

# External economic forks of Russian hydrogen strategy

**Prof. Dr. A.A.Konoplyanik,**

**Adviser to Director General, Gazprom export LLC;  
Co-chair of Work Stream 2 “Internal Markets”, Russia-EU Gas Advisory Council;  
Member of Scientific Council on System Research in Energy, Russian Academy of Sciences**

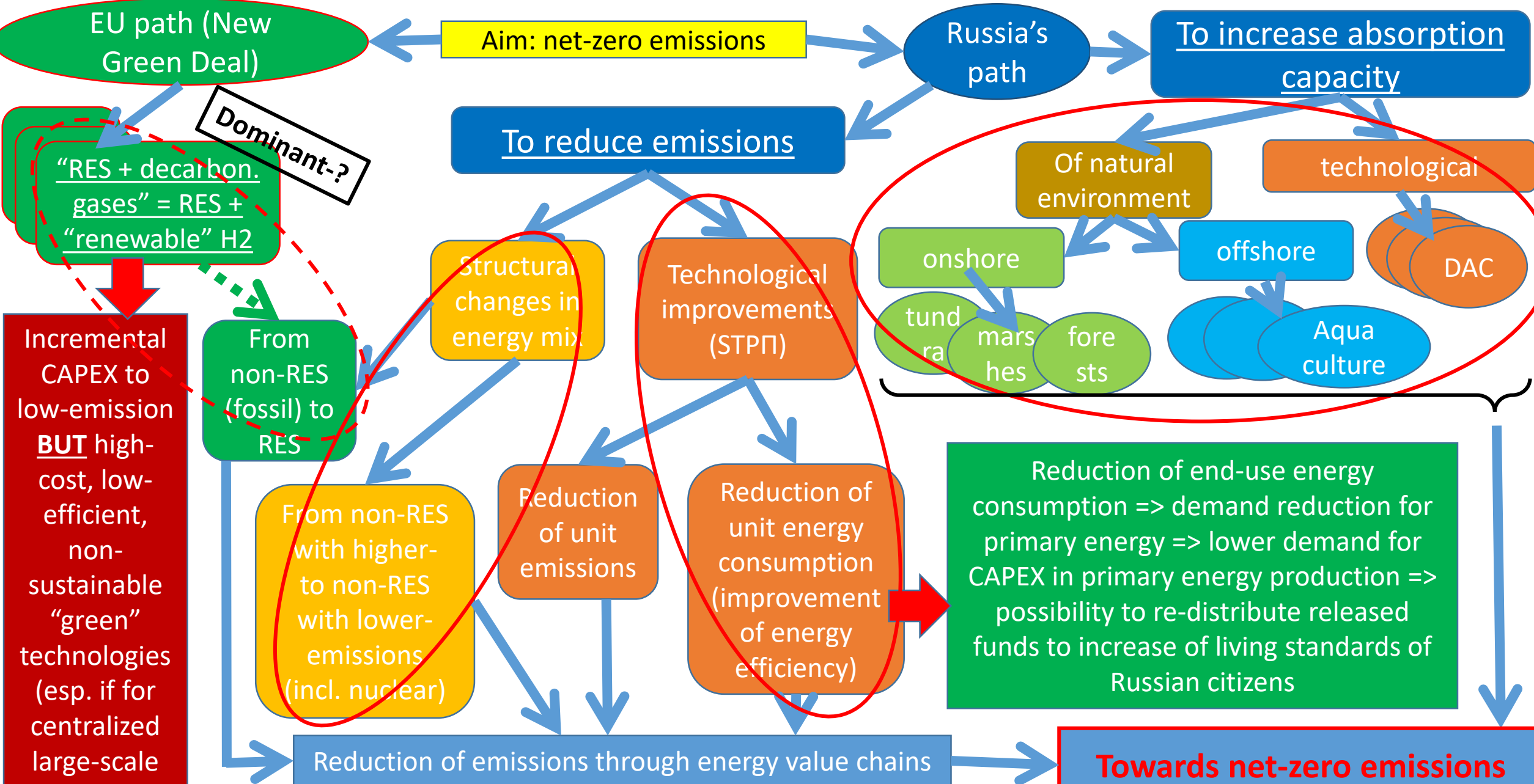
**Presentation at the "Hydrogen Russia and CIS 2021" conference,  
20-21.10.2021, Vostock Capital, Moscow, online**

**Disclaimer:** Views expressed in this presentation do not necessarily reflect (may/should reflect) and/or coincide (may/should be consistent) with official position of Gazprom Group (incl. Gazprom JSC and/or Gazprom export LLC), its stockholders and/or its/their affiliated persons, or any Russian official authority, and **are within full personal responsibility of the author of this presentation.**

# Table of content

- 1) Russia and the EU: two ways to net-zero emissions in energy**
- 2) EU Hydrogen Strategy: energy transition based on semi-truth => distorted “advantages” & imaginary ecological exclusiveness of “green/renewable” hydrogen
- 3) Two avenues for development of external economic segment of Russian hydrogen energy: to follow European concept which is gently imposed on us by EU/Germany and which reflects their national interests, OR to defend concept of cooperation in hydrogen based on balance of interests of the parties?
- 4) Governmental concept of hydrogen energy development in Russia – why by European model?
- 5) Alternative concept based on balance of interests of the parties, non-distorted system of arguments and technological neutrality principle: it diminishes decarbonisation costs for the EU, increase monetization of Russian gas resources, leads to increase of welfare of both Russian and EU citizens

# EU & Russia: two ways to net-zero emissions in energy



# Table of content

- 1) Russia and the EU: two ways to net-zero emissions in energy
- 2) EU Hydrogen Strategy: energy transition based on semi-truth => distorted “advantages” & imaginary ecological exclusiveness of “green/renewable” hydrogen**
- 3) Two avenues for development of external economic segment of Russian hydrogen energy: to follow European concept which is gently imposed on us by EU/Germany and which reflects their national interests, OR to defend concept of cooperation in hydrogen based on balance of interests of the parties?
- 4) Governmental concept of hydrogen energy development in Russia – why by European model?
- 5) Alternative concept based on balance of interests of the parties, non-distorted system of arguments and technological neutrality principle: it diminishes decarbonisation costs for the EU, increase monetization of Russian gas resources, leads to increase of welfare of both Russian and EU citizens

# All other conditions being equal, methane pyrolysis (& similar technologies) have clear competitive advantages against two other key technologies in hydrogen production (MSR+CCS & electrolysis) under technologically neutral regulation

CC(U)S is needed!!! => additional imputed costs (CAPEX + OPEX) => add. 20/30+% (\*) (CEC: twice as high (\*\*)) => additional element of cost budget => **WORSENS** financeability

Vision to diminish high-cost energy density – to use excessive RES electricity at zero or negative prices => this leads to unstable (regularly interrupted by natural reasons) RES-based H2 production cycle => prolongation of pay-back periods (of debt-financed CAPEX) => **WORSENS** financeability

Steam reforming of natural gas	$\text{CH}_4 + 2\text{H}_2\text{O} \rightarrow 4\text{H}_2 + \text{CO}_2$
Water electrolysis	$2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$
Methane pyrolysis	$\text{CH}_4 \rightarrow 2\text{H}_2 + \text{C}$

CO<sub>2</sub> emissions  
in kg CO<sub>2</sub>/kg hydrogen

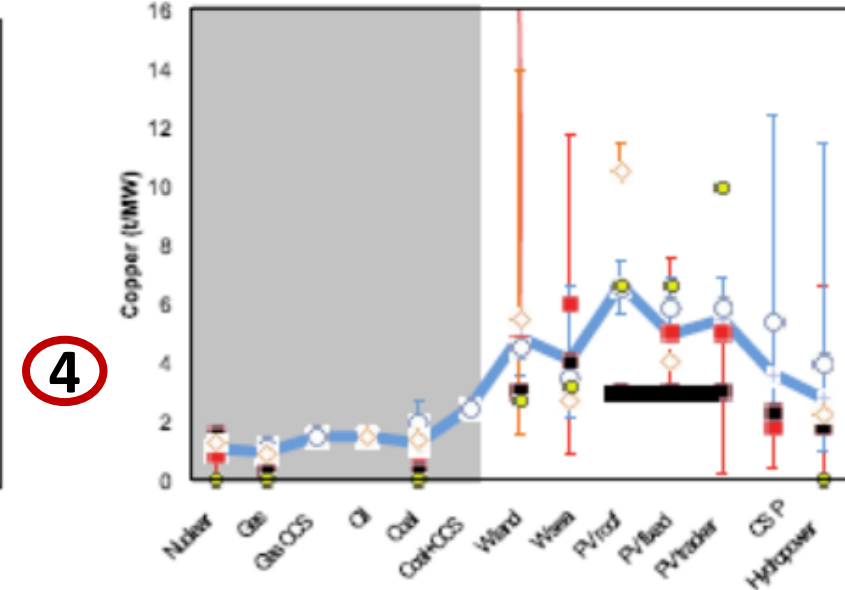
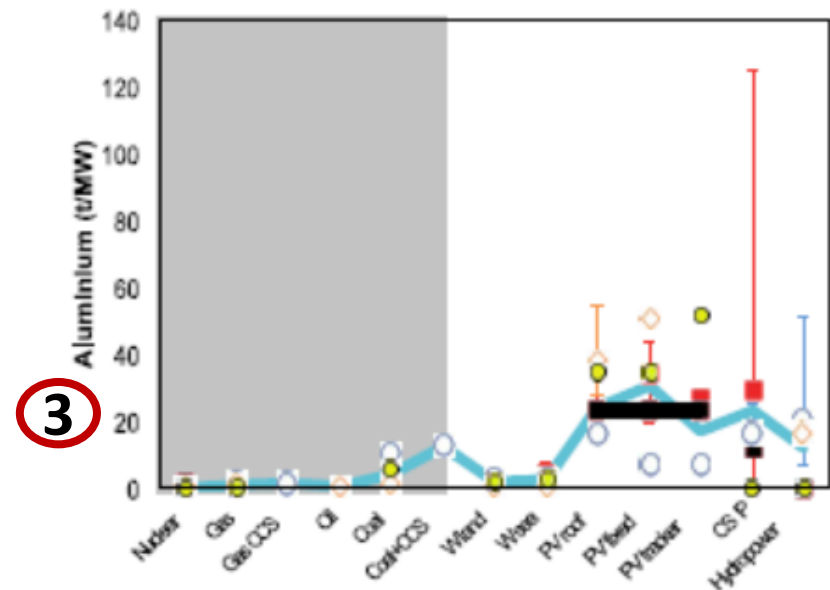
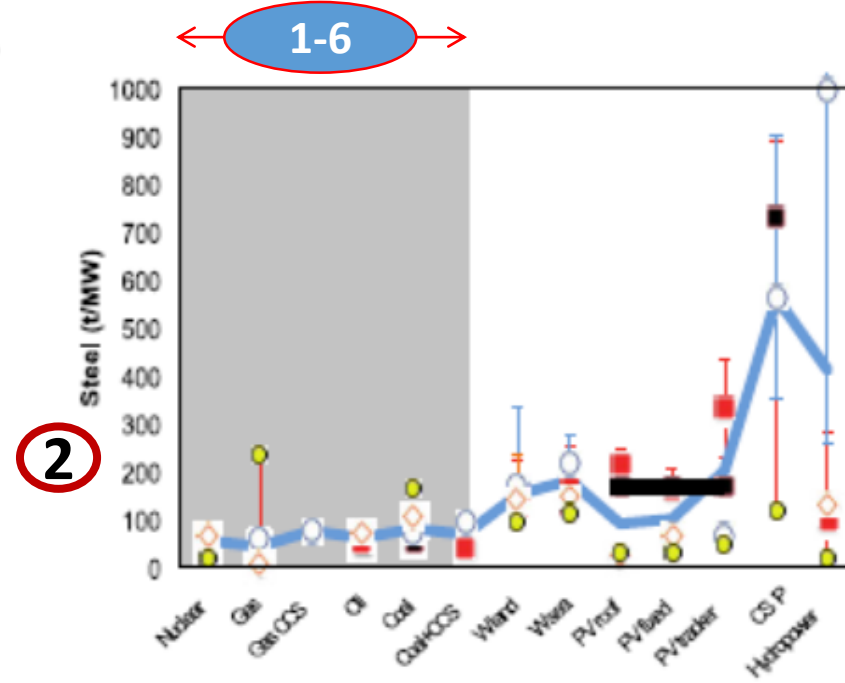
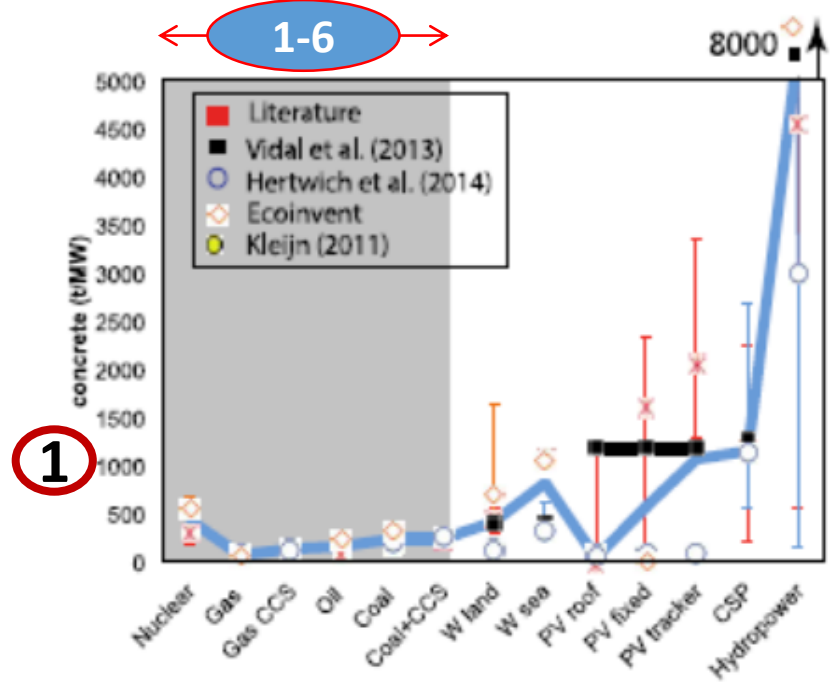
energy demand  
in kJ/mol hydrogen\*



Source: A.Konoplyanik based on: Dr. Andreas Bode (Program leader Carbon Management R&D). New process for clean hydrogen. // BASF Research Press Conference on January 10, 2019 / (<https://www.basf.com/global/en/media/events/2019/basf-research-press-conference.html>)

- (1) No need in CC(U)S => CAPEX/OPEX saving
- (2) Marketing of carbon black = additional element of revenue budget => start of new investment cycle(s) based on carbon black
- (3) In case of storage, carbon black does not provide same negative effects as CO<sub>2</sub> => **IMPROVES** financeability

(\*) René Schutte, N.V. Nederlandse Gasunie. Production of Hydrogen. // Masterclass in Hydrogen, Skolkovo – Energy Delta Institute, Moscow, May 23, 2019 ([https://drive.google.com/open?id=1g\\_4TiiKAKGajziXG8TWjTdpncfipj9x1](https://drive.google.com/open?id=1g_4TiiKAKGajziXG8TWjTdpncfipj9x1))  
 (\*\*) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions. A hydrogen strategy for a climate-neutral Europe // EUROPEAN COMMISSION, Brussels, 8.7.2020, COM(2020) 301 final, p.4-5, footnote 26 ([https://ec.europa.eu/energy/sites/ener/files/hydrogen\\_strategy.pdf](https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf))



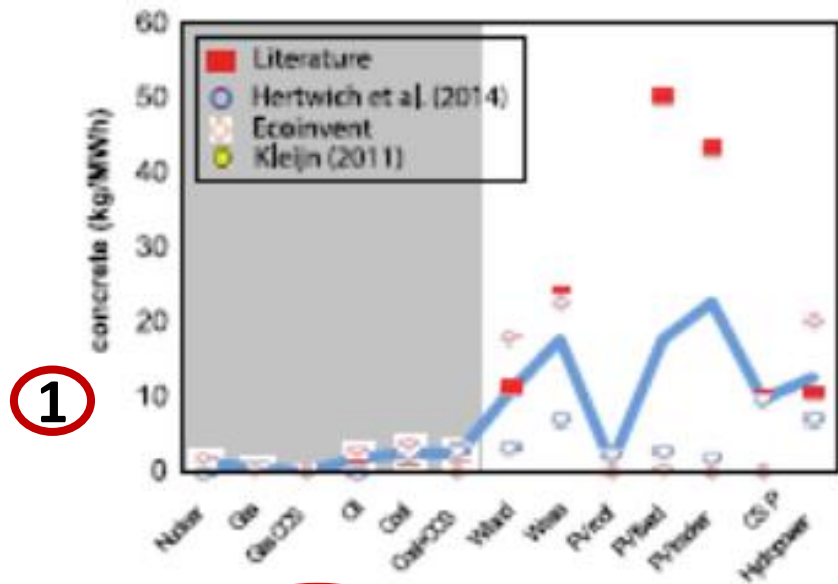
## Quantities (t/MW) of four structural materials used to manufacture different power generation infrastructure (material intensity) :

- 1- concrete,
- 2- steel,
- 3- aluminium,
- 4- copper

(fossil fuel power generation technologies are in the gray shaded area; colour version of the figure at: [www.iste.co.uk/vidal/energy/zipp](http://www.iste.co.uk/vidal/energy/zipp))

Source: Olivier Vidal. Mineral Resources and Energy. Future Stakes in Energy Transition. // ISTE Press Ltd - Elsevier Ltd, UK-US, 2018, 156 pp. (Figure 5.2./p. 72)

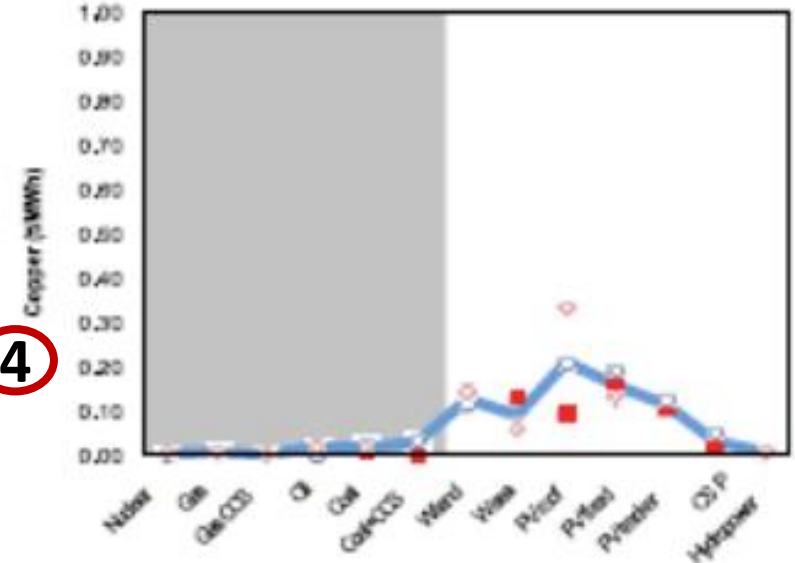
From left to right: (1) Nuclear, (2) Gas, (3) Gas+CCS, (4) Oil, (5) Coal, (6) Coal+CCS, (7) Wind land, (8) Wind sea, (9) PV roof, (10) PV fixed, (11) PV tracker, (12) CSP, (13) Hydropower



1

2

1-6

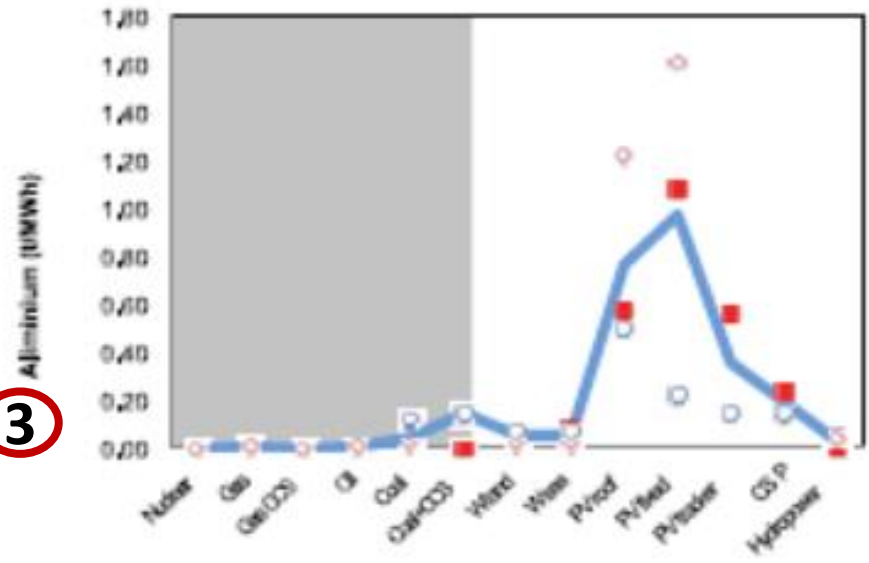


**Mass of material in kg required to produce 1 MWh electricity:**

- 1- concrete,
- 2- steel,
- 3- aluminium,
- 4- copper

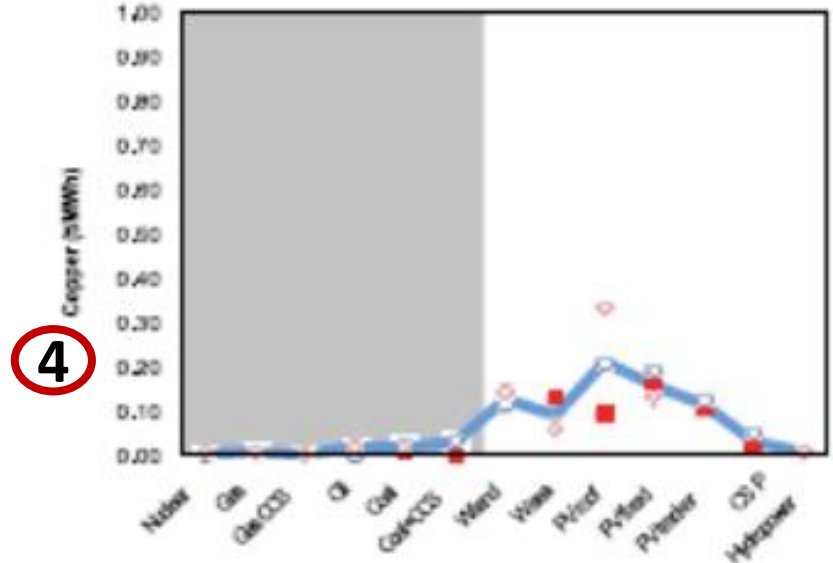
(calculated with the material intensities shown in Figure 5.2 and Table 5.1; the gray shaded area indicates fossil fuel-based electricity production; colour version of the picture at: [www.iste.co.uk/vidal/energy.zip](http://www.iste.co.uk/vidal/energy.zip))

1-6



3

4



From left to right: (1) Nuclear, (2) Gas, (3) Gas+CCS, (4) Oil, (5) Coal, (6) Coal+CCS, (7) Wind land, (8) Wind sea, (9) PV roof, (10) PV fixed, (11) PV tracker, (12) CSP, (13) Hydropower

# What is clean energy? Depends on how you calculate/consider it...

Wrong perceptions as if renewable H2 is the only clean H2 and, moreover, that it is clean at all

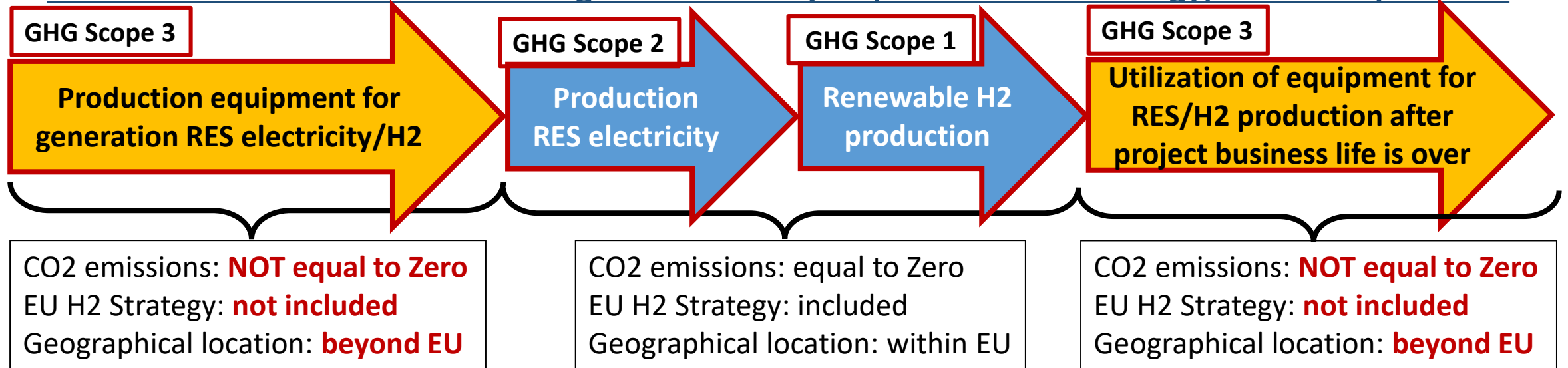
A hydrogen strategy for a climate-neutral Europe (Brussels, 8.7.2020 COM(2020) 301 final):

'Renewable hydrogen' is hydrogen produced through the electrolysis of water (in an electrolyser, powered by electricity), and with the electricity stemming from renewable sources. The **full life-cycle greenhouse gas emissions of the production of renewable hydrogen are close to zero <...>** 'Clean hydrogen' refers to renewable hydrogen.

Siemens/Gascade/Nowega (Hydrogen infrastructure – the pillar of energy transition..., Sept.2020):

"If the electricity required for electrolysis comes exclusively from renewable, CO2-free sources, the **entire production process is completely CO2-free.**"

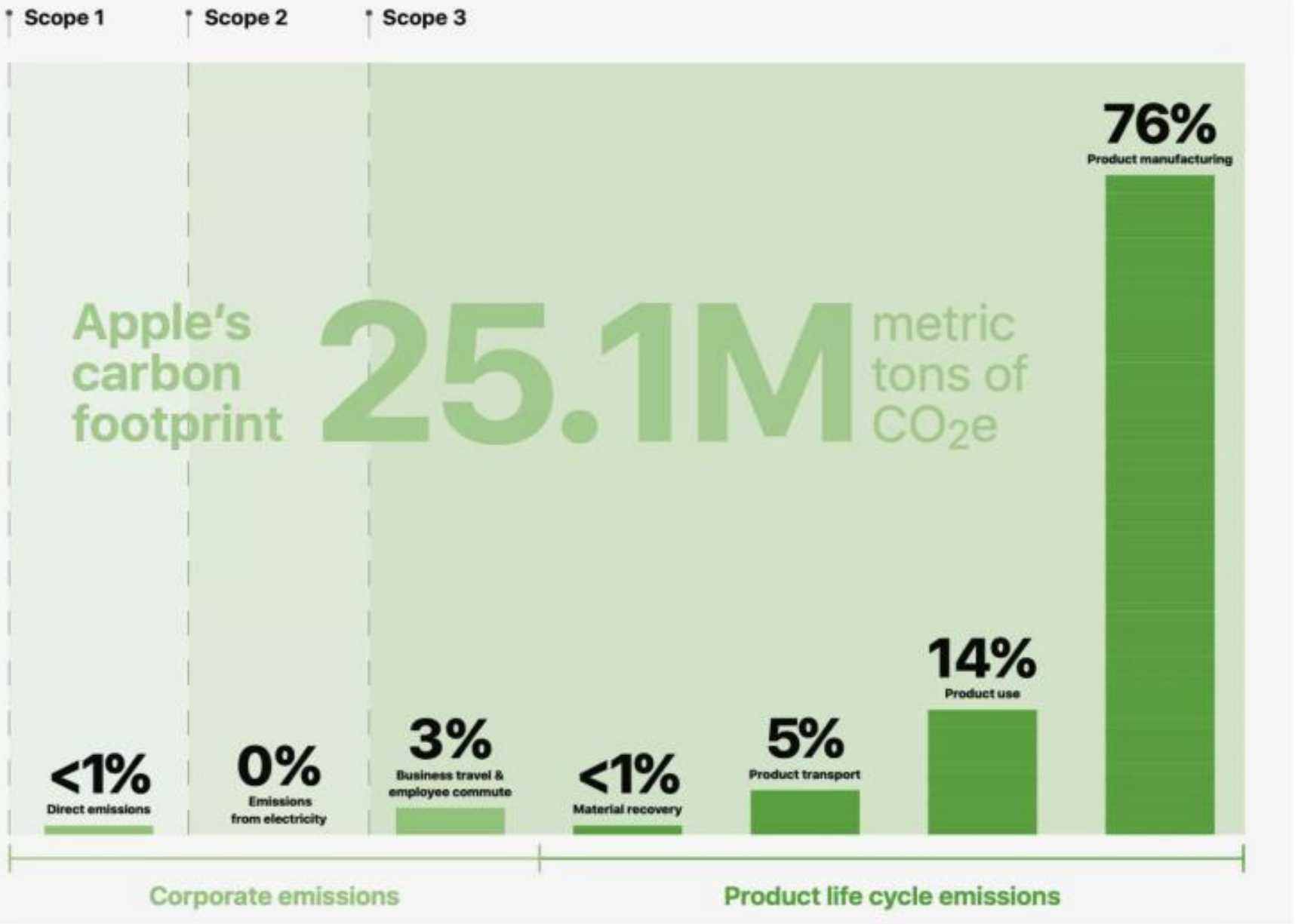
## Carbon track of renewable H2 through the full life-cycle (acc. to EU H2 Strategy) – GHG Scopes 1-2-3



**Daniel Yergin**, Pulitzer Prize winner for "The Prize" book at presentation of his new book "The New Map":  
**"NEW SUPPLY CHAINS FOR NET-ZERO CARBON REQUIRES CARBON!!! ... They require diesel to operate shuttle in mining..."**

(Source: A conversation with Pulitzer Prize winner and energy expert Daniel Yergin, Atlantic Council, 25.09.2020; <https://www.youtube.com/watch?v=hWMOU8IjRhI>)





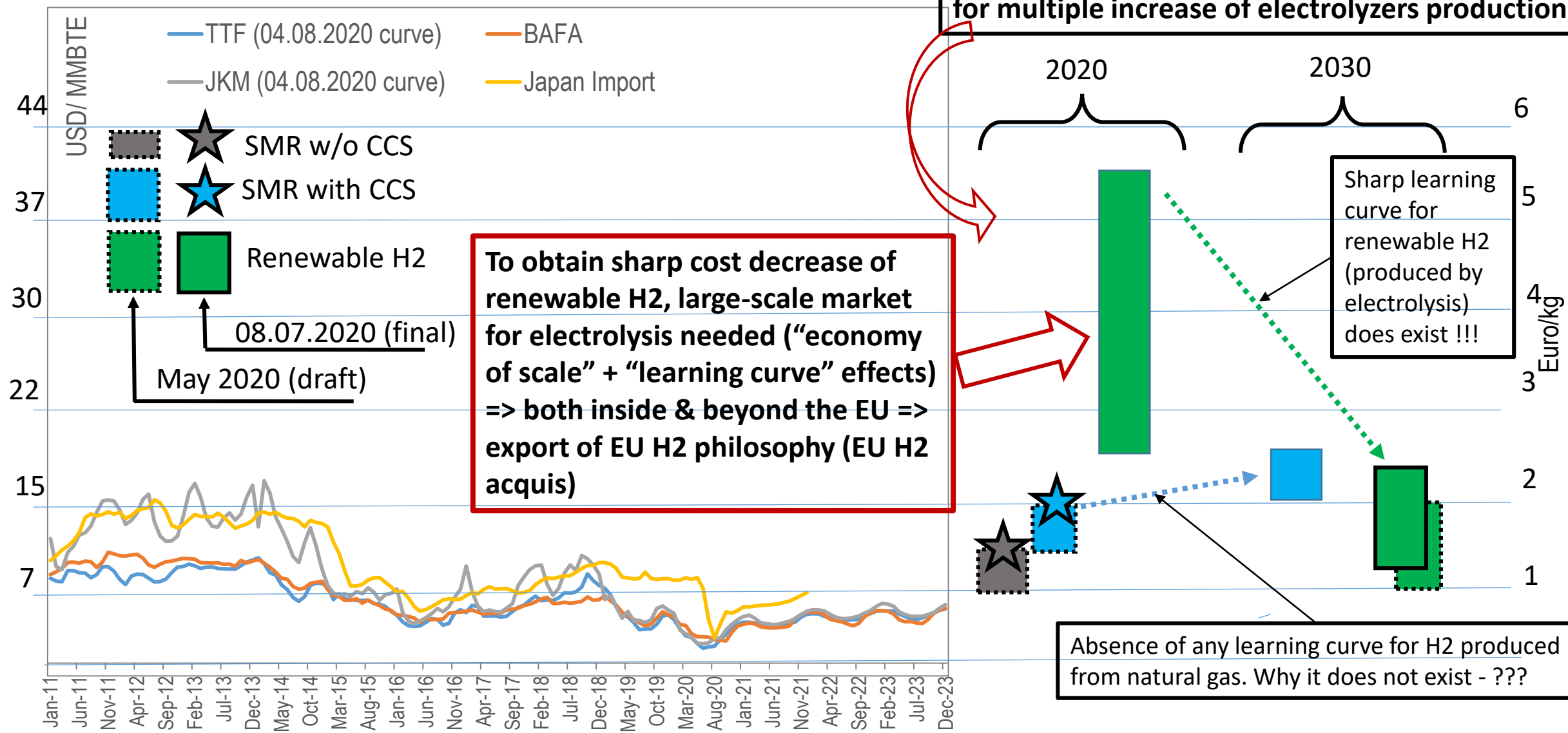
**Why it is important to consider GHG emissions within all THREE Scopes?**  
 (Illustrative example from Apple which it has presented to the public voluntarily – direct analogy with “green” H2)

Source: What are Scopes 1, 2 and 3 of Carbon Emissions? // PlanA Academy, 12.08.2020  
[\(https://plana.earth/academy/what-are-scope-1-2-3-emissions/\)](https://plana.earth/academy/what-are-scope-1-2-3-emissions/)

The importance of scope 3 emissions – Apple carbon footprint  
 Credit: Apple

# European Commission's estimated costs of H2 production by the key technologies (as presented in the EU Hydrogen Strategy as of 08.08.2020) – and natural gas prices

**Wright's Law: each doubling of production volumes diminishes unit costs by 28% => demand for multiple increase of electrolyzers production**



# Problems of & proposed solutions for “renewable/green” H2 in the EU

= f (price of purchased electricity)

Electrolysis: high costs =

= f (cost of electrolyzers)

To buy excessive RES electricity at zero/negative price, BUT Germany (2019): excessive RES electricity = 211 from 8760 hours/y => utilization rate (UR) = 2.5% (UR wind onshore= 20%, offshore = 45%)

Internal EU market is not enough to provide economy of scale effect (Wright’s, Moore’s, Swanson’s laws/effects) => expansion beyond EU borders needed ( 2X40 GW green H2) => cooperation on green H2 to market electrolyzers “Made in Germany” internationally => 2 bln Euro in German Hydrogen Strategy to promote this model of hydrogen cooperation with foreign countries

**Will not work as major route for cost decrease**

**Corresponds with national interests of EU/Germany, does NOT correspond with Russian national interests => does NOT provide for balance of Russia-EU/German interests !**

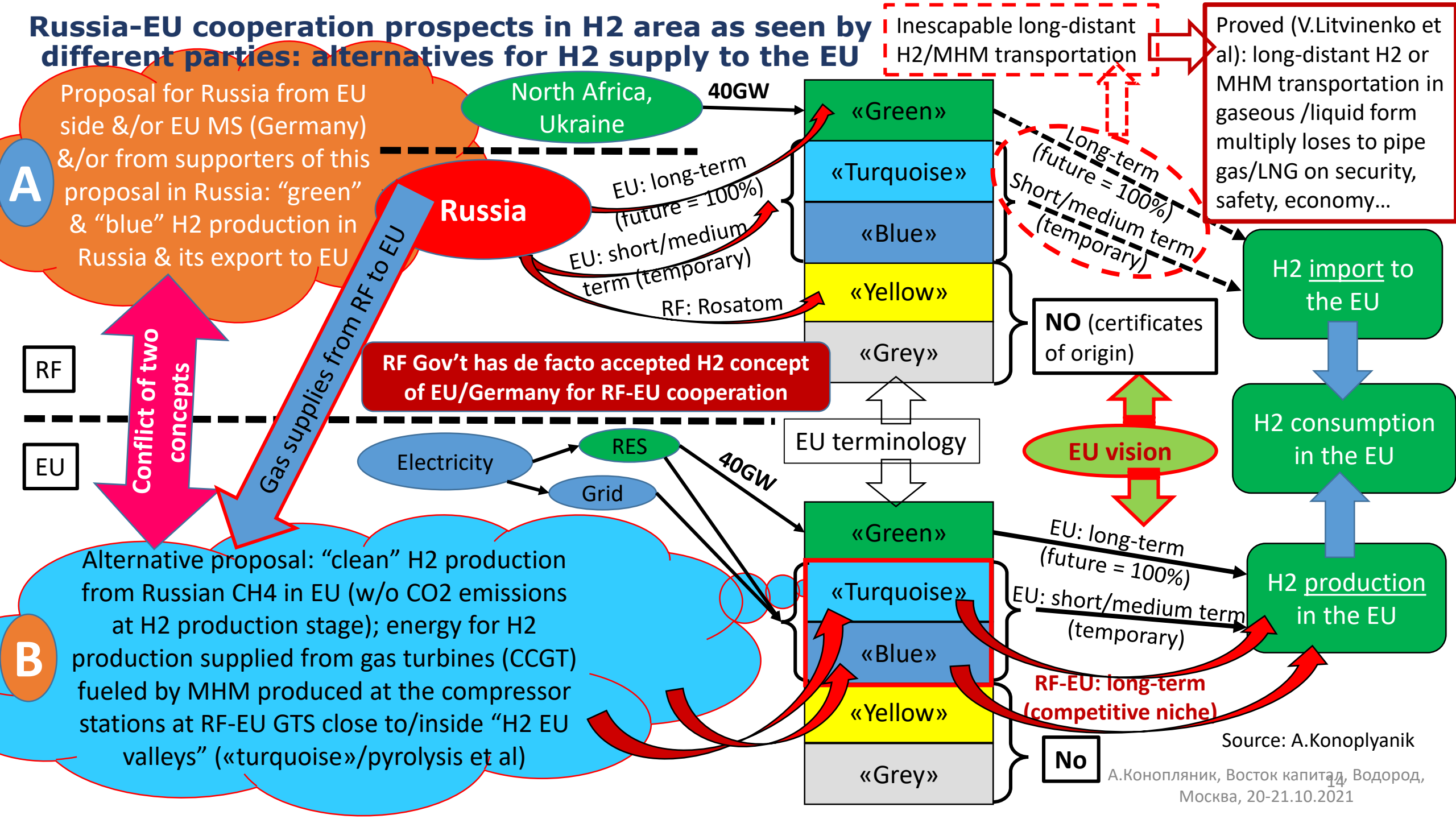
# They try to allure Russian into “overtaking development” based on counter-productive European model of “green energy transition” – whether we have already swallowed the bait???

- Energy transition based on semi-truth (absolutisation of “RES + green H2”). Distorted frame of reference & system of arguments to prove “green energy transition” on the EU model:
  - Increase of global temperature: technogenic (energy) vs natural factors, cyclical changes vs linear growth
  - Emissions: estimation of CO<sub>2</sub> only (+CH<sub>4</sub> since recently) vs combination of all emissions (+ NO<sub>x</sub>, SO<sub>x</sub>, solid particles) => climate vs (climate + ecology)
  - Energy (predetermined key offender): non-RES (fossil) vs RES (consideration only Scope 1 & 2 emissions, non-consideration of Scope 3 emissions) => fight against carbon (to refuse from fossil fuels), but not with emissions (thus neglecting STP in all spheres through all energy value chains) => terminology: carbon-free vs emission-free; blue H<sub>2</sub> = MSR+CCS
- Changeover of the Elites & global competition: climate is not the major aim but just the means.
  - “Green energy transition”: aim for EU – EU autonomy based on Euro, to form global market of technologies for green H<sub>2</sub> => quick US return to Paris Agreement (at first day of Biden’s Presidency) – to prevent EU from leading the process & press up \$
  - Attempts to move Russia away from our zone of competitive advantages: STP in non-RES (but terminology: to resign from fossil fuels) + huge onshore & offshore territories with high cumulative absorption capacities (but methodology of calculations).
- Beneficiaries:
  - Global (anglo-sax) financial institutions – financing energy transition: projects + emissions trading quotas
  - EU manufacturing companies: Russia etc. as a market for utilization RES equipment & electrolyzers “Made in Germany /EU” =>
- Russian decarbonisation on Western model = overtaking development. Recently – export of “acquis communautaire”, nowadays – export of energy transition model. For this – “knout & bisquite”.
  - Knout: (1) Transition from “soft law” (the states shall endeavour) to “hard law” (the states shall) within implementation of COP-21 provisions, both at corporate and state levels. Precedents (April 2021): court decision on Shell in The Hague + decision of German constitutional court; (2) CBAM
  - Bisquite: «Hydrogen carrot at a price of 2 bln Euro» (Germany) => it seems that Russian Government has swallowed the bait...

# Table of content

- 1) Russia and the EU: two ways to net-zero emissions in energy
- 2) EU Hydrogen Strategy: energy transition based on semi-truth => distorted “advantages” & imaginary ecological exclusiveness of “green/renewable” hydrogen
- 3) Two avenues for development of external economic segment of Russian hydrogen energy: to follow European concept which is gently imposed on us by EU/Germany and which reflects their national interests, OR to defend concept of cooperation in hydrogen based on balance of interests of the parties?**
- 4) Governmental concept of hydrogen energy development in Russia – why by European model?
- 5) Alternative concept based on balance of interests of the parties, non-distorted system of arguments and technological neutrality principle: it diminishes decarbonisation costs for the EU, increase monetization of Russian gas resources, leads to increase of welfare of both Russian and EU citizens

# Russia-EU cooperation prospects in H2 area as seen by different parties: alternatives for H2 supply to the EU



## Decarbonisation upstream: some physical & chemical barriers to long-distant high-pressure transportation & storage of H<sub>2</sub> (acc. to Litvinenko et al, SPB Mining University) (\*)

- (1) Effectiveness of gas pipeline transportation is directly contingent upon quantities of the product, and thus on the density of gas. **As concentration of H<sub>2</sub> in MHM increases from 10 to 90 %, density of MHM decreases more than four times.**
- (2) **Energy obtained from one volume of H<sub>2</sub> is 3.5 times less than the energy obtained from methane.**
- (3) Increase in energy required to compress 1 kg of MHM to raise the pressure by 1 MPa with increasing proportion of H<sub>2</sub>. While **H<sub>2</sub> content in MHM rises from zero to 100%, energy costs (work) are raised by around a factor of 8.5.**
- (4) Increasing proportion of H<sub>2</sub> in MHM increases explosion risks of the MHM
- (5) Export/storage of *liquid* H<sub>2</sub>: **CH<sub>4</sub>** liquefies at atmospheric pressure and temperature below - 161.5 °C, LNG volume is 600 times less than its gaseous form. **H<sub>2</sub>** liquefies at atmospheric pressure and temperature below -252.87 °C, it reduces in volume by 848 times. (ii) The closer temperature of a substance to absolute zero, the more **quantum properties** (superfluidity, superconductivity, etc.) begin to appear. (iii) Under same conditions and tank capacity it is **possible to store or transport almost 5.9 times more LNG than liquid H<sub>2</sub>.**
- (6) H<sub>2</sub> has extremely high penetrating ability, its molecules spread faster than molecules of all the other gases in the media of another substance and penetrate through almost any metal. **Pressurized H<sub>2</sub> is capable to escape even from airtight tanks during long-term storage.**
- (7) Research into effect of H<sub>2</sub> on metals has been carried out for decades. Back in 1967 in USSR scientific discovery "Depreciative effect of hydrogen on metals" was made (N 378), however, the reactivity of hydrogen is still not sufficiently studied, whereas its negative effects have already become a substantial technical issue (**stress corrosion**). Due to stress corrosion Gazprom replaced over 5,000 km of large-diameter pipelines.

А.Конопляник, Восток капитал, Водород, Москва,  
20-21.10.2021

(\*) Within **43** items of RF Gov't Action plan on H<sub>2</sub> Saint Petersburg Mining University is mentioned as co-participant in **42** items

# Table of content

- 1) Russia and the EU: two ways to net-zero emissions in energy
- 2) EU Hydrogen Strategy: energy transition based on semi-truth => distorted “advantages” & imaginary ecological exclusiveness of “green/renewable” hydrogen
- 3) Two avenues for development of external economic segment of Russian hydrogen energy: to follow European concept which is gently imposed on us by EU/Germany and which reflects their national interests, OR to defend concept of cooperation in hydrogen based on balance of interests of the parties?
- 4) Governmental concept of hydrogen energy development in Russia – why by European model?**
- 5) Alternative concept based on balance of interests of the parties, non-distorted system of arguments and technological neutrality principle: it diminishes decarbonisation costs for the EU, increase monetization of Russian gas resources, leads to increase of welfare of both Russian and EU citizens



**Geography of nuclear & hydro power stations and major area of gas production in Russia (Nadym-Pur-Taz & Yamal) – proposed domestic production of H2 for export would be deep inside Russia & will require long-distant large-scale transportation of H2/MMH to the EU via existing RF-EU GTS to be deeply modernized**



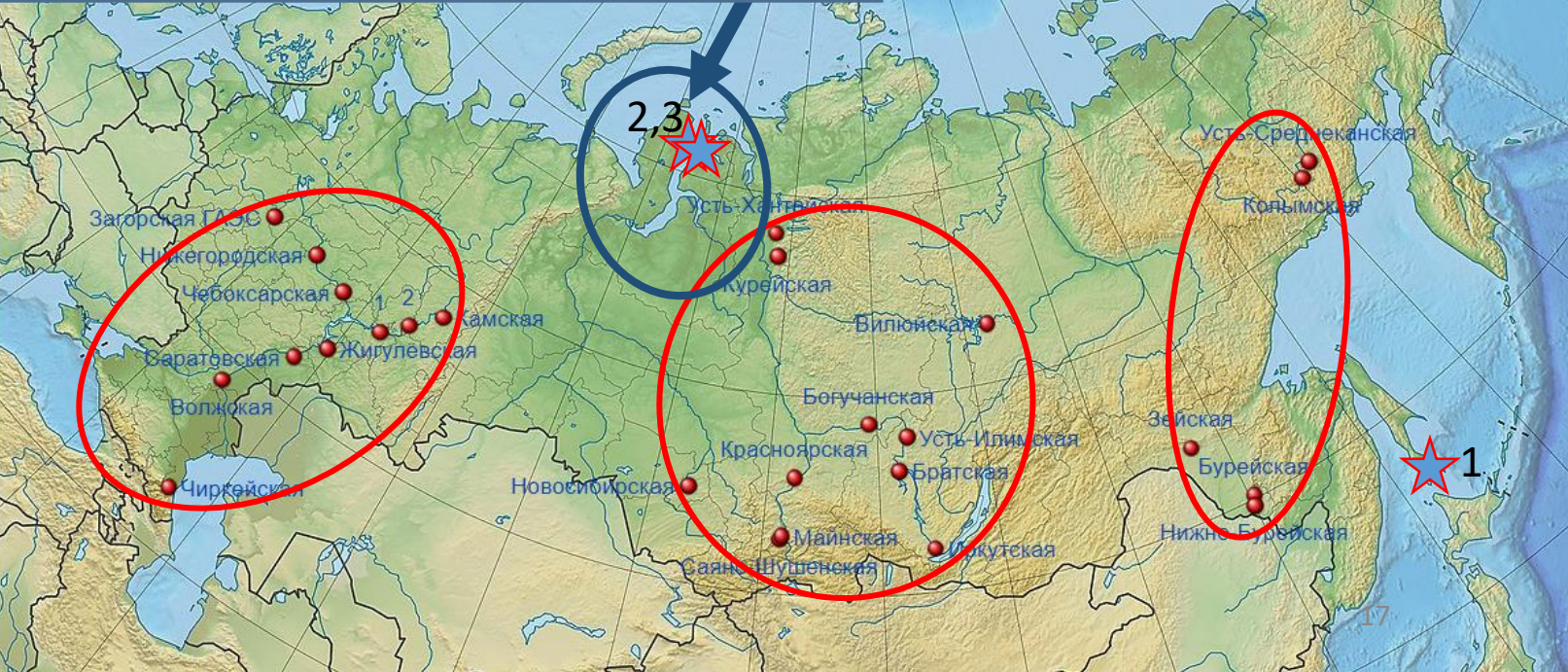
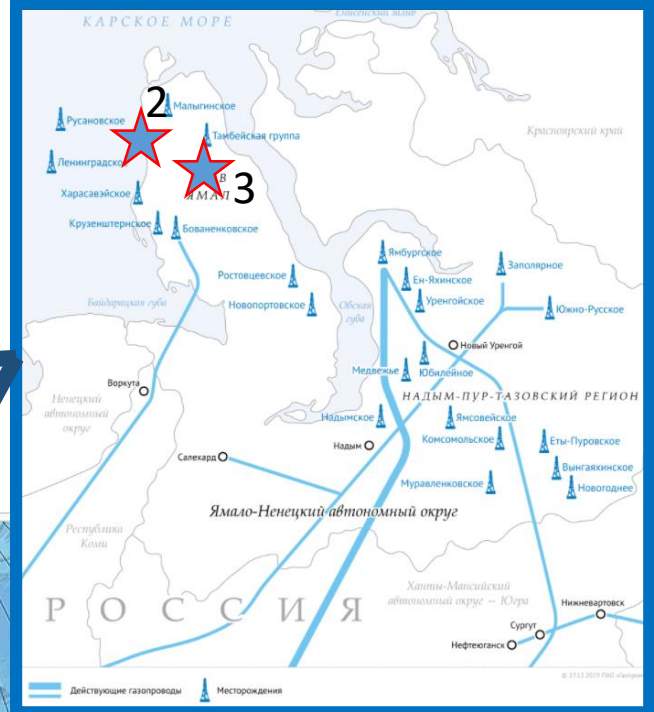
- Nuclear
- Hydro
- Nadym-Pur-Taz & Yamal

★ Large-scale LNG plants, acting: (1) Sakhalin-2; (2) Yamal LNG; (3) Arctic LNG

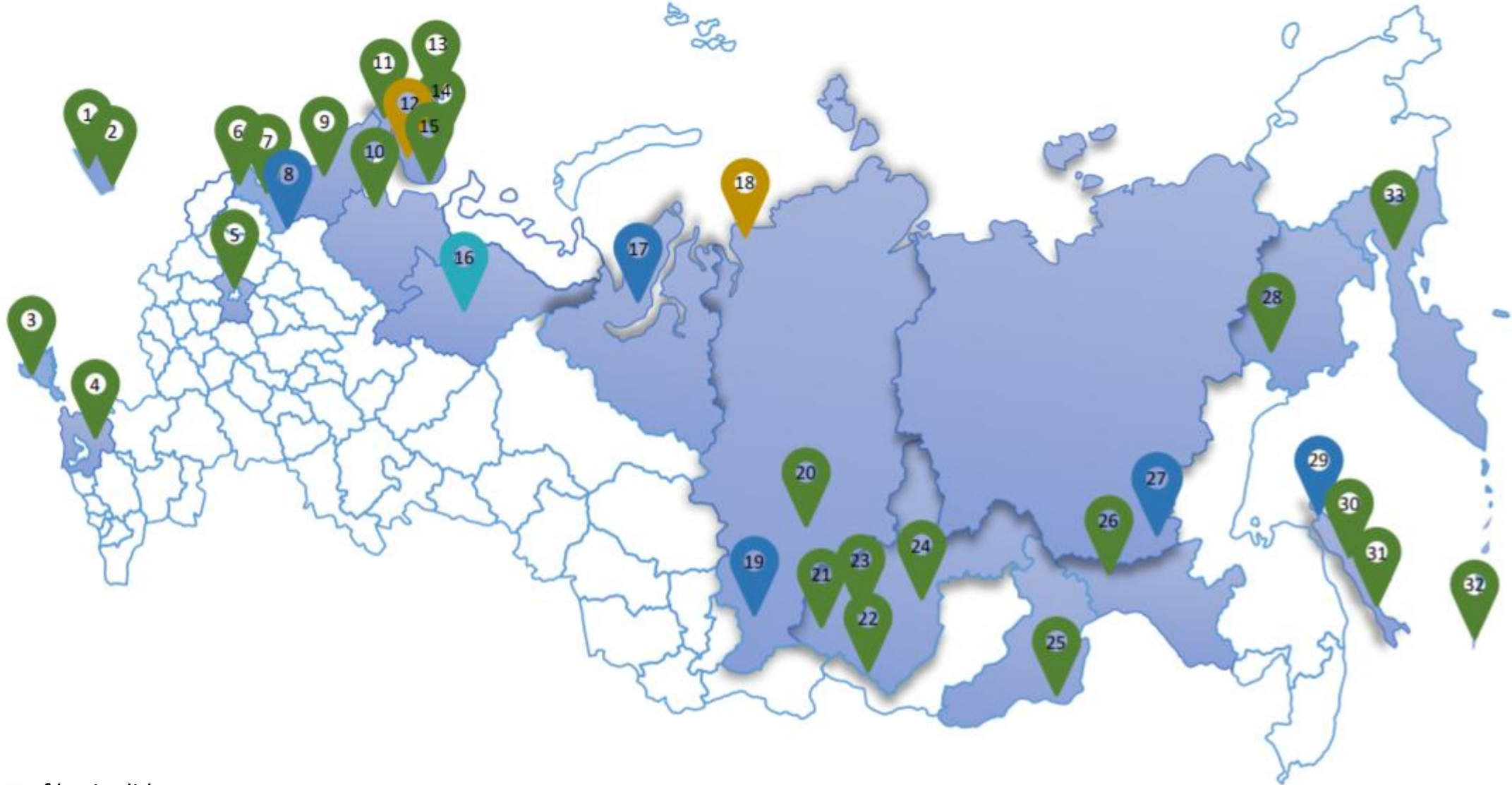
Sources of maps:  
<https://www.gazprom.ru/f/posts/15/770293/map-yamal-ru-2019-12-30.png>;  
[https://ru.wikipedia.org/wiki/Атомная\\_энергетика\\_России](https://ru.wikipedia.org/wiki/Атомная_энергетика_России;);  
[https://ru.wikipedia.org/wiki/Список\\_гидроэлектростанций\\_России](https://ru.wikipedia.org/wiki/Список_гидроэлектростанций_России);  
 21.10.2021

**Concept of Russian H2 Strategy (05.08.2021) => four territorial export-oriented H2 clusters:**

1. North-Western: export H2 to the EU,
2. Eastern: export H2 to Asia,
3. Arctic: zero-carbon energy supply systems for Arctic zone RF and/or export H2 & H2-based energy mixes,
4. Southern (based on NatGas & RES): close to export ports



# Russian Ministry of Industry & Trade (MinPromTorg): Atlas of Russian projects for production of low-carbon & zero-carbon (\*) hydrogen (H<sub>2</sub>) & ammonia (NH<sub>3</sub>)



Source of basic slide:

<https://minpromtorg.gov.ru/common/upload/docVersions/6169d30a613>

64/actual/Atlas\_en\_15102021\_compressed.pdf

А.Конопляник, Восток капитал, Водород, Москва, 20-

21.10.2021

(\*) more correctly would be: with low-direct & zero-direct emissions

# Ministry of Energy/Russian Government: more & more ambitious stake on H2 export, but the problem with his delivery to export market technically is not solved, while voiced draft solutions – counter-productive, unprofessional & devastating...

Export, mln tonnes	2024 г.	2025 г.	2030 г.	2035 г.	2050 г.
(1) Russian Energy Strategy ( <b>June 2020</b> )	0.2		-	2	-
(2) Governmental Road Map (October 2020)	-		-	-	-
(3) Draft Concept Russian Hydrogen Energy Development ( <b>April 2021</b> )	0.2-1.0		-	2-7	7.9-33.4
(4) Yu.Dobrovolsky (*) (« <u>We with Minenergo... acc. to conservative forecast</u> ») (O&GV, June 2021)	-	2-3	20-30 и более	-	-
(5) Concept of Russian Hydrogen Energy Development ( <b>August 2021</b> )	0.2-1.0		-	2-12	15-50

(1) Энергетическая стратегия Российской Федерации на период до 2035 года. Утверждена распоряжением Правительства РФ от 9 июня 2020 г. № 1523-р (<http://static.government.ru/media/files/w4sigFOiDjGVDYT4lgsApssm6mZRb7wx.pdf>)

(2) План мероприятий «Развитие водородной энергетики в Российской Федерации до 2024 г.». "Утвержден распоряжением Правительства РФ от 12 октября 2020 г. № 2634-р (<http://static.government.ru/media/files/7b9bstNfV640nCkkAzCRJ9N8k7uhW8mY.pdf>)

(3) Итоги работы Минэнерго России и основные результаты функционирования ТЭК в 2020 году. Задачи на 2021 год и среднесрочную перспективу. Материалы заседания Коллегии Минэнерго России, 12 апреля 2021 г., слайд 7 (<https://minenergo.gov.ru/system/download-pdf/20322/154219>)

(4) Ю.Добровольский. Водороду нужна господдержка. // «Нефтегазовая Вертикаль», июнь 2021, №11-12, с.80-84 (84)

(<http://www.ngv.ru/upload/iblock/ad7/ad759fe2657454a1adbe4d7435d1fba3.pdf>) (\*) позиционирует себя как один из основных разработчиков водородной стратегии России

(5) Концепция развития водородной энергетики в Российской Федерации. Утверждена распоряжением Правительства РФ от 5 августа 2021 г. № 2162-р

(<http://static.government.ru/media/files/5JFns1CDAKqYKzZ0mnRADAw2NgcVsexl.pdf>)

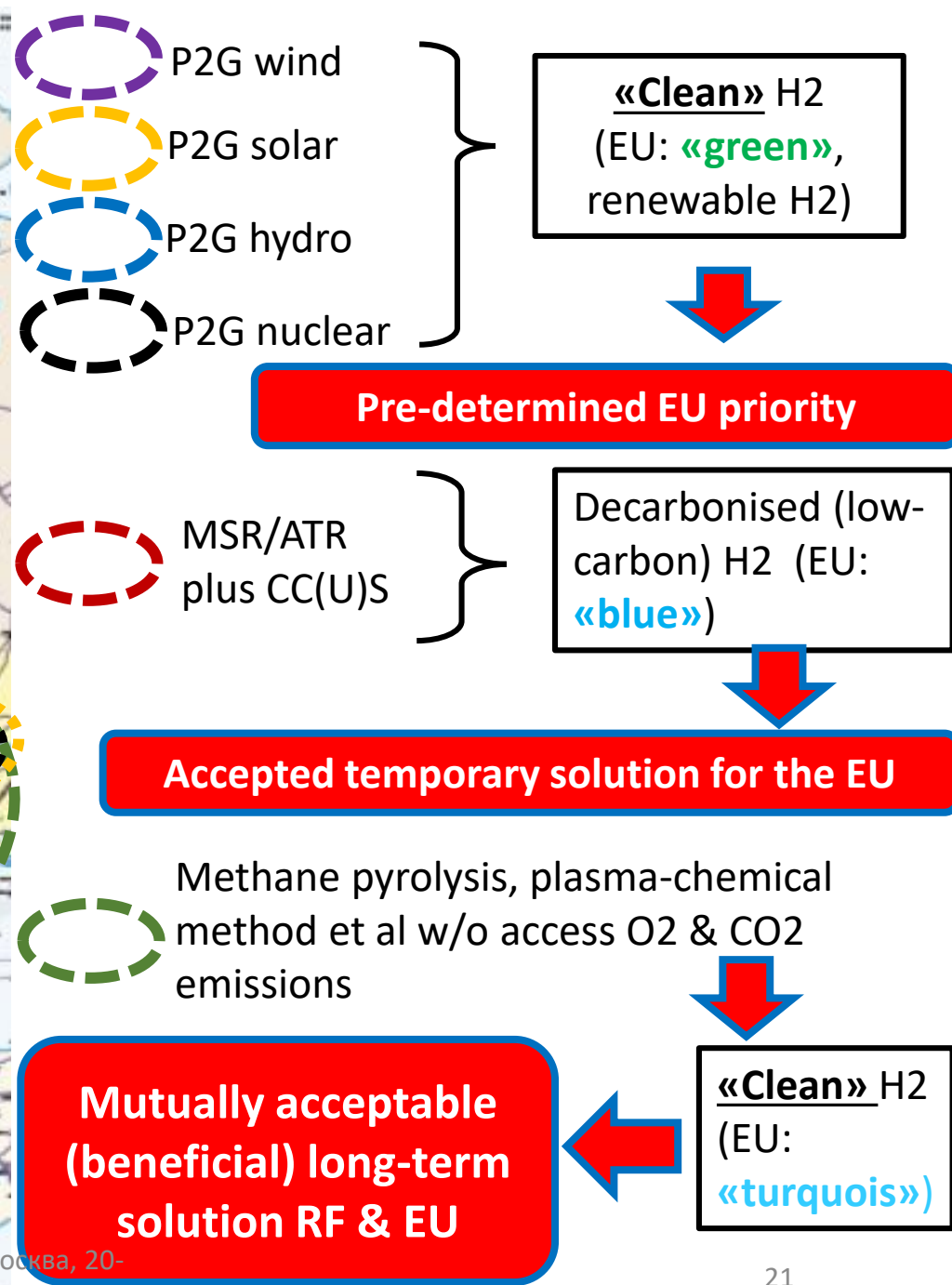
# Table of content

- 1) Russia and the EU: two ways to net-zero emissions in energy
- 2) EU Hydrogen Strategy: energy transition based on semi-truth => distorted “advantages” & imaginary ecological exclusiveness of “green/renewable” hydrogen
- 3) Two avenues for development of external economic segment of Russian hydrogen energy: to follow European concept which is gently imposed on us by EU/Germany and which reflects their national interests, OR to defend concept of cooperation in hydrogen based on balance of interests of the parties?
- 4) Governmental concept of hydrogen energy development in Russia – why by European model?
- 5) **Alternative concept based on balance of interests of the parties, non-distorted system of arguments and technological neutrality principle: it diminishes decarbonisation costs for the EU, increase monetization of Russian gas resources, leads to increase of welfare of both Russian and EU citizens**

# Approximate potential areas of preferential use of key H2 production technologies in Europe under state regulation based on "technological neutrality" principles – potential new competitive niche for Russian gas & technologies for H2 production w/o direct CO2 emissions

Source: dashed lines - A.Konoplyanik, based on conversations with Ralf Dickel; dotted lines - Ukraine & North Africa are added based on "The 2x40GW Green Hydrogen Initiative Paper" Hydrogen Europe study for illustration purposes with the observation of this author's skepticism in regard to long-distance transportation of H2 produced in these geographical areas

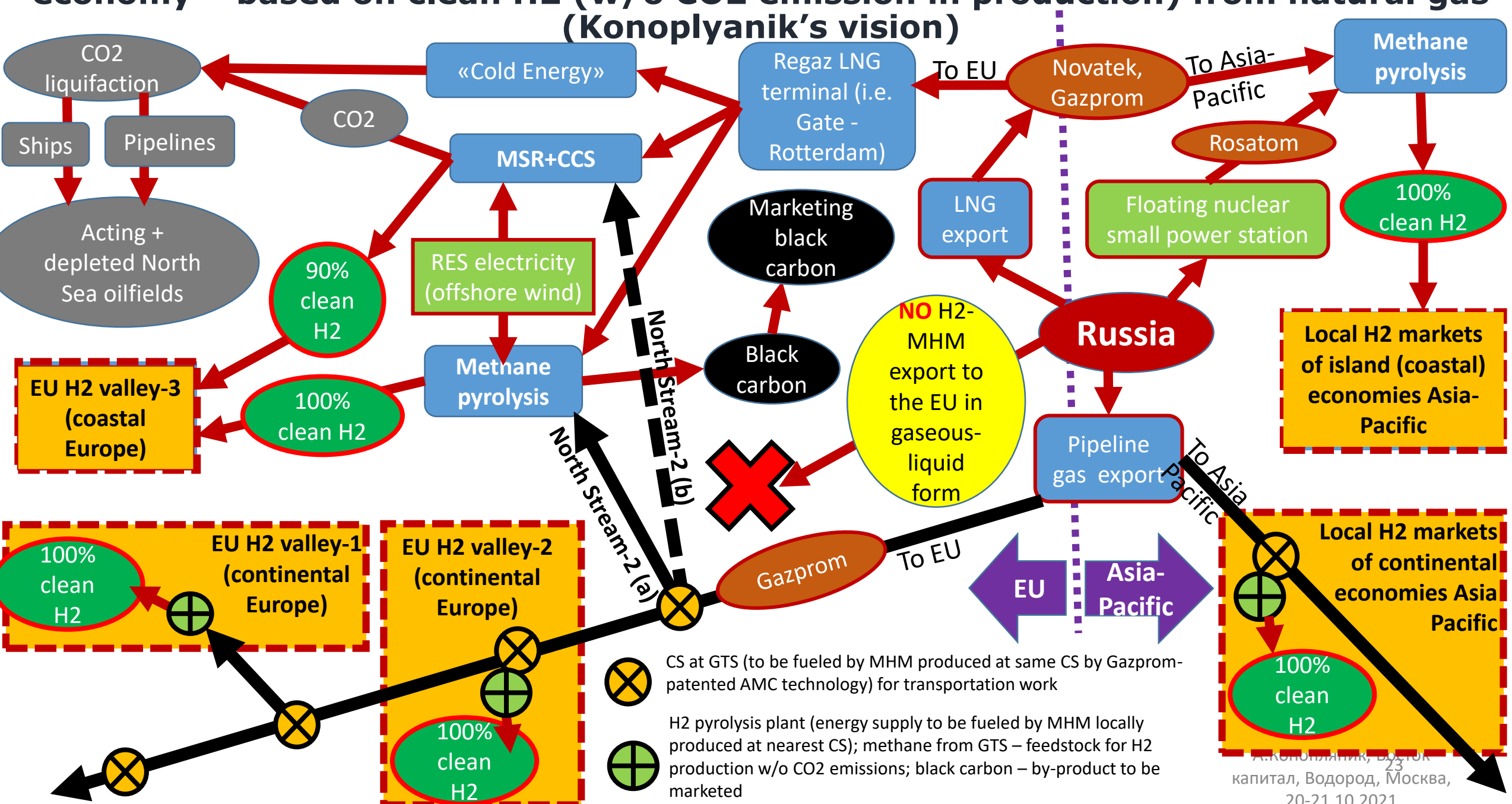
Map source: ENTSOG  
 А.Конопляник, Zoom-заседание Экономического клуба ФБК "Россия без нефти: рецепты выживания", 09.06.2020



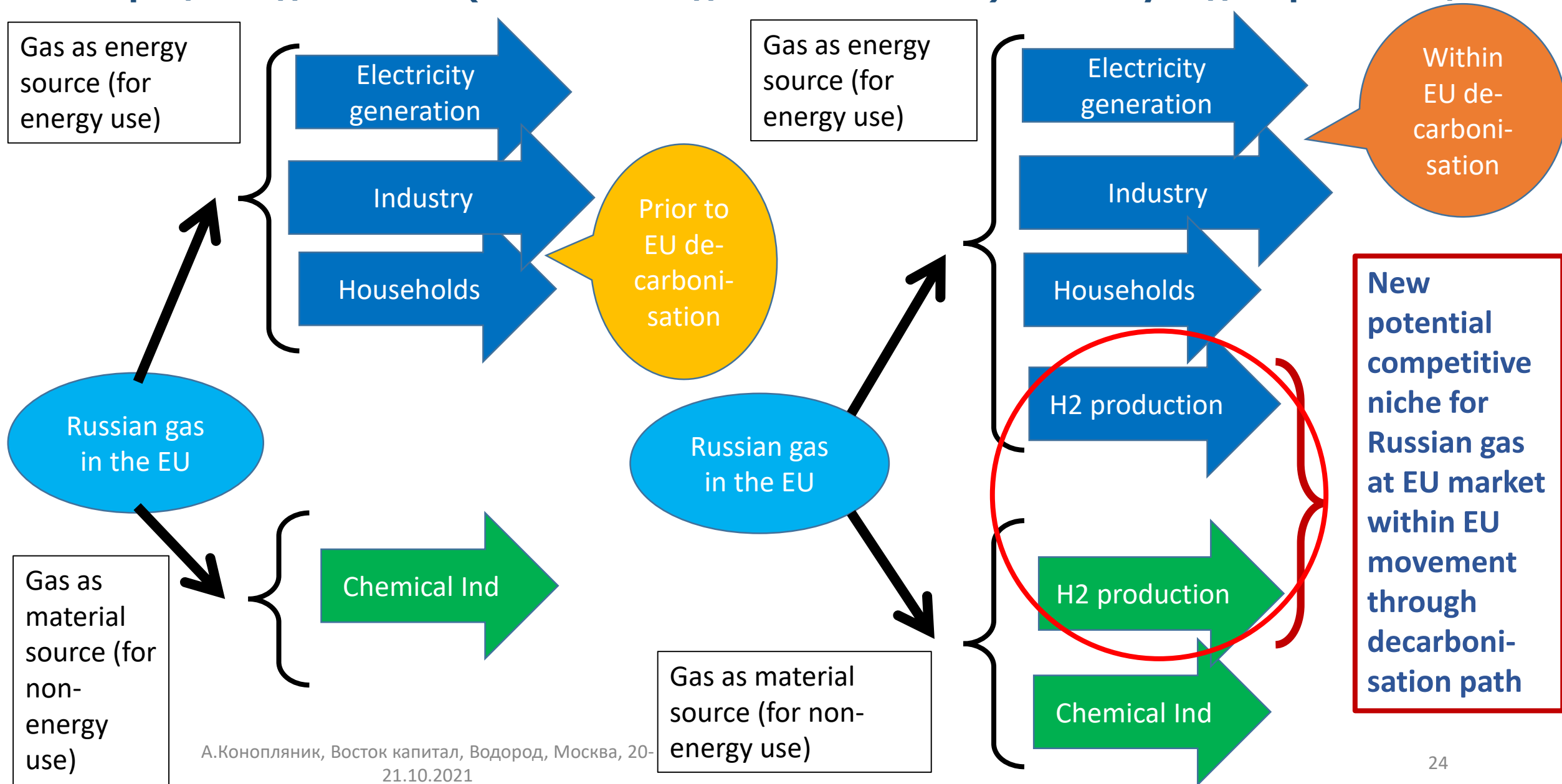
# Clean H2 production (w/o CO2 emissions) from natural gas downstream EU based on existing Russia-EU GTS & MHM (as energy source) produced at CS on-site

- Clean H2 production close to EU demand centers (H2 valleys) located close to existing compressor stations (CS) at cross-border RF-EU GTS. To use gas from the grid:
- As **energy source** for:
  - (1) transportations work:
    - to produce MHM on-site at CS on transportation routes of Russian gas to the EU;
    - to use this MHM at these CS as a fuel gas instead of methane for further gas transportation.
    - Such substitution of CH4 by MHM as fuel gas at CS diminishes CO2 emissions by 30% (acc.to Gazprom);
  - (2) clean H2 production:
    - at the H2 production plants which are to be built close to these CS in “H2 valleys”;
    - scale of production adequate to H2 demand of particular “H2 valley”;
    - energy supply of CCGT of adequate capacity - acc.to above-mentioned scheme in (1).
    - Though substitution of CH4 by MHM as fuel gas is not for transportation work, but for energy supply (electricity &/or heat) to H2 production plant;
- As a **feedstock** for:
  - (3) clean H2 production:
    - new plants for clean H2 production from CH4 (pyrolysis et al);
    - plants to be located close to CS and aimed to cover H2 demand of local “H2 valley” (this will exclude demand for long-distance transportation of H2 or MHM).

# Alternative concept for export-oriented segment of Russian hydrogen energy economy – based on clean H2 (w/o CO2 emission in production) from natural gas (Konoplyanik's vision)



# Конкурентные ниши для российского газа на рынке газа ЕС до начала (существующие) и в процессе движения (возможные дополнительные) ЕС по пути декарбонизации





## Summary

- EU Hydrogen Strategy is based on semi-truth. Within distorted frame of reference “renewable” H<sub>2</sub>, produced by water electrolysis with RES electricity, is considered within EU as if the only one clean H<sub>2</sub>, which does not correspond to the reality. EU considers only Scope 1 & 2 emissions for green H<sub>2</sub> production, where there is really no CO<sub>2</sub> emissions. But it does not consider Scope 3 emissions where all these emissions are concentrated, while in enlarged quantities. This is why green H<sub>2</sub> has been unjustifiably put in a preferential position within EU, while other H<sub>2</sub> production technologies (i.e. H<sub>2</sub> from natural gas, incl. without direct CO<sub>2</sub> emissions) are discriminated and/or ignored. Aim – to create global market of green H<sub>2</sub> & technologies based on Euro.
- Russia has been gently imposed the concept of H<sub>2</sub> cooperation with EU based on costly & devastative & counter-productive model which de facto considers Russia as the market for electrolyzers and RES equipment “Made in EU/Germany”. It is proposed to produce H<sub>2</sub> in Russia (on the basis of excessive hydro & nuclear production capacities & gas-producing capacities) and to supply it to the EU through existing GTS which is not designed for transportation H<sub>2</sub>/MHM despite many contrary statements (both in the EU and Russia). Such approach will destroy Russian GTS integrity (costly precedent with US Strategic Defense Initiative’s economic effect for Russia).
- Nevertheless, Russian Government, based on Minenergo and its experts, actively promotes just this model of H<sub>2</sub> cooperation, aimed at more-and-more ambitious plans of H<sub>2</sub> export with no justification.
- Author proposes alternative scenario of H<sub>2</sub> cooperation (based on “three-steps Aksyutin’s pathway”), with continued natural gas export to the EU and H<sub>2</sub> production downstream in EU within “H<sub>2</sub> valleys” close to EU end-users within volumes adequate to these local centers of H<sub>2</sub> demand in EU, on the basis of H<sub>2</sub> production technologies to be commercialized jointly with partner-companies from the EU, first and most – by pyrolysis group of technologies (H<sub>2</sub> from natural gas without direct CO<sub>2</sub> emissions).

# Thank you for your attention!

[www.konoplyanik.ru](http://www.konoplyanik.ru)  
[andrey@konoplyanik.ru](mailto:andrey@konoplyanik.ru)  
[a.konoplyanik@gazpromexport.com](mailto:a.konoplyanik@gazpromexport.com)

**Disclaimer:** Views expressed in this presentation do not necessarily reflect (may/should reflect) and/or coincide (may/should be consistent) with official position of Gazprom Group (incl. Gazprom JSC and/or Gazprom export LLC), its stockholders and/or its/their affiliated persons, or any Russian official authority, and **are within full personal responsibility of the author of this presentation.**

*Note: Research is undertaken with financial support of Russian Foundation for Fundamental Research (RFFR) within the project “Influence of new technologies on global competition at the raw materials markets”, project № [19-010-00782](#)*