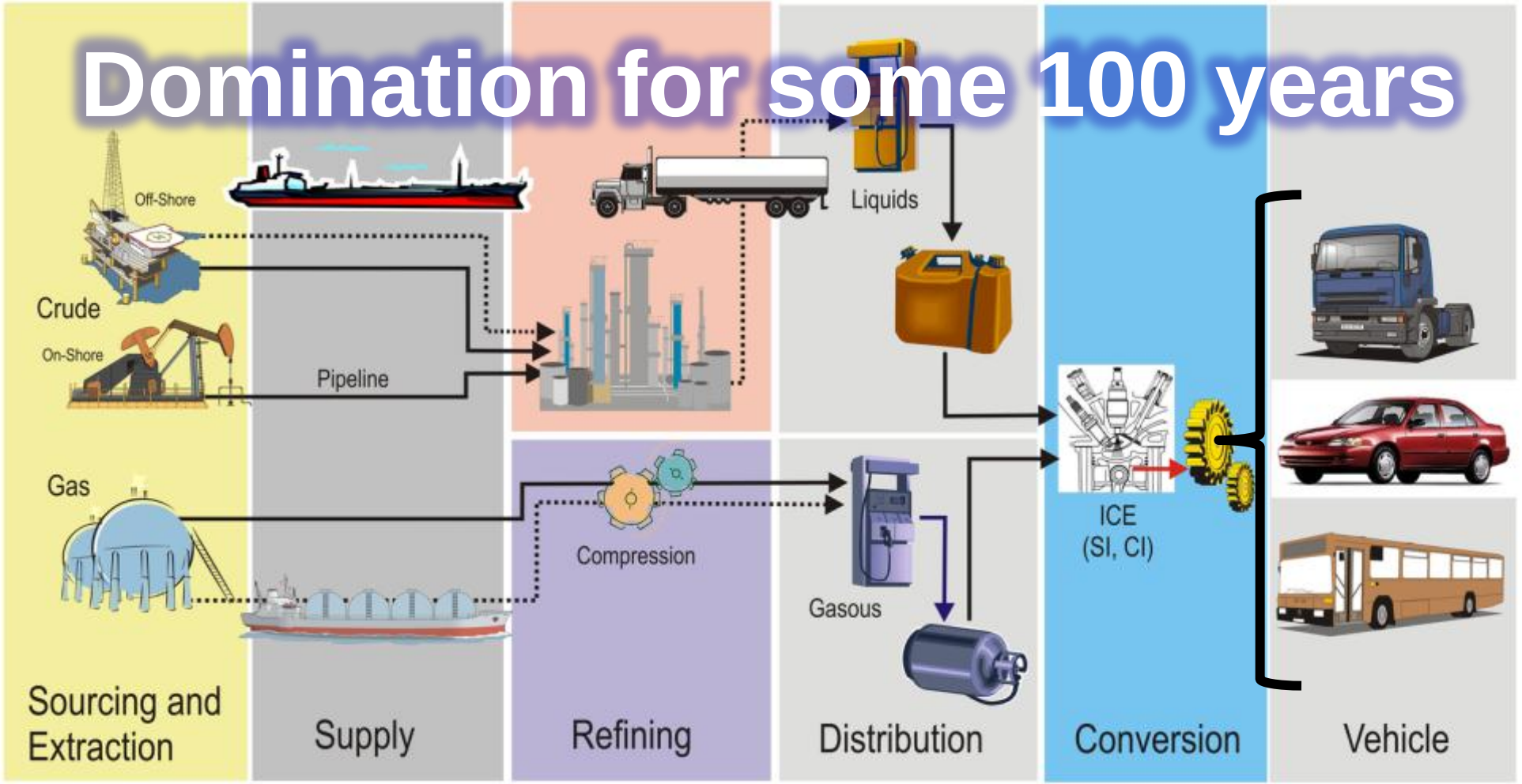

CLIMATE AND TRANSPORTATION SOLUTIONS
Findings from the 2009 Asilomar Conference on Transportation and Energy Policy
DANIEL SPERLING AND JAMES S. CANNON (EDITORS)
ITS UCDAVIS
INSTITUTE OF TRANSPORTATION STUDIES

What Ultimately Determines the Future?

- There is ***not one, Deterministic Future*** that we need to predict!
- ***The Future is determined by the choices, decisions, and actions We take***
- It is not only necessary to prepare for the future, but ***we may also actively contribute*** in order to:
  - Avert the looming threats, or
  - ***<u>Create new opportunities</u>***
- ***Interactively we can contribute to the development paths that will result in different futures!***

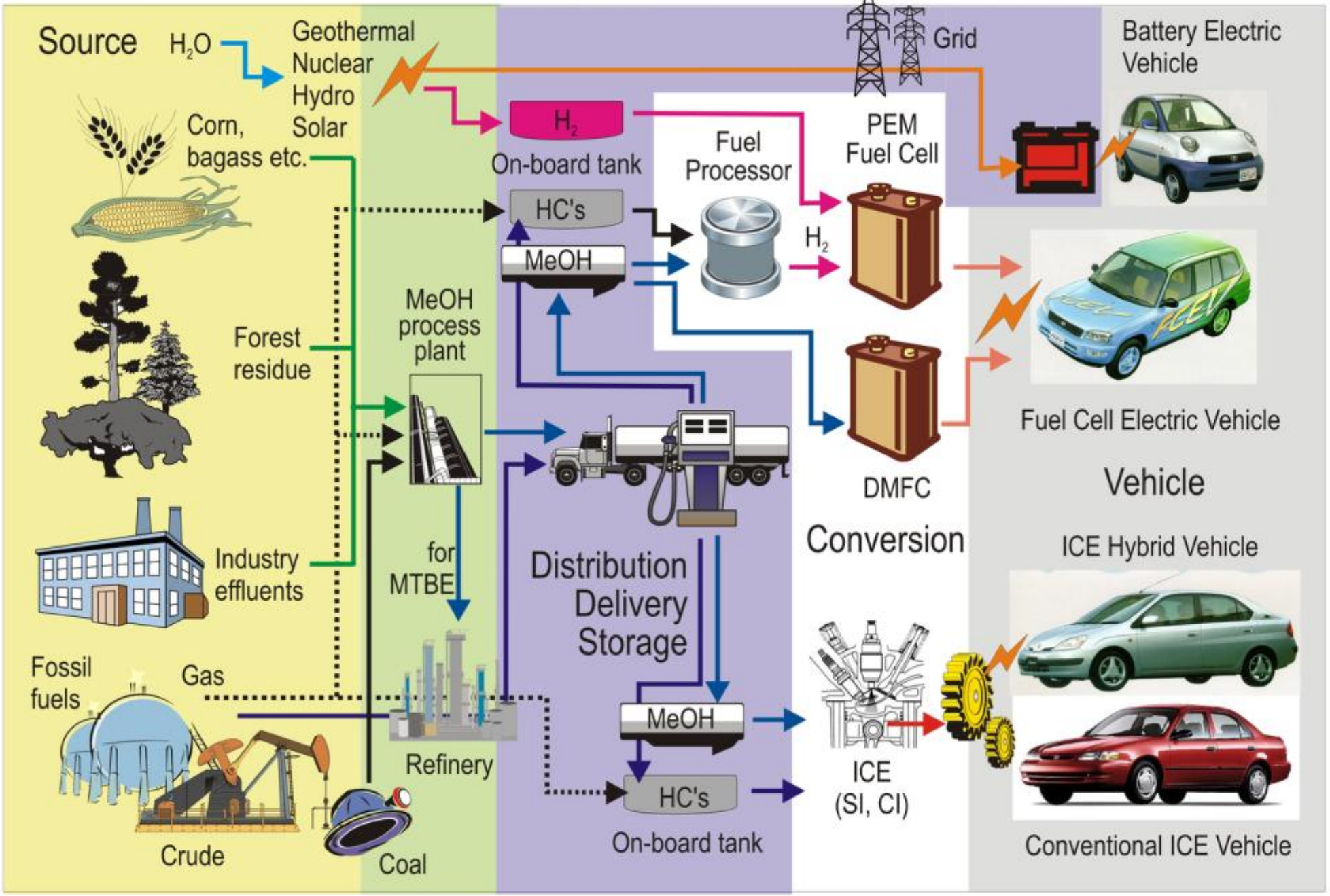

What Makes
the Prediction Difficult…

Traditional Pathway of Fossil Fuels in Transport Energy Use

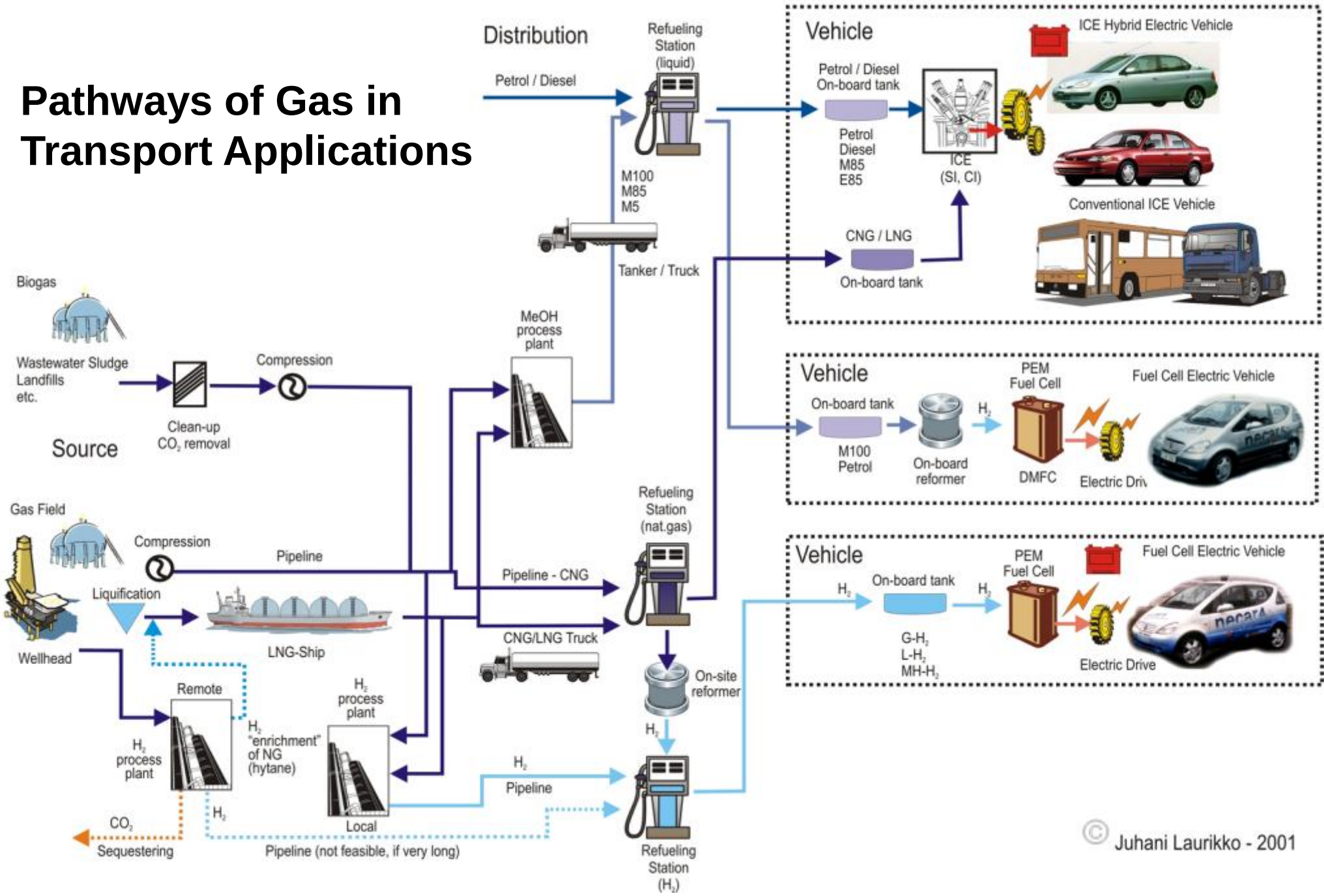


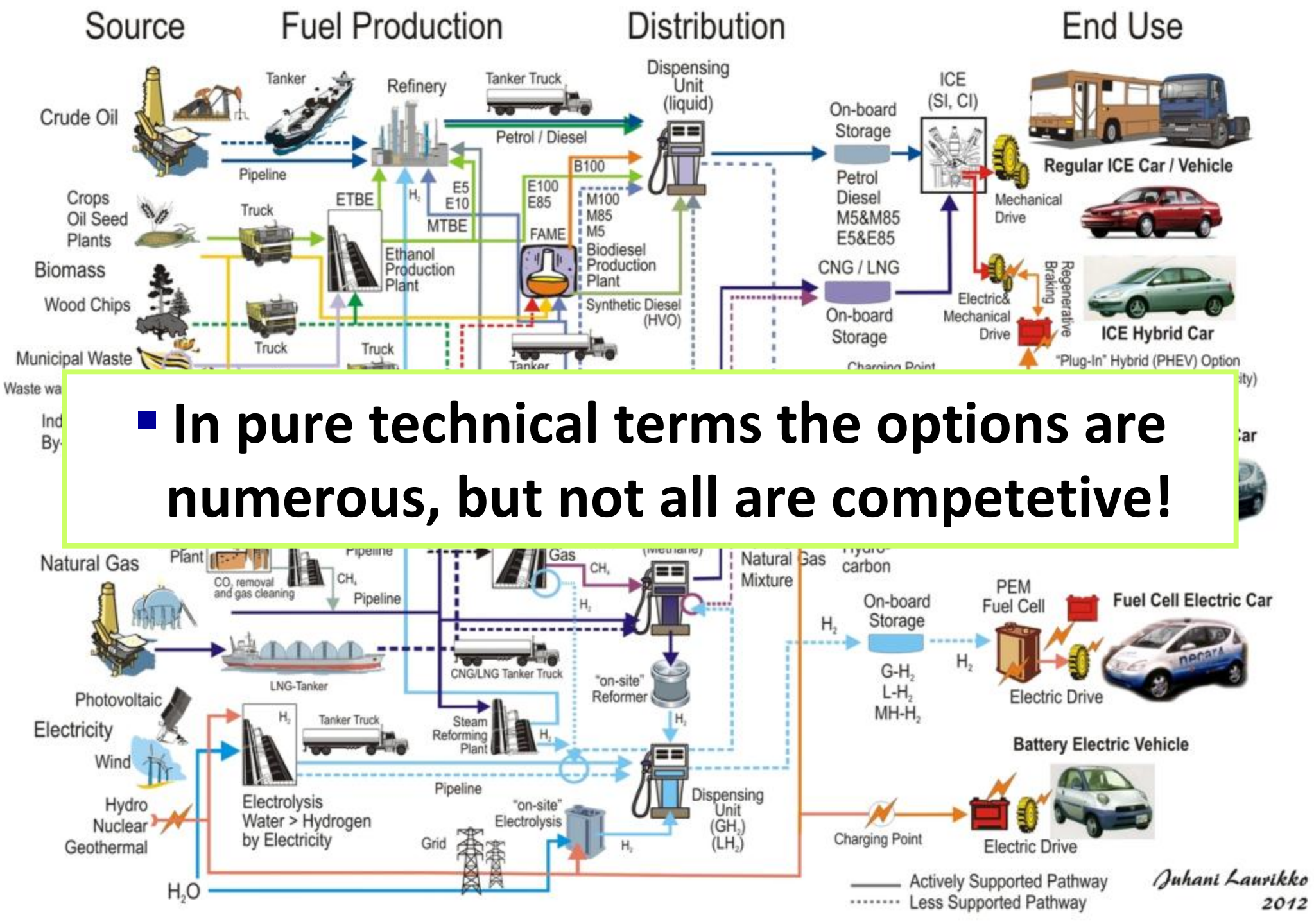
”The Race is On”

Pathways of Fuels & Energies in Transport Energy Use



Pathways of Gas in Transport Applications

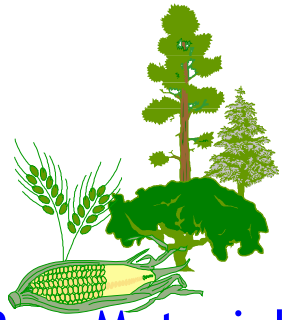




- **In pure technical terms the options are numerous, but not all are competetive!**

Pathway analysis – Well-to-Wheels (WTW)

Energiaketju - "lähteestä pyöriin"



Raw Material Extraction

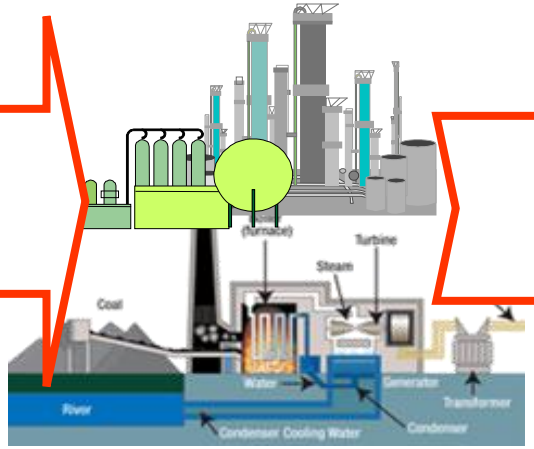
Raaka-ainetuotant

Primary energy

Primaarienergia

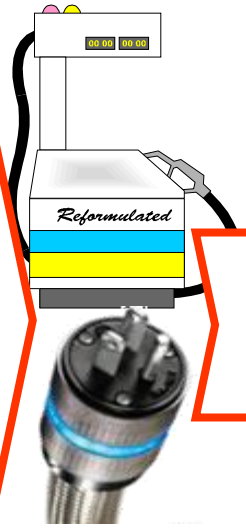
Fuel production

Polttoainetuotanto



Electricity production

Sähkön tuotanto

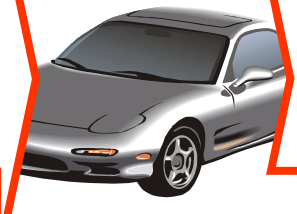


Distribution, Refuelling, Recharging

Jakelu ja tankkaus & lataus

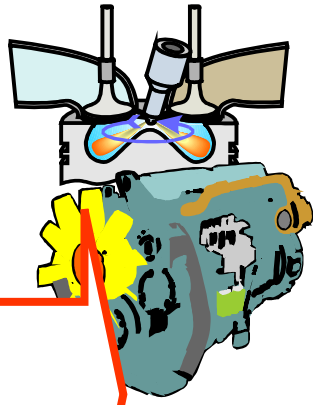
On-board fuel

Polttoaine tankissa



Electricity On-Board

Sähkö akussa

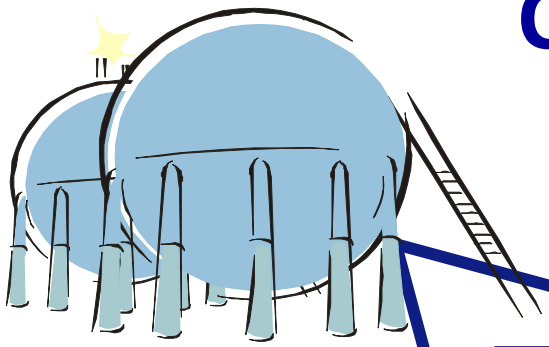


Energy conversion

Energian muunto työksi

Critical Issues

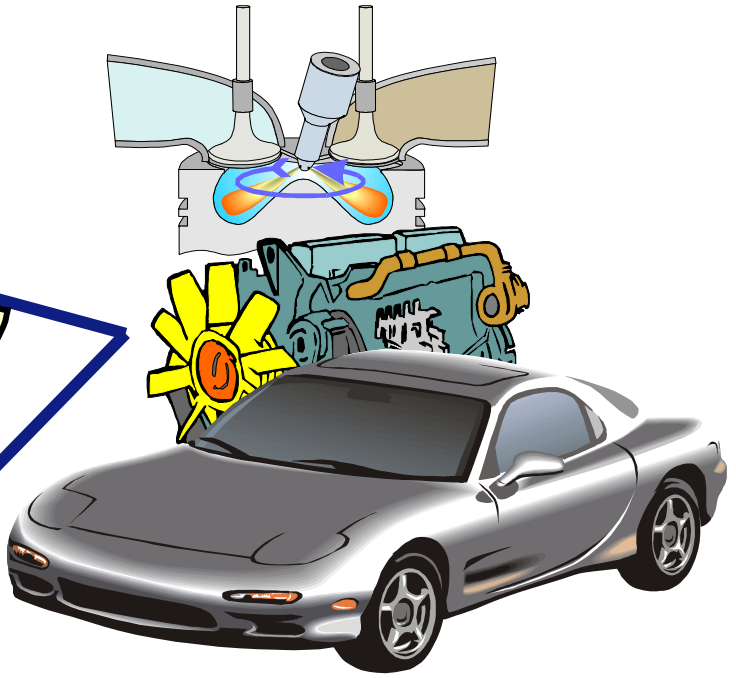
Kriittiset tekijät



Abundance

Saatavuus

Any one of these can set the limit!



Compatible engines&vehicles

Yhteensopiva kalusto

Refuelling infrastructure

Polttoainejakelu

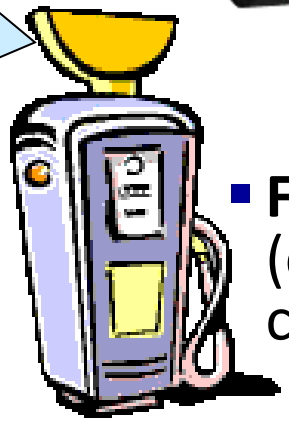
KEY DRIVERS IN THE OPERATIONAL ENVIRONMENT

- **Raw materials** (Abundance, costs)

- **Vehicles** (compatibility, performance)

- **COSTS**

- **Legislation** (exhaust emissions, fuels, taxes)



- **Fuel Distribution** (compatibility, coverage)

KEY DRIVERS IN THE OPERATIONAL ENVIRONMENT

- **Raw materials**
  (…ndance, costs)

TECHNOLOGY

- **Vehicles**
  …atibility,
  …rmance)

COSTS

POLITICS

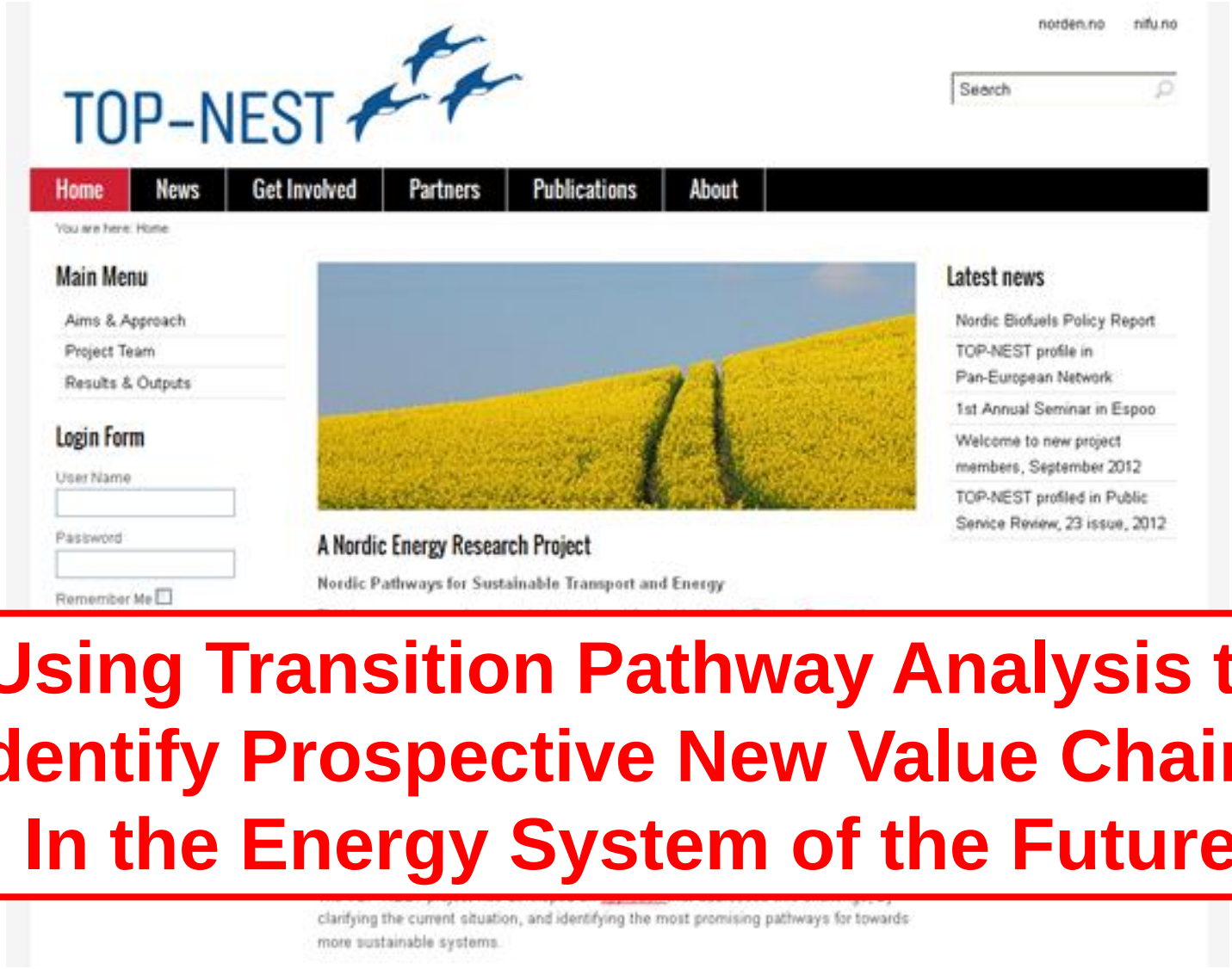
- **Legislation**
  (exhaus
  emissions,
  fuels, taxes)

ECONOMY

- **Fuel Distribution**
  (compatibility,
  coverage)


What Helps us out in
Our Predictions…

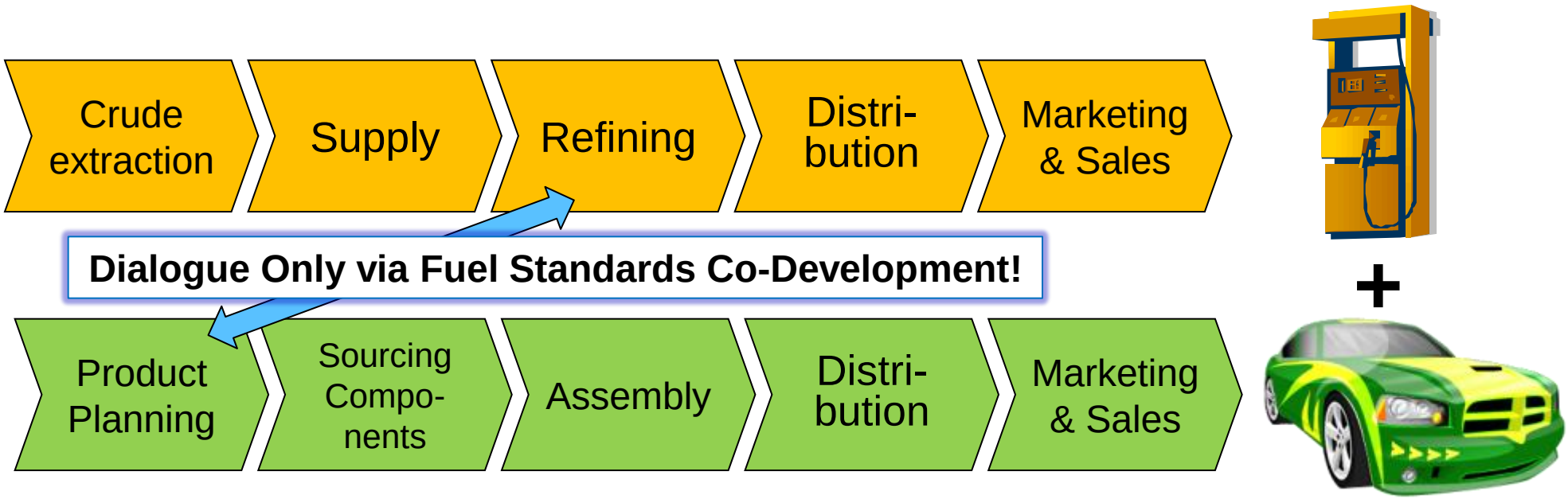
Use the Right Tools



Using Transition Pathway Analysis to Identify Prospective New Value Chains In the Energy System of the Future

www.topnest.no

Present-day Value Chains of Cars & Fuels



Well-Established and Long-Term Co-Existence, but No Cross-Ownership!


Opportunities

With the Introduction of Electricity as ”Fuel”, a New Value Chain Can Emerge

- Electricity generation is much more diversified and localised than present-day transportation fuel supply
  - ***Security of supply is inherently quite high***
- Power grid is relatively widespread
  - ***Must only concentrate to the ”last five meters”***
- Quality is not an issue - ”one size fits all”
  - ***No need to segregate ”transportation-quality” electricity***
- Also many fairly large, multi-national companies
  - ***Ability to invest, if new market is foreseen***

- But: Grid balance must be secured
  - ***Generation capacity must be exploited wisely: ”Smart Grid”***


CHALLENGES
AHEAD

CHALLENGES OF INTRODUCING NEW VALUE CHAINS FOR TRANSPORTATION SECTOR

Nº 1 - STAGNANT AND SLOW-CHANGING BUSINESS

- Status Quo for the sector is quite stagnant, because:
  - Very large global companies are overruling both stages
  - Huge incumbent investments
  - Long history and legacy, some companies over 100 years old
  - High degree of technology with emphasis on quality vs. price
- Strong competition between companies, but simultaneously strong and united opposition against newcomers

Nº 2 - "THE GATEKEEPERS"

- to be able to introduce a new fuel or energy carrier you must seek consent with the "Gatekeepers"
- Why?
- Because each one has his own key, and you need all of them:
  - **Auto industry** controls vehicle and engine technology
  - **Oil industry** controls the fuel and distribution infrastructure
  - **Financial sector** controls capital for new investments needed







AUTO INDUSTRY's KEY

- you must agree with the auto industry, because…
  - if the new energy product needs new storage and conversion devices on-board, like electricity or hydrogen, new cars are needed
  - considerable lead-time needed, if new technology is needed, as the auto industry has a legacy of safeguarding high quality and "crashproofness" of their products







OIL INDUSTRY's KEY

- you must agree with the oil industry, because…
  - if the new product is suitable for blending with the existing fuels, it can be distributed via the existing infrastructure
  - however, lead-time needed here also to ensure compatibility of the new product with the existing and future vehicle park
  - if it does not fit in with the existing standards, must develop new

FINANCIAL SECTOR's KEY

- you must agree with the financial sector, because…
  - if your product is non-compatible with the existing fuels, and there is no existing infrastructure for it, you must build one
  - Building new system will require heavy long-term investments, where growth of revenue and pay-back times will be very long
  - New fuel or energy need to be offered quite widely before consumers can commit themselves, unless bimodal cars are used

Nº 3 - ATTITUDE

“WE WELCOME YOUR NEW IDEAS, INVENTIONS AND INNOVATIONS WITH GREAT ENTHUSIASM!”













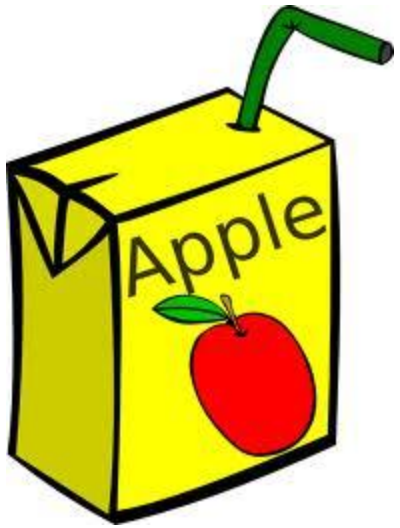


Are We in a Dead-end?

IS THE CURRENT BUSINESS MODEL THE ONLY WAY TO SUCCESS?

WHAT IF IKEA WOULD START SELLING CARS…

WHAT IF APPLE WOULD START SELLING CARS…



LIKELY IT WOULD RUN JUST WITH THIS!

WHAT IF APPLE WOULD START SELLING CARS…

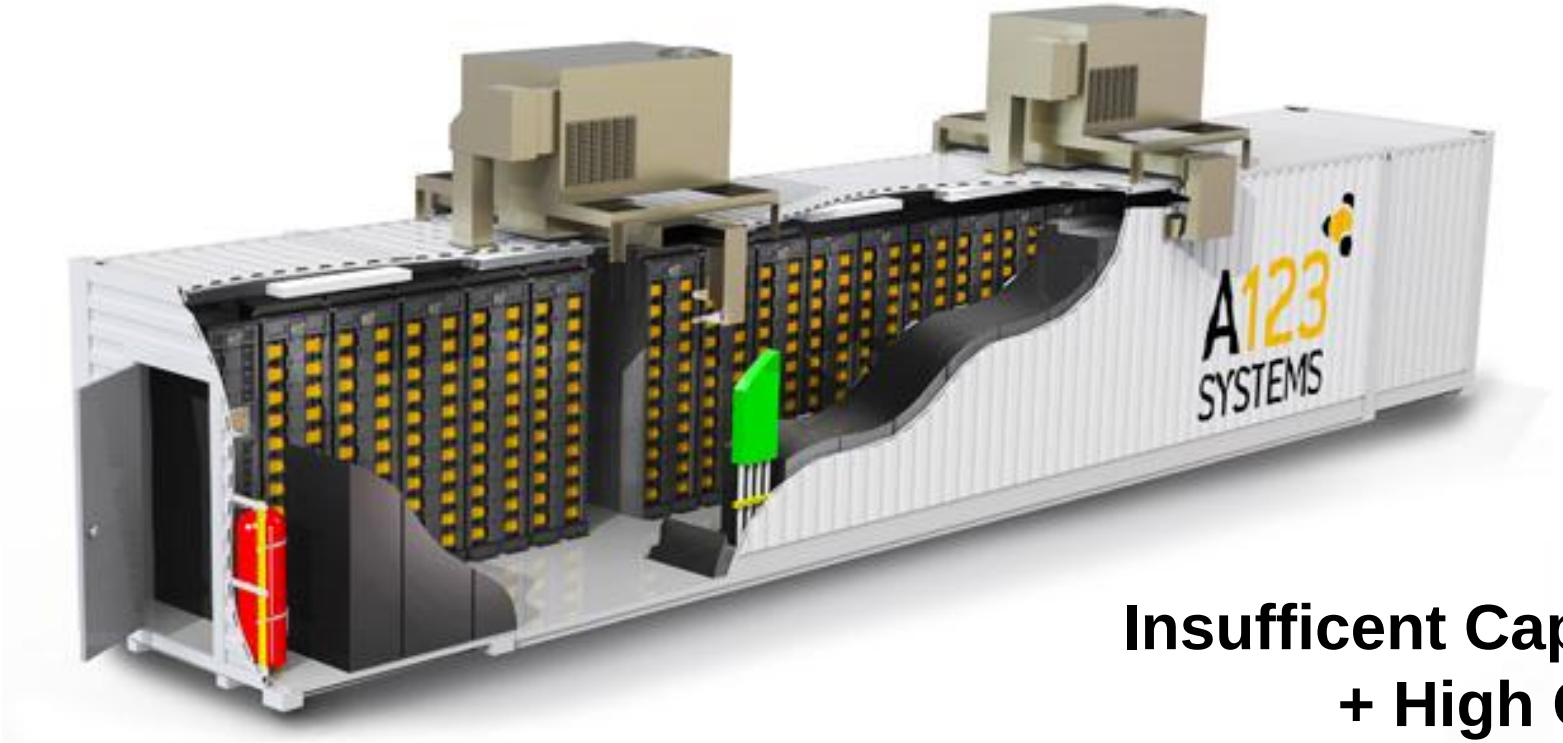
…PROBABLY YOU WOULD ALSO STEER IT BY WAVING YOUR HANDS!

CAN WE REALLY SEE THE GAME TO CHANGE?

YEAH, SOME REFRESHING NEW IDEAS, BUT…

Who is the Scapegoat?

Show-stopper Nº 1 – ”Battery Technology Sucks!”



Insufficent Capacity
+ High Costs
+ High Risks (lifetime?)
= Stay Away From It!

“Take A Detour Instead”


D 820
H2

”FUEL OF CHOICE” by the Auto Industry

CHEERS:

- **Even Higher Potential for Use of Renewable Energy Resources**
- **Decent Range with One Fill, and Fill-up Time Like with Petroleum Fuels**
- **High Efficiency of the Electric Drivetrain**
- **Fossil (Methane Reformate) Option Offers Nearly-decent Entry-level Cost per MJ**

JEERS:

- **Must Find Capital & Partners to Create Distribution Infrastructure**

New automotive alliances have been formed for FCEV commercialization in January 2013

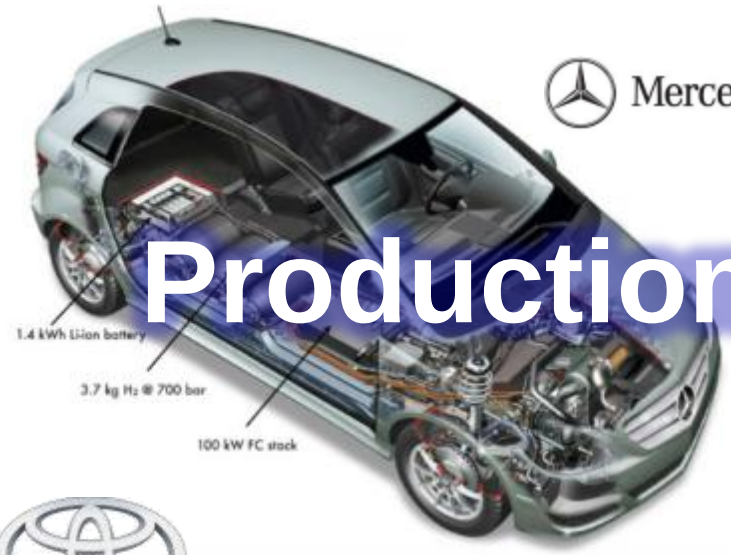
Timeline for Introduction

"Toyota FC → BMW

Mercedes → Nissan+Ford

”We Are Ready to Roll-Out”

Mercedes-Benz



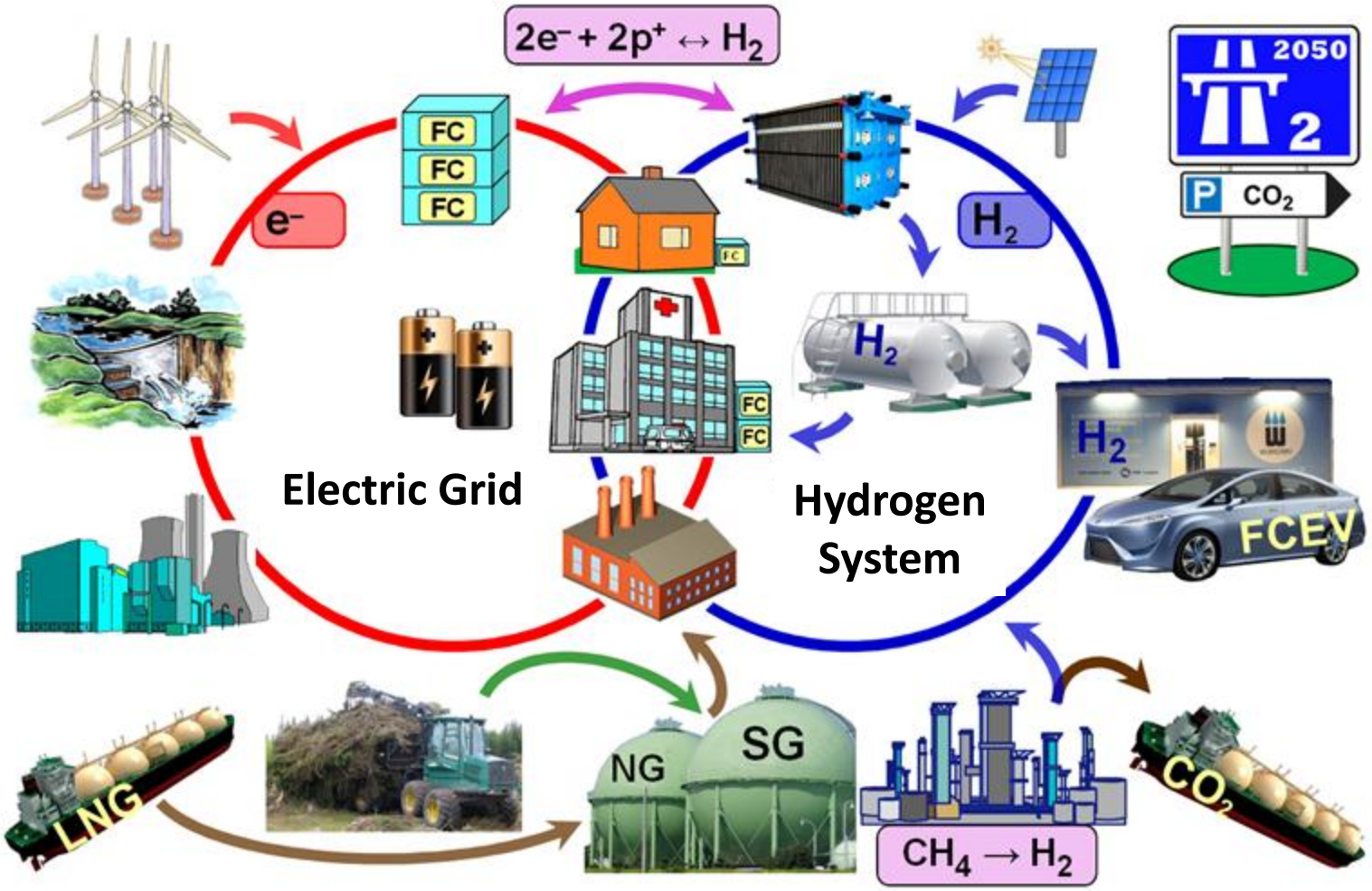
HONDA

Production > 100k by 2015

TOYOTA

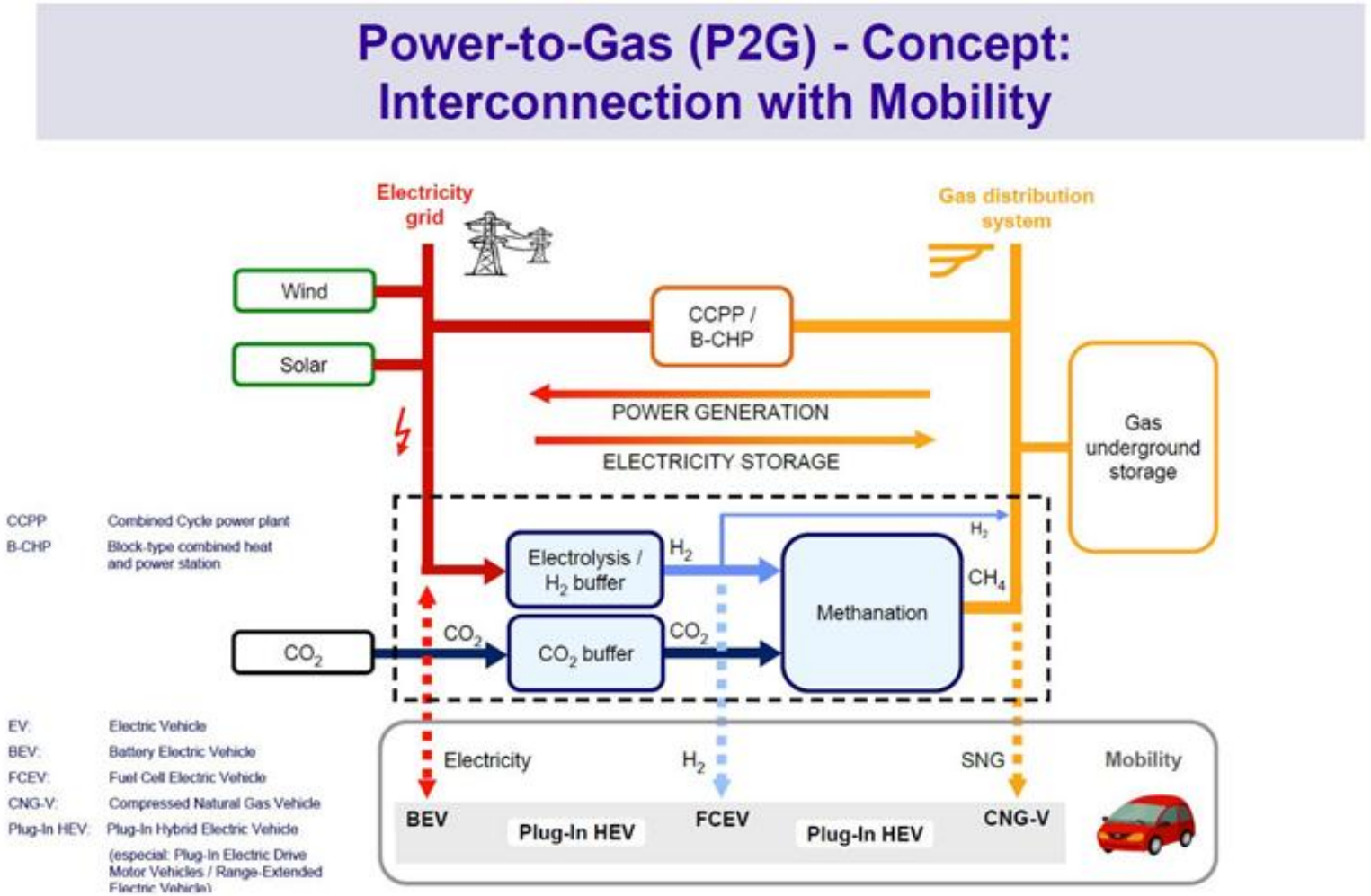
HYUNDAI

Integrated Energy System of the Future



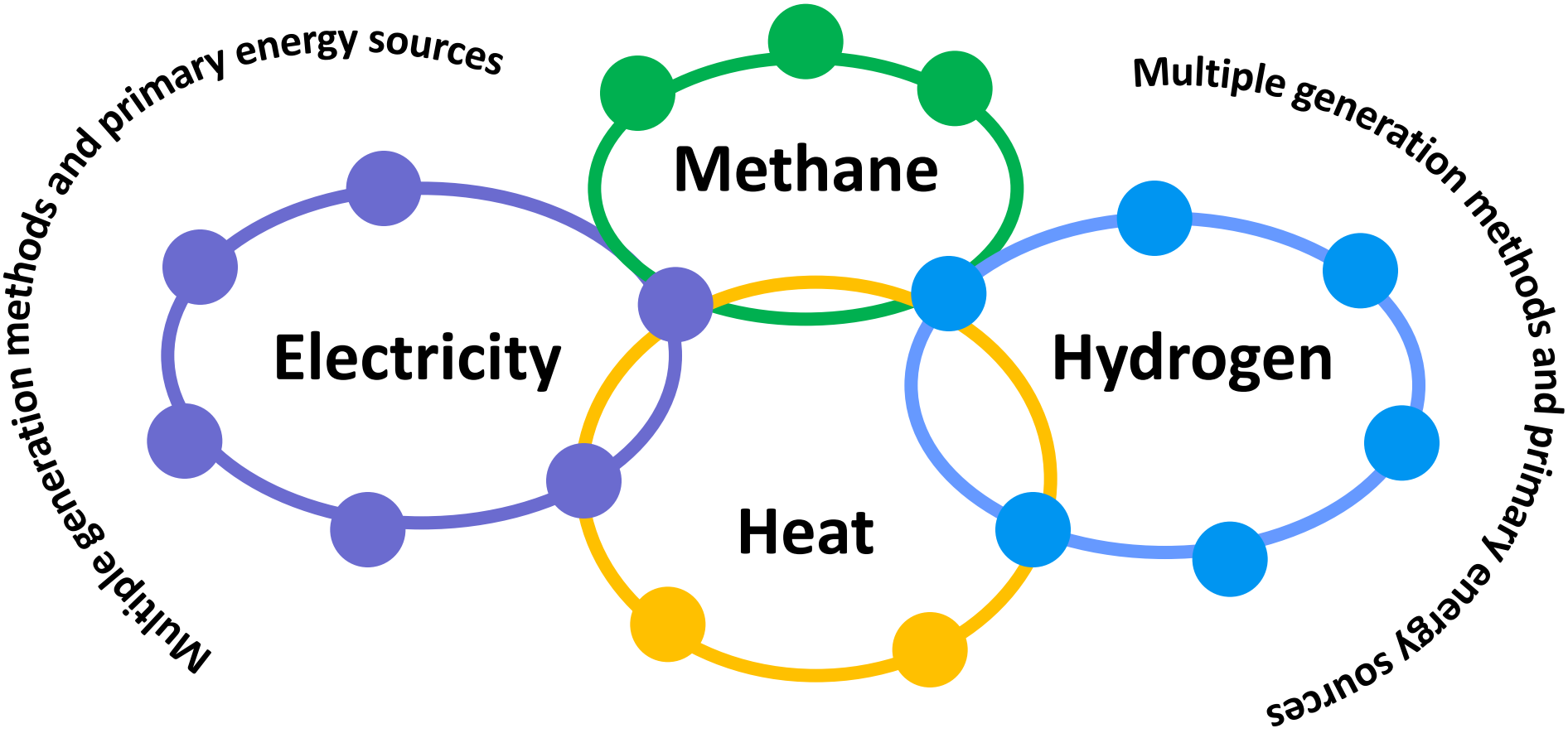
Graph by Jussi Solin, VTT

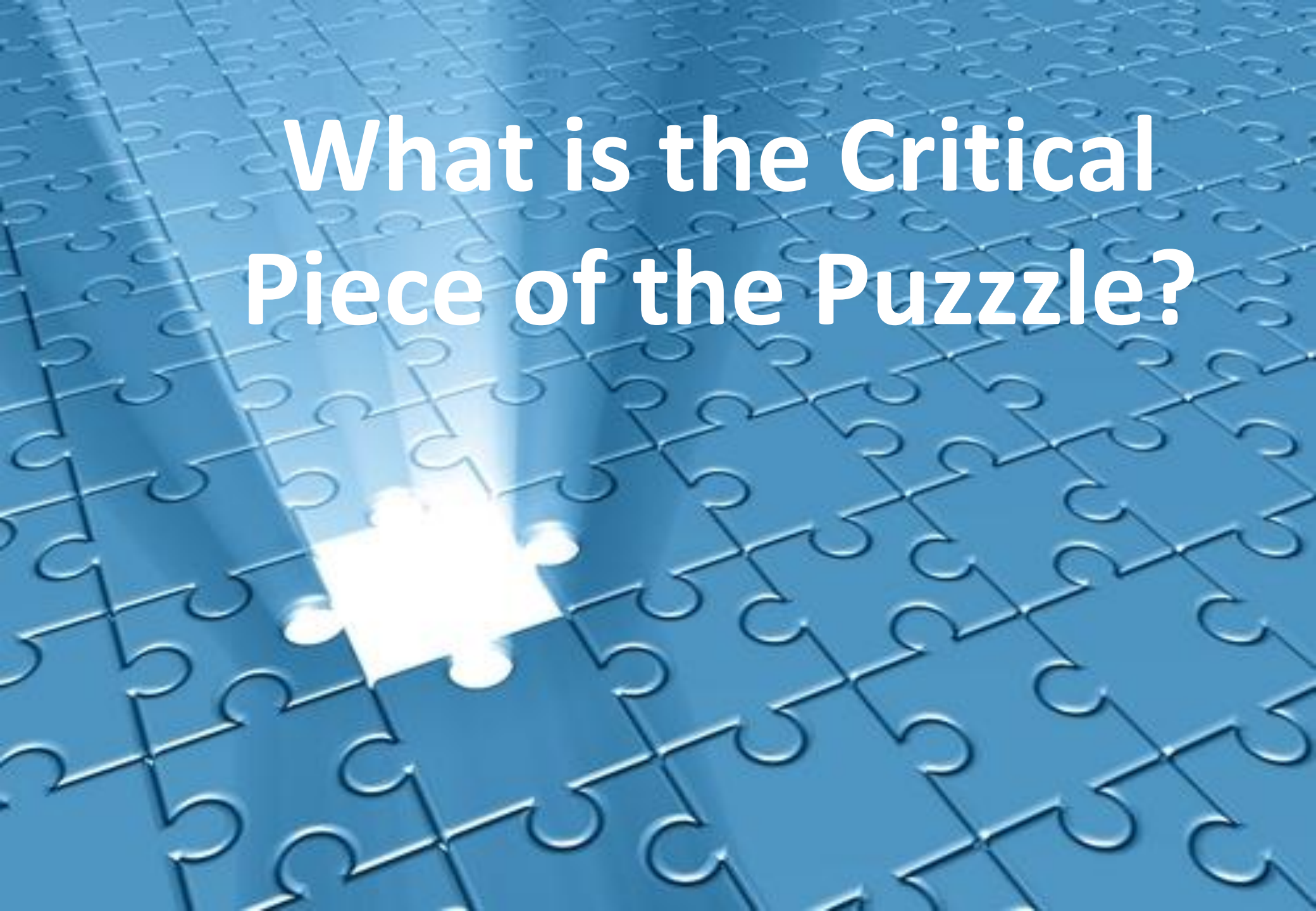
Integrated Energy System of the Future



German “Power to Gas” concept by Michael Specht, ZSW. see http://www.powertogas.info/

Parallell, Co-working ”Energy Circles” with Binding, Two-way Nodes




What is the Critical
Piece of the Puzzzle?

The Last Necessary Piece is…

"Lots of Lazy Capital"

CONCLUSIONS

- ***The Future cannot be predicted, but we can influence it***
  - It is based on our decisions and actions, not “God Given”
- ***The basis of the Future lies in today, mostly linear change***
  - So far, no strong disruptive game-changers
- ***Automotive/transportation sector is slow to change***
  - Huge, incumbent investments
  - Longish product cycle and vehicle lifetime

CONCLUSIONS

- ***Future challenges cannot be met with just one energy carrier***
  - Several co-existing fuels/energies and conversion technologies
  - However, future carriers are non-specific to transport use
- ***Lately, revolution has gotten more attention than evolution***
  - Strong battery-electric car hype, but poor industry support
  - Hydrogen fuel cell is seen more viable by the Auto industry
- ***Strong, incumbent actors rule the stage and slow-down change***
  - New and innovative value chains are difficult to create, even if lucrative
- ***Furthermore, we must always keep in mind***
  - “Affordability”, market-acceptance and trust of the consumers
  - You cannot mandate vehicle sales!

The End

Questions & Discussion

- Thank you for your attention!