WHITE PAPER

A policy- and support regime motivating investment in production of truly sustainable and scalable 2G renewable fuels

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Contents

1 Scope and objective

This White Paper is intended as a guide to policymakers, expert agencies and promoters of renewable fuels to a meaningful policy and support regime permitting investment in 2G renewable [1]fuels production.

The guide focuses on how to handle price and volatility [2] risks in renewable fuels production and the need to provide grandfathering for projects as subsequent projects move down in cost on the learning curve – this so that projects can be made financeable. The key underlying risk is political risk – a large portion of the value of renewable fuels is politically created and is therefore extremely sensitive to changes or uncertainty in policy.

The guide does not cover numerous other production project risks such as technology, feedstocks etc., which also have to be allocated and mitigated to secure financing. It is the authors' experience from hands-on development and financing of 2G renewable fuels technology and projects as well as power projects that the price and volatility risk is the most challenging risk to handle in this context.

The document does not analyze EU competition and state aid law in detail. Based on the authors' practical experience in successfully obtaining DG competition clearance and given the below

- policy and support regimes similar to that proposed herein have already well served the renewable electricity market
- state aid law and competition has significant provisions allowing state aid provided the societal benefit outweighs the cost of market distortion
- EU regulation explicitly recognizes the needs and exceptional nature of 2G renewable fuels productions[3], we certainly believe a meaningful policy and support regime is implementable in Sweden.
- a previous, government-commissioned study, Fossilfrihet på väg (Fossil free road transport) has found that similar schemes are implementable under EU law[4]. The scheme proposed herein also adds an auction mechanism to further increase a competitive element.

[1] The term 2 G renewable fuels is used herein to encompass both 2G renewable fuels and fuels such as 2G electrofuels (for example, the conversion of renewable power to liquid or gaseous fuels)
[2] We use price risk to mean the risk that general market price level is or becomes permanently insufficient to permit a viable business. By volatility risk we mean the risk of prices fluctuating between periods due to market forces or, importantly, to political context or actions; this may make debt service uncertain and lead to default in given periods even if the price level were to be adequate as a long-term average.
[3] EUROPEAN COMMISSION Guidelines on State aid for environmental protection and energy 2014-2020 (2014/C 200/01): "(114) In addition, the Commission will consider that the aid does not increase the level of environmental protection and can therefore not be found compatible with the internal market if the aid is granted for renewable fuels which are subject to a supply or blending obligation (60), unless a Member State can demonstrate that the aid is limited to sustainable renewable fuels that are too expensive to come on the market with a supply or blending obligation only."
[4] SOU 2013:84 Fossilfrihet på väg (Fossil free transport) p. 840

Lastly, we note that there is nothing new under the sun, 2G renewable fuels promoters and researchers have in various forms and forums identified and communicated all issues and proposals herein during the last decade. [5]

Encouragingly, the last 5 years have seen a number of Swedish Government-commissioned studies or other reports which have correctly analyzed requirement for 2G production, the impediments to investment and, in some cases, meaningful solutions supporting 2G production. [6][7]

We hope that the present document can bring a further level of concreteness and accelerate the process of implementing policy and support which motivates the needed investment in 2G renewable fuels.

[5] For example, Chemrec AB formal answer including proposal for CFD instrument to DG Energy on EU SET plan "How to close the risk finance for advanced renewable fuels projects" June 2013

[6] For example, but not limited to: SOU 2013:84 Fossilfrihet på väg (Fossil free transport); Energimyndigheten: Kontrollstation 2019 för reduktionsplikten. (Mid-term review 2019 for the reduction obligation); SOU 2019:11 BioJet för flyget (Aviation renewable fuels)

[7] For example, "Development and analysis of a durable low-carbon fuel investment policy for California" by the International Council of Clean Transportation (2016). This extremely well-written white paper also proposes a CFD-type instrument.

2 Background: Ambitious Swedish targets for fossil-free road transport

- Sweden has set ambitions targets for reduction of CO2 emissions from road transport fuels. The reductions are calculated as a reduction from an all-fossil-fuel baseline and are as per below:

Reduction obligation versus fossil baseline GHG emissions

Year	2018	2019	2020	2021	2025	2030	2045
Status	Law	Law	Law	Proposed	Proposed	Proposed	Proposed
Diesel	19.3%	20.0%	21.0%	24.6%	39.8%	60.0%	92.9%
Gasoline	2.6%	2.6%	4.2%	6.3%	15.2%	27.6%	80.6%

- Non-fulfilment by an obligated party (the distributors) is subject to a penalty per Kg CO2 equivalent of 5 SEK for diesel and 4 SEK for gasoline - below expressed both on an energy and on a volume basis using the standard energy contents from the regulation.

Energy content and penalties for shortfall from reduction obligations

	Energy content, MJ/l	g CO_2/MJ	kg CO_2 / l	Penalty for shortfall from obligation: **per kg CO_2 eqv**	SEK per MJ	SEK per litre
Diesel	35.3	95.1	3.4	**4**	0.38	13.4
Gasoline	32.2	93.3	3.0	**5**	0.47	15.0

Source: Swedish Energy Agency, Kontrollstation 2019

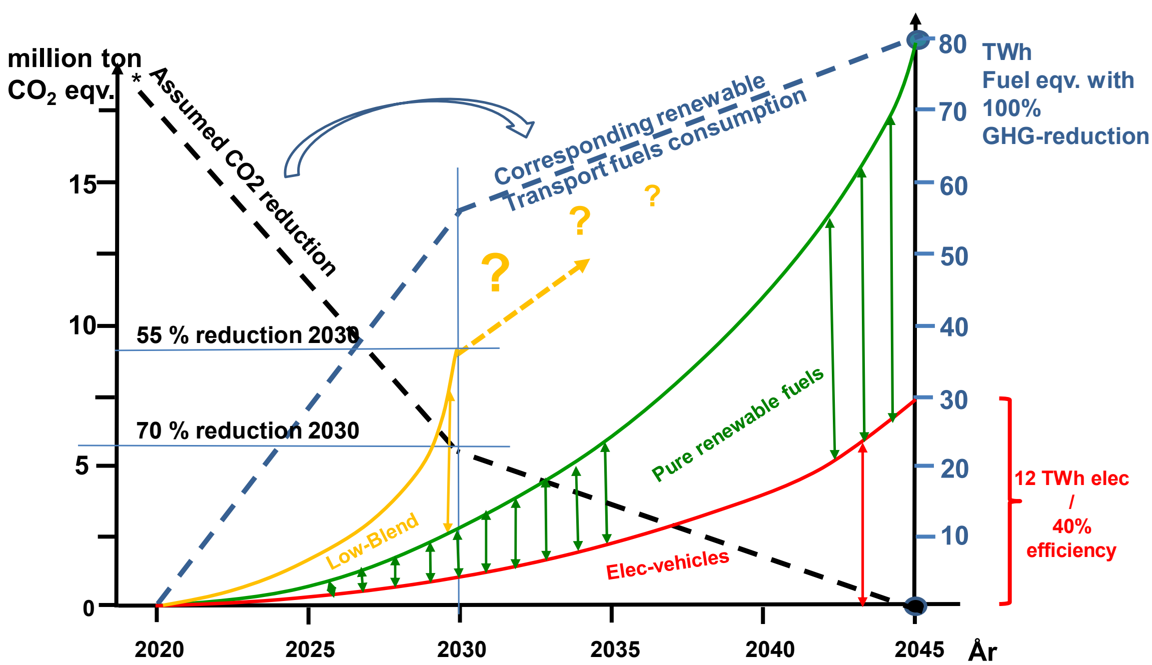
- High blend or pure renewable fuels are currently afforded exemption from energy- and CO2-taxes on rolling short-term decisions. This system risks being phased out as it is by some considered politically unattractive (reduces tax-revenues) and not always in line with EU views on market distortion. However, we would in this context note the importance of grandfathering, i.e. that investors are provided with regulatory stability and perennity of the same rules as when the investment was made at least for a period sufficient to recover capital and returns. Currently, investors do not trust that this principle is upheld- there are numerous examples worldwide, including in Sweden of policy change detrimental to investments already made. As an aside, while not in scope of the present paper, to secure existing plants one may consider a civil-law CFD paying out the difference between the tax-exemption value ex-ante and the tax-exemption actually obtained for a period determined for individual projetcs sufficient to recoup capital and returns.
- The current system, while ambitious, cannot support adequate investment in truly sustainable, scalable- and non-fossil-lock-in 2G fuels, so its targets cannot be met. A solution to this issue is described in this document. [8]
- Current volumes of renewable fuels used to meet obligations are largely either imported and/or not based on truly sustainable, scalable and non-fossil-lock-in 2G fuels, so current achievement is not indicative of future ability to achieve targets.

[8] SOU 2013:84 Fossilfrihet på väg 14.7.2 pp.733-734

3 Issue: 1G renewable fuels and low-blend won't reach targets-need pure renewable fuels

The below graph demonstrates that to reach the goal of 100% renewable fuels 2045, domestic production of pure renewable fuels needs to start now. We cannot low-blend our way to 100% renewable. It is,

- Impossible to reach the targets through co-blend of renewable fuels with fossil (Yellow curve)
- Pure, not fossil co-blend, renewable fuels (green curve) and electricity (red curve, electricity converted to fuel equivalents) is a necessary condition for reaching fossil free transport.
- Swedish targets currently met approximately 85% through imports, some with dubious sustainability (e.g. PFAD)
- Late in the day; given lead times for the large investments needed, plant investment needs to start.



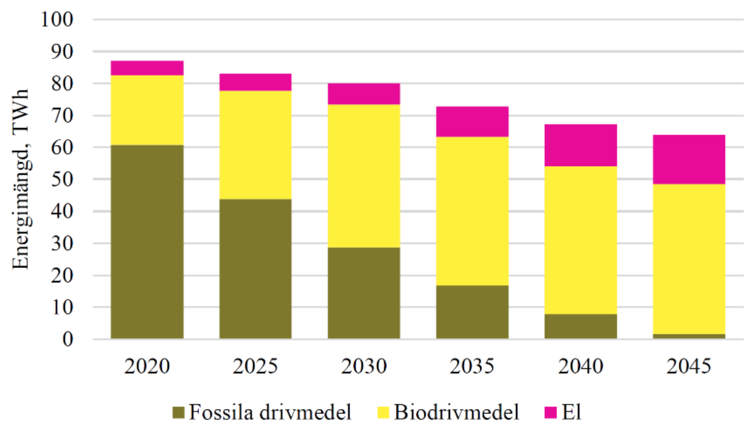
* This starting point excludes reduction from today's blend-in of biofuels

4 Why are 2G renewable fuels required?

There is no single definition of 2G renewable fuels. For the purposes of meeting the targets set, we believe these should meet the following criteria:

- GHG reduction consistent with targets (average approx. 85%, will be used for prurposes of discussion herein)
- Sustainable biomass feedstocks and/or renewable power for production, including land-use change and food competition aspects
- Higher energy and resource efficiency
- Typically, more scalable
- No lock-in to a fossil system, i.e. fuels should have a route which does not require co-production of fossil fuels.
- Provide additionality, in other words, incremental volumes
  - not built on non-scalable imported volumes, the use of which decrease renewable fuels use across the border commensurately with our use
  - with feedstocks which do not have alternative productive non-energy uses (e.g. PFAD)
- Examples of 2G renewable fuels include both drop-in and non-drop in fuels produced on sustainable basis per above (non-exhaustive list):
  - Synthetic gasoline
  - FT Diesel
  - DME
  - Methanol
  - Cellulosic ethanol
  - Electro-fuels – energy carriers produced using renewable electricity from, for example, wind or solar power
  - Novel fuels from conversion of lignocellulosic feedstocks through using non-fossil systems units incl. renewable hydrogen or microorganisms etc.

- The Swedish Energy Agency (SEA) projects that a significant portion of domestic transport energy use will be provided by renewable fuels in 2045.



[9]

- SEA estimates that there are projects planned or discussed to produce some 16 TWh of renewable fuels (an additional 1.5 million tons on top of 600 000 tons available today)[10]. Of the 1.5 Mt, a significant portion risks being fossil co-blend, locked-in to a fossil energy system, dependent on non-scalable feedstocks, and imported feedstocks (some of which may have sustainability issues under EU-directives). This can be compared with SEAs estimated need of some 50 TWh[11] to meet the targets. Clearly, there is a need for major new investment in production plants for 2G renewable fuels. The SEA states that additional investment will be needed to meet the needs.[12]

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[9] Energimyndigheten: Kontrollstation 2019 för reduktionsplikten. (Mid-term review 2019 for the reduction obligation Figure 8, p. 42 "The energy use for domestic transport excluding construction machinery" [Note: Electricity is shown as TWh- if shown as transport fuels equivalent, has to be multiplied by approximately 2.5.

[10] Idem section 6.6 pp. 34-36

[11] idem

[12] idem

5 The key challenge in securing 2G renewable fuels production

While the impediments for investment in 2G renewable fuels production have been communicated by promoters and practitioners to EU and Swedish lawmakers for over a decade, in the last five years there have been several encouraging Government-commissioned studies which have correctly analyzed the requirement for 2G production, the impediments to investment and, in some cases, meaningful solutions supporting 2G production.

The comprehensive 2013 Government commissioned study of fossil-free transport notes:

> "…the reduction quota obligation system is not considered sufficient to provide investment in the planned [2G renewable fuels] plants which require several billion SEK financing each and which will not happen without stable [policy] conditions"[13]

The Swedish Energy Agency notes :

> "Next Generation renewable fuels will in several cases have an opposite [to 1G] situation where …feedstocks are low price but where the production plant has a large investment cost. Therefore a larger portion of production cost will consist of capital costs..." [14]

The 2019 Government-commissioned study of Biojet fuel for Aviation notes that the large [2G] plants needed for fuel production (which will normally co-produce both aviation- and road transport fuel) likely will require production support for investment to take place, a quota system being insufficient. The study also notes that [2G] fuel production for road transport faces analogous issues[15]

These conclusions are also evident from past history and experience both in Sweden, the EU and the US(RFS). Current support schemes are simply not meaningful for generating investment in 2G plants with the above characteristics.

- 2G pure renewable fuels require significant investment in plant capacity. There are important economies of scale.
- 2G fuels often have relatively higher CAPEX intensity but lower OPEX vs. 1G fuels. In other words, while feedstocks are cheaper for 2G, they require higher CAPEX. This makes them more exposed and sensitive to political, regulatory and market risks.
- Lead times for plant investment can be up to 5 years to production, provided political risk is handled up front.
    - Currently, easier to import less sustainable, less scaleable fuels than to build 2G capacity
    - Current legislation and regulation are unfit for purpose –they do not address key political and market risks and cannot motivate the required investment in 2G renewable fuels.
    - Need new legislation and regulation providing the required risk allocation and certainty

[13] SOU 2013:84 Fossilfrihet på väg 14.7.2 pp.733-734
[14] Kontrollstation 2019 för reduktionsplikten. 6.5 p.34
[15] SOU 2019:11 BioJet för flyget 10.2.4 pp. 231-22

Clear evidence for the lack of incentives is also the fact that virtually no 2G projects have advanced to a final investment decision. An example is the Domsjö project which secured equity financing, a 55 MEUR grant, EPC wrap guarantees etc. but which could not raise debt following the refusal by the Ministry of finance to guarantee the perennity of biofuels incentives which provided the price basis.

6 Why the current system cannot motivate required investment in 2G

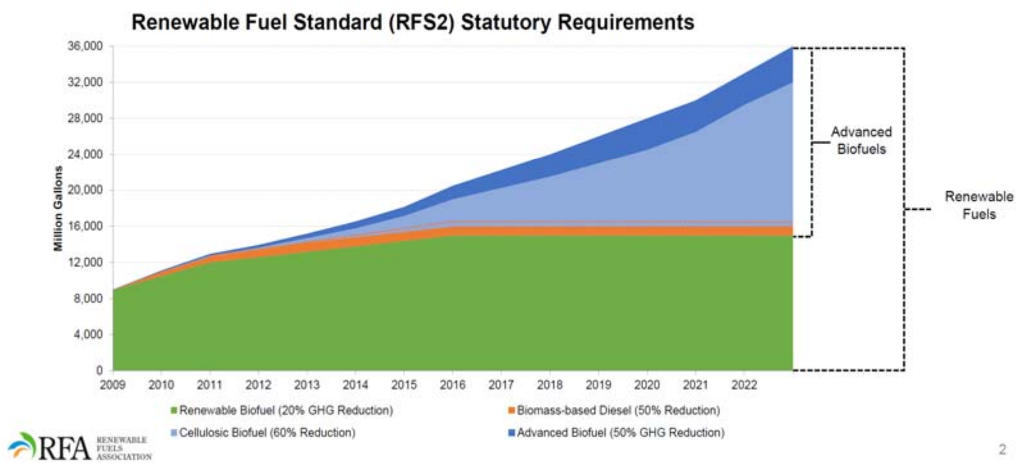
A promoter making an investment decision faces both the irreversibility of investment (typically no alternative use of the plant) and volatility/uncertainty of the value of the product.

- The high potential 2G fuels are all positioned early in their product life cycle, and have not yet benefit from economies of scale or learning curves. In addition to the higher unit cost of energy, vehicles for these fuels are also fairly early in their product life cycle and market interest is uncertain. Simply put, it is easier to import drop in fuels to blend into diesel and gasoline than take the risks of developing domestic production.
- The reduction quotas set (Sw:"Reduktionsplikt") do not provide reasonable certainty and possibility of quantification regarding the level and risk of the price premium for sustainable over fossil. 2G projects with their relatively higher CAPEX are particularly sensitive to this issue.
- Potential future penalties for not meeting quota obligations (Sw: "Reduktionspliktsavgift") are severely discounted by promoters and capital markets(as discussed below) and clearly cannot give an adequate indication of the future value of 2G renewable fuels at the time of an investment decision(needed for investment). The penalties for non-compliance can in theory grow so large that promoters generally believe it is unlikely that they would be imposed should there be a shortfall in production capacity investment and insufficient 2G volumes available to meet target. This belief is in part based on the US RFS experience below but also on simple math, the financial penalties could grow so large so as to put in jeopardy the financial viability of several market actors. This means that there is a reasonable expectation by investors that targets will be reduced and/or penalties waived.
- Renewable fuels markets are, compared to fossil fuels, small and more volatile.

The US RFS (Renewable Fuel Standard) system is a good real-world example why future targets and uncertain values of production support have low value in generating investment in 2G renewable fuels:

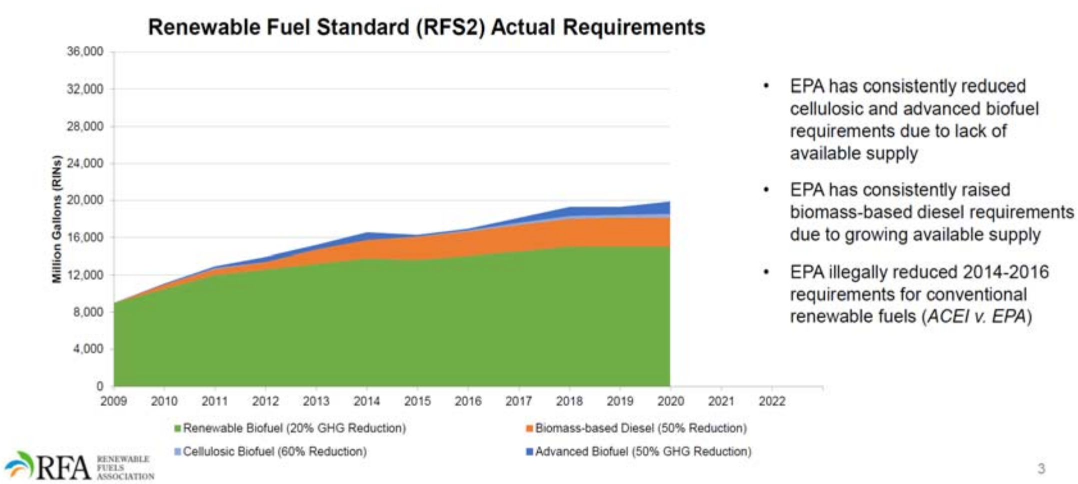
Political risk in targets – targets may be changed if they cannot be met

- The US Environmental Protection Agency (EPA) set ambitious targets for Advanced renewable fuels (High- GHG reduction fuels, akin to what we call 2G fuels)
- When targets could not be met (due to insufficient investment in Advanced renewable fuels production which was in turn due to regulatory uncertainty), the EPA reduced them, provided waivers etc. A similar dynamic has operated in emissions trading markets.
    - Initially set ambitious targets for Advanced Renewable fuels:



[16]

When production capacity investment did not materialize, targets were reduced to an insignificant fraction of the initial targets:



[16] Understanding the RFS and RINs Geoff Cooper Renewable Fuels Association August 29, 2018

- Significant analysis is available on how much above a break-even price the expected price needs to be for an advanced renewable fuels production plant promoter (and their funders) to decide to invest – This price referred to as a trigger price, and is typically 70-100% above the break-even price [17] [18] [19]. Simplistically, this common sense result is due to the lack of a sufficient risk premium to outweigh both market- and political factors generating volatility and uncertainty, coupled with the irreversibility of capital investment.
- Translating this into the context to the Swedish system means that:
    - History from the RFS system shows that targets which cannot be met are politically decreased or waived rather than imposing massive penalties for non-compliance. Therefore, the reductions obligation targets are not sufficiently credible by themselves to support significant investment in 2G production.
    - The value today of a potential future penalty is mathematically very low – An obligated party and/or potential investor today will significantly discount a future possible penalty for non-compliance. Its nominal value therefore has limited bearing on the price which could be used to justify an investment decision. While it can be readily analyzed using real options and time value of money, this is a rational and common sense result- rather than investing in a 2G plant today, it makes more sense to wait and see, knowing that:
        - the underlying renewable fuels markets are very volatile, including the risk of being undercut by imported volumes
        - it is unlikely, based on past experience that targets and penalties will be maintained in case of non-fulfilment.
        - the schemes in place are not civil law contracts securing cash-flow to a specific plant so they have limited value in raising financing.
- The above also means that neither RFS nor the Swedish reduction obligation system are technology-neutral: These systems clearly favor 1G, refined feedstocks such as oils, incremental additional to fossil systems and incumbents – all with relatively lower up-front CAPEX but unable to achieve the targets - this as opposed to new 2G stand-alone technology.

[17] Estimating the influence of US ethanol policy on plant investment decisions: A real options analysis with two stochastic variables. Energy Economics, 33(6), Schmit, Luo, Conrad, J. M. (2011). pp. 1194-1205.
[18] Uncertainty, irreversibility, and investment in second-generation renewable fuels. BioEnergy Research, 8(2), (2014) McCarty, Sesmero, pp. 675-687
[19] Examining the effects of uncertainty on second-generation renewable fuel investment by using a two stochastic process approach, Markel, Sims and English (2016) p 43, Table 9

7 Requirements of an instrument which can motivate investment in 2G

A meaningful policy instrument must address the following requirements to be fit for purpose, politically and financially viable:

- Handle the key risk – the uncertain and volatile value of both fossil and renewable fuels over the duration of the project. The underlying risk is largely political in nature.
- Project-specific policy instruments – The levels of CAPEX for 2G plants preclude investment based on general instruments (essentially a speculative bet), even if one believes they are set in stone.
- Civil-law contract providing the support to the specific project - Investors have been burned time and time again by relying on general legislation which may or may not be maintained over time, which generally is not project specific and whose value is not only volatile and unpredictable but also may not accrue to a specific project.
- Predictable, capped and optimized cost imposed on obligated parties and by extension on consumers – Feed-in tariffs (FIT) were very successful in creating large volumes of solar and wind projects. FITs are what allowed economies of scale, technology evolution and therefore rapid cost reduction for solar PV and wind turbines. However, a perception of over-compensation often politically overshadows the main, and highly successful outcome – the achievement of competitive and scalable technology. Even if the true social cost of the over compensation in question clearly is dwarfed by the societal benefits from the technologies generated, a new policy instrument needs to avoid being tainted by such a political perception to be successful.
- Minimize political risk by not directly implicating the state budget.
- Allow several different 2G technologies to be contenders.

8 A proposed policy scheme and instrument: Contract for Difference (CFD)

8.1 What is a Contract for difference?

A contract for difference is a typically a civil law contract between two parties under which one or both parties commit to pay the other party the difference between a set price (strike price) and a market price or value.

CFDs are instruments which are well-known by capital markets and which have been very successful, for example in developing and securing finance for off-shore and on-shore wind in the UK and in Denmark.

CFDs also avoid the obvious and inherent shortcomings described in this document of general quota- and mandate based systems such as the current Swedish system, the US RFS System, the EU advanced renewable fuels or aviation renewable fuels targets, or trading of green certificates – all of which have proved unsuccessful in driving significant investment in 2G renewable fuels plants.

Proposal: In the context of 2G renewable fuels projects and proven policy instruments, the following would allow investment in 2G production capacity and meet the criteria:

2G renewable fuels production projects bid for, and winners are awarded, CFDs in so called reverse auctions (lowest bid wins). These pay out the difference between an uncertain or insufficient market price and the price required to finance the project (strike price). Auctions are held on a recurring basis according to set categories each for a different type of route to renewable fuels, with specific maximum administrative strike price and specific terms. These parameters can change according to policy needs, technology and cost reduction, leaving the Government in control - the key feature is that they do not change for a project once offered and awarded, providing the required long-term stability needed to finance.

Key benefits for the Government and for consumers include:

- Plants which make target achievement possible can actually be built
- The cost of the support regime is minimized through reverse auctions
- The maximum cost imposed on consumers is known up front and can be controlled (Each auction can have different conditions, for example a maximum price which is typically lowered over time to reflect technology improvement. (An example from offshore wind is that CFD strike prices have drastically gone down between different years' auctions)

8.2 Implementation and structuring of a CFD program[20]

We believe a Government agency such as the Energy Agency could administer and manage a CFD program. This process and program could take the below form:

8.2.1 Implementation of regulatory framework and targets

- **Definition of auction categories and pre-qualification requirements.** Categories can provide for differing routes and sizes of projects for the production of 2G renewable fuels, but all require high GHG-savings performance and sustainability:
  - GHG performance, e.g. at least some 85% reduction versus fossil fuel baseline.
  - Environmental and social sustainability criteria
  - Scalability and indirect effects
  - Technologies and categories (for example electro-fuels, biomass gasification, pyrolysis)
  - Routes definition – from energy source to usable fuel incl. energy efficiency
  - Auction process, Time lines and decision on frequency of auction. An illustrative example is given in section 10.
  - Energy volumes – the volumes in TWh or MJ to be auctioned in each category.
  - The categories can change from year to year as technologies, costs and/or target achievement change.

- **Development of the CFD contract structure.** This is described below under section 8.2.2.

- **Definition of obligated parties.** Distributors of fuels subject to energy tax shall be required to distribute 2G fuels per below quotas and according to the rules herein. It should be noted that a project promoter or other party may set up or contract with a third party for the distribution and/or creation of a distributor for a given project. This distributor may then become an obligated party. An example is setting up a distributor for a fuel for which current distributors do not yet handle the product, such as for DME.

- **Setting of quotas for obligated parties** for each category with penalties for non-achievement equal to the non-compliance fee ("reduktionspliktsavgift"). This is intended to provide additional incentives for obligated parties to distribute the fuels.

  - We recommend that quota-fulfilments may be traded between obligated parties.
  - One may note that the Government commissioned study "Fossil free transport" concluded that high-blend and pure renewable fuels should also fall under quotas but, as noted above that this was not sufficient to generate investment in 2G plants.[21] Furthermore, it is implicitly recognized in EU regulations that 2G renewable fuels of the type considered herein can be subject to both quotas and specific support as only one of the instruments may be insufficient.[22]

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[20] Significant credit for the structure and completeness of this section is due to ICCT "Development and analysis of a durable low-carbon fuel investment for California" (2016)

[21] SOU 2013:84 Fossilfrihet på väg 14.7 p.705 and 14.7.2 p.733-734

[22] EUROPEAN COMMISSION Guidelines on State aid for environmental protection and energy 2014-2020 (2014/C 200/01): "(114) In addition, the Commission will consider that the aid does not increase the level of environmental

- **Definition and implementation of framework for allocating costs of CFDs to obligated parties**. The cost of the CFDs is allocated to obligated parties in proportion to their share of total distribution of fuels subject to energy tax. This is in line with recommendations in the Fossil Free Transport study. An alternative would be to allocated these costs only to the fossil fuel pool, which would be more consistent with the polluter pays principle but which could have more extreme impacts on fossil fuel prices.[23] Allocation can be done either through excise taxes on fuels the revenue of which are earmarked for financing CFDs or through the obligation to purchase certificates generated at production of the fuels at a price sufficient to finance the CFD costs. Other mechanisms, including a partial Government subsidy could be envisioned to accelerate implementation and mitigate impacts on consumer fuel prices.

- **Creation of a Government contracting party to CFD, administering agency, legal contracts**
    - Please refer to below description of key terms of the CFD
    - The key terms of the CFD and the energy volumes on offer in each auction makes the maximum cost of the program quantifiable.

- **Ongoing and pre-launch validation of program with capital market parties.** Typically, renewable fuels policies and support schemes have been launched without formal and structured validation with neutral capital market parties De minimis, an entity such as the EIB needs to be requested to confirm to the Swedish Government *that "the proposed scheme which is intended to give more certainty on the revenue, volume and price risk faced by a renewable fuels producer (whatever its form) will allow EIB to provide non-recourse financing to promoters. This provided that all other project risks(e.g. technology, feedstock, are mitigated and allocated in a satisfactory and customary manner)"* If such assurance cannot be given, the designer of the scheme needs to solicit tangible modifications to the scheme from, in this case, the EIB. This is the acid test, without such validation, policies are likely to be unfit for purpose.

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protection and can therefore not be found compatible with the internal market if the aid is granted for renewable fuels which are subject to a supply or blending obligation (60), unless a Member State can demonstrate that the aid is limited to sustainable renewable fuels that are too expensive to come on the market with a supply or blending obligation only."

[23] SOU 2013:84 Fossilfrihet på väg p733

8.2.2 Bid phase and CFD contract

- **A pro forma civil law CFD contract** for each category is provided to potential bidders as part of the invitation to bid process. This should be identical to the final CFD contract awarded. It needs to set out the CFD terms with high precision in order that financing institutions and promoters can incorporate it in investment and credit analysis:
  - The CFD contract characteristics include:
    - **Maximum energy volume on offer in the category and for a project**, needs to be sufficient for a plant of sufficient scale. Sample of order of magnitudes per year of production: for biomass gasification 1 TWh (3.6 PJ,~120 000 m3 diesel eqv); for an electrofuel project, 0.25 TWh or 0.9 PJ per year. These yearly volumes times the duration of the CFD gives the maximum total volume supported.
    - **CFD maximum administrative strike price** (this is the maximum possible value of the CFD on offer, which, multiplied by the volumes above give the maximum costs). This could be set either based on analysis and understanding of the various routes for production of 2G or at the current level of non-compliance penalty ("Reduktionspliktsavgift"), which is 5 SEK/kg CO_2 for diesel and 4 SEK/kg CO_2 or Gasoline or, expressed per MJ using the regulatory standard values for energy content, respectively
    - **CFD market price proxy**. Given that renewable fuels markets are small, less transparent, very volatile and subject to large political risk, it is proposed that market price proxies similar to the following are used (on an energy equivalent basis):
      - Diesel substitutes: Market price proxy is the lower of:
        - i) Average of Rotterdam EU compliant FAME prices from Platts and Argus or equivalent agency for the closest period, and
        - ii) Average prices for the closest period Rotterdam EU Diesel prices per Platts and Argus
      - Gasoline substitutes: Market price proxy is the lower of:
        - i) Average of Rotterdam T2 ethanol prices from Platts and Argus or equivalent agency for the closest period, and
        - ii) Average of EU wholesale gasoline prices per Platts and Argus
        - Alternatively, a market price proxy could be an arms-length contract with an obligated party; however, this will require more complex evaluation and comparison of bids as less transparent.

- Adjustment components, for example for tax impacts(including a possible tax imposition of cO2 and energy tax also on pure biofuels), unfavorable regulatory or legislative decisions/change of law and incremental distribution costs. Incremental distribution costs may be applicable if a fuel is not drop-in and requires additional distribution arrangements and infrastructure, and where it is appropriate to break this out as opposed to bundling it in the strike price bid. The distribution component may be indexed according to an appropriate CPI or PPI price index.
- The value of the CFD during operation will thus vary while the net revenue to the producer will be close to stable, but be according to the following formula:
  - CFD Payout per MJ produced of qualifying fuel =

    MAX [Strike price bid – (Market price proxy + tax impacts + adjustment for non-passthrough change-of-law unfavorable impacts + adjustment for incremental distribution costs), 0]
  - The CFD proposed only pays to the producer if the sum of market price plus adjustments is below the strike price. Should the market price be above the strike price, no claw back is proposed, i.e. the producer does not have to pay the CFD counterparty. We believe this additional potential reward for risks is warranted for not yet de-risked first plants and risky renewable fuels markets. (CFDs used for some offshore wind projects do have payments going both ways.)

- **Duration**, maximum 3 years development and construction followed by 15 years of operation. The project, after win of CFD but before start of construction, is assured of 15 years of predictable revenues. This permits the project to demonstrate capacity for equity and debt service, required to raise finance.

- **Counterparty**. It is proposed that the CFD counterparty be a Government entity so as to minimize the counterparty credit risk. However, we propose that the counterparty is funded by allocating the cost of the CFD in line with the approaches discussed in 8.2.1

- **Bid requirements** – to ensure that winners will actually go ahead and build plants, the below types of items need to be provided. It should be noted that for a large project using a technology not previously commercialized, the cost of provision of these items can, depending on the accuracy of estimates and risk accepted in the underlying contracts, run into low 10s of millions of EUR and require significant time; this needs to be taken into account in the invitation to bid and auction process in order to allow new entrants:
  - Promoter presentation and consortium agreement demonstrating a solvent and competent promoter and or consortium
  - Financing term sheets for equity and debt conditional on CFD win
  - Financing plan
  - Conditional rights to suitable site and site analysis demonstrating likelihood of permits /Construction and environmental permits
  - Construction/EPC agreement conditional on CFD win
  - Project plan
  - Lifecycle GHG analysis and ESIA(Environmental and Social Impact Analysis)
  - Offtake or distribution agreement conditional on CFD win
  - Possibly, bid bond which is forfeited if bid is successful but is not followed through
  - CFD counterparty, the entity which develops, finances, builds and operates the plant

8.2.3 Auction and award phase

Bids are submitted, including:

- the bid requirements documentation
- the strike price and volume bid. The volume may be for all or part of a project's production and may be for part of the quota in the category bid for.

Bids are evaluated for meeting the qualitative requirements.

Bids are then evaluated for minimum expected CFD cost, probably weighted for GHG savings.

This can, depending on the exact CFD structure, market price proxies and production profiles, be done using a levelized cost projection over the 15 years (NPV of CFD costs over 15 years / NPV of MJ produced over 15 years, at appropriate discount rate) or by comparison to a reference market price per the date of the invitation to bid.

CFDs are then awarded to the lowest CFD cost bidder(s) in respective categories. At the time of acceptance of the award, the bidder will have to post a performance bond to provide assurance that the project will be implemented. Should winning bidder not accept the award, the bid bond will be forfeited.

9 Example of 2G project and CFD

9.1 Financials and financing of a 2G production project

Below are highly simplified financials for a type of 2G renewable fuels plant. The example is based on a type of biomass gasification plant (Black liquor) producing synthetic gasoline and reflects a first plant of commercial size.

Figures are based on 28 000 hr pilot plant experience, significant engineering studies and design, and budgetary estimates from Engineering Procurement and Construction contractor (EPC). The EPC provided customary EPC wrap performance and completion guarantees and liquidated damages, reflecting an acceptable technology risk

One may note that for subsequent de-risked plants, as the unit, in addition to producing renewable fuels, replaces a so-called recovery boiler in a pulp mill, CAPEX can be reduced by an avoided cost from 490 MEUR to 250 MEUR – another reason for a support scheme allowing the first plants to be built.

MEUR except where indicated **Plant financials**	**Renewable energy (Ethanol lge eqv)**	**Fossil energy price (Gasoline)**
CAPEX: 490 MEUR		
Production: 185 million litres gasoline equivalent per year		
EUR/lge Biofuels price	0.90	0.60
Revenues	166	111
Opex	(65)	(65)
EBITDA	101	46
Debt service and dividends		
Debt service, 70% debt	(49)	(49)
Dividends, 30% equity	(35)	(35)
Total capital service (10 years)	(84)	(84)
Base case debt service coverage and break-even price points. Prices in EUR/lge		
Simple debt service coverage (EBITDA/debt service)	2.1	0.9
Min price allowing capital service (OPEX + Capital)/Volume	0.81	0.81
Min price after debt repayment allowing 20% ROE (OPEX + Dividends)/Volume	0.54	0.54
0 EBITDA Break-even price after debt service (rational to produce above this price)	0.35	

Assuming financing by: 70% debt over 10 years @7% and 30% equity @20% return, the project:

- Can service debt and equity at renewable fuels prices above 0.81 EUR per liter gasoline equivalent (lge).

- Cannot service debt and equity at current fossil prices, Debt service coverage ratio at 0.9 at 0.60 EUR/lge
- After debt is reimbursed, can pay dividends at prices above 0.54 EUR/lge, approaching competitiveness with fossil
- Can generate positive EBITDA above 0.35 EUR /lge. This is relevant post debt-reimbursement as it means the plants will likely stay in production after the support scheme terminates.
- For subsequent or n'th plant where avoided cost can be credited, the plant production cost approaches parity with fossil.

Note: Given perceived risk of first-of-their-kind projects, debt and equity providers may need to be assured of a price of at least 0.81 EUR / lge during the debt tenure of 10 years plus a margin of safety. In the following CFD example, we have assumed a 15-year duration of the CFD contract.

9.2 CFD example for the 2G project

The following example assumes that the project has won a reverse auction in its category by offering a strike price equivalent to 0.81 EUR per lge (or 0.025 EUR per MJ). A CFD has been awarded with a duration of 15 years. (For simplicity we ignore the adjustment terms)

A simulation using a set of random market prices gives the following: (DSCR: Debt service coverage ratio, here simplistically EBITDA / debt service)

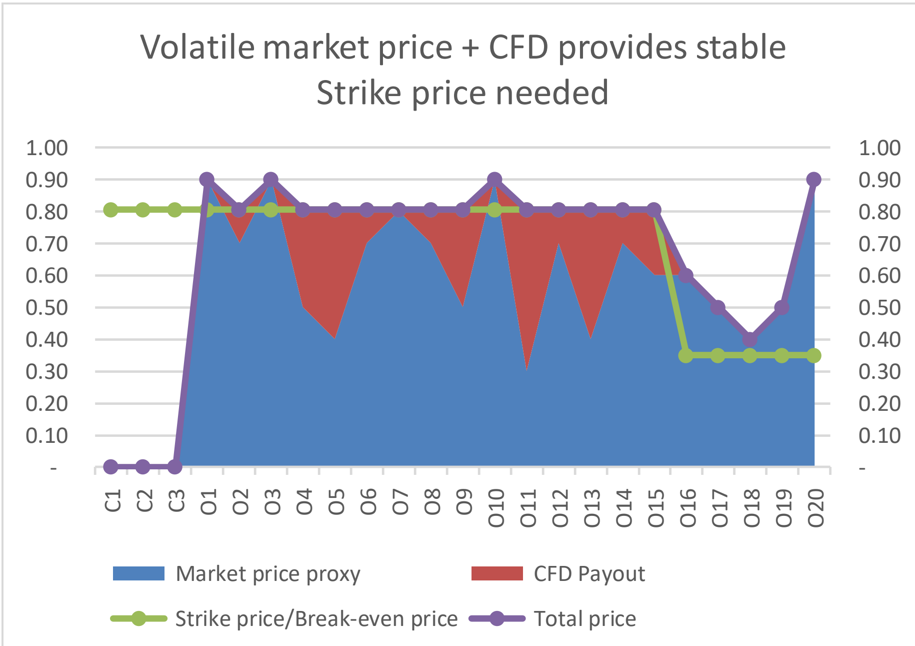
	Period	Market price proxy	CFD Payout	Strike price/Break-even price	Total price	DSCR at mkt price	DSCR w. CFD
Construction	C1			0.81	-		
	C2			0.81	-		
	C3			0.81	-		
15 years of operation covered by CFD*	O1	0.90	-	0.81	0.90	2.08	2.08
	O2	0.70	0.11	0.81	0.81	1.32	1.72
	O3	0.90	-	0.81	0.90	2.08	2.08
	O4	0.50	0.31	0.81	0.81	0.56	1.72
	O5	0.40	0.41	0.81	0.81	0.18	1.72
	O6	0.70	0.11	0.81	0.81	1.32	1.72
	O7	0.80	0.01	0.81	0.81	1.70	1.72
	O8	0.70	0.11	0.81	0.81	1.32	1.72
	O9	0.50	0.31	0.81	0.81	0.56	1.72
	O10	0.90	-	0.81	0.90	2.08	2.08
	O11	0.30	*0.51*	*0.81*	*0.81*	*(0.19)*	*1.72*
	O12	0.70	*0.11*	*0.81*	*0.81*	*1.32*	*1.72*
	O13	0.40	*0.41*	*0.81*	*0.81*	*0.18*	*1.72*
	O14	0.70	*0.11*	*0.81*	*0.81*	*1.32*	*1.72*
	O15	0.60	*0.21*	*0.81*	*0.81*	*0.94*	*1.72*
Operation post-support**	O16	0.60		0.35	0.60		
	O17	0.50		0.35	0.50		
	O18	0.40		0.35	0.40		
	O19	0.50		0.35	0.50		
	O20	0.90		0.35	0.90		

* Example has 10-year debt but a 15 year CFD - this reflects an additional risk buffer. A bidder has a tradeoff between offering low risk to secure financing(longer period CFD support) and and minimizing the expected cost of the CFD to win the bid(low value CFD, short period support).

** Post support, and post debt repayment, the breakeven price is lower and on the order of being fossil-competitive

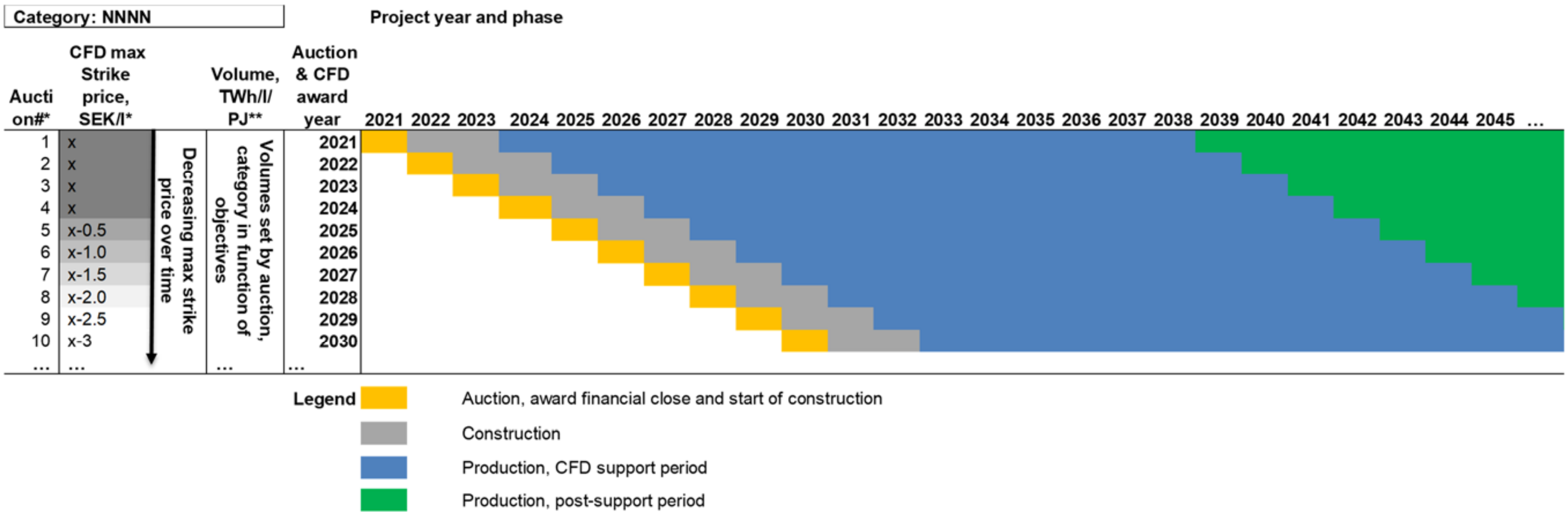
Per above and the below graphical representations

- It is evident that the project exposed to volatile market prices cannot ex ante demonstrate a capacity for debt service
- The CFD kicks in and pays out whenever the market price goes below the strike price
- The cost of the CFD to fossil fuel consumers is represented by the red area times the volume.


Volatile market price + CFD provides stable
Strike price needed
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
-
C1 C2 C3 O1 O2 O3 O4 O5 O6 O7 O8 O9 O10 O11 O12 O13 O14 O15 O16 O17 O18 O19 O20
Market price proxy
CFD Payout
Strike price/Break-even price
Total price

10 Example of auction and production program

Below is a simplified example showing how recurring auctions would generate projects which are built, operate with CFD support and, in many cases) continue to operate post CFD support. In a real-life program, each auction round would normally have several categories as explained earlier. Key to note, as has been the experience for off-shore wind, the expectation that CFD strike prices (and cost for the consumers) move downwards as technologies move down the learning curve. Note that strike prices and auction timing are only illustrative.



Note:

- Simplified presentation; each year's auction would have several categories of routes and types of 2G production, each with appropriate strike prices and volumes

(*)

- The illustrative reduction steps are taken from SOU 2013:84. In practice, this would not have to be committed to beforehand as the results of a year's reverse auction would inform setting the max strike price for the next auction. This has worked well in practice for offshore wind where the strike prices have basically been halved. For example, if the winning bid strike price in a given category is below the admin strike price, a subsequent auction in the same category would, all things equal, have a max admin strike equal to or below the previous auction winning bid.

- x, the initial maximum strike price could be set by techno-economic bottom up analysis for a category or at the level of the reduktionspliktsavgift (reduction obligation non-compliance penalty). Currently, the reduction obligation non-compliance penalties expressed per litre are 15 SEK/litre gasoline and 13.4 SEK per litre of diesel.

(**)

Volumes are set per category and auction in function of objectives. Volumes could be set on a basis of energy or energy-equivalent volumes and/or weighted by GHG performance