well good morning everyone and welcome to today's Biz tech Huìhuà chat the
future of green hydrogen I'm absolutely delighted to be introducing this session today
it's been
a really full session uh we've got over a hundred people registered for for this
uh and I would like to provide a little bit of context to it for you before we begin I'll be
keeping my remarks quite
short because I have a very full program and people have been dialing in uh from all
over the world
now I'm Michael Mainelli I'm one of the directors as Z/Yen and Z/Yen has been working
very hard to try and keep
discussions and dialogue going on some more advancing topics that we see around the
world hydrogen is definitely one of
them uh we're also delighted to be doing this in conjunction with a CDI the China
development Institute our long-term friends who've been working on us for many years
on the Global Financial
Center's index and this particular session on hydrogen demand in the future
was something that I personally was very very keen on and I'm thrilled to see today on
the line a variety of people
from all around the world not just the biz text they want chats we wanted originally
which were between Europe and
China but in many other nations have come in today from Japan from Korea from
the Middle East and from America and although he won't be speaking today a
particularly warm welcome to my dear
friend Nick Schuss who's dialing in from Hamburg Nick has been a fervent adherent
and proponent of hydrogen for many many years over 35 years and has created the
H2 stifter which we'll hear more of later anyway just to try and set the scene many of the
people here will be experts
but for those who are not uh just a quick glance at some figures on hydrogen demand
so hydrogen demand you can see
here at 94 uh megatons it you know is a five percent increase on 2020
um between 2020 and 21. uh demand is it seems okay new applications are growing
quite rapidly but I contrast that with uh where the Institute sorry IA the
International Energy uh Authority uh the expects things together by 2030 to be at
around the 180 million uh sorry 180 Megaton Mark now you look at that you
say well that's actually 100 increase and I'd say in many other industries that would be
quite good over the next
sort of eight years or what have you but in truth uh for a booming industry that's
supposed to be supplying uh the
global energy Transportation around the world that seems uh given the scale of the
climate change challenge a the low
but our experts today will give us a lot about so if we move on to the next slide because
um one of the things like here are the color codes of hydrogen uh it's often
said that there are seven colors in the rainbow and you can see here that we've already
got six colors of hydrogen I'm

not quite sure what we're missing uh purple or what have you uh but despite the terminology in the field it
basically boils down to you know do you produce it a green you know fully renewable using techniques that are
emitting absolutely nothing or do you have variants along the way uh that are
in some polluting uh with possibly I guess pink uh the most uh interesting outlier there simply because it it
depends on where you fall on nuclear energy being green and renewable or whether you think nuclear energy
shouldn't be so we're going to be hearing a lot of those color codes but at the core of the debate for me is is
really what is this is is this a transportation mechanism or is it an end
use production mechanism but whatever it is and one of the reasons are quite interested in it whatever
hydrogen is uh it is going to be traded and that is one of the reasons we would
like to keep these discussions going uh because at the training level we feel that we have a lot that we can bring to
bear now the program today was a fairly straightforward we're going
to try and get a number of people uh as you can see on this slide here we're going to try and get a number of people
to present Michael can you thank you and we're trying to get a number of people
uh to present so that we can actually have a decent amount of questions comments and discussions uh Mike and I
have assembled a crowd with the help I say the enormous help of CDI uh so we'll
be starting with Dr Leo you that will be moving back here into the UK for Hugo
spowers who's an engineer with River symbol which is doing a hydrogen Automobiles of Transportation uh back to
China back to the UK for an analysis view back to China on on some of the
Sciences uh back to the UK for element two um which is uh trying to build hydrogen stations in the background or when it comes to questions and comments and observations uh we have Marcus and Timo
from the h to shift that Nicholas she was founded and H2 shifting is trying to
build the global market uh and we'll be hearing more about that from Germany so it's going to be uh bouncing around
quite a bit if I if you don't mind I'd like to ask the speakers to please keep the time and could I also leave people
out there because I can hear if you live please check if you're not speaking please put yourself on mute I've heard a
dog and a sneeze and a few other things so uh just just please use your move buttons and so with no further Ado uh
asking Mike Wardle who's behind the scenes and we'll be leading uh the question time Mike would you please uh
hand the floor to Dr Leo the executive director of the new Energy Research Center uh who's with the China

development Institute thank you thank you very much and Dr Liu please
take the floor uh distinguished guests good morning good afternoon
I'm going to share with you the uh one of the three most dynamic
regions in China namely the greater Bay Region and its
development in hydrogen as we know the greater Bay Area or the GBA is one of
the important economic powerhouses in China with a total GDP of 13 trillion uh
that was in 2022 that accounts for 11 in China's GDP
economic development is one of the important features in the GPA but
looking back on its energy consumption it accounts for larger proportions in
the total consumption of China That's roughly 10 percent that's to say the GBA is not
owning a
center of economic development but also a center of energy consumption let's
take a look at its energy structure well as for Energy Mix
the greater Bay Area has three regions two
special administrative regions and one province in terms of primary energy
source Guangdong Province Hong Kong and Macau still rely most of the time on fossil
fuels if you look at your left hand side the feet the first picture the first
chart shows that whole natural gas and fossil fuel still accounts for a large
proportion as for Hong Kong coal and oil
make up 90 or above in its primary energy source but things are similar in
Macau oil and gas account for high proportion whereas electricity
is most of the time generated by fossil fuels but you can see that in the next
chart in terms of installed power
most of them it's still fossil fuel that means the primary
energy consumption and energy electricity generation power generation
are still very much rely on fossil fuel indeed our first picture you can see
that a thermal power accounts for the highest proportion in Guangdong Province
in 2018 the number
was 80 million uh kilowatt hours and in Hong Kong Paul
fired power and natural gas have a very high percentage over 90 percent well
things are similar in Macau and we can draw a conclusion namely we
have a very high proportion of installed power capacity relay reliant on fossil
fuel and to reduce carbon uh
and commission emission we need to move forward
and move towards and the transition relying on renewable energy I believe
one of the directions one of the possibilities is as the theme today shows uh is to
move forward the energy transition in Greater Bay Area through hydrogen I
believe the moderator and the chairman also said that in the future we're looking at
much higher uh capacity of
hydrogen and by 20 30. um
it's going to reach a milestone given its safety
and given its economy hydrogen has become an important energy source
it's a renewable energy and it's a
generation is from electrolyzed water which is very clean

so there is very good output for the development of green hydrogen
as for its economics given lower cost of hydrogen energy storage and the use of renewable energies hydrogen can be a new way of storing
energy and as a big Power in renewable energy
China with energy can avoid waste of power for example curtailment of wind and PV power speaking of its safety hydrogen
can also feed back to electricity grid maintaining its
reliable operation and it's useful for China to set up a new type of electricity system featuring renewable
energy so from an energy safety energy security point of view hydrogen works as a stabilizer for the National Grid what are the challenges faced by the
greater Bay Area you can see in the chart on the right hand side
some cities in Guangdong Province proposed to develop actively develop energy through hydrogen for example we have a target of reaching 10
000 hydrogen-powered vehicles and building 200 hydrogen refueling stations
many cities have their own plans for example Guangzhou aims to reach
60. yo billion of uh RMB worth of industry for hydrogen and
by 2030 the goal is to reach 200 billion RMB forshan is a good example of hydrogen development and its goal is to reach a 100 billion RMB Market by 2030.
likewise Hong Kong is going to put energy a hydrogen power the buses on the road this year many other cities all came up with a ambitious plan to develop
um hydrogen but the reality is where do we get
hydrogen in what way in what model so we can support Industrial Development and the operation of hydrogen cars energy storage and electricity grid on
the left hand side you can see some numbers take Photon as a good example of hydrogen every day we are talking about 16 to 18
tons of hydrogen but there is only a capacity of 5 ton per day in this city
despite its ambitious goals the shortage of hydrogen
uh given that only one third of hydrogen-powered vehicles can put on the road due to the shortage of supply I think one of the options
given the energy shortage is to give a strong boost to Green hydrogen and for that we have to rely on offshore wind we need to make use of the abundant resources from offline wind power so we can realize localize the supply of hydrogen we believe that's the most important solution to the hydrogen shortage in the greater Bay Area
21.1 percent is from the byproduct hydrogen from Industries there is only
one 25 percent is provided by the electrolysis of water for Guangdong Province and also the GPA the major share is still from the industrial hydrogen production which cannot ensure other industrial needs in the future we can learn from the European countries with UK included we would like to make more Explorations on how we can produce more hydrogen using the offshore wind energy in the future with the production cost going down that will be very potential little will elaborate on this we know that Guangdong is endowed with a lot of resources we always very rich offshore wind and we

also have the planning for the wind the power plants over
3013 million kilowatts and we have a lot of Island resources to promote the development of hydrogen production in the future with the decreasing cost and also the lowering technological barriers the course for offshore wind hydrogen production will be going down which will be much lower than that is being introduced by other moderator we
estimated that the production cost will be about 10 AM billion per kilowatt over
in the future if the GBA can promote the hydrogen production using
offshore wind energy and we can develop the Upstream
Downstream in this case by 2025 the output value
for the hydrogen will be about 1 trillion by 2035 it was among to five
Training ambivalent and that will be very conducive for the construction of
marine time ocean economy which include the Marine bonds blue energy
and we can also promote the hydrogen production using
the offshore wind energy which include the power generation
hydrogen production the sea water Des sanitation the Marine Temple branches
storage the Verso hydrogen refueling so as to have the Net Zero development of
the islands that is on my presentation thank you so much well thank you babe thank you very much
um and we're going to move swiftly on um to our next speaker to hear from Hugo
spouse the founder and chief engineer at riversimple I'm speaking from River simple we are a
sustainable car company that I set up uh 20 years ago explicitly uh we are a
sustainable car company rather than a hydrogen car company uh we don't argue about whether we whether solar PV or
wind turbines are going to win the Renewable Energy race they're just different and we need them both and I
think the same's true of batteries and and hydrogen however nothing can be as sustainable as a hydrogen car but the
sort of range to which we've become accustomed so there is a a sense that uh
battery cars have won the the race there's a lot of battery cars around there's very few hydrogen cars but I
think it's quite explicable really when you look at the maturity of the Technologies
battery cars are not new
we've had them as long as petrol cars the car on the left broke the land speed record in 1899 running on batteries it
was the first car 300 kilometers an hour and this is uh on the right a picture from Mercedes-Benz website
they meet as the world's first fuel cell vehicle I think it's probably strictly speaking the world's first uh Road
registered fuel cell vehicle but nonetheless you can see that there's a lot of work to get all that technology
in the back that fills the back of the van under the Bonnet of a car at the price that customers can afford with the

reliability we've come to expect and um by and large apart from uh
countries in the Far East the European and American manufacturers have really not been investing in technology over
the last 25 years that they must have known that they were going to need so now that the regulations for tailpipe
missions have come in there's a rush to produce air emission cars and the only thing we're ready to produce in Europe
is battery cars so and we have to sell them to avoid the fines and we can't
sell them if we say this is just a stop Gap measure we're going to sell you something else in five years time so uh
uh I I think that probably every car manufacturer in the world now has a a serious hydrogen vehicle program
including the ones who deny it there is one um uh Mantra that we we don't entirely agree with and that is that we need hydrogen for trucks because they're large and we'll do cars with batteries
we do need Hydro trucks that's absolutely true but it's nothing to do with their size and there's two examples
I can give to illustrate that one is you can easily make a battery electric hgv if you're happy to do 50 miles a day but
it's not what hgvs do it's the range and the uptime the other example down below is that the
only mature market for hydrogen Mobility today is in Materials Handling forklifts
and pallet carriers I believe that over 30 of food in American warehouses is now moved by hydrogen and a pallet carrier
one man with a joystick moving a single pallet is not a large device so clearly size isn't the issue it's again
utilization and this principle applies irrespective of size or weight from a
pallet carrier right the way up to a a forklift truck
and this is showing that the longer range vehicle problem with battery cars
the orange dots are the battery cars available on the market today in the UK
and as you can see there's a strong correlation between cost and range the
range is the vertical scale and the horizontal scale is the total cost of ownership for a three-year for three
years of one of these cars and you can see that a lot more money
buys you a little more range on up at the top is a red dot and that's
a basic Ford Fiesta and however much money you've got there is no battery car
on the market that you can buy that gives you the equivalent range to the basic Fiesta the green dots are hydrogen
cars you can see they're above that band and the market we're aiming at is the
equivalent cost of ownership of of a of in fact a golf um but with equivalent range as well
and uh with hydrogen we feel that absolutely this is this is commercially viable Here and Now
those longer range battery cars have enormously expensive batteries our car

weighs less than the battery does in any any of the long range uh battery Vehicles available today
and unfortunately though battery electric powertrain is very efficient
the efficiency of the vehicle depends also on its weight and if you have a heavy vehicle with a very high
powertrain efficiency it's still an inefficient vehicle and we can see that with petrol cars they range between 20
and 23 percent uh powertrain efficiency across the board today but the fuel
efficiency figure of the vehicle varies wildly so clearly there's something else to the the story than um
than powertrain efficiency and weight is the the chief issue as you build a battery car for longer and longer range
you need more and more batteries each battery takes you less far than the previous battery because the car is
getting heavier and less efficient and we have got a serious problem with uh resource allocation this is a summary
by the Spiegel of some International Energy agency figures on
um raw materials needed to hit Net Zero and this is if we're going to do it with battery vehicles and you can see it's a
13-fold increase in Global Production in the next in seven years time and 25 fold
in in 24 by 2040 and it's not just battery vehicles that need these raw
materials the whole renewable world is much more dependent on critical materials than a fossil based world that
can muddle through with steel and Alley and we need better ways of allocating resources and certainly putting 900 kilos of raw materials into a battery for a a single personal use is is not a
practical uh allocate solution in the long run um that's by comparison what would be needed for hydrogen vehicles um there is not nearly enough emphasis
We Believe on the business model of the industry at the moment if we sell cars we make more money by selling more cars
so we're rewarded for maximizing resource consumption and I don't see how we can ever have a sustainable
industrial society based on rewarding industry for the opposite of what we're trying to achieve
if on the other hand you sell the vehicle as a service much more Revenue goes to the Vehicle Manufacturer and it
if it stays on the balance sheet of the manufacturer they're rewarded for longevity rather than obsolescence for
low running costs rather than high running costs and uh and it turns efficiency and sustainability more wild more widely into a source of competitive Advantage rather than a a a
um a cost on the bottom line it also eliminates the economic barriers
from bringing these new technologies to Market if you sell cars you've got to match the extraordinarily low prices of

conventional cars today and uh and to do that you need to get the volume up but to get the volume up you need to get the
price down so it's a chicken and egg if you sell the service of the vehicle uh
the pricing for the customers based on Lifetime cost and end-of-life value recovery lower operating costs and
longer revenue streams can all offset a higher build cost so you can come to Market an equivalent price to the
customer long before it's as cheap to build finally I'd just like to have uh say a
couple of things about uh um uh green hydrogen and hydrogen production and the transition to a truly
renewable energy Society River simple was set up for environmental reasons it's our rate on death and clearly the
end game has to be a hundred percent carbon-free hydrogen but I do have serious concerns about the how we're
getting there I'm concerned about this rainbow and I'm concerned about the Mantra that the only good hydrogen is green hydrogen clearly
this is true in the long term uh but it's not going to happen overnight night and we can't insist that New Uses of
hydrogen have to be in lockstep with green hydrogen we didn't do it with battery electric cars we didn't say you
can only use a battery electric vehicle if you charge it with green electricity and and it will hobble both the
deployment of hydrogen vehicles and the development of green hydrogen production if we if we put them in lockstep
obviously for vehicle deployment it's harder if we insist on Greed hydrogen only if we don't allow cars to tap into
the 70 million plus tons of hydrogen that we produce but also if electrolytic
hydrogen production is to use any green hydrogen it's not going to be able to generate operate 24 7. a study for the
Welsh government estimated that to give equivalent yield to a 10 megawatt electrolyzer you need to install a 16 megawatt
electrolyzer over 50 extra capex if we're going to use uh green a green
electricity only and finally um hydrogen from methane is 75 efficient
whereas it's considered our cleanest form of fossil generated electricity at 49 which brings me back to my first
point from the whole system perspective we decarbonize quicker if we use green electricity to displace natural gas from
electricity production at 49 efficiency rather than to displace natural gas from hydrogen production at 75 efficiency I'll leave it there thank you very much
well thank you very much either um and you know a perspective there from
um the real industry side of a patron and its use I'm going to now um ask Dr
Liam Faye to take the floor professor at the Hunan University of Technology and business

yes I'm here thank you very much for this opportunity for sharing my studies and some ideas
um sorry the material is still in Chinese so allow me to switch back to
Chinese since we have an interpreter here um
first of all I would like to extend my gratitude for having such a opportunity
to share with you of my studies my studies are on the hydrogen I've been
working on this topic for many years starting from 2017
2018 till now so within a short period of four to five years I have witnessed
the writing of the hydrogen so I would like to elaborate from the
policy making perspective pathological perspective and also commercial development perspective the past four
and five years have witnessed the rapid
progress of hydrogen in China even the World At Large I still recall that about
one year ago we are talking about the power generation
power grid integration and also the electricity
loading integration hydrogen in China's
policy making profile we can see that it is important energy storage
means by now we are not talking about the PV winged
hydrogen and also the energy storage in this sense it has become
future green Energy Mix featuring
bring hydrogen so I think the changes will be very meaningful
and have great implementations on us in the future about seven years ago we have
conduct research and I think this research is quite forward looking and we
put forward that in China how can we commercialize the production of hydrogen
in China we started with large-scale
demonstration we proposed this in 2020 and we published a paper in 2021
on a scientific journal back then we interviewed government
institutions scientific institutions um companies and some International
think tax um about energy and some acting
Academia as well we did two rounds of a questionnaires
the goal was to help China find and identify proper policies
to promote the implementation of large-scale hydrogen projects that was
what we did three years ago but today
there are many large-scale commercial hydrogen projects that have been already
implemented I'll give you our conclusion in a moment
we aim to realize that in five years but actually it was
completed in only two years we asked one question what's the role of green
hydrogen in China and are people satisfied with government support and
how many years does it take to use hydrogen at Large Scale the answer
was five to ten years but in reality uh this speed has been much more
accelerated in some Northern provinces like inner Mongolia
if we are talking about Green hydrogen projects with annual capacity of 10
000 or more uh there are many but years ago there was
only one project in Junction they use the wind power to support the

production of green hydrogen powering their own um fuel cell vehicles
up until now gray hydrogen have been used so back
then green hydrogen was owning a wishful thinking
and it wasn't reality yet and we have also learned what challenges people were
faced with when it comes to Green hydrogen there are
chat uh there were indeed some policy barriers and a shortage of
infrastructure we also learned learned this information according to
the response we received we came up with this road map
predicting in which sectors green a hydrogen will be looking at a keen
demand most of the colored boxes circle around
midterm namely five to ten years some sectors have moved faster
so China has moved fast in general when it comes to Green hydrogen we thought
fossil fuels and ccs would be one of the major methods of the hydrogen generation
hydrogen from a renewable energy will pick up in the future but not yet we see
that the hydrogen pipelines were being built by cyano pack in Beijing and inner
Mongolia so we believe the large-scale commercial projects have already started
some experts here mentioned the possibility of international
hydrogen trades in the future I couldn't agree with him more and we are also
actively promoting a project in collaboration with with
Mongolia that is an area in inner Mongolia which is abundant wind and PV
power years ago Mr yashi's son from SoftBank Japan proposed a plan to use
electricity grid to generate hydrogen back then it was called Asia supergrade
but it was difficult to put that into
reality because technically speaking it would be extremely difficult to connect
everything and there were energy security concerns but we believe it's
highly likely that we can turn this energy into green hydrogen because they
are as tradable as oil and natural gas the only difference is that we can use
green electricity as a medium and traded as a green commodity in the global
market so in 20 21 we started a research project
covering different aspects geopolitical uh energy environment industry
technology economy Etc on how we can turn the project in
inner Mongolia into a real green hydrogen industry so it can serve the
whole North East Asian market We Believe China Japan and Korea will become the
main Market that will see a keen demand for green hydrogen
we believe it's highly likely to develop a huge amount of
and the renewable energy in this region and and that's the region colored in
yellow you can see we can transport hydrogen
through some pipelines connecting to bohi Bay in Northeast to China because
if we are looking at the routes from Australia to Japan or from Brunei to
Japan this long-haul Transportation projects of hydrogen have been very
successful in the pilot stage so technically it's doable and we have done
some calculation it's also feasible so in terms of technology
technology environment eventual political areas this project will be very feasible

and we have also learned the possible challenges and the solutions we have done research into the details and the
re results of the research were published on a scientific journal
in Chinese we have also drafted a road map on the possible
actions before I close I'd like to give you some
updates on the development of hydrogen in China as I said in China
the number is that by 2024 by the end of
2024 we will see uh the production of 650
000 um uh tons per year we're talking about individual projects uh per project
so how can we absorb such a high level of energy this is even higher than some of the European countries when it comes to the production and usage of hydrogen in the early development stage China produces uh
hydrogen in certain areas and absorb and use them in local areas because this hydrogen projects are largely combined with a petrochemical
stew making and other projects at the end of last year before early
this year there was a new policy in China being rolled out
saying that petrol chemical industry will be included in the carbon trade
market in China against that backdrop petrochemical
companies are highly motivated to deploy Technologies and projects around green hydrogen so green hydrogen will generate profitable returns in carbon trade
projects in the future for the very reason this hydrogen resources are consumed and absorbed locally and they're also building pipelines transporting hydrogen from western China
to Eastern China these pipelines will be built very soon covering a length of 400 kilometers this is going to be the very first Hydrogen pipeline in China the
only pipeline specifically used for hydrogen so I'm very optimistic and interested in the development of hydrogen energy in China at the same time we are
moving forward with a new research project we predict that the hydrogen
industry in China will become a leading industry in the world if that's the case China's International cooperation on hydrogen will become an important piece
of the puzzle so we are doing a research project on how China can be better involved in international hydrogen ecosystem so these are some updates on
our recent project and we look forward to more in-depth cooperation with you in the future thank you thank you very much Dr Lee um I'm moving swiftly on to Rick studdard's climate change specialist for the beaver investors uh Rick over to you great thank you and apologies that I haven't got a slideshow so you'll have to enjoy whatever background is behind
me um so I've worked on climate change investment funds for the last 17 years and have been following the um the debate around hydrogen for a while
um and seen the sort of hype bubbles come and go and I think over the last few years I've been Amazed by the amount of research that has been generated by the discussion around hydrogen um you know that we're seeing
uh recently so as we've looked into it we've looked into what are the potential future uses of hydrogen um and so for this we have uh isolated

it into could it be as a source of power and we you know as Hugo said we don't think it would be an efficient replacement for uh fossil fuels where we are seeing the cost declines of
Renewables and energy storage becoming much more competitive
um as such it may have a role as a form of long duration storage
um though even here we're seeing other competing Technologies in this space so nothing certain with regards to power with regards to heating we can split this between the Residential Heating markets and Industrial heating from the residential side there's a lot of discussion about blending uh hydrogen into the the existing gas pipelines but as we know you know once you get over that 20 blend it becomes corrosive uh to the pipeline so we would need to exchange you know change out all of the systems and pipe Works supplying supplying gas or in this case hydrogen to the residential Market uh making it uh quite cost prohibitive uh and then on top of that we would look at the efficiencies of a hydrogen boiler versus a heat pump and we see that the cost efficiencies of a heat pump are four to six times that of a hydrogen boiler so we we don't see any logical reason why hydrogen will play a role in Residential Heating um so uh but then you know it comes to
the other argument is it can provide high levels or intense heat for industrial processes for steel and aluminum chemicals for example
um and so we do think it may have another potential role in that market though equally we also conscious that there are other forms of electrical Heating and whether infrared or
um that can deliver similar levels of heat so again
another competitive field for hydrogen and then we think about transport so uh you know at the moment you look at the market uh it is dominated by electric vehicles we don't think that is going to be changing uh anytime soon in the small sort light vehicle categories um we do see that there are some examples of hydrogen fuel cell buses for
examples um and it might you know but even here we are seeing the evolution in energy storage and battery power so that you are going to get the range that you require for heavy good vehicles from
batteries and the downtime is the overnight when you're not allowed to drive anyway so you know that again it's
it's facing competition and there are other markets becoming rapidly established
um there is talk obviously within the aviation sector uh where you know this is a sector which doesn't have any clear in the education of how it's going to achieve Net Zero now talk of hydrogen
flakes uh but here we have the challenge of the volumetric energy density of hydrogen and you know
the ability to store enough to power a long distance flight so
I think the conclusion of where we see the future is that it's not entirely clear um there is a lot of incumbent uh support for hydrogen uh obviously from the fossil fuels which is uh obviously attracting a lot of lobbying uh

attention and and influence in political debate
um but it is of a um sort of competitive area though we
think the most likely area will be in the industrial um industrial hubs that we've heard about um in terms of sort of the the colors of hydrogen uh you know from a climate perspective
obviously we're looking uh at Green hydrogen being the um being the sort of
the option that we would all like uh to see evolve um and but you know the costs of this is dominated by the cost of the electrolyzers and electricity costs
um we've seen electricity costs coming down we're seeing electrolyzer costs declining in a similar way that we've
seen solar and wind power decline over the last few years and just as an aside
I'd add in that the iea forecasting is a notoriously bad on uh disrupted technology so we've seen this with its ability to poorly forecasters cost Decline and penetration of renewable and
solar we've seen it again recently with its inability to forecast the uh
penetration and of electric vehicles and so I'm sure uh to Michael's comments at the beginning would probably see it with its inability to actually these forecasts the uh uptake of hydrogen as
well um but we are seeing the electrolyzers uh cost declines coming in
um but you know with green hydrogen uh similar comment to what uh here was saying was that why would you use renewable energy to create uh green hydrogen you know the round trip efficiency from uh using that to create the hydrogen which then can be turned
back into electricity as a 31 uh efficiency ratio so it's a very
inefficient use of uh green electrons um but you know and obviously we need to see the scaling up of renewable energy uh primarily for the electrification of our global economy first and then you know for additional areas such as uh you know it's a green hydrogen secondary um in addition one of the com one of the areas not talked about so far is the water demands of green hydrogen if we are going to see see it going at scale we have to address the sustainability of fresh purified water supply um this is a big challenge obviously uh
if it's impure this affects the efficiency of the electrolyzers um most of the parts of the world where
you see sufficient sort of Natural Resources in terms of solar and wind are
also facing water scarcity challenges so this is another headwind for uh for the generation of green hydrogen on the blue hydrogen side we're not very positive on CCS asset technology it has consistently failed to deliver uh and you know we know that it will never be Net Zero uh compliance it will fail to capture 100
of CO_2 from the um exhaust stacks of the
the power stations that are used to generate it so we'd be skeptical about you know the the overall value of blue
hydrogen um but you know and then also we have the issue of methane leakage in the value chain so you know as you're extracting the the gas to to use to

create the hydrogen there is that leakage there obviously methane has a higher global warming potential in than
CO2 and so that's a critical issue to be conscious of oh you know as we're looking at this decade to really start to drive down greenhouse gas emissions
um so yeah so our conclusions are we're not entirely positive on the future of hydrogen we do believe that it will have a role it will not be a primary role
um we uh you know Green hydrogen will probably become more cost effective uh towards the end of the decade uh than now as we see the electrolyzer costs come down uh obviously we also need to
see an increase in carbon pricing uh coming in uh where you know at the moment we're looking for a carbon price of a hundred dollars per ton to make green hydrogen uh have
parity um but you know around the world there aren't any you know there well there are a few carbon markets but at the scale if we need this yeah we've not seen that carbon price occurring currently so
that's our conclusions there thank you well thank you very much indeed um and I'm going to move swiftly on we're just running a little bit behind time um and asked Dr zutong to take the floor
um over to you I will talk in compilation of China's hydrogen development policy making practices I will also talk about the problems that exist in the hydrogen field the development of hydrogen in China is
in phase of three major issues number one different countries are also in face of the similar issues number one the raw materials
for hydrogen production are primarily the fossil fuels so that will cause great pressure to the emission of carbon dioxide and we can see the share of the electrolysis of water to produce hydrogen is less than five percent same in the story in China so for China the
hydrogen production by the industrial byproducts is about 20 percent
in 2020 the carbon dioxide emission by producing hydrogen using the fossil fuel has been over 3.3 million tongues accounted for 25 percent of total carbon dioxide emission so it is really taking up a very large Shear now the green hydrogen is not becoming the primary Energy Mix to promote the development of the hydrogen will give rise to the carbon dioxide emission from the gray hydrogen production we need to pay attention to this phenomenon Manning localities cities are trying to
promote some hydrogen production projects but primarily they are free hydrogen production secondly many local governments attach
great importance to the development of hydrogen anyhow as we will know Global widely speaking many countries which include EU the UK Japan South Korea they have promoted now policies for developing cooling energy but the Technologies for the hydrogen development are still in the piloting stage it has been commercialized on a very
large scale against this backdrop of a planning for the hydrogen and also the establishment of the hydrogen parts has been overheated that means there are

many provinces and cities which have issued and released now planning for the development of hydrogen according to incomplete Statistics over 70 percent of the prophecies putting forward that they would like to develop the hydrogen but before the
commercial application over 70 percent of the professors and series would like to have the pilot projects in hydrogen this will give rise to the waste of resources money investment and low standard investment
besides the planning for the hydrogen is quite singular
the utilization of hydrogen is primarily in
fossil fuel and also industrial sectors which include Transportation fertilizers power generation Etc according to a report from the
international hydrogen Alliance around 2013 there will be over 22 end applications while trying to reduce carbon dioxide emission which include Refinery long-haul Transportation hydrogen refinery Etc but the pilot projects in China are still concentrated on Transportation so the application scenarios much to singular we have some buses public transportation means and passenger vehicles the application scenarios are much true melodious and singular the greatest application of hydrogen should be in the industrial sector I believe that will be the most important sectors
for the future application of hydrogen regarding passenger vehicles
from the perspective of experts if we check the progress besides heavy duty Vehicles heavy duty trucks under the trailers the Eevee is very
competitive name I believe in the future
regarding the application of hydrogen the major application scenarios will be chemical sectors including shipping
but of a pilot projects are making very slow progress I believe we should pay more attention
to these issues in summary
we are talking about the future role of hydrogen in bandage transition decarbonization the most application scenarios will be in the industrial sectors primarily petrochemical but its application in the transformation sector according to many estimates Transportation will not be the most important application scenario or sector
for hydrogen against the backdrop of the energy transitioning we need to consider the proper role of hydrogen we are using a lot of hydrogen in
hydrogen chemical but the primary source is gray hydrogen so we need to consider how can we change the gray hydrogen into green hydrogen instead of thinking about this application in the transportation sector besides we do not only consider about the technological features hydrogen what's more important in energy transitioning on the carbon neutrality what are the
roads exclusive to hydrogen instead of other sources or energy
let me set a very simple example if we consider transportation
passenger vehicle sector now the electrification is a very obvious trend EVS become very competitive that public transportation will be largely dependent

on the transportation infrastructure and the future the transportation infrastructure will be further developed
if you want to establish another Transportation infrastructure featuring
hydrogen I don't think it's very economical and very competitiveness so would it consider those special
purposes or special usages of the hydrogen for example they cannot be
replaced by other energy mix or sources so we need to think about the entry
points of hydrogen considering the Practical situation of a country
you cannot resort to different aspects let's take your for example Europe is
with well-developed natural gas Industries and infrastructure may have
considered starting the hydrogen development with the hydrogen doping
besides I'm also talking about hydrogen it's
a fuel to the transportation sector and when you develop the transportation
infrastructure please consider this very special scenarios so the most important
scenario will be the industrial sector especially how can we
decarbonize the green hydrogen in the industrial sector that is all my presentation thank you
well thank you very much indeed um and moving on now to hear from Tim
Harper the founder and chief executive officer element two uh dealing with hydrogen uh Transportation Networks
all right so um good morning good afternoon Nihao um I suppose I'd like to give a little bit more of a
entrepreneurial uh view on where we're going with hydrogen because
um I think one of the things I hear is a lot of people tend to look at it from a
theoretical policy perspective um but without really considering where
the unmet need is so when we set up element two uh almost three years ago
now most of the people in the UK were talking about chickens and eggs from the
old saying which came first the uh the chicken or the egg and the reason for that is there a lot of people wanted to
use hydrogen for various things but a lot of people wanted to supply hydrogen
but nobody's willing to take that first step and uh and a lot of that just came
down to an unwillingness to invest in capital intensive infrastructure when
there's an unproven or a very mature Market um now we looked at this and spoke to a lot of people in the hydrogen business and looked at potential end users of hydrogen and the end users range from
people with hydrogen-powered cars there's about 40 or 50 hydrogen powered
cars in the UK so that's not a huge Market uh all the way up to people
wanting to decarbonize heavy industry steel Ceramics and the problem you have
at that end is there isn't the infrastructure in place to get enough hydrogen into the places where it's
needed um uh the uh the technology for putting it through gas Mains isn't quite there
and for the sheer scale that's required you can't transport it by tube trailers
on on the road but we realized that there was a there was a sweet spot for

us and that was in the heavy end of transports that's commercial vehicles um and the reason the reason for that is
that a lot of people in the transport industry uh especially Fleet managers Logistics have already started work on decarbonizing their fleets and what they're finding is that battery electric is suitable for maybe 20 percent of of the use cases so the the problem with battery electric is yeah one you have the issue of range and the second is the issue of recharging which means that if you're a logistics company you have to disrupt your business model so instead of filling up with diesel for 15 minutes
you've got to find a way of having these these trucks static um and it gets even worse than that
because if you want to have a 40 44 tonne heavy Goods vehicle to get three 400 500 kilometers range you need somewhere around a megawatt 1.5 megawatts battery that will weigh somewhere between 10 and 15 Tons which means that you've immediately lost almost a third of your cargo carrying capacity so it has a further impacts on
your uh on your business model so when we spoke to people in the in the heavy end of Transport they were crying out for something that would allow them to get to NetZero 0 and
um and uh and and uh produce some produce zero emissions now it's not just Fleet managers wanting to do this it's also the investors in those companies because of uh ESG pressures uh a lot of
investors now are saying to um logistics companies ah we we're not sure if we can actually put our money into your business because the your main contribution to the environment is
driving up and down roads emitting uh greenhouse gases and uh and Diesel particles and of course the logistics operators are getting the same message from their customers uh whether that's
consumers or major supermarkets who once again don't want to be responsible for those emissions um so the the solution that everybody was looking for was hydrogen uh and
there was a need to put in hydrogen refueling infrastructure now we realized very early that the current model of producing hydrogen on site storing it on site uh just wasn't economic so we our business model is very much technology agnostic so we don't own or take a bet on any technology but if any of our Chinese colleagues have got a better more efficient way of storing transporting or dispensing hydrogen
we'll be happy to uh happy to talk to them and uh and displace our existing uh inefficient suppliers
um and uh and we focus solely on building the infrastructure so we have 30 hydrogen refueling stations under construction uh going through planning and Construction in the UK most of our hydrogen is green the reason we can do that is that a lot of the sources of hydrogen for uh that Supply the volumes required by the transport industry um are from Renewables so by Renewables

that's everything from waste to hydrogen all the way through to curtailed
electrons because we do have a big problem in the UK that if you put up a wind farm you might not be able to
actually connect it to the grid for another four or five years so hooking it out up to an electrolyzer
[Music] doing it but but why why are we doing
this well it's very simple uh almost a third of the UK's greenhouse gas
emissions come from transport and a third of those come from heavy transport
so rather than the 35 million Passenger cars it's the 600 000 commercial
vehicles that are responsible for a third of the emissions from transport So the faster we can get those off the road
and transition them to zero emission Technologies and you know from our
perspective we don't mind whether it's battery or hydrogen I think we're always going to have a mixture of energy
sources just as we do at the moment so um that's that's what we're doing the uh
the reception we have from the uh the fleet uh managers is is very good and
there's and and I should add this this not just fuel cell um hydrogen Vehicles there's also hydrogen combustion Vehicles being developed by people like JCB and Cummins and there's also a lot of interest in
hybrid systems where you're running vehicles on a blend of hydrogen and
Diesel which isn't totally zero emission but it does two things for you one is it does cut the tail Park emissions by 60
70 but the most important thing for a lot of uh Fleet operators is it does
extend the lifetime of their vehicles because obviously electric vehicles and Fuel Cell vehicles are a lot more
expensive than the um than the uh the current diesel so so just to conclude
um the reason we're doing this is because you know there is a private crisis going on you know we've said
people demonstrating about it in London or last weekend um and and those people are voters they
are consumers uh and they are investors in in companies so uh by by rapidly
decarbonizing the uh some of the low-hanging areas such as as transport we can make a real difference very very
quickly thank you uh thank you very much uh Tim for that
contribution looking at um this sort of a business point of view in the UK
um next I'm going to turn to Dr dingling Chief expert on Energy Research at the China construction Bank financial asset
Investment Company um Dr Dean over to you
I will not use the slides to share with us our ideas and observations about the
recurring hydrogic energy so we know that actually the consumption
for the hydrogen will be about 90 million tons by 2020 China is the
largest producer and also consumer of hydrogen in the world accounted for one
third of the global total increasing by over 30 30 percent compared with that of
2022 and the consumption for hydrogen in 2030 will be almost 40 million tons

if we check the consumption mix of the
hydrogen Refinery on the dependent chemical will be the major
consumption sectors in the short and medium I believe that will be a very important
solution for the industrial use China is still using the hydrogen in the
traditional sectors which include electricity transportation
by 2030 I believe the share for the hydrogen in the transportation sector
will be about five percent with the technological advancement that
also the lowering production cost they will be used in the transportation
building industrial sectors now we are considering about the hydrogen
production and data sector is a transportation
electricity will be the sectors well within its very large scale now we are
using the synthetic ammonia methanol industrial or the petrochemical will be
very important sector for the utilization of hydrogen Petro China and
designer pack are also trying to produce a lot of hydrogen the yearly output will
be about 440 tons per year
to produce a ton of hydrogen we need a lot of methanol or the other industrial
materials we have very high demands for the industrial raw materials while the
greatest demand will generate a very large Market
besides we can see the lead for the hydrogen in the petrochemical sector is
also on the right in transportation sector up to this point and we can see we are very
concerned about the Vehicles EVS actually we have over
6.7 meaning of yourself because China is with a very
large inventory or stock of the fuel cell vehicles from the perspective of energy
storage according to the 200 megawatts Planet projects
Empower generation the cost for the
and storage has been reduced from nine 0.9 to 0.5 RPM per kilowatt
so I believe these projects will help us to break even and even make some profits
by 2030 with the lowering cost of renewable energy power generation the
host for the hydrogen storage will be reduced to 0.4 ambiguan per kilowatt so
I believe that would be very important scenarios for us
natural gas we can reduce the cost of uh hydrogen transportation
now we have a 400 million cubic emitters of natural gas that means there will be
a huge Market in Metallurgy training Aviation uh
a hydrogen will be used in this area in in Long future housed on the French
company has a SMART Train project in China and
China Railway Corporation has also uh over 20 000 kilometers of a trial
project of a smart Railway using hydrogen we believe this is uh one of the most
important industries for carbon reduction in many European companies
and bow steel and other steel companies are
building um hydrogen for mythology uses but we
believe it will only be commercialized in 2030 and 20 35 due to lack of
Technology as an investor we are most concerned about the cost problem of n
hydrogen we all know that green hydrogen is very expensive We Believe
natural gas only has a cost of two dollars and we are targeted at 1.5 RMB or even

less even if we take the trough electricity
tariff as an example hydrogen powered electricity will be as high as two RMB
per kilowatt hour that's not economical um I think
we can only reduce the cost of green energy when the electricity used to
generate hydrogen can be ignored given the abundant resources of solar
and wind power in uh North is the China and South is in China we can reduce uh
the cost of hydrogen we believe we still have a long way to go there are different
Pathways a hydrogen
plus the solar energy through some combinations of wind solar and hydrogen
power if we can raise it to 4
000 hours per year then the cost would be reduced to 11 RMB
we believe uh when the levelized cost
um of green hydrogen is a 0.1 or 0.15 RMB that will make it
very competitive but we can increase the installed
capacity we can increase the efficiency per unit we can reduce
the manufacturing cost of a hydrogen to 15 to 18 RMB
with a better Carbon Market
there would be the advantage for a scrapped hydrogen
now the carbon price in China is owning a 50 RMB per ton but when it increases
to 200 RMB same as Europe then the hydrogen cost would be over 20 RMB then
green hydrogen will have a clear advantage the green hydrogen projects in China
especially after the national plan on the installed capacity was wrote up last
year in by 2025 renewable energy in China will see a newly added capacity of 200
tons per year by 2025 green hydrogen will surpassed 800 000
that's much higher than expectation in q1 there were 23 hydrogen projects all
of them being green hydrogen China invested
55 billion RMB and there are projects with 400 000 billion RMB being
planned the main users include the main cities
using a lot of new energy they're concentrating in Eastern China
in North China there are hydrogen storage projects
and in Eastern China there are hydrogen generated by
solar power and offshore wind in terms of policy support in 2022
we meet to long-term development plan for any new energy made it clear that
hydrogen-powered vehicle will be 50 000 vehicles and we think it's important
that uh the development strategy would be green hydrogen plus gray hydrogen in
China on the one hand we believe more locations will be made
available for hydrogen it was previously managed as a hazardous chemicals
requiring license but since last year many cities in China have
launched policies allowing companies to build up uh hydrogen projects in
specific locations providing more development up room
in China different governments give different levels of subsidy to bring
hydrogen projects for example discounted electricity tariff or quota for solar
and wind power we believe all this policy support will benefit the future development of
energy hydrogen in China We Believe investors will offer a diversified

Capital support as a Commercial Bank we're looking at Capital intensive
low-risk project for example um Channel generation of hydrogen coupled
with utility skill PV power stations of course we need more uh relaxed
regulations when it comes to pipelines and the storage cans and these are also
what our bank is interested in we will support some technological companies
featuring R D including new energy batteries and electrolyzes uh we're also
talking about storage facilities uh pressurizer Catalyst
Etc and we are also looking at a few cells liquefied hot nitrogen and other
cutting-edge Technologies in other possible investment projects so I'll leave it there
thank you very much and
sorry for the technical glitch
well uh thank you very much indeed and um but first of all just to invite Marcus
hexenberger from HD stifton um to give a brief explanation of how
um h27 is trying to create markets in hydrogen markets good morning thank you
very much for having me it's the H2 Global foundation on age to global system so that's
that's the brand and
that's the name but thank you very much for inviting me thank you very much to Mr
shoes I see you are in the call today
so Mr Shoes is one of the first supporters of the H2 Global idea was
developed two and a half years ago just to overcome these chicken and egg problem
why nobody is investing in H2
because it is not bankable you cannot bind your Finance on it so H2 Global was
developed two and a half years ago like I said to become these over these to overcome
these chicken and neck problem
it is a very defined system it is defined by size and defined by time the
German government and the Dutch government provided already 6 billion Euro for these
supporting mechanisms so
we are now executing age to Global it is based on the contracts for difference
mechanism just to make sure that these very high prices now for the production of
green hydrogen needs to be covered
because you cannot get let's say the amount of money on the on the on the
sales side and there is a price Gap and that needs to be covered everything H2 Global is
doing is very competent a
competitive base so we have a so-called double auction a mechanism to make sure
that it is as smart as possible and as
cost efficient as possible I will show you how it looked like so what H2 Global
is now doing we are starting we started already in December with the first auctioning
process so we are auctioning
now green hydrogen derivatives minced green hydrogen as ammonia green hydrogen
within or as a green methanol and cream synthetic air fuels with a whole amount
of 300 million euro each whoever provides the best best price so
the lowest price will get the strike strike means they will get from our
from our company it is called hinco hydrogen intermediate Network company but will
provide a contract with a

guaranteed and fixed price over the period of 10 years Indico will not store
these products because all these products needs to be physically delivered to Europe to a so-called
triangle between the harbor of Hamburg the harbor of adverb and the harbor of these books so we want to have these
products physically in in Europe it is a global auction but hinco will not store
these products of course Hinkle will sell these products into the European market as short as possible to just with the
short-term contracts 6 months 12 months or 18 months as short as possible just
to make sure that we can make use of these upcoming increase of prices so
what you can see here on the flat line on Top This is the guaranteed price by hinco provided for the period of 10
years so whoever wins or whoever gets the strike whoever will be awarded out
of this auction can really bind his Finance on it because we are backed by the German and by the Dutch government
so you hinko is really acting as a as a triple A or as a blue chip investor on
the market so what we expect within the next couple of years is increasing prices because of
upcoming regulation because of upcoming willingness to pay higher prices for Queen hydrogen products or green
hydrogen derivatives we don't know exactly when it will match so we expect it will be within the next couple of
years as well doing so we are reducing the risks in the market because all these uncertainties in regard of how a product should look like certification standardization so we have set our own
standards we have set our own certification scheme it is absolutely and I would say 99.99 in line now what
was uh uh already you know presented now by the European Commission
in regard of delegated act and in regard of of Red 2 and often upcoming red three
so this is something what a H2 Global provides as well reducing the risks for
all Market uh uh uh for all participants within the market the production side
and the optic side what H2 Global is or what what we are doing we are working in a so-called
window logic whoever provides funds to H2 Global so using the H2 Global
mechanism to cover these price gaps needs to Define precisely for what kind
of product from what kind of region within what kind of criterias and so on it is not a decision made by the H2
Global Foundation or by the hint code it is always a decision made by the by the provider of the funds so the first
contribution window within the amount of 900 million use was provided with funds
by the German government and data selected precisely the criterias the products Etc the second
contribution window will will have the amount of 3.53 billion Euro as well

provided with funds by the German government the third contribution window will have the amount of 1.4 billion Euro
this is as well German government's money but just for the purpose of synthetic fuels for the shipping and for
the airline sector the fourth contribution window is made now for the Dutch government they will select they
will Define precisely for what kind of purpose for what kind of product and so on we are I can see a hand is raised yes
shall I be quicker or uh yes quick if you're gonna be a very quick quick
please Marcus thank you yeah of course I'll I'll do so so we are doing that as well for other governments for the
Australian government we are in cooperational with the Japanese government over the sorry it was a Japanese government not because the
Chinese was a Japanese government with the United Arab Emirates and with different other countries in Europe uh
we developed uh an additional or a second um uh um mechanism uh now for the U.S government they asked us uh for for such kind of uh concept this is now a second concept beside the IRA the H2 Global Foundation just my last word this is
organized and done because we uh what we have needed was a very independent body to execute age to Global the concept and the idea we have not already 60 uh
funders let's say more or less all the most of the big companies who are dealing with uh hyperton uh worldwide
and we are growing week by week so I'm happy if you would like to have more information to send out uh all document documents and more information about H2 Global thank you very much for your time
thank you so much Mark it's very useful and just maybe over for a last word to Michael um sorry we've run slightly over time
due to the technical problems um but Michael would you just like to round things off yes again our apologies
uh normally we we like to do we do like to have a bit of conversation here but we've had some input from the audience
and as Michael says uh we'll be circulating slides uh just in terms of two other points uh we are gearing up
here in London for next month's Net Zero delivery Summit that'll be held on the 24th of May so anybody coming through
London uh please let us know we'll try and get you access to the Guild Hall event being run by the city of London
corporation uh Z/Yen log finance and uh with the sponsorship of hexterra and the cooperation of the Viva investors will be hosting an event as well on the Tuesday the 23rd of May in the afternoon
and again any of you coming over uh please do let us know that's going to be looking at a new Global Financial
architecture to support preventing climate change so a lot Happening Here

in London as ever check out the website and our sincere thanks to all of you for your contributions and for listening
uh thank you Michael uh thank you all uh for the contributions this morning this afternoon and goodbye