Rapid Energy Transition
by Paying Renewable Energy Up Front

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Abstract

This paper presents a pricing-and-governance schema that accelerates solar deployment by bringing forward revenues to finance immediate capacity growth while guaranteeing lower, stable prices afterward. Consumers commit to a fixed "average" monthly energy amount to discourage manipulations and smooth seasonal variation; usage above that level is billed at market rates, and unused allotments accumulate as credits. The model is paired with strict orchestration: capped expansion per investing entity, shareholder-workers with required competencies, limits on liability cash-outs, and a reinvest-first rule supported by a temporary tax holiday during the growth phase. The result is a policy-portable, transparent framework that aligns investor incentives with climate goals, fosters job creation, expands reliable supply, and shields households from inflation and volatility over the contract term.

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1 Introduction

The most comprehensive estimates set 2050 as the target for a near-complete transition to renewable energy. Meanwhile, the same report states that the CO_2 budget will be spent by 2037, falling short of the target by 13 years.[1]

Globally, access to electricity rose from 84% of the population in 2010 to 91% in 2021, adding over a billion people. However, instead of reducing fossil fuel consumption, the rise of AI and the continued prioritization of infinite economic growth have led to increased energy use and higher CO_2 emissions. In just the last 20 years, CO_2 emissions have grown by 42%, from 29 Gt in 2004 to 41 Gt in 2023.

It is clear we must act quickly—but the pressing question is: what can we do, and is it even possible within such a short timeframe?

In this paper, I would like to show that it is possible to fully switch all our planet-wide energy needs to renewable energy within seven years or less. This rapid transition, along with the surplus energy generated, could give us a fighting chance against anthropogenic climate change and its effects that are already visible. The suggested method can be applied with existing technology, without any drastic measures and restrictions on the general population's freedoms, while being comparatively affordable relative to many other methods proposed so far.

1.1 Problem

The central question is how to decarbonize our economy rapidly enough to meaningfully confront climate change—while avoiding political and economic destabilization.

To approach this challenge, we must first examine the key factors behind the current sluggish transition. Despite increasing interest in renewable energy, even as climate-related extremes grow more frequent and globally destructive, progress remains limited. Despite witnessing and experiencing flash floods, supercell storms, intensifying hurricanes, scorching heatwaves, and raging wildfires, we are still not doing enough. Why is that?

Drawing on various sources, the following have been identified as primary barriers to the widespread adoption of renewable energy:

1. Economic & Financial Barriers
    - **High upfront costs**: Solar, wind, and other renewables require significant initial capital, with long payback periods that deter investors[2] [3] [4].
    - **Unequal subsidies**: Traditional fossil fuels still receive much larger government subsidies, making renewables less competitive[2].
    - **Expensive financing**: Renewables often face higher interest rates and limited access to low-cost financing, due to perceived risk.
2. Technical & Infrastructure Challenges
    - **Grid capacity and integration**: Power transmission systems were designed for centralized fossil fuel plants, not for geographically dispersed renewables. The lack of new lines and smart-grid upgrades slows connection of new projects[5].
    - **Intermittency and storage issues**: Solar and wind aren't constant. Storage options (like batteries) are limited and expensive, and long-duration solutions like green hydrogen or seasonal storage lag behind[6].
3. Policy, Regulatory & Institutional Hurdles
    - **Unstable or inconsistent policies**: Frequent policy changes create uncertainty that inhibits investor confidence[3],[7].
    - **Bureaucratic red tape**: Complex and lengthy permitting processes delay project approvals by years[8].
    - **Market design issues**: Markets are still structured around fossil fuels, without sufficient compensation or price signals for renewables[3].

This article focuses on the core model and principal results. Additional derivations, extended datasets, validations, and broader policy implications are discussed in an extended version of this paper published as a book: [Aleksandar Ristevski, "The Rapid Energy Transition Schema" ISBN: 978-0-9956750-5-6].

4. Social & Political Dynamics
    - **Local resistance (NIMBYism)**: Community opposition to wind turbines or solar farms can halt projects [5].
    - **Limited public awareness**: Many people lack understanding of renewables' benefits, leading to low consumer demand [9].
    - **Institutional inertia**: Existing energy systems and powerful fossil-fuel incumbents create entrenched resistance [10].

In summary, it's not **one** single hurdle but a web of many economic, technical, policy, and social challenges slowing down the renewable energy transition. But with cohesive strategies and clear commitment, these obstacles can be overcome.

2 Proposition

The goal of the following schema is to show we can have a quick renewable energy deployment, that it does not need to be expensive or complicated, and that it is possible with currently existing technology without inventing something exotic or ingenious that will need a lot of R&D time. The goal is to show that with the schema presented in this paper, the transition would be possible to tackle most of the above problems of slow transitions listed above, such as: high upfront costs, subsidies, expensive financing, policies, grid capacity, etc.

Rapid energy transition will give us a fighting chance against rising CO_2 levels and also the ability to move away from the negative effects of the usage of fossil fuels. In that way, we can concentrate more efforts on finding more advanced sources of energy, such as nuclear fusion, opening new possibilities for our civilization as a whole. Additionally, it will give us a definite confirmation on the question of whether CO_2 is the main culprit of current global climate events.

2.1 Schema Introduction

The main idea of this schema is to speed up deployment by bringing future earnings to the present. By increasing the price during the rapid growth period, and then decreasing it afterward, investors gain the ability to shift future costs to the present, and by that **cost "time travel" trick**, reinvest future earnings today as is necessary for tackling the challenges of anthropogenic climate change. Multiplier and divider need to be chosen as the optimal numbers among affordability, ROI, and the pressure and severity of anthropogenic climate change we are experiencing.

In the beginning customers (residential, commercial, and industrial) will choose the **average amount of electricity** (a fraction of their maximum spending) or the amount they can afford to pay during the first 36+ months (depending on the case) of this schema, signing a 20-year contract with the company.

In the first 36+ months of the contract, consumers will pay **higher price** (example: 3 times), so that they can in the next 204 months or less pay **significantly lower price** (example: half of the market price) at the beginning. The price will not change during the 20 years of the contract. Inflation will not have an impact on this contract, neither the producer nor any party can change prices afterward. Multipliers, length of the period, and dividers, can be chosen depending on the country and their specific case study, so it benefits everyone.

Consumers can get this deal only for the average monthly energy they are spending during 36+ months of multiplied price; overspent kWh will be paid at the current market rate. Underspent kWh will add up until they can be deducted from overspent kWh (after "high-price" kilowatt-hours / kWh) in the next months. This is done to avoid seasonal manipulations. During the first 36+ months and the next 1 year the customer will always pay the chosen contracted amount with the price in the initial contract regardless of whether they spend that energy or not, so it is important to choose carefully, and it is better to choose a bit less than more.

This schema benefits customers as over the total period of the contracted time they would pay significantly less than if they bought electricity at the standard market rate (see Example). Schema is beneficial for the economy as it would create a lot of jobs, and provide enough energy for future advancement and betterment of society.

Why a fixed amount, and not whatever the customer spends they pay? To avoid manipulation where a customer for instance pays for 100 kWh a month during the first 36+ months with higher price, and then expects to spend 1,000 kWh a month paying the lower price for the next 204 months or less. It would be possible to make it work in a way that the average energy spent during 36+ months is what they would spend and would be the energy they would pay for at the lower price for the next 204 months or less, and everything else at market price, etc.; but in this example we are trying just to simplify the model and contract so the schema would be easy to understand and feasibility a bit simpler to calculate, and also easy to create policy with fewer loopholes.

With this schema, a single registered group of investors (company) should not expand more than (example: 14 MW) of installed prescribed cap set by the orchestration body. One investor (person, or legal entity) should not be involved in multiple ventures. Shareholders, who are at the same time active, need to be the working force as well and have the necessary knowledge. There should be a maximum number of shareholders per entity.

Cash-out limits to avoid fraud Seed-investing entities in the rapid transition schema should not have "limited liability".

Initial investors will have the ability to change ownership, but under certain rules. For instance, new investors need to be fully aware of the liability transfer attached to such transactions. While selling shares may yield a lump-sum payout, that amount will almost always be significantly lower than the potential long-term gains and the material value of all equipment, and quite possibly the selling price will be determined for them by the governing orchestration body.

By signing an investment contract with the government and a 20-year contract with consumers, investors will be personally liable until fulfilment of the consumer contract. Regardless of who holds the shares, contractual obligations toward consumers must always be fulfilled.

In the rapid transition schema, the system is not decentralization but a balancing network, as all together in one country they will create a single union, and a central governing orchestration body will secure land and locations that will consider population density, location of customers, but also future plans of the state and logistics, and many other things.

During the growth period, the state will not charge any taxes, but investors will need to reinvest the entire sales profit in capacity scaling and installation growth (there can be a few exceptions).

There are some other rules and limits to the schema; for instance, it is not allowed to build the entire installation "14 MW@" all at once; the process must be orchestrated, etc. Schema is not set in stone and can come in many flavors and varieties depending on the number of parameters.

All of these will be explained later, with the reasons behind them.

2.2 Example

Total years: 20 Consumption kWh per year: 10680 Consumption kWh per month: 890

	Rapid Schema		Commercial
months	42	198	240
base price $	0.26	0.26	0.26
multiplier	3	0.4231	1
schema price $	0.78	0.11	0.26
total $	29,156.4	19,384.2	55,536

Current commercial consumers paying **$0.26 per kWh** will, over a 20-year period, pay a total of $55,536.00.

(A+B)-C = 48,540.6 - 55,536.0 = **-6,995.4 USD** (or US$ 8,165 saved over a period of 20 years)

The average price per kWh is ((42 * 0.78) + (198*0.11)) / 240 = 0.2273 ~ **$0.23 per kWh**, which is below the current commercial price of electricity ($0.26 per kWh) in our example.

If we check the numbers, we can see that over a period of 20 years, customers who enroll in this scheme and are spending about 890 kWh per month will save almost ~$7,000 on energy bills. Of course, the more customers buy initially, the more they will save over the entire period of time, and vice versa.

This calculation does not take into account potential increases or decreases in electricity costs over time. At present, it is not possible to predict whether electricity will become cheaper in the future or whether consumers will end up worse off by the end of the contract; however, considering historical electricity prices, recent inflation hikes, and global instabilities, this appears highly unlikely.

The following are a few examples for different periods and different prices, just to get a sense of how a small tweak in the formula changes the outcome. Three examples were done for a lower-bound price of $0.11, $0.13, and $0.15 with periods of 3, 3.5, and 4 years for the higher price; these reflect the results for the 20-year average price:

- Price $0.11 per kWh:
  - ((36 * 0.78) + (204*0.11)) / 240 = 0.2105 (-0.0495) 20y savings $10573.2
  - **((42 * 0.78) + (198*0.11)) / 240 = 0.22725 (-0.03275) 20y savings $6995.4**
  - ((48 * 0.78) + (192*0.11)) / 240 = 0.244 (-0.016) 20y savings $3417.6
- Price $0.13 per kWh:
  - ((36 * 0.78) + (204*0.13)) / 240 = 0.2275 (-0.0325) 20y savings $6942
  - ((42 * 0.78) + (198*0.13)) / 240 = 0.24375 (-0.01625) 20y savings $3471
  - ((48 * 0.78) + (192*0.13)) / 240 = 0.26 (-) No gains & no losses
- Price $0.15 per kWh:
  - ((36 * 0.78) + (204*0.15)) / 240 = 0.2445 (-0.0155) 20y savings $3310.8
  - ((42 * 0.78) + (198*0.15)) / 240 = 0.26025 (**+0.00025**) **20-year loss of $53.4**
  - ((48 * 0.78) + (192*0.15)) / 240 = 0.276 (**+0.01600**) **20-year loss of $3417.6**

In reality, these prices and times will need to be balanced with utmost care so they satisfy other criteria that will be discussed in this paper later on, as wrongly adjusted parameters can create more problems than benefits.

2.3 Ideas behind

From a consumer's perspective, there is no such thing as free energy; consumers can use energy in following ways:

2.3.1 Grid Electricity

Grid/On-grid/Grid-connected - Consumers pay more[11] on a monthly basis for the electricity they use but do not need to worry about installation, repairs, cleaning, or insurance against damage (such as breakdowns, fires, environmental hazards, or theft of energy generation and transmission equipment). The only upfront cost is typically the connection fee—although in some countries this is provided free of charge—after which consumers pay for the electricity consumed and maintain only the electrical installation and equipment within their own premises. For this higher monthly fee[12], they can simply plug devices into the socket and expect them to work.

The main drawback of being connected to the grid is that consumers are subject to the pricing policies of energy companies and the fluctuations that come with economic and market volatility.[13]

Electricity prices can vary greatly by country. In Germany the price per kWh was €0.394 (US$0.46); for the EU27 average €0.287 (**US$0.34**); in Croatia €0.148 (US$0.16); and in Turkiye €0.062 (US$0.072) per kWh consumed.[14],[15]

Globally, the pattern is similar: Bermuda records US$0.46 per kWh, Australia US$0.27, the United States US$0.18, and Canada US$0.13, with countries such as Iraq, Libya, and Cuba offering prices as low as US$0.01 per kWh.[14],[15]

Please note that these figures are drawn from multiple sources covering the years 2023 to 2025. While minor discrepancies exist between sources, these differences are not significant enough to affect the overall point of this paper.

2.3.2 Off-Grid

Off-Grid - refers to systems where consumers pay a large sum of money upfront, with the total cost depending on the size of the system and the method of deployment—whether they assemble their own off-grid system or hire a third-party company. In most cases, the cost per kWh is lower than “On-Grid” over time, unless unexpected damage occurs, which the consumer must repair at their own expense.

For example, a 10 kW system will produce, on average, 1,255 kWh per month. If the system costs US$15,471, over 20 years this translates to **US$0.05 per kWh** ($15,471 ÷ (20 years × 12 months × 1,255 kWh)). This assumes the consumer purchases the equipment and installs it independently. [16]

This option is not for everyone. The customer would need to be proficient with tools, and because high voltage is involved, prior knowledge and experience are advisable to avoid damaging equipment, creating a fire hazard, or risking injury.

For those unwilling to commit their own time or take on such risks, there is another option.

With third-party installation in the USA, after applying tax credits, a solar system typically costs about US$5,000 more than a DIY installation. This raises the cost to approximately **US$0.07 per kWh** ($20,000 ÷ (20 years × 12 months × 1,255 kWh)). For this additional expense, customers gain the assurance that the installation is completed correctly, avoid the time and safety risks of DIY work, and receive an installation warranty in addition to the standard equipment warranty. [17]

2.3.3 Shared off-grid

Shared off-grid - There are several ways in which multiple off-grid systems can be interconnected, enabling neighboring systems to exchange energy according to their needs—particularly in densely populated areas with rooftop solar installations.

Additionally, off-grid systems can be connected to the main grid, allowing users to enter agreements with the network operator to feed excess energy into the grid and withdraw it later when needed. Rarely does the network offer a 1-to-1 exchange rate; more often, users supply significantly more energy than they receive in return. This imbalance is largely due to the Duck Curve problem—excessive production during peak sunlight hours. Later in this paper, we will outline several ways to address this challenge and develop a more profitable model that benefits all stakeholders.

This arrangement, in which an off-grid system is connected to the grid, is generally referred to as a prosumer model (“producer” and “consumer”). In this setup, participants can not only exchange energy but also sell kWh to the grid, and in return, either pay for or be compensated for the net difference between what they consume and what they supply.

2.3.4 Rapid Transition Schema

Rapid Transition Schema refers to the theoretical framework proposed in this paper.

Currently, customers do not have much choice beyond two options for electricity pricing: either they pay upfront a large amount of money, becoming liable for their own system while enjoying a lower price per kWh (typically $0.05-$0.10), or they pay more per kWh ($0.15-$0.50) and someone else takes care of everything. There is nothing in between.

Is there a way to find a balance between grid price and off-grid?

So this schema is an attempt to find a middle path, a cheaper, stable price per kWh where someone else takes care of everything, and the customer only plugs, plays, and pays, while allowing us to rapidly transition to green energy sources.

The easiest solution, transition-wise, would be for each consumer to have their own solar PV installation, but the problem is that the majority of the population lives in cities, and they do not have the physical space to place solar panels (rooftops or commercial buildings) even when they have enough money to cover upfront costs.

Customers could buy stocks of solar farms, or invest in some crowd-share or unionized solution where they could together build solar farms; equally, they could invest in the stock market, but that does not guarantee company security — businesses can boom or bust — just as a higher share price does not mean that a company will profit, make money, or expand its venture. Investing in the stock market does not free customers from liability for those projects or give them secure delivery over a long period of time, nor does it guarantee the price of electricity in the future.

The solution we are trying to find should satisfy the following criteria:

- Allow us to transition to green energy sources quickly
- Consumers should only “plug, play, and pay”

- Price for customers should be lower than the existing grid price and more resilient to market volatility

The following is one of the ways we could achieve all that:

1. Pushing ROI forward in time As producers have the cost of equipment, installation and maintenance, including a calculated profit that will incentivise them to begin investing, we need to find a way to speed up the return on investment so that it can be reinvested more quickly due to climate urgency.

   We could do that by **increasing the overall cost of kWh** or introducing carbon taxes that will be put on consumers, but in each case it increases the burden on consumers, and starts an **inflationary** cycle that will drive all prices up, including the cost of work and equipment, returning us to the same point where we started.

   Instead, we could shift future costs to the present, and by that electricity cost **"time travel" trick,** reinvest future earnings today. This can be done by increasing the price during the rapid growth period, and then decreasing it afterward. In other words, consumers paying for electricity upfront translates to a shorter period of 'return on investment' (ROI) and therefore investors will have the ability to reinvest sooner and grow installations more quickly.

   In return, consumers get a lower price after the initial period (typically 36+ months), which will reduce their total electricity bill during a 20-year contract.

   It is essential to recognize that the true measure of a civilization's advancement does not lie in the volume of its monetary transactions, but in the scale of its energy use. Money merely serves as a temporary incentive until a society reaches a certain threshold. By contrast, energy consumption is a direct indicator of progress, whereas an increase in the total amount of money in circulation is not. Misaligned incentives can impede civilization's progress, distorting priorities and constraining the very progress they are meant to encourage.

   In this schema, it is crucial to create correct incentives by finding a balance between affordability for customers and faster ROI and healthy profit for investors, thereby improving the economy and accelerating the rate of progress.

   Therefore, the correct multiplier and divider ratios for the electricity price must be calculated in each country in such a way that the contract is beneficial for consumers, incentivizing them to pay more upfront monthly (2-3x of $0.26), so that they can benefit from a significantly lower price afterward ($0.13 or less), and overall save a substantial amount of money.

2. Contract duration According to the Solar Energy Industries Association (SEIA), solar panels last between 20 and 30 years. Some well-made panels may even last up to 40 years.

   "Panel quality can make some impact on degradation rates. NREL reports premium manufacturers like Panasonic and LG have rates of about 0.3% per year, while some brands degrade at rates as high as 0.80%. After 25 years, these premium panels could still produce 93% of their original output, and the higher-degradation example could produce 82.5%."[18]

   We can use two methods to calculate panel decay:

   - **Linear loss (straight-line)**

     If r is the annual loss rate, n is the age in years, and q is the number of items in the cohort:

     Loss fraction per cohort:

     $$\text{LossFraction}_{\text{linear}}(n) = r \cdot n$$

     Total weighted loss % over all cohorts:

     $$\text{Loss\%}_{\text{linear}} = 100 \cdot \frac{\sum_{i=1}^{k} q_i \cdot r \cdot n_i}{\sum_{i=1}^{k} q_i}$$

     where:

$$n_i = \max(0, T - t_i)$$

T = evaluation year, t_i = purchase year index for cohort i.

- **Compound loss (decay)**

  If losses are always a % of *remaining* value each year:

  Loss fraction per cohort:

$$\text{LossFraction}_{\text{compound}}(n) = 1 - (1 - r)^n$$

  Total weighted loss % over all cohorts:

$$\text{Loss\%}_{\text{compound}} = 100 \cdot \frac{\sum_{i=1}^{k} q_i \cdot [1 - (1 - r)^{n_i}]}{\sum_{i=1}^{k} q_i}$$

  with n_i defined the same as above.

Here, "linear loss method" is used to calculate total loss after 20 years, taking into account that not everything will be installed at once but over time.

Years	20				
Year	0	1	2	3	4
No.õf 100 kW Blocks	3	10	37	57	33

Degradation %	Total degradation %
1.00	17.24
0.50	8.62
0.25	4.31

The first table shows total length of contract of 20 years, and the number of installed PV farm blocks of 100 kW installed power in subsequent years, while the second table shows how much of the total output power will be lost after 20 years for different degradation levels of solar panels.

This model does not account for the temperature coefficient, which not only reduces immediate power output under heat stress—since silicon cells produce less voltage at elevated temperatures—but also accelerates long-term degradation. Empirical studies across Europe suggest that module degradation rates increase by approximately 0.05-0.1% for every 1°C rise in the annual average module temperature. Although regions with abundant sunlight generate more electricity overall, higher ultraviolet (UV) exposure and total irradiance accelerate the yellowing of encapsulants and the deterioration of anti-reflective coatings. Field data indicate that in Mediterranean and desert climates, photovoltaic modules typically degrade at rates of 0.7-1.0% per year,[19] whereas in northern, temperate climates degradation is generally lower, in the range of 0.3-0.6% per year. While the model may apply the upper bound for conservative estimates, site-specific case studies should incorporate local climatic conditions to refine degradation assumptions.[18]

Weathering, damage and expected delays can after 20 years reduce output power of a single 14 MW installation up to 20%, which can be seen as a loss of 25 out of 140 installation blocks of 100 kW, after 20 years. This is a significant expense that needs to be calculated into and planned as a part of a renewal and maintenance long-term strategy.

Part of the same long-term strategy should be selling expired or near-expiry solar panels; in this way the company could reclaim a portion of the cost for the new panels, and also give those panels — operating at 80% to 90% of nominal capacity — a second life. Key valuable data here would be recording each panel with production series, manufacturing date, utilisation start date, what raw materials were used in production, in which facilities, what was its efficiency during its lifetime, and so on, that could be very valuable for future production and improvements.

Used (second-hand) panels on the market typically cost between **$0.05 and $0.60 per watt** [20], some sources note the range could stretch up to **$0.75 per watt** [21]. New panels, in comparison, tend to cost between **$2.50 and $3.50 per watt** [22]. That means used panels can be **50-80% cheaper** or even more, depending on type and condition [23], [24]. Therefore, the company could potentially retrieve 20-50% of the cost of new. Of course, we have to take into account again constantly falling prices of solar panels, and that with high supply those retrievals would be probably in the range of 5-15%, which shifts emphasis to second life and avoiding immediate recycling of still operational panels.

For some people, it will probably make more economical sense to buy 100 × 400 W panels operating at 80% capacity to get 40 kW, at 20% of the price (100 * ($2.50*20%)* 400W = **$20,000**) than to buy 80 panels of 400 W producing 100% of declared output for 100% of the cost (80 × 2.5 × 400 = **$80,000**). Even for businesses this makes sense, but unlike private consumers, businesses must think long term and plan for renewal as part of quality-assurance control.

With regard to inverters and batteries, they typically last significantly less than panels, around 10-15 years, which also must be considered when considering total length of contract.

Looking at things from another angle, companies need to consider **depreciation time** for the purpose of taxes, which can vary from country to country depending on their laws, but generally we can consider it to be around 10 years for solar panels, inverters, and batteries.

Also, 20 years is an optimal contract length for the consumer to be cost-effective by lowering price during the second phase of 16.5 years to compensate for the first 3.5 years of higher price.

3. Reducing total average price of kWh over the span of a 20-year contract, in comparison to current grid prices. The reason for increasing the price by 3 times ($0.78 per kWh) during the first 36+ months and decreasing the price afterward is so that all involved parties can benefit in some way in this schema.

   In the first 36+ months, we have rapid scaling of green energy infrastructure, which means that investors would reinvest all profits into expanding installations. This benefits investors, but also—if done correctly—rapid transition will benefit the entire planet, giving a fighting chance against anthropogenic climate change.

   By lowering the total (example: paying $6,995.4 less over 20 years) and lowering the average monthly price (example: $0.23 per kWh), consumers will benefit, knowing they will, besides a pat on the back, get something tangible. If investors get significant returns on investment, then it is not just fair but also necessary to attract consumers to buy as much energy as possible.

   After the initial period, consumers will benefit from paying less for electricity (and energy overall) — for example, $0.11 per kWh — in comparison to those that decide not to join the schema (example: $0.26 per kWh).

   The multiplier is used more as a measure of comparison with the original price, but that is not as important. What is important are the set price ($100,000) of a solar installation block (100 kW), how much energy that installation produces, and the price per kWh. The higher that price is, the faster the return on investment. (Check "Transition Speed Variables" chapter in the book [!!!]*)

   It is important to choose the price carefully, so that even poor households and small businesses can afford it and later benefit from it. We do this as a reasonable necessity, just as Henry Ford recognized that raising the wage of his workers would allow them to buy his car. The reason for price reduction is risk reduction—for investors, but also to satisfy the needs of consumers, bearing in mind states and tax collection, protecting all parties in the process.

   The main idea is to find a balanced approach that will entice as many consumers as possible to join in fighting anthropogenic climate change, while again not creating significant expectations or pressure, and to give them a monetary benefit.

Everyone will benefit from tackling anthropogenic climate change, and everyone will benefit from cleaner air, rivers, lakes, and seas polluted by the fossil fuel industry, regardless of how difficult it is to move forward.

Study says that “notably, 69% of the global population expresses a willingness to contribute 1% of their personal income”[24], so I have a reasonable question: how many people/companies/institutions would express a willingness to “contribute” if we pay them to do so, or give them back money for doing that (example: $6,995.4 over 20 years for spending 890 kWh per month)?

4. Keeping a off-hand approach for customers (“plug, play, and pay”) Off-grid systems, except that they come at a large up-front cost, also need space, installation, cleaning, maintenance, and basic electrical engineering skills and foundational knowledge; DIY (do it yourself) carries the risk of hazards or injuries.

   Outsourcing all those requirements to third parties increases, and sometimes doubles, the average price per kWh over the entire lifespan of the equipment. Additionally, off-grid solutions buyers need to pay for a different type of insurance that will protect them from fires, hazards, and natural calamities.

   This schema, same as being connected to the grid, means consumers only consume and pay, and all other complexities are handled by energy producers. Producers are responsible for maintenance, reliability, insurance and everything else behind the scenes.

5. No need for a big lump-sum payment up front (as in off-grid systems) If a consumer wants an off-grid system, they typically need to pay up-front, depending on the size of the system, a lump sum of $5,000 to $50,000; in this schema that is not necessary: the monthly fee is increased temporarily (36+ months) and then decreased in comparison to the commercial grid price.

   Consumers and investors with this schema do not need to take loans from banks. The schema is profitable enough to be attractive for all interested parties, and has a low entry point so that even small investors could take part. Additionally, it would remove the need for disproportionate and unfair subsidies for those that already have wealth and money, sponsoring the already rich by public tax money, making them even richer.

   This system is not decentralization. It is fortifying the existing network and securing energy distribution and the economy by circulating money and resources in a better and more useful way for the advancement of the entire civilization.

   From the perspective of production this may look like decentralization, but a different term would be more fitting - “network balancing”. Very similar to what we have with the internet, where multiple providers offer their services and connection nodes, while the network as a whole is more secure against failures.

   By having hundreds or even thousands of “limited nodes” (14 MW) the network becomes more stable because it is strategically spread. In return, in case of unexpected events like the one in Spain (April 2025 blackout in Spain and Portugal[25]) or the USA[26], entire countries do not need to be without power for an unknown number of hours/days, with all side effects that those create.

3 Feasibility

3.1 Installation Power Output

To simplify calculations in the model, we will assume that all consumers pay equally for energy and are otherwise identical—though we have already explained this is rarely the case. Our energy target is set at **220,000 TWh per year**, which, as previously discussed, is the estimated total global energy demand (not just electricity) for the year 2030.

During all calculations, only solar energy will be considered. Other energy sources—such as nuclear, wind, hydro, tidal, and one of my personal favorites geothermal—will be excluded. Furthermore, we will assume there are no pre-existing renewable energy installations, meaning the model starts from zero.

This does not imply that other energy sources are unimportant; rather, it is intended to simplify the model and make several concepts easier to explain and understand. Excluding existing installations simply means that, if taken into account later, our target could be reached even sooner than the model suggests.

We will consider installations in **blocks of 100 kW**, with an ultimate goal of reaching approximately **14 MW** per single investment entity or business. The reason for selecting "14 MW" will be explained later.

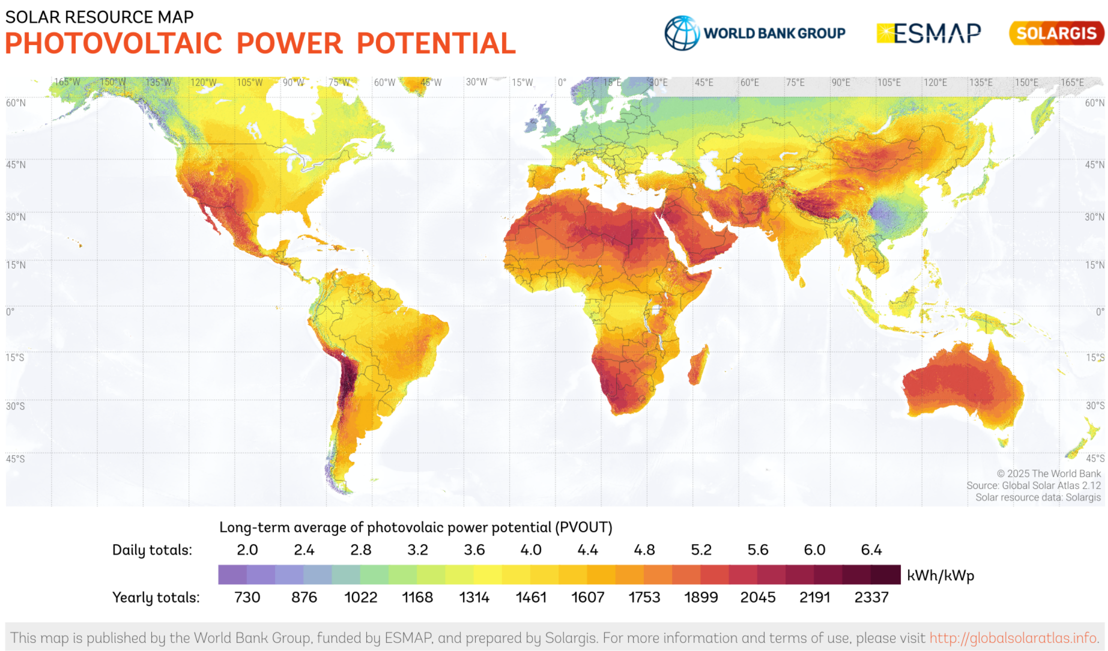
On average, a **100 kW solar power plant** can produce between 6,700 kWh and 18,300 kWh per month, or roughly 84,000 kWh to 219,600 kWh annually. For example:

- **Worst-case** (Northern Europe): ~80,000-110,000 kWh/year
- **Moderate** (Central Europe, parts of the US): ~120,000-160,000 kWh/year
- **High-sun regions** (Southern Europe, Australia, deserts): ~160,000-220,000+ kWh/year

For calculations, we will consider that our 100 kW block has output power of **168,000 kWh per year** (14,000 kWh × 12 months). This figure will vary by season and geographic location (proximity to the equator), as well as by weather patterns. However, since the cited data represents "average" conditions, we will treat it as though seasonal differences are already factored in. We will also exclude the likely future decline in equipment costs and the continual improvements in solar panel efficiency, which would otherwise mean greater output for the same panel area at a lower cost.

Country	kWh/kWp/y *	US$/kWh **
Namibia	1965	0.0254
Afghanistan	1642	0.0305
Serbia	1300	0.0385
Ecuador	1278	0.0391
Germany	1068	0.0468
Ireland	907	0.0551

- Specific photovoltaic power output kWh/kWp/year (multiply by 100 to get kWh per year) ** Cost of installation per kWh generated, assuming PV farms last at least 20 years, panel efficiency loss does not exceed 1% per year, and a 100 kW solar PV system can be built for $100,000.



Source: Global Solar Atlas

From the Global Solar Atlas,[27] it is evident that most countries have strong potential for solar power generation, with only a few in Northern Europe facing less favorable conditions. Accordingly, the assumption of 168,000 kWh per year for each 100 kW of installed capacity used in this paper can be considered reasonable.

But to be precise average output of 241 countries and designated areas is 1725 kWh/kWp/y while average per capita is 1741 kWh/kWp/y. [‘DataModel.xlsx’ (Sheet: AggregationViability)]

3.2 Optimal seed installation size

Here we will check how we derived the final size of the seed to be 14 MW of installed power, using China as an example. Let’s examine the following starting points:

- C_{block} - Cost in $ per 100 kW PV block = 100,000
- Pr_{year} - 100 kW block production in kWh/y = 168,000
- Pr_{month} - 100 kW block production in kWh/m = 14,000
- P - Population in millions = 1408
- E_{tot} - Total Energy 2030 TWh/y = 64,105

No of seeds	billion $	MW Installation
381,577,381	38,158	0.1
190,788,690	19,079	0.2
95,394,345	9,539	0.4
47,697,173	4,770	0.8
23,848,586	2,385	1.6
11,924,293	1,192	3.2
5,962,147	596	6.4
2,981,073	298	12.8
1,490,537	149	25.6
745,268	75	51.2
372,634	37	102.4
186,317	19	204.8
93,159	9	409.6

When we divided “Total Energy for year 2030” by the “100 kW block production in kWh/y” we obtained 381,577,381 seeds.

- No_{seed} - Number of seeds in one country.

$$No_{seed} = \frac{E_{\text{tot}}}{Pr_{\text{year}}} \quad \text{(start “blocks” or seeds)}$$

Taking that production capacity could cope with such extreme demand, it would take $38.2 trillion to transit in an extremely short time of one month.

$$C_{tot} = \frac{C_{\text{block}}\, No_{seed+i}}{10^9} \quad \text{(Cost total in \$ billions)}, \quad i = 0, 1, \ldots, 12$$

Following the data rows in the table, we are halving the number of seeds with each increasing index, and the fall in the initial cost we need to invest. Each country will have its “sweet spot” or affordability level.

In the third column we can see the size of installations in megawatts (MW) of installed power calculated as:

- S_{install} - Size of finished seed installation in MW

As the result is given in number of blocks, and one block is 100 kW, we need to divide by 10 to get how many megawatts should be the installation size.

$$S_{installs+i} = \frac{\left(\dfrac{E_{\text{tot}} \cdot 10^9}{No_{seed+i}}\right)}{E_{\text{block}}} \cdot \frac{1}{10}$$

Except for the initial cost, we need to consider that it is better to have a middle-range number of seeds as a fail-safe. In case of wars or environmental disasters it is better to have a wider and more distributed network than one single point of failure or a low number of points of failure. By having a widespread network, even with severe storms or earthquakes, it is very likely that a country's network will remain with its energy delivery integrity.

Later in the chapter "Transition Speed Factors", a few additional factors will be listed that determine the size of installations. We will also explain why, in some cases, it will be necessary to increase the number of seeds beyond the optimal value.

3.3 Number of 100KW Blocks & Seed Installations

To meet all global energy needs from scratch, we would require: $(220{,}000 \times 10^{12}) \div (168{,}000 \times 10^{3}) = 1{,}309{,}523{,}809$ installations of 100 kW each.

At first glance, this may seem like an enormous number. However, when these 1,309,523,809 installations are distributed across multiple countries and implemented over several years, the task becomes far more manageable—and quite achievable within a relatively short timeframe.

Having that we said that our single business (seed solar PV installation) has aproximately size of 14 MW installed power or 140 x 100 kW blocks, this means that we need $1{,}309{,}523{,}809 \div 140 = 9{,}353{,}742$ seed installations (businesses) to cover all the energy needs for the world.

3.4 Total Cost of the Scheme

Multiplying 9,353,742 seed installations by the $100,000 cost per installation block results in a minimum required investment of **$936 billion**. At the maximum advised level—five times higher—the investment would total **$4.7 trillion**. Some countries will need larger initial investment but we will revisit that later in the "Model - Examples".

After this initial investment, no additional external funding is required.

To clarify: each of the 9,353,742 seed installations (business entities) must initially secure at least $100,000 to purchase their first solar PV farm block. Thereafter, revenues generated will come as a fast forward ROI during the first 36+ months, through the sale of electricity at a predetermined multiplier, enable immediate reinvestment into additional solar PV farm blocks.

The maximum advised initial contribution of $500,000 serves two purposes: accelerating early deployment and providing a safety buffer to bridge potential supply-chain delays and cover internal labor expenses. These funds are structured as director loans, ensuring that reinvestment of earnings remains unaffected.

In this context, stating that the scheme will "pay for itself" means that the financial burden on investors is removed, while consumers will start benefiting after a high intensity period (typically 36+ months) of time.

At the same time, countries must exercise caution: neglecting best practices, expert advice, and coordinated consultation could result in significant trade deficits.

The scheme must therefore be implemented in a manner that ensures, by the end of deployment, each participating country achieves full energy self-sufficiency without major reliance on foreign energy or energy producing equipment imports.

Although the initial cost may appear large, it represents the investment required to kickstart the scheme on a global scale. Once established, the scheme is self-sustaining, financed entirely by monthly electricity payments from consumers (individuals, households, companies or institutions).

4 Model

4.1 Methodology

The methodology for this paper combines a systematic review of references with computational analysis. The purpose is to ground the proposed idea in established theory while validating it through quantitative modeling.

1. **Reference Identification and Review**
    - Surveyed peer-reviewed journal articles, working papers, and institutional reports (World Bank, IMF, OECD, etc.) relevant to the subject.
    - Applied selection criteria based on recency, methodological soundness, and applicability to the research question.
    - Organized references thematically to highlight consensus, gaps, and divergent views.
    - Extracted numerical data and conceptual frameworks as inputs for computational work.
2. **Computational Analysis**
    - Developed a set of **Python support programs** to structure datasets, perform sensitivity testing, and visualize outcomes.
    - Applied **Excel computation** for scenario analysis, compound growth projections, and comparative tables.
    - Integrated core economic parameters (population, capital flows, labor costs, energy prices, etc.) derived from both literature and public databases.
    - Conducted sensitivity analyses across multiple parameter sets to assess robustness.
    - Validated results by comparing modeled outputs with historical data and established case studies.

This dual approach, combining literature synthesis with Python and Excel-based computation, ensures the analysis is both theoretically informed and empirically tested.

4.2 Computational Analysis

Program

RTS_Model.py - includes the computational model and analytical scripts used to validate the results. The program lists all examples used in this paper, and different types of tracing can be used to cross-check computations.

Excel as supplement

RTS_Data.xlsx - partly contains data and analysis necessary for this paper, with the following sheets:

- **RepaymentSpeed -** Repayment Dynamics of Solar PV Farms in Relation to Output and Electricity Price per kWh
- **SolarOutput -** Specific Photovoltaic Power Output (kWh/kWp/y) in different countries of the world
- **Price_kWh -** Price of electricity (USD/kWh) per country
- **ConsumptionQBTU -** Total energy consumption in Quadrillion BTUs for the year 2022 per country
- **AggregationViability -** Preliminary calculation of the viability of the Rapid Transition Schema across different countries, including likelihood of economic success
- **AggVals-Excerpt -** Excerpt from the previous sheet containing random and most important examples

4.3 Worldwide viability

Out of 241 countries and dependent territories, only 16 countries with a combined population of 4,582,860,931 people (57.19% of the world's population) use more than 1% of the world's energy or a combined amount of 77.27% of the world's energy.

Those countries are, in order of their energy usage: China, United States, India, Russia, Japan, Iran, Canada, South Korea, Saudi Arabia, Germany, Brazil, Indonesia, France, Mexico, United Kingdom, and Turkey. Solving the energy transition in those countries (especially the first five) will solve it on a planetary scale.

Regardless of the decisions of other countries, each country should focus on what they can do, as this schema has very good economic potential for some countries if implemented in the correct way.

The following table illustrates the relative viability of implementing the rapid transition schema across different groups of countries and the share of global energy demand they represent:

Viability Ranks	years	year	% w. energy	Countries
Good	7	2032	32.99	123
Viable	14	2039	18.13	56
Marginal	21	2046	33.33	21
Weak	28	2053	9.35	15
Unviable	28+	2060	6.20	26

In 123 countries (representing 33% of worldwide energy consumption) the transition could be achieved within seven years, indicating both strong feasibility and substantial economic potential. We will emphasize this group further by dividing it into three subgroups which are self-explanatory.

Viability	years	year	% w. energy	Population	Countries
Exceptional Economic Potential	4.0	2029	1.91	243,938,325	50
Strong Economic Potential	5.5	2031	9.61	881,712,012	53
Notable Economic Potential	7.0	2032	21.47	782,427,243	20
			32.99	1,908,077,580	123

Those countries are characterized as already having plenty of sun potential but also relatively high prices of electricity that could further boost the speed of deployment, making them ideal for transition. Of course, it is important to stress that this is only the case when implemented correctly.

A further 18% is in the "Viable" group, requiring around fourteen years, while 33% is "Marginal," with expected completion extending to twenty-one years. Both "Viable" (7 to 14 years) and "Marginal" (14 to 21 years) do not necessarily indicate a pessimistic outcome from the perspective of the CO_2 budget in 2037. Rather, it means that we would need to adjust other transitional factors in order to finish everything within a significantly shorter timeframe, for instance seven years.

In contrast, the "Weak" group of countries either does not have enough sun potential or relies on fossil fuel prices that are so low that, in practice, it is not feasible to transition profitably. It can make sense from other points of view, but profitability-wise it will not make much sense to investors, so it will need additional measures from the government.

Lastly, the "Unviable" category accounts for a little more than 6% of global energy, reflecting significant locational, structural, or financial barriers, which make transition simply impossible. One of the biggest consumers in that group, Iran (with 2.26% of the world's energy consumption), although having plenty of land with solar potential, has such an abundance of oil and such low electricity prices that it is simply not viable to have any benefit except for being off-grid for the sake of having your own energy source.

The distribution suggests that more than half of global energy demand is situated in countries where rapid adoption is economically and technically realistic, underscoring the potential for large-scale impact if resources and policy frameworks are effectively aligned.

The above calculations and conclusions are drawn from the full table is provided in the Excel file included in the supplemental material.

Order	Rank	Location/Name	Population	% World	Quad BTU	TWh	TWh 2030	% TWh	Price kWh	Solar Out kWh	Price*3>0.7	Years
0		World	8,012,749,559	100.0%	598.456	175,347.6	220,000.0	100.0	0.1891	1,725	-	100000
166	162	Solomon Islands	750,325	0.009%	0.004	1.17	1.47	0.0	0.7400	1,607	TRUE	1.8
66	65	Somalia	19,655,000	0.2%	0.01	3.52	4.41	0.0	0.5000	2,200	TRUE	1.8
211		Turks and Caicos Islands	50,894	0.0006%	0.004	1.17	1.47	0.0	0.4500	2,044	TRUE	2.3
151	148	Guinea-Bissau	1,781,308	0.02%	0.01	1.47	1.84	0.0	0.4200	2,046	TRUE	2.3
...												
174	168	Cabo Verde	491,233	0.006%	0.01	2.93	3.68	0.0	0.3200	2,057	TRUE	3.0
189		Curaçao	155,826	0.002%	0.000	-	-	-	0.3050	2,177	TRUE	3.0
194	181	Grenada	109,021	0.001%	0.005	1.47	1.84	0.0	0.3200	1,976	TRUE	3.1
215		Sint Maarten	41,349	0.0005%	0.000	-	-	-	0.3000	2,131	TRUE	3.1
...												
20	20	France	68,668,000	0.8%	8.29	2,428.97	3,047.51	1.39	0.3200	1,271	TRUE	4.8
...												
19	19	Germany	83,577,140	1.0%	11.09	3,250.25	4,077.93	1.85	0.3600	1,087	TRUE	4.9
...												
205		Guernsey	64,781	0.0008%	0.000	-	-	-	0.3066	1,171	TRUE	5.4
12	12	Philippines	114,123,600	1.4%	1.80	526.81	660.97	0.30	0.2000	1,727	FALSE	5.5
...												
3	3	**United States**	340,110,988	4.2%	94.79	27,773.76	34,846.37	15.84	0.1800	1,642	FALSE	6.4
...												
7	7	Brazil	212,583,750	2.6%	10.77	3,154.44	3,957.72	1.80	0.1500	1,926	FALSE	6.6
11	11	**Japan**	123,360,000	1.5%	16.89	4,948.77	6,208.98	2.82	0.2200	1,319	FALSE	6.6
...												
39	39	Poland	37,412,000	0.5%	4.06	1,188.12	1,490.67	0.68	0.2400	1,087	TRUE	7.3
...												
10	10	Mexico	130,417,144	1.6%	7.56	2,215.96	2,780.25	1.26	0.1000	2,091	FALSE	9.1
...												
30	30	South Korea	51,164,582	0.6%	12.20	3,575.77	4,486.34	2.04	0.1300	1,455	FALSE	10.0
...												
4	4	Indonesia	284,438,782	3.5%	9.10	2,666.89	3,346.01	1.52	0.1000	1,688	FALSE	11.1
...												
37	37	**Canada**	41,548,787	0.5%	12.27	3,593.94	4,509.14	2.05	0.1300	1,187	FALSE	12.1
1	1	**India**	1,417,492,000	17.3%	35.26	10,330.30	12,960.92	5.89	0.0800	1,861	FALSE	12.6
62	61	Malawi	20,734,262	0.3%	0.03	7.91	9.93	0.00	0.0700	2,042	FALSE	13.1
...												
2	2	**China**	1,408,280,000	17.2%	173.96	50,971.45	63,951.37	29.07	0.0800	1,506	FALSE	15.5
36	36	Afghanistan	43,844,000	0.5%	0.11	32.23	40.44	0.02	0.0600	2,004	FALSE	15.6
...												
18	18	Turkey	85,664,944	1.0%	6.03	1,765.33	2,214.87	1.01	0.0500	1,678	FALSE	22.2
...												
125	123	Oman	5,306,976	0.06%	1.41	413.42	518.70	0.24	0.0300	2,291	FALSE	27.0
9	9	**Russia**	146,028,325	1.8%	32.54	9,534.51	11,962.48	5.44	0.0600	1,138	FALSE	27.2
50	50	Nepal	29,911,840	0.4%	0.18	52.74	66.17	0.03	0.0400	1,655	FALSE	28.0
137	134	Qatar	3,173,024	0.04%	2.20	644.89	809.12	0.37	0.0300	2,153	FALSE	28.7
128	126	Kuwait	4,881,254	0.06%	1.72	502.79	630.82	0.29	0.0300	2,072	FALSE	29.8
...												
176	169	Brunei	455,500	0.006%	0.21	61.24	76.83	0.03	0.0072	1,410	FALSE	181.6
17	17	**Iran**	85,961,000	1.0%	13.50	3,956.09	4,963.51	2.26	0.0040	2,016	FALSE	228.4

Table 1: This is an excerpt of the supplementary table, showing a few selected countries.

Below is an excerpt of the supplementary table, showing a few selected countries.

The following columns are displayed:

1. **Order** - the original ordering number of countries from the country name source.[28]
2. **Rank** - original ordering without counting dependent territories.[28]
3. **Location/Name** - name of the country or dependent territory.[28]
4. **Population** - population number per country [1] .[28]
5. **% of world** - percent of a country's population in relation to total world population.[28]
6. **Quad BTU** - Total Consumption (2022) in Quad BTUs.[29]
7. **TWh** - Total Consumption (2022) in TWh (terawatt hours) of energy obtained by multiplying the 6th column (Quad BTUs) by 293 to get TWh.
8. **TWh 2030** - Entire world consumption in 2030 was previously estimated to be 220,000 TWh. From there, a multiplying coefficient was derived to be 1.25465070501561. Each country's TWh in 2022 (7th column) was multiplied by that coefficient.
9. **% of TWh** - How much is the share of energy consumption in the global economy ((country's consumption ÷ total consumption) × 100).
10. **Price kWh** - Price of kWh in USD per country, aggregated from different sources.[30],[31],[32],[33]
11. **Solar Out kWh/KWp/year** - "Country indicators" sheet "Average theoretical potential (GHI, kWh/m^2/day), long-term" column multiplied by 365 to get "Average theoretical potential kWh/KWp/year" from World Bank data "Global Photovoltaic Power Potential by Country" Excel file *solargis_pvpotential_countryranking_2020_data.xlsx*.[34],[35],[36],[37]
12. **Price * 3 > 0.7** - a very rough measure of how fast ROI would be. $0.7 is chosen as a number representing very fast returns within our perceived timeframe of a few years.
13. **Years** - time needed to build the entire installation without deployment delays [2], taking into account a country's Solar Out kWh/KWp/year and existing price per kWh multiplied by 3.[3]

From the table, we can see that China, India, and Russia among themselves consume more than 40% of world energy. We can also see that they have unfavorable electricity prices. However, by adjusting certain "transition speed factors" it is still possible to complete their transition within the desired timeframe, but it would come at the expense of profitability—a trade-off that may be justified by the wider societal and economic benefits.

4.4 Selected Examples

Cases shown here are selected with the previous section in mind, considering that 4 main countries (China, USA, Russia, and India) comprise 56% of total energy consumption. Additionally, one micro-country is included to represent all those with excellent odds of improving their economies if they implement the schema correctly. All other countries more or less fall within those scenarios, although we should keep in mind that, regardless of the two main parameters (solar output and current price), current purchasing power as well as the level of democracy—or, more precisely, the absence of corruption—can greatly define the outcome of success, creating either an economic boom or total failure, even further entrenching a country in debt and economic decline.

These examples are not just meant to show viability, but actually to pinpoint various issues that may arise from case to case, which each country needs to overcome.

4.4.1 Case 1: High enough price / high solar yield

For this case, we consider the small island country **Cabo Verde**, which has a population of approximately 491,233 and an estimated energy consumption in 2030 of 3.68 TWh (or 0.00167% of global energy consumption), which is a very small share. For simplicity, we round this figure to 4 TWh. This country is representative of the group identified in the supplementary Excel file as having *Exceptional Economic Potential* (that is, a calculated coefficient of 4.0 or lower in the final column).

[1] Strict precision is not needed, an approximation is sufficient. It is also important to note that in the source the World figure excludes around 220 million people, as there is a discrepancy between UN projections and other sources of data. For our purposes, however, this is not significant.

[2] Calculations with delays are shown in model examples in the following chapter. They do not show a significant overall discrepancy (even two years is acceptable considering the end goal), nor do they impair the overall conclusion that the rapid schema could improve our odds of success.

[3] All data used in the above table are provided in the supplementary Excel file 'DataModel.xlsx' (Sheet: AggVals-Excerpt), which is an excerpt from the full dataset contained in (Sheet: AggregationViability).

Regardless of their size, due to the existing price of electricity and solar potential, all those countries have extremely good potential to significantly enrich their economies if they implement the rapid transition schema correctly. Additionally, success can depend on the overall wealth of the population and its ability to pay for electricity during the high-price period.

In this example, Cabo Verde's current electricity price is \$0.32 per kWh, and its average solar potential is 2,057 kWh/kWp/year, significantly above the reference threshold of 1,680 kWh/kWp/year. To maintain a conservative estimate, we reduce this value to **1,800 kWh/kWp/year**.

Instead of assuming a threefold price increase during the high-price period, the price for a **42-month** high-price phase is set at **\$0.75 per kWh**, taking into account that the average salary was approximately 204,000 CVE (Cape Verdean Escudos), or about \$2,170 USD per month in 2025. The monthly minimum wage was CVE 17,000 (around \$180 USD). With limited data available, approximately 15 percent of the population live on this minimum income, which coincides with the poverty line. For this group, it would be very difficult to afford electricity bills during the high-price period, which already poses a challenge at current prices.[38]

For the low-price period of **198 months**, we will set a price of **\$0.13 per kWh**, giving investors a healthy profit while at the same time producing an average price for the entire 240-month period of \$0.2385 per kWh, creating sizable savings compared to the market price of 25.47%. If a household were spending 300 kWh per month over a 20-year (240-month) period, by being in the schema they would pay a total of \$17,172 (\$9,450 (42m × 300kWh × \$0.75) + \$7,722 (198m × 300kWh × \$0.13)) for 20 years, while paying the market price they would spend \$23,040.00 (72,000 kWh/20y × \$0.32), which means that **they would save \$5,868.00** under this basic calculation model.

That being said, the price of a 100 kW PV installation block will be set at \$100,000. With this, we can conclude that a 100 kW block would annually produce **180,000 kWh**, derived from solar potential and installed capacity, which is around 15,000 kWh per month.

Taking the estimated energy consumption of 4 TWh in 2030, we can use the method from the chapter "Why should seed installation have size of 14 MW?" to find the optimal number of seed installations. From several options, **160 seeds** are chosen as optimal, as they will give installations with **13.9 MW capacity**. The schema will need **\$16 million in initial investment**, and around 1,600 investors with trade skills, with a minimum of \$100K per each 10 investors. Finally, it would take 50 months to finalize the job if everything were paid at the high price and there were no delays.

With delays, we will use the program to calculate time, which will show that, in the optimistic scenario with delays and a single initial solar block per installation seed, the job could be completed within **73 months** (**6 years and 1 month**).

Changing only one variable (*solar potential*) to be closer to Cabo Verde's potential from the Global Solar Atlas (200,000 kWh/y per 100 kW solar block) could allow the job to be completed in 44 months (**3 years and 8 months**).

Based on the supplied data, over a 20-year period, an initial investment of \$100,000 is projected to yield a gross profit of \$45,487,439, corresponding to a compound annual growth rate of approximately 35.8%, which falls within the range typically observed in exceptional technology startups.

4.4.2 Case 2: Start example

In one of the first chapters, "Example," we used the following numbers:

- Total contract time: 20 years
- High-price period duration: 42 months (3 years and 6 months)
- Low-price period duration: 198 months (16 years and 6 months)
- Market price: \$0.26 per kWh
- High-period price: **\$0.78 per kWh**
- Low-period price: **\$0.11 per kWh**
- Which resulted in an average price for the transition schema of \$0.22725 per kWh
- If a household consumed 300 kWh a month over 20 years (basic calculation), being in the rapid transition schema would save them \$2,358 (((240m × 300kWh × \$0.26) - ((42m × 300kWh × \$0.78) + (198m × 300kWh × \$0.11)))).

A country with a similar profile already exists. From the previous mentioned Excel table, we can take Northern Cyprus, with a population of 476,214, a price of \$0.27 per kWh, and a solar potential of 1,698 kWh/kWp/y, as the closest match to a $0.26 market price per kWh and **1,680 kWh/kWp/y** used throughout the text.

It is estimated that Northern Cyprus will consume around **36.39 TWh** of energy in 2030.

The labor force of Northern Cyprus in 2024 was 195,159 people, with 185,607 employed and 9,552 unemployed, and the unemployment rate stood at 4.9%.[39] The mean monthly salary in 2024 was €2,487 (US$2,920), while the median monthly salary was €1,887 (US$2,215).[40] This means that residents of Northern Cyprus would have enough purchasing power to withstand the high-price transition period in order to enjoy lower prices later on.

Now, what does that mean from the perspective of investing and completing the energy transition?

Estimated energy consumption in 2030 for Northern Cyprus is approximately 36.39 TWh, which is quite high (; the original source data[41] are derived from Cyprus, not Northern Cyprus alone), but we will use this number just to demonstrate what to do in a case like this.

Calculations have shown that the optimal number of **seed installations would be around 1,400**, where each seed company would need to create **15.5 MW** installations, requiring 14,000 investors/workers. Northern Cyprus barely has the population and workforce to carry out the work.

Using our program, including high and low periods and build delays, it resulted in a build period of **94 months (almost 8 years)**, which is quite good.

In the chapter "Installation Time vs. Manpower," we calculated that we would need approximately 85,000 man-hours to deploy a 14 MW solar PV installation, or ~600 per 100 kW block.

Therefore: ((36.39 TWh / 12) / (168,000 / 12) = 216,607 × 100 kW) or (1,400 seeds × 15.7 MW) = 21.7 GW 21.7 GW / 100 kW = 217,000 blocks Total effort to build 217,000 100 kW blocks × 600 hrs/man = 130,200,000 hrs/man Given that a single person has 1,920 hrs available per year (5 days × 48 weeks × 8 hrs), it means that the project would need:

- 67,813 workers/investors for 1 year
- 13,563 workers/investors for 5 years
- 6,782 workers/investors for 10 years

to build everything. Thus, in our case, having 14,000 workers over 8 years is acceptable.

Having in mind that in Northern Cyprus energy consumption per capita is quite high, but the available population is low, finding a workforce could be challenging, although finding initial investors with sufficient savings should not be an issue.

Here, we calculated that consumption of 60,000 kWh per capita can represent the demarcation point, and that there are 24 countries accounting for 31.28% of world consumption, among which are the USA and Russia. Each of those countries would need to carefully calculate whether they are able to complete the transition solely from the perspective of the necessary workforce requirements and within the desired timeframe.

Some of these, such as the USA and Russia, will be covered in separate calculations, as they have other edge parameters as well.

In terms of profitability, this case is very similar to the first one. Based on the supplied data, over a 20-year period, an initial investment of $100,000 is projected to yield a gross profit of $40,644,048, corresponding to a compound annual growth rate of approximately 35.1%, which falls within the range typically observed among exceptional technology startups.

4.4.3 Case 3: Mid-range price / average yield

Here we will take the **United States of America** as an example:

- The USA has a population of 340 million, while the **labor force is 168 million people** strong, with a 4.3% unemployment rate, meaning that at any moment **7.2 million people are unemployed**.
- Total contract time was 20 years.
- High-price period duration was 42 months (3 years and 6 months)
- Low-price period duration was 198 months (16 years and 6 months)
- Market price was **$0.18 per kWh**
- The high-period price was set to **$0.55 per kWh** (3x=0.54 bit more)

- The low-period price was set to **$0.09 per kWh**
- Which resulted in an average price for the transition schema of $0.1705 per kWh
- Specific photovoltaic power output: 1,642 kWh/kWp/y average (2,000 kWh/kWp/y in Arizona, New Mexico, etc.)

If a household consumed 300 kWh a month, over a period of 20 years (with a basic calculation), being in the rapid transition schema would save them $684 ((240m*300kWh*$0.18)-((42m*300kWh*$0.55)+(198m*300kWh*$0.09))).

- Specific photovoltaic power output: **1,600 kWh/kWp/y** will be used.
- USA's energy consumption is estimated at **34,846.37 TWh/y**.
- Installed capacity to cover energy needs should be a minimum ((34,846.37 TWh / 12) / (168,000 / 12)) = 207,418,869 of 100 kW PV blocks or **a minimum of 20.75 TW of installed power**.
- 20.75 TW requires (600 hrs/man*207,418,869) 124,451,321,400 man-hours to complete:
  - 64,818,397 workers/investors for 1 year
  - 12,963,679 workers/investors for 5 years
  - 6,481,840 workers/investors for 10 years
- The schema would need **1,400,000 seed installations** with an $100,000 investment each building **14.8 MW** installations, requiring an initial investment of $140 billion and 14 million people involved, with $10,000 for each of 10 skilled investors/workers.
- Having in mind that the USA is the richest economy in the world with a GDP of $30 trillion, [42] and the mean personal income of $67,080 in 2024[43], and the fact that 23.8 million people have a net worth of at least $1 million[44] — this should not be a problem.

With the set parameters, the transition could be completed in **220 months** (18 years and 4 months), which is not satisfactory from a climate perspective, but also from a profit perspective.

So, let's try to fix one parameter, the USA's specific photovoltaic power output **1,600 kWh/kWp/y** is the average for the country, but most of the time the goal should be to build large solar projects in regions with a lot of sun. Looking at the Global Solar Atlas, we can see that a good portion of California, Arizona, New Mexico, and Texas near the Mexican border have between 1,800 and 2,000 kWh/kWp/y, so we will use **1900 kWh/kWp/y**.

Just by choosing an appropriate location, our odds of success increase and the time to complete the project is reduced to **144 months** (12 years), which is at the edge of climate goals."

If we wanted to speed the transition even further, we could, for instance, add 2 blocks at the start instead of 1, increasing initial investment to $280 billion, and that would slash the time of completion to **96 months** (8 years).

From a financial standpoint, implementing this scheme in the United States over a 20-year period would allow an initial investment of $200,000 to generate a gross profit of $27,030,868, corresponding to a compound annual growth rate of approximately **27.8%**, which indicates a notably high level of profitability.

Another good thing about the USA is that it could, with the wealth it has, quickly build all infrastructure projects faster than any other country.

4.4.4 Case 4: Low (or Marginal) price / good-enough yield

In this example **China** , with a population of 1.41 billion people, and **India** , with a population of 1.42 billion people, will be shown. Although they have very similar population sizes, China has the largest energy consumption of **63,951.37 TWh/year**, while India consumes five times less, or **12,960.92 TWh/year**. Both have a similar price of $0.08 per kWh, although China has an average solar potential of 1,506 kWh/kWp/y and India , 1,861 kWh/kWp/y. China also has vast desert regions where the specific photovoltaic power output exceeds 2,100 kWh/kWp/y.

Here we will address China, while India will fall within a similar scenario:

- Total contract time was 20 years.
- High-price period duration was 42 months (3 years and 6 months)
- Low-price period duration was 198 months (16 years and 6 months)

- Market price was **$0.08 per kWh**
- The high-period price was set to **$0.22 per kWh**
- The low-period price was set to **$0.05 per kWh**
- Which resulted in an average price for the transition schema of **$0.07975 per kWh**
- Specific photovoltaic power output: **1,800 kWh/kWp/y** (for both China and India)

If a household consumed 300 kWh a month, over a period of 20 years (with a basic calculation), being in the rapid transition schema would save them $18 ((240m*300kWh*$0.08)-((42m*300kWh*$0.22)+(198m*300kWh*$0.05))); so in a practical sense that is not much, except citizens would have the benefits of breathing clean air and having generally better health, and of course a fighting chance against climate change.

- Minimum installed capacity to cover energy needs can be calculated as ((63,951.37 TWh / 12) / (180,000 / 12)) = 355,285,389 of 100 kW PV blocks or a minimum of **35.53 TW of installed power**.
- 35.53 TW requires (600 hrs/man*355,285,389) 213,171,233,400 man-hours to complete the work, or:
  - 111,026,684 workers/investors for 1 year
  - 22,205,337 workers/investors for 5 years
  - 11,102,668 workers/investors for 10 years
- The schema would need **2,400,000 seed installations** with a $100,000 investment each, building **14.8 MW** installations, requiring an initial investment of US$240 billion and **24 million people** involved, with US$10,000 for each of 10 skilled investors/workers.

Funding should not be an issue, bearing in mind that China is the second-richest economy in the world with a GDP of US$19.2 trillion,[45] and the median per capita disposable income (2024) is RMB 34,707 per annum, or RMB 2,892.25 per month (~**US$406/mo**)[46], the fact that 6.2 million people have a net worth of at least $1 million[47], and Chinese households held over 160 trillion yuan (approximately $22.30 trillion) in total deposits at the end of March 2025.[48]

With the above parameters set, the transition could not be completed within **240 months**.

Only with **10 start blocks** per seed would the time decrease to **223 months**.

What if we increase the number of seed investors? **4 million seeds** and 40 million people/workers/investors involved, building 8.8 MW installations, would drive down the duration of construction to **154 months** (12 years and 10 months) with a profit that still beats some index funds. For an initial investment of **$1,000,000, this would generate a gross profit of $5,732,202, corresponding to a compound annual growth rate of approximately** 9.1%**.

From the gross income of **$5,732,202**, before paying taxes, transport fees, utilities and admin costs, if they are lucky, they will end up with 50% net income. When $2,866,101 is split among 10 people, the profit is $286,610 over 20 years for an invested $100,000 per investor. That means a real gain of $186,610/20=9330.5/12 = ~**$777**, just slightly higher than the median monthly salary of $406 in China.

Now, this does not make the schema attractive to higher earners, who may have $100K at their disposal for investment. Being a communist country, China could subsidise the entire schema with the necessary US$4 trillion and give loans to skilled people who know what they are working toward.

So, it is doable, especially in China, which represents the world's factory. But in order to succeed in the desirable timeframe, the planet will need to spread production. A greater share of production should be moved from China if we want to succeed; in that way, by sharing the load across countries, we may all succeed with the climate goal.

4.4.5 Case 5: borderline price / borderline yield

Russia has a population of 146 million people, and has sizable energy consumption of **11,962.48 TWh/year**, which is very similar to India's , but their electricity price is on the borderline of what is possible with this schema: $0.06 per kWh, and Russia , despite its vast territory, has very low average specific photovoltaic power output of **1,138 kWh/kWp/y**, only near the Kazakhstan border and Georgia can that potential climb to 1,300 kWh/kWp/y. To be fair, Russia has regions with solar potential exceeding 1,700 kWh/kWp/y in Oblasts such as Volgograd, Irkutsk, Amur, and the border of Mongolia, but the issue with those regions, apart from the harsh climate, is that those regions are not very well infrastructurally connected and that not many people live there.

Following properties are set as:

- Total contract time was 20 years.
- High-price period duration was 42 months (3 years and 6 months)
- Low-price period duration was 198 months (16 years and 6 months)
- Market price was **$0.06 per kWh**
- The high-period price was set to **$0.15 per kWh**
- The low-period price was set to **$0.04 per kWh**
- Which resulted in an average price for the transition schema of **$0.05925 per kWh**
- Specific photovoltaic power output: **1,200 kWh/kWp/y** (middle value in some better locations)

If a household consumed 300 kWh a month, over a period of 20 years (with a basic calculation), being in the rapid transition schema would save them $54 ((240m*300kWh*$0.06)-((42m*300kWh*$0.15)+(198m*300kWh*$0.04))); so in a practical sense that is nothing much, except citizens would have the benefits of breathing clean air and having generally better health, and of course a fighting chance against climate change.

The first question we need to ask is whether a solar PV block is even cost-effective at those prices.

- With a price of **$0.04** our 100 kW solar block producing 120,000 kWh/y would pay itself in 20 years and 10 months, so 10 months more than its contract. To be fair, in the right conditions PV panels can last 30 years.
- Minimal price per kWh within 20 years would be **$0.042**.
- With an average price of **$0.05925** the solar installation would pay itself in 14 years and 1 month.
- Minimum installed capacity to cover energy needs can be calculated as ((11,962.48 TWh / 12) / (120000 kWh / 12)) = 99,687,334 of 100 kW PV blocks or a minimum of **9.97 TW of installed power**.
- 9.97 TW requires (600 hrs/man*99,687,334) 59,812,400,400 man-hours to complete the work:
  - 31,152,292 workers/investors for 1 year
  - 6,230,458 workers/investors for 5 years
  - 3,115,229 workers/investors for 10 years
- Optimal number of seed companies with 14.88 MW installations would require **670,000 seed installations**.

With the above setup and with that number of seeds it would not be possible to complete deployment in **240 months**. Even if we invest more at the start by adding 10 blocks at start, it will not change the outcome.

But if we increase the number of seed companies to **1 million**, and increase the initial number of solar PV 100 kW blocks to **30**, then the schema would successfully complete in **187 months** (15 years and 7 months), but at a loss of US$923,374.

It would require increasing the initial number of seeds to 67 at the start in order to create profitability. With **1 million** seed companies employing **10 million workers/investors** involved in building 9.96 MW installations, they would need to invest in 67 initial blocks, each $6,700,000 per seed and $670,000 per investor, and at the end of the contract period the projects would generate a $10,019,207 gross profit each. After paying taxes, transport fees, utilities and admin costs, and assuming that 50% is net, or $5,009,603. Keep in mind that before subtracting taxes etc., the initial investment of $6.7 million must be taken out, leaving only $3,319,207, after which the net is $1,659,603, which is not very attractive profit, but if we look at the larger picture of what we want to do in the world it would still make sense.

Also, we need to keep in mind that the price from the Excel file is a bit misleading, as in 2025 Russia's price was 3.02 RUB per kWh and the most expensive was 11.24 RUB per kWh (US$0.037-US$0.14) with a quite complex electricity price system.[49]

If we adjust the high price period to be $0.30, the low price period to be $0.07, the average price for all would be $0.1179.

Then for **1 million** seed companies with **10 million workers/investors** they would need to invest in 20 initial blocks, i.e., $2,000,000 per seed or $200,000 per each of 10 investors. Deployment would finish in 96 months (8 years), which is a much better outcome.

Generating a gross profit of $9,991,528, yielding a compound annual growth rate of roughly 8.3%—a rate that is comparable with some index funds.

After taking out the initial investment $7,991,528 and after 50% (taxes, transport, utilities etc.) $3,995,764 will be left for investors to split, which comes to $399,576 / 20 years = 19,978 / 12 = ~$1,665 per month per investor. For comparison the average monthly wage in Russia in 2024 was 87,952 rubles ($980).[50]

4.4.6 Case 6: Impossible price

Iran belongs to the group of unviable cases, at least based on the price of electricity, which is $0.004 per kWh, due to heavy government subsidies and abundance of oil. Even though it has an extremely good solar potential of 2,016 kWh/kWp/y (in the range of countries like Cabo Verde from our second example), even if we increased the price by an order of magnitude, the price of electricity in Iran would be just $0.04 per kWh, which is still not enough to make solar energy or any other type of renewable or non-renewable energy cost-effective there.

Fortunately, the world has only a handful of such countries that together account for about 6% of global energy consumption. If those countries do not transition, it would not significantly impact the global energy transition and climate goals.

5 Conclusion

If implemented correctly, this schema could significantly accelerate the transition to renewable energy, strengthen national economies, and provide a meaningful opportunity to mitigate anthropogenic climate change. However, if applied without the necessary safeguards (some of which extend beyond the scope of this paper), it could result in long-term economic harm.

Researchers, policymakers, and stakeholders who find this framework valuable are encouraged to explore its application further and to adapt it responsibly to their specific national contexts.

6 Data Availability

All data supporting the findings of this study are included in the supplementary materials accompanying this paper.

RTS_Data.xlsx - contains selected datasets and analytical calculations relevant to this study, organized across several sheets.

RTS_Model.py - includes the computational model and analytical scripts used to validate the results.

Additional publicly available datasets referenced in this study (including sources from NREL, IEA, SEIA, and the World Bank) are freely accessible via the links provided in the References section.

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