NOVEMBER 2021

SOLAR FULL CYCLE TOKEN

OFFICIAL WHITEPAPER

Solar Full Cycle ($SFC)

The Crypto Currency Response to address the
Solar Panel Waste Problem that stands to emerge as the next,
most abysmal, and predictable environmental catastrophe
that will perhaps be second nature only to
Global Warming and Climate Change.

Dr Priyantha Wijesooriya

Flanked by

Sachith Samarasinghe and

Nirodha Amarasekera

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White paper cover

Original by SFC Team

Selected Glossary

Amorphous silicon non-crystalline form of silicon formed using silicon vapor which is quickly cooled.

Mono-crystalline silicon is manufactured in such a way that it forms a continuous single crystal without grain boundaries.

Poly- or multi-crystalline silicon is manufactured in such a way that it consists of a number of small crystals, forming grains.

Thin-film technology is used to produce solar cells based on very thin layers of PV materials deposited over an inexpensive material (glass, stainless steel, plastic

Extended Producer Responsibility: Extended Producer Responsibility (EPR) is an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. An EPR policy is characterized by (1) shifting responsibility towards the producers and away from governments and (2) the provision of incentives to producers to take into account environmental considerations when designing their products.

Raw material Basic material which has not been processed, or only minimally, and is used to produce goods, finished products, energy or intermediate products which will be used to produce other goods.

Pay-as-you-go and pay-as-you-put In a pay-as-you-go (PAYG) approach, the cost of collection and recycling is covered by market participants when waste occurs. By contrast, a pay-as-you-put (PAYP) approach involves setting aside an upfront payment of estimated collection and recycling costs when a product is placed on the market.

Last-man-standing-insurance is an insurance product that covers a producer compliance scheme based on a PAYG approach if all producers disappear from the market. In that situation, the insurance covers the costs of collection and recycling.

In a joint-and-several liability scheme, producers of a certain product or product group agree to jointly accept the liabilities for waste collection and recycling for an SFC recycle product or product group.

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Section 1.0

Solar Full Cycle - Project Outline

Solar Full Cycle (SFC) is a tokenized green-energy investment platform dedicated to establishing recycling panel waste in the flourishing solar industry. While the huge number of solar panels currently being installed is a welcome move against Global Warming and Climate Change, the trend shall also see colossal panel waste being generated that will pose one of the most predictable environmental disasters humankind has ever known.

The International Energy Agency (IEA) estimates that solar is now being installed globally with about 70,000 panels every hour for five years to come by. This will mean no less than 75 million tons of solar panel waste would be globally generated by 2050, too large a number to be dealt with local solutions.

Researchers have reported that [1]:

- The problem of solar panel disposal "*will explode with full force in two or three decades and wreck the environment*" because it *"is a huge amount of waste, not easy to recycle."*
- *"The reality is that there is a problem now, and it's only going to get larger, expanding as rapidly as the PV industry expanded 10 years ago."*
- *"Contrary to previous assumptions, pollutants such as lead or carcinogenic cadmium can be almost completely washed out of the fragments of solar modules over a period of several months, for example by rainwater."*
- Regulations and arrangements to prevent the surge of solar waste material leaking to the soil and landfill are abominably poor in most countries and often totally absent as well, this lack of enforcement includes, quite unfortunately, the larger part of US states that accommodates one of the highest levels of solar installations.

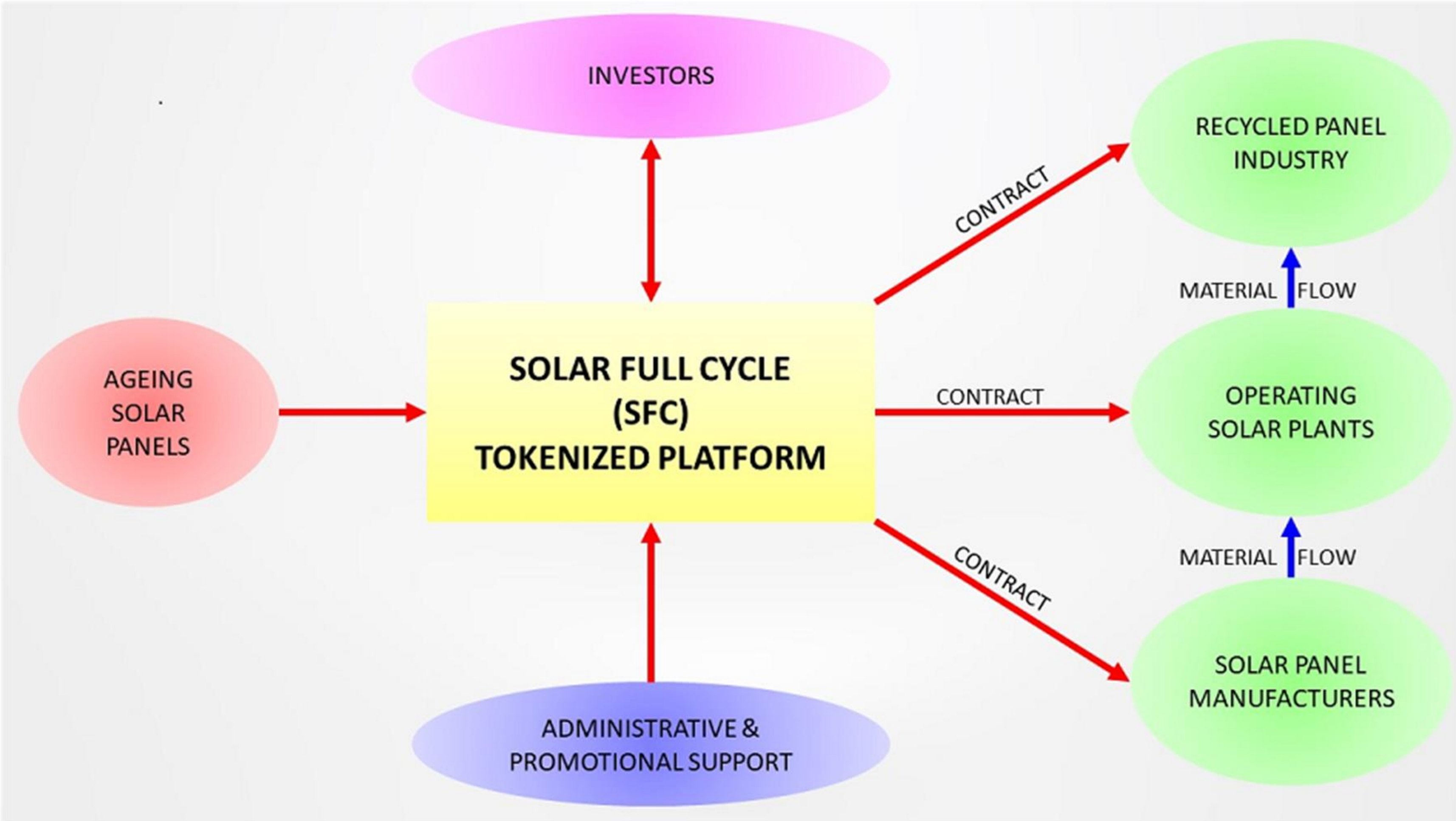
Solar panels often contain lead, cadmium, chromium and other toxic chemicals that cannot be removed without breaking apart the entire panel. *"Approximately 90% of most PV modules are made up of glass,"* notes a researcher. *"However, this glass often cannot be recycled as float glass due to impurities".*

Researchers also state that *"solar panel disposal in regular landfills is not recommended in case of modules break and toxic materials leach into the soil* and so *"disposal is potentially a major issue."*

In this backdrop, SFC brings a systematic network presence through the blockchain process that will obligate solar panel producers and power plant owners to responsibly recycle their solar panels; a drive that would also see a new generation of recycled solar panels emerging in the marketplace. The launch of SFC would therefore address a sustainability gap that has always been there, and provide assurance on responsible solar waste recycling. It will be a full cycle of renewable energy in the world of solar.

An initial coin offer (ICO) for SFC will be soon announced with substantial financial leverage for pioneering investors.

Schematic Diagram on SFC Tokenized Platform



Section 2.0

Vision & Mission Statement

The **Vision** of Solar Full Cycle (SFC) is to be a responsible corporate leader looking for ways to institute responsible recycling of waste material from renewable energy systems foremost solar power plants.

The **Mission** of Solar Full Cycle (SFC) is to be a corporate pioneer and leader in developing effective waste recycle technologies for the solar power industry and indeed for other renewable energy use, and to develop associated eco-friendly investment opportunities for ethical investors and the energy sector as a whole, using the blockchain-based $SFC tokens and associated crypto mechanisms.

Section 3.0
Profiles

Dr. Priyantha Wijesooriya

Founder
(https://www.linkedin.com/in/dr-priyantha-wijesooriya-091a3416)

The ongoing global pursuits to dissuade global warming and climate change with green energy technologies is certain to leave behind, if we are not careful, a wave of problems to be equally menacing as climate change has already demonstrated to be; and none is more representative than the impending huge solar waste overload that will overwhelm Mother Earth if panels and auxiliaries are not properly recycled. This realization led me, along with my team, to explore effective recycling solutions and Solar Full Cycle (SFC) was the result

Dr. Priyantha Wijesooriya is a US and Sri Lanka trained energy engineer (B.Sc and M.S in Energy Engineering, PhD in Dispatch Optimization & Future Economics). He is a Rotary Foundation Scholar at the University of Massachusetts (UMass) and has pioneered renewable energy and sustainable development for years. He is the founding president of the Solar Industries Association of Sri Lanka (SIA-SL) and founder of SELCO Sri Lanka Program with Neville Williams (see below). Dr. Wijesooriya is an Accredited Consultant to Sustainable Energy Authority of Sri Lanka (SL-SEA) and lead design engineer for 100-MW Utility-scale (Siyambalanduwa) Solar Park for the Government of Sri Lanka. Other previous experience: 1st CEO of SELCO Sri Lanka under SELCO USA for island-wide solar rural electrification, solar design engineer for IoM (affiliated to the UN) for war-affected civilians in Northern Sri Lanka, Intern with Enersol US Solar Program in the Caribbean in UMass Study Program, Consultant for World Bank RERED solar outreach program, Consultant for outer island Wind & Solar Electrification, Asian Development Bank (ADB). Current pursuits; Solar PV storage & dispatchable designs, biomass and wind energy development. Since 2018 engaged in reforestation activities with Imran Ali (Founder - Save Planet Earth, UK) in the endangered Knuckles Mountain Range, Sri Lanka. *Mentors: Sir Arthur C. Clarke Science Visionary, Neville Williams Founder SELF, SELCO and Standard Solar, David Freeman, Energy advisor to Carter administration, Richard Hansen formerly Westinghouse Corporation and Founder of Soluz and Enersol Solar rural Electrification Initiatives and others.*

International Advisory Team

Currently being drawn and finalized from a list of visionaries in Sustainable Development who are also well-known combatants against Global Warming and Climate Change. Some of them are:

- Neville Williams, Solar Pioneer & Environmental Advocate, Solar Electric Light Fund (SELF), SELCO and Standard Solar USA
  (http://www.nevillewilliams.com)

- Lalith Guneratne, International Solar Pioneer, Environmental Advocate and Management Training Exponent, Sri Lanka
  (https://www.linkedin.com/in/lalith-gunaratne-7b20319)

- Robert Freling, & Environmental Advocate, CEO, Solar Electric Light Fund (SELF), USA
  (https://www.linkedin.com/in/bob-freling-08264)

- Dr. Cynthia Caron, Professor in International Development, Community and Environment, USA
  (https://www.linkedin.com/in/cynthia-caron-3b48374b)

- Geoff Stapleton, International Solar Systems Trainer with major training outreach programs and Chair, ISES (International Solar Energy Society) Chapter, Australia
  (https://www.linkedin.com/in/geoff-stapleton-44641428)

- Richard Hansen, Formerly Westinghouse Corporation, and Founder, Soluz and Enersol Solar Electrification Program, the USA and Americas

Sachith Samarasinghe

Executive Director

(https://lk.linkedin.com/in/sachithsamarasinghe)

Sachith Samarasinghe, a young innovator in his early 30's and member of Solar Full Cycle (SFC) Core Design Team, studied Electronics and Computer Systems at the reputed Sri Lanka institute of Information Technology (SLIIT). Then, post campus level, he gained engineering and advanced IT experience from a number of job engagements; developing a fully automated tea withering system to enhance quality to produce 'Ceylon Tea'; and then as a networking engineer learning many facets in cyber-scape engagements.

Sachith's career undertakings cover developing auto-support network services to help (auto) customers to get good value addition *(as after-sales services from manufactures delivering on warranties and guarantees have many shortcomings).* Experience shows that customers need fast and affordable local solutions. This led to Sachith's pioneering efforts to set up an Auto Support Company to cater for brands like Mercedes, Audi, BMW, Toyota, Nissan, Suzuki so on and thus develop local solutions with attentive speed. He is contemplating taking this business model to a few countries.

Within Solar Full Cycle (SFC), Sachith's is in the core design team, and works under the guidance of Dr. Priyantha Wijesooriya, an internationally known solar energy pioneer. Sachith is entrusted in developing the primarily-important *'use case scenarios'* and physical business model of SFC, and his work is verified by other proponents of SFC. He also works to develop graphic based promotional tools required for SFC program.

Sachith also works periodically with Dr. Priyantha Wijesooriya in related areas of renewable energy; and recently completed preliminary designs involving Off-Shore wind Power Programs and Semi-Dispatchable Solar Power Plants that are targeted to operate in Sri Lankan territorial limits.

Post-school, Sachith has read for Business Management in a number of prestigious specialized learning institutes in Sri Lanka and quite versed in entrepreneurship and digital networking systems.

Nirodha Amarasekera

Executive Director

(https://www.linkedin.com/in/nirodha-amarasekera-0a832829)

Nirodha is innovative, business savvy and up to date in knowledge areas of emerging technologies in particular involving the virtual currency market. Since leaving high school, his career stints covered Sri Lankan and overseas engagements where the theme areas were information technology (IT), business and climate finance. As a young entrepreneur in his early 30's he is currently on a technological initiative to develop energy storage in renewable energy systems. He is interested in developing virtual platforms where consumers could literally pay up front for energy storage utilizing utility scale batteries banks, that will assist power utilities as well. He foresees this storage system as part of a broad, demand side management program that will retrofit to any country's energy scenario for storing renewable energy and also saving off-peak power to save fossilized fuels for better use.

Since about 2019 he has been working with Dr. Priyantha Wijesooriya to develop the recycling arena of renewable (energy) and associated waste problems from older equipment that must be disposed of. Here, he contributed with inputs that are ingrained in the current development initiatives of the Solar Full Cycle (SFC) program. He is assisted by other design members, as well as by the International Advisory Pool of SFC that have rich legacies worldwide in renewable energy development.

Nirodha's past times focus on environmental issues and how sustainable development could be factored in to the market place where digital currencies could progressively take the load off the current monetary system and thus removing financial overheads that otherwise takes a toll in day-to-day transactions.

Section 4.0

Solar Industry Analysis and Recycling Opportunity

A good idea on the impending solar waste challenge could be discerned when global solar growth rates up to the current time frame are examined.

The cumulative solar photovoltaic capacity has grown continuously since 2000 now estimated at 40%+ growth rates annually in global terms. Between 2000 and 2019, global figures increased by 632.4 gigawatts. In 2019, the cumulative capacity amounted to 633.7 gigawatts, with 116.9 gigawatts of new PV capacity installed in that same year. Some of the country-wise solar installation landscape is embodied in the following, extracted from research [2].

A news feed from the World Economic Forum says the following [3]:

The world will add 70,000 solar panels every hour in the next 5 years.

Source: World Economic Forum & Reuters - Alvin Baez

International Energy Agency (IEA) states that 70,000 new solar panels will be added every hour – enough to cover 1,000 soccer pitches every day

China remained the overall solar leader in terms of capacity with 204,7 GW cumulative installed, almost one-third of the global PV capacity in terms of 2020 figures China solar PV demand could surpass 100 GW in 2022; massive' production overcapacity predicted.

According to Asia Europe Clean Energy (Solar) Advisory Co. Ltd, demand for solar PV in China could "effortlessly" surpass 100 GW in 2022, following a year of "flat" demand in 2021. It adds that a "massive overcapacity" situation in the production sector. Meanwhile, the distributed solar PV market is on track for huge growth, with the potential for annual demand to reach upwards of 20 GW+ from next year [4].

It is estimated that global solar power capacity will triple by 2022, driven by Chinese demand and the ever-falling cost of buying and installing solar panels.

According to the International Renewable Energy Association (IRENA), photovoltaic solar power grew faster than any fuel in 2016, and there will be far more solar capacity added in the next four years than any other type of renewable energy, including wind and hydropower [5].

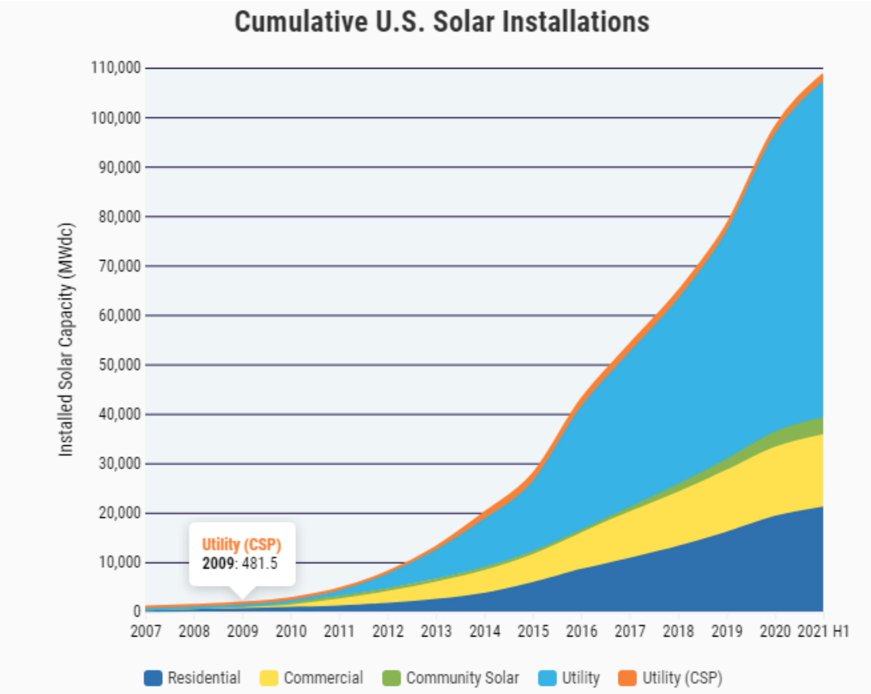
China is expected to add 40% of the world's new solar panels between now and 2022, despite having already surpassed its solar power target for 2020.

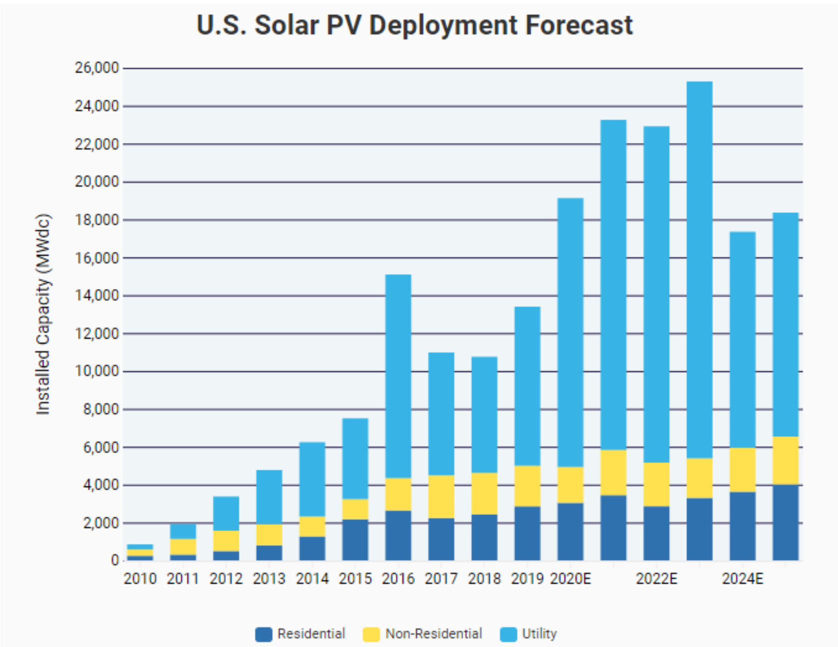
Outside of China, the global solar PV market grew from 58 GW in 2018 to at least 85 GW in 2019, a 44% increase year to year computed that time.

The European Union installed close to 16 GW in the same durations and the rest of Europe added roughly 5 GW. The largest European market in 2019 was Spain (4,4 GW), followed by Germany (3,9 GW), Ukraine (3,5 GW), the Netherlands (2,4 GW), and France (0,9 GW).

The US market increased to 13,3 GW, with utility-scale installations accounting for roughly 60% of new additions. The U.S in overall terms installed 5.7 GW of solar PV capacity in Quarter-2, 2021 to reach 108.7 GW of total installed capacity, enough to power 18.9 million American homes. The US officially surpassed 3 million installations across all market segments, the vast majority of which are residential systems. Before the investment tax credit (ITC) is fully phased down under current law, the solar industry will continue to break annual installation records every year for the next three years.

Despite obstacles posed by the Covid Pandemic, the U.S. solar market set a new annual record with 19.2 GW installed in 2020. The US industry is set for a series of record growth years until 2024. The end of the decade is premised on continued price declines and growing demand from utilities, states, corporations, and distributed solar retail customers. Over the next 10 years, 348 GW will be installed in the US, more than 3 times the amount installed through 2020.





Source: [5]

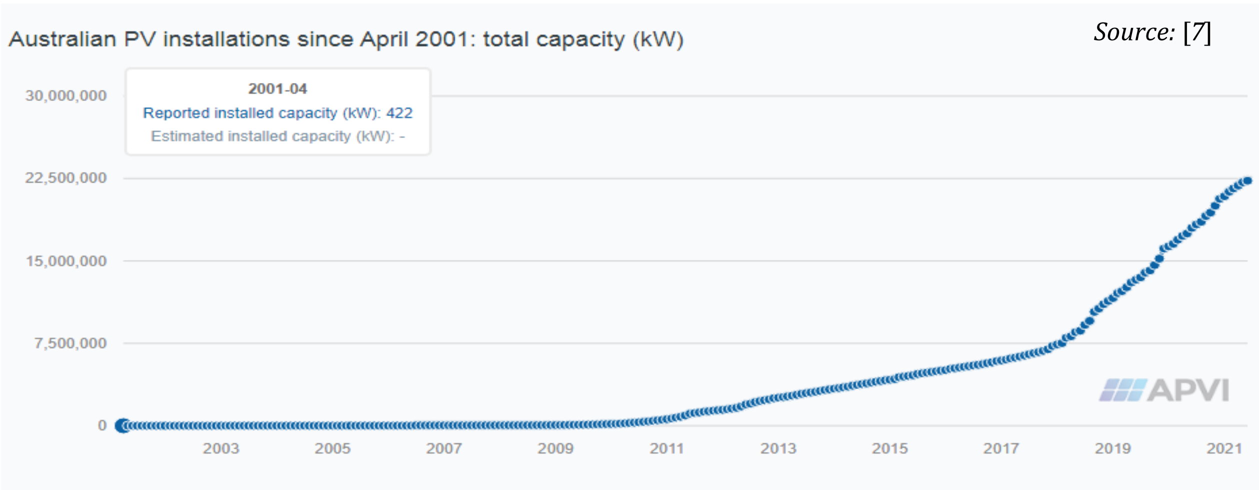
Source: [5]

The following figures show cumulative US-based solar installations up to 2021 [6].

- Japan ranks fifth, with an estimated 7 GW annual installed capacity. Some other major markets contributed significantly in 2019, such as Vietnam (4,8 GW).

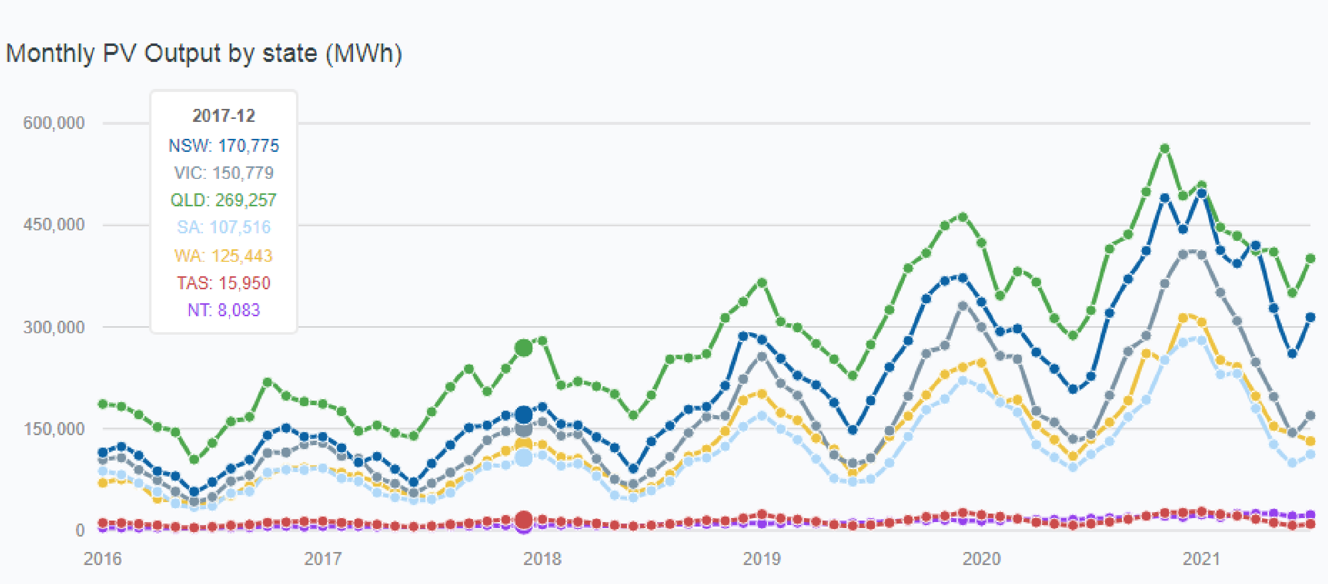
- India decreased slightly, with the annual market reaching 9,9 GW, including around 1,1 GW of distributed and off-grid installations during 2019.

- In Australia, Solar photovoltaic (PV) accounted for 21.7% of Australia's total power capacity in 2020 and this is estimated to reach 48% in 2030. According to Global Data, a leading data and analytics company, solar PV capacity in Australia stood at 17.99GW in 2020 and is estimated to reach 80.22GW by 2030 [6].

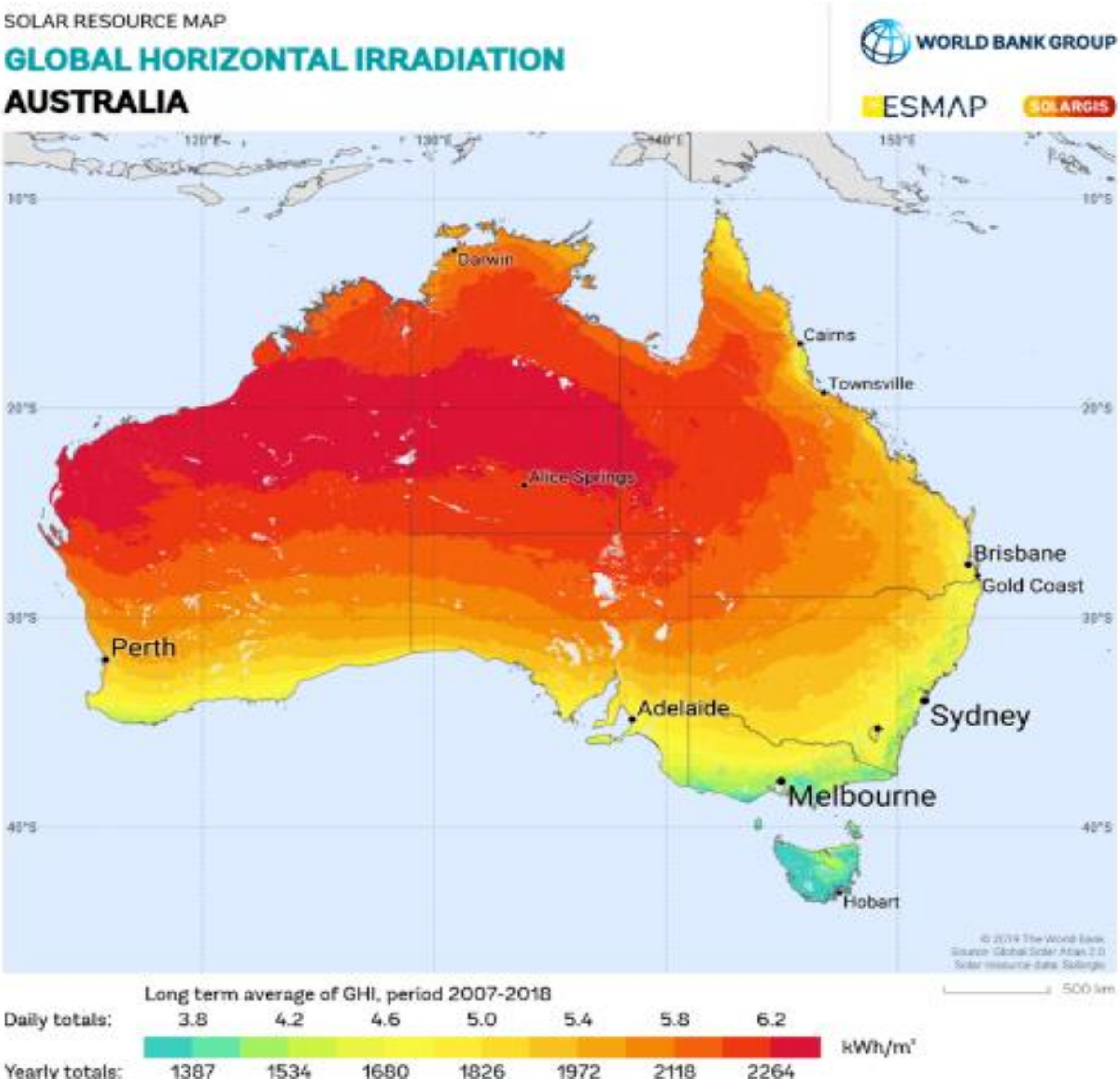


Source: [7]

Source: [7]



Monthly PV Output by state (MWh)
2017-12
NSW: 170,775
VIC: 150,779
QLD: 269,257
SA: 107,516
WA: 125,443
TAS: 15,950
NT: 8,083
600,000
450,000
300,000
150,000
0
2016
2017
2018
2019
2020
2021



SOLAR RESOURCE MAP
GLOBAL HORIZONTAL IRRADIATION
AUSTRALIA
WORLD BANK GROUP
ESMAP
SOLARGIS
Darwin
Cairns
Townsville
Alice Springs
Brisbane
Gold Coast
Perth
Adelaide
Sydney
Melbourne
Hobart
Long term average of GHI, period 2007-2018
Daily totals: 3.8 4.2 4.6 5.0 5.4 5.8 6.2
kWh/m²
Yearly totals: 1387 1534 1680 1826 1972 2118 2264

Observed solar growths are also in South Korea with 3,1 GW, Brazil (2,0 GW), the United Arab Emirates (2,0 GW), Egypt (1,7 GW), Taiwan (1,4 GW), Israel (1,1 GW), Mexico (1,0 GW),

In the top 10 countries, there are now six Asia-Pacific countries (China, India, Japan, Vietnam, Australia and Korea), three European countries (Spain, Germany and Ukraine) and one country in the Americas (the USA) that are pursuing solar PV installation policies and operations under federal and state support systems and regulatory facilitation.

The top 10 countries represented 72% of the global annual PV market, a declining number signaling that the market is less focused: • Honduras, Israel, Germany, Chile, Australia, Greece, Japan, Italy, India, Belgium, the Netherlands and Turkey now have enough PV capacity to theoretically produce more than 5% of their annual electricity demand with solar PV [2, 7].

Speaking of the EU, PV represents around 3 % of the global electricity demand and 5% in the Union... The contribution of PV to decarbonizing the energy mix is progressing, with solar PV saving as much as 720 million tons of CO2 equivalent.

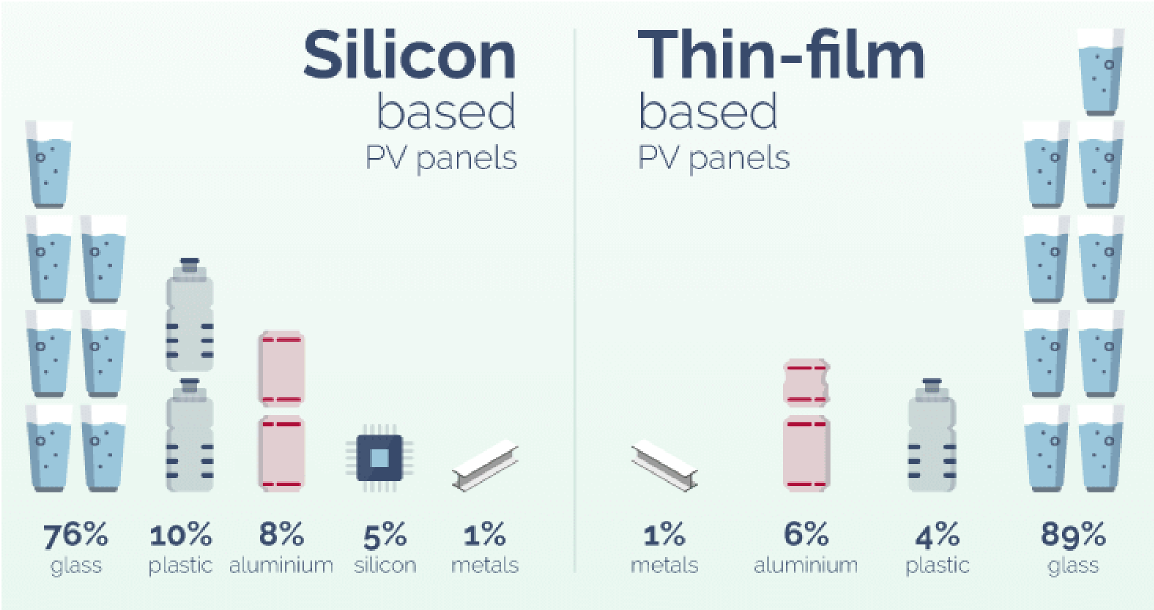
At the end of 2019, PV contributed to reducing global CO2 emissions by 1,7% or 2,2% of the energy-related emissions and 5,3% of the electricity-related emissions, compared to a world without PV.

According to the IEA document referenced above, much remains to be done to fully decarbonize and solar PV deployment should increase by at least one order of magnitude to cope with the targets defined during the COP-21 in Paris, France.

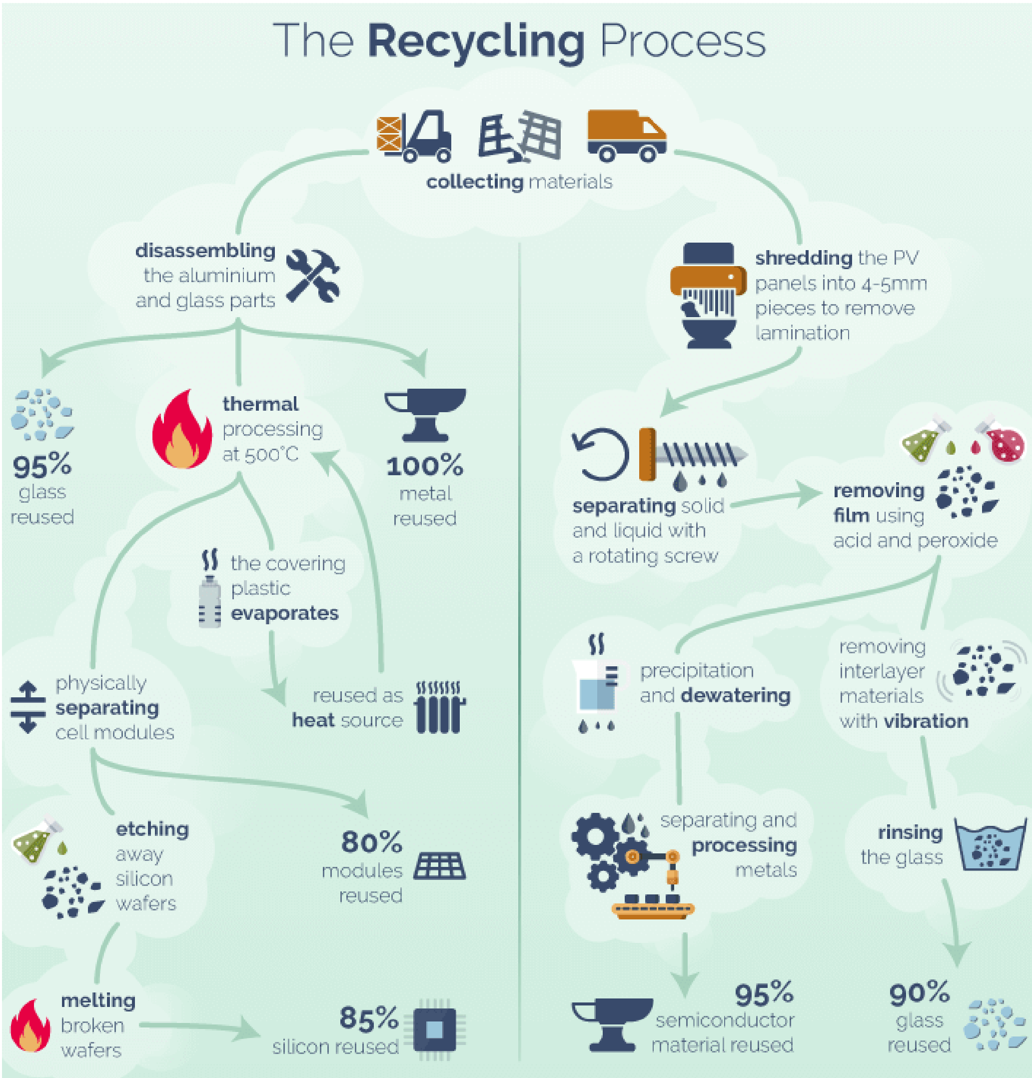
Solar Panel Waste

In fact, if recycling processes were not put in place, there would be 78 or 80 million tons of solar PV panel waste lying in landfills by the year 2050; these figures vary from research report to report. But all agree that the 2050 figure will be a minimum of 50 million tons of solar waste anyway. Since all PV cells contain some degree of toxic substances, the mere dumping of solar panels would truly become a *not-so-sustainable* way of sourcing energy.

The following figures sourced from the literature shows the constituent breakdown of the two main solar panel types in the market today and how the recycling for each is outlined [8].

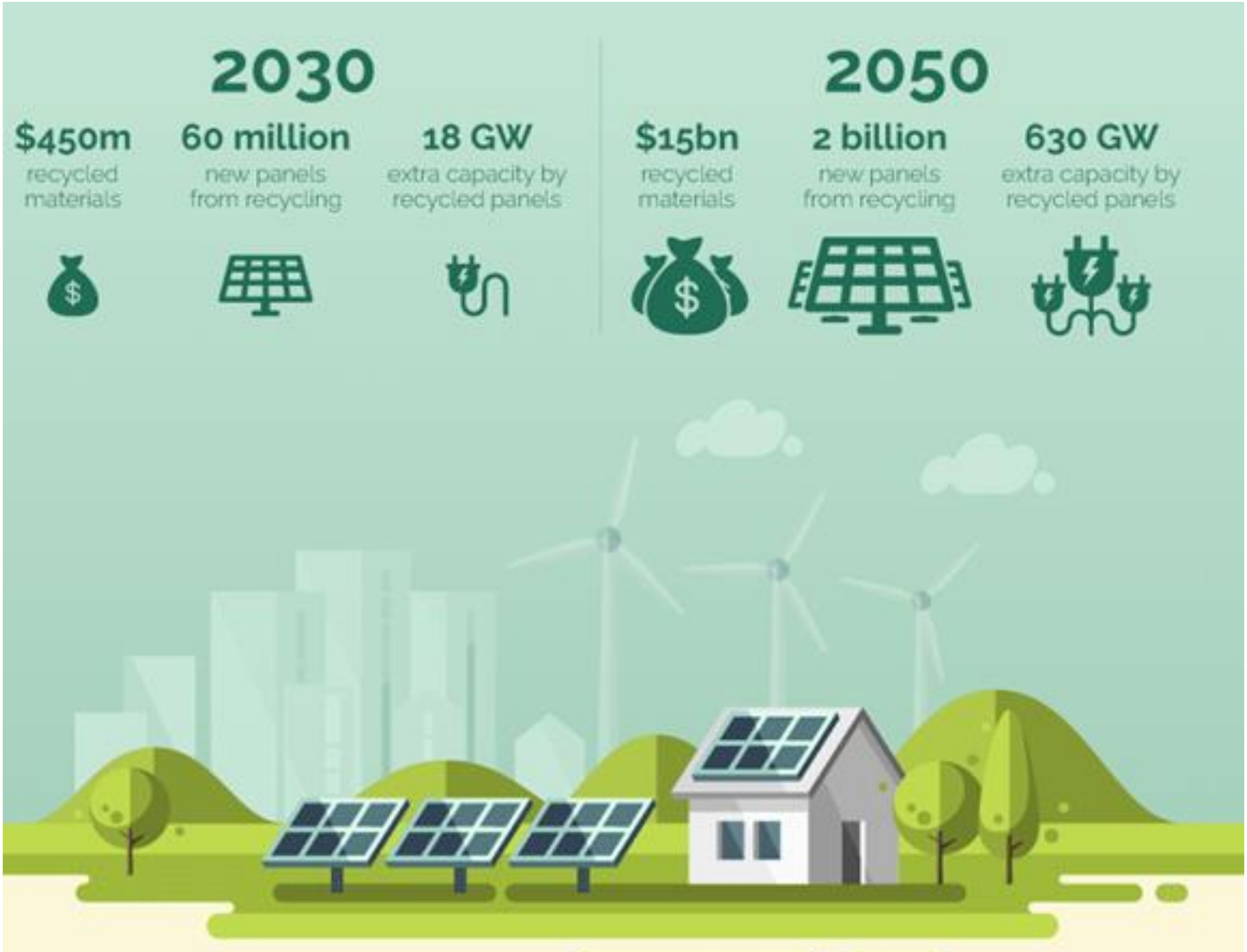

Silicon based PV panels
76% glass
10% plastic
8% aluminium
5% silicon
1% metals
Thin-film based PV panels
1% metals
6% aluminium
4% plastic
89% glass

Source: [8]


The Recycling Process
collecting materials
disassembling the aluminium and glass parts
95% glass reused
thermal processing at 500°C
100% metal reused
the covering plastic evaporates
physically separating cell modules
reused as heat source
etching away silicon wafers
80% modules reused
melting broken wafers
85% silicon reused
shredding the PV panels into 4-5mm pieces to remove lamination
separating solid and liquid with a rotating screw
removing film using acid and peroxide
precipitation and dewatering
removing interlayer materials with vibration
separating and processing metals
rinsing the glass
95% semiconductor material reused
90% glass reused

If Solar Power (PV) Technology is to provide a genuine environmental benefit to humankind, then it cannot be left to be accumulated as waste in a landfill. *End-of-life* recycling will help finance the future growth of the solar power industry.

On average up to about 96 per cent of material can be reused to produce new solar panels. Potential material influx could produce 2 billion new solar panels by 2050 [10]. Recycling units will create additional employment opportunities. PV panels will become *'double green'* products by both serving as a source of renewable energy generation and being able to be re-used for the same or different purposes after their life cycle ends.



Source: [*8*]

Other applications for which recycled panel material could be used are diverse and relates to the semiconductor and electronics industry.

In the following map, countries that produce the most panel waste are shown [9]:

Web Link: https://www.greenmatch.co.uk/blog/2017/10/the-opportunities-of-solar-panel-recycling

This map shown above provides some good details on solar waste per country shown. For example, the map shows some illustrative solar panel waste (loads) for some selected locations around the world.

← United States

name
United States

description
Amount of solar panel waste in the US (in tons):
- in 2016: 6,500 t
- in 2020: 13,000 t
- in 2030: 170,000 t
- in 2040: 1,700,000 t
- in 2050: 7,500,000 t

← Australia

name
Australia

description
Amount of solar panel waste in Australia (in tons):
- in 2016: 900 t
- in 2020: 2,000 t
- in 2030: 30,000 t
- in 2040: 300,000 t
- in 2050: 900,000 t

← Japan

name
Japan

description
Amount of solar panel waste in Japan (in tons):
- in 2016: 7,000 t
- in 2020: 15,000 t
- in 2030: 200,000 t
- in 2040: 1,800,000 t
- in 2050: 6,500,000 t

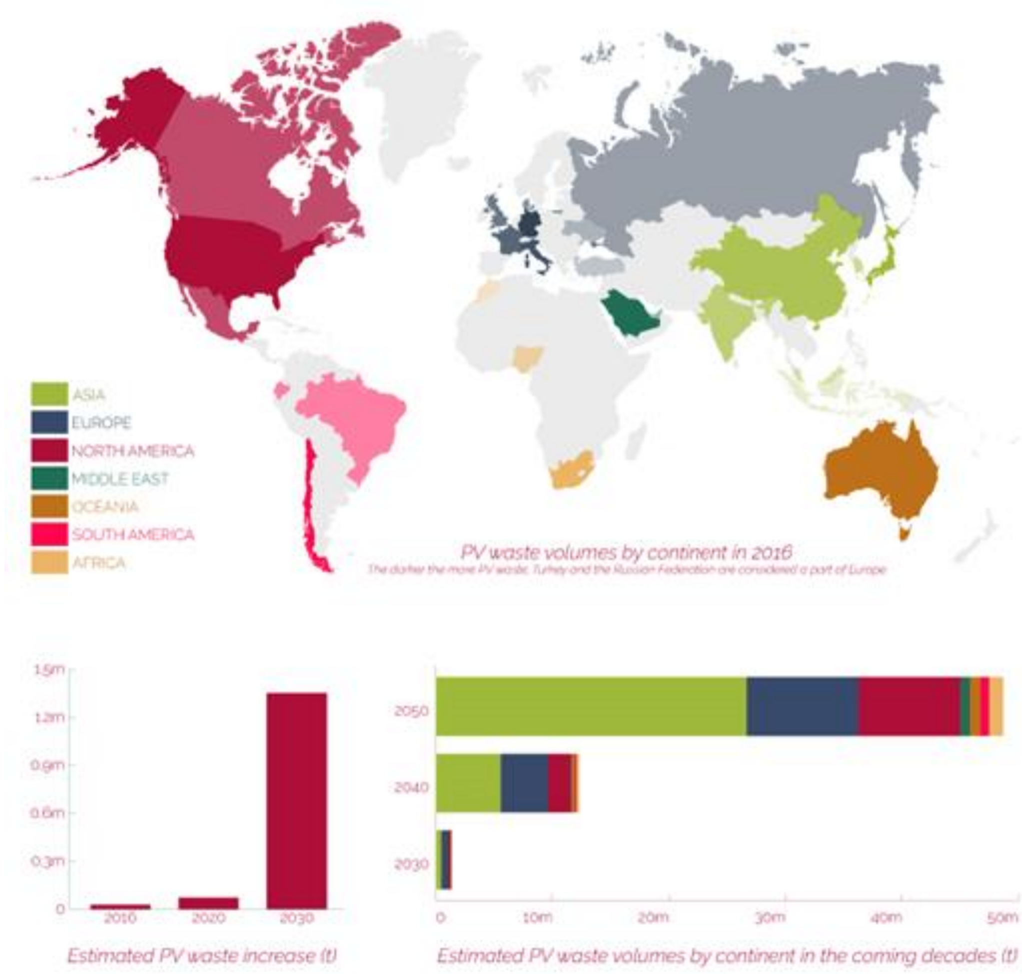
← South Africa

name
South Africa

description
Amount of solar panel waste in South Africa (in tons):
- in 2016: 350 t
- in 2020: 450 t
- in 2030: 8,500 t
- in 2040: 150,000 t
- in 2050: 750,000 t

Other country locations and their solar waste load up to 2021 are shown on this map. Sufficient to say that there is now knowledge about the solar waste from most countries that have been verified by independent observations and research.

The following figures complement the above-noted figures; by providing solar waste accumulation by continents and would also provide a measure of the rate of increases.



Source of Figure: [8]

43,500 tons of solar Waste recorded by 2017; 50- 60 million tons of solar waste by 2050.

Also produced in an impactful selection from the literature on alternatives available to make recycled solar waste into value-added material.

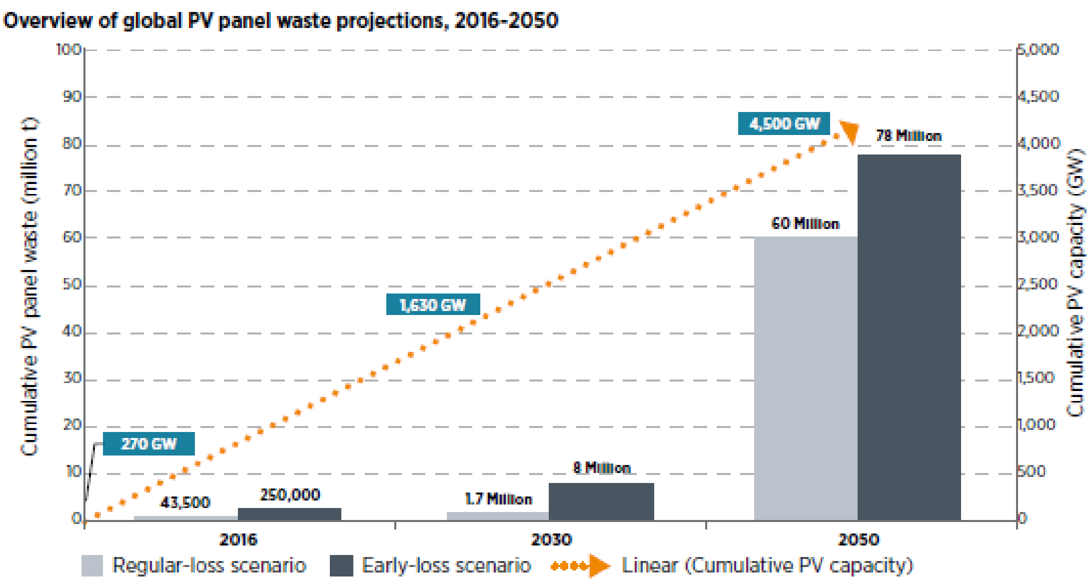
Decommissioned Solar Plants

As the global PV market increases, so will the volume of decommissioned PV panels. At the end of 2021, cumulative global PV waste streams are expected to have reached 43,500-250,000 metric tons. This is 0.1%-0.6% of the cumulative mass of all installed panels (4 million metric tons). Meanwhile, PV waste streams are bound to only increase further. Given an average panel lifetime of 30 years, large amounts of annual waste are anticipated by the early 2030s. These are equivalent to 4% of installed PV panels in that year, with waste amounts by the 2050s (5.5-6 million tons) almost matching the mass contained in new installations (6.7 million tons).

Growing solar waste presents a new environmental challenge, but also unprecedented opportunities to create value and pursue new economic avenues. These include the recovery of raw materials and the emergence of new solar PV end-of-life industries. Sectors like solar PV recycling will be essential in the world's transition to a sustainable, economically viable, and increasingly renewables-based energy future. To unlock the benefits of such industries, the institutional groundwork must be laid in time to meet the expected surge in panel waste.

The world's total annual electrical and electronic waste (e-waste) reached a record of 41.8 million metric tons in 2014. Annual global PV panel waste was 1,000 times less in the same year. Yet by 2050, the PV panel waste added annually could exceed.

10% of the record global e-waste was added in 2014. As the analysis contained in the literature shows, the challenges and experiences with e-waste management can be turned into opportunities for PV panel waste management in the future.



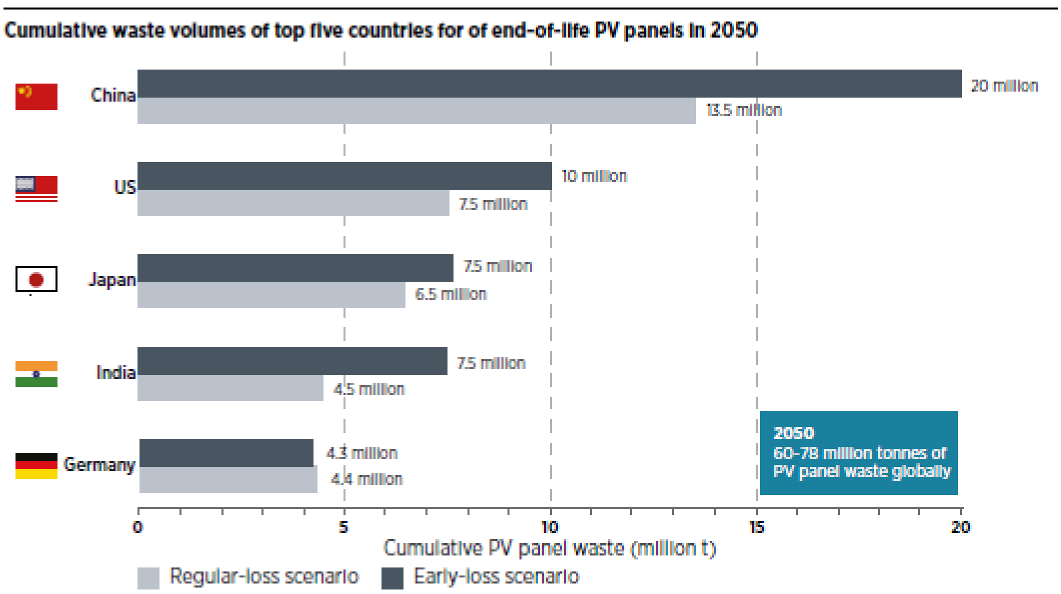
Source: [10]

This White Paper presents the first global projections for future PV panel waste volumes to 2050. It investigates and compares two scenarios for global PV panel waste volumes
until 2050.

- **Regular-loss:** Assumes a 30-year lifetime for solar panels, with no early attrition.
- **Early-loss:** Takes account of “infant”, “mid-life” and “wear-out” failures before a 30-year lifespan.

Policy action is now needed to address the solar waste challenges ahead, with enabling frameworks being adapted to the needs and circumstances of each region or country. Countries with the most ambitious PV targets are also expected, hand in hand, to account for the largest shares of global PV waste in the future.

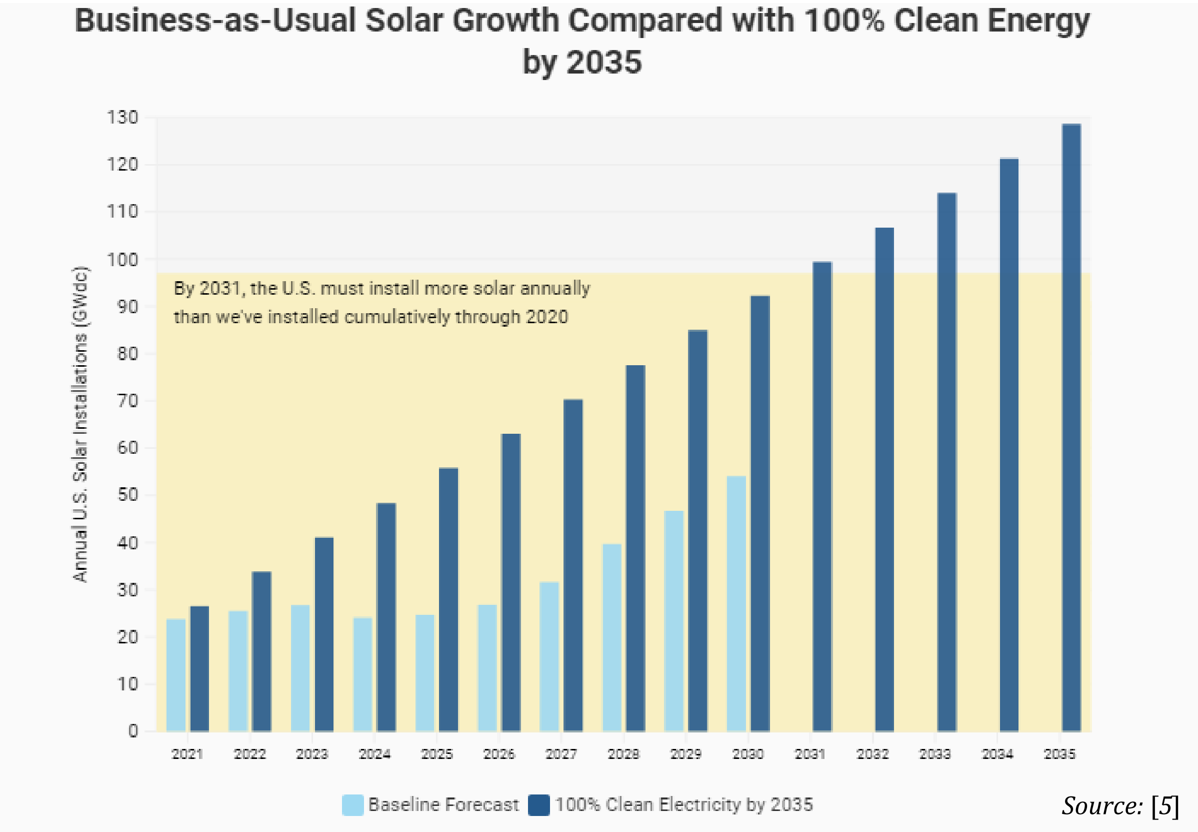
By 2030 the top three countries for cumulative projected PV waste are projected to include China, Germany and Japan. At the end of 2050 China is still forecast to have accumulated the greatest amount of waste but Germany is overtaken by the United States of America (US). Japan comes next followed by India.



Source: [*10*]

The Dilemma of Solar PV: Reach Climate Goals or Perish with Lack of Recycling

Turning to the US; while projected growth over the next 10 years puts the solar market in reach of ambitious clean energy goals set by the industry and the US administration, more work is needed to achieve the pace required for 100% clean energy electricity system. Annual installations will need to grow from less than 20 GW in 2020 to more than 80 GW by 2030, with cumulative totals nearing 600 GW by the end of the decade. A combination of private sector innovation and stable, long-term public policy will set the solar industry on a path to achieving these more aggressive goals to address climate change and decarbonize.



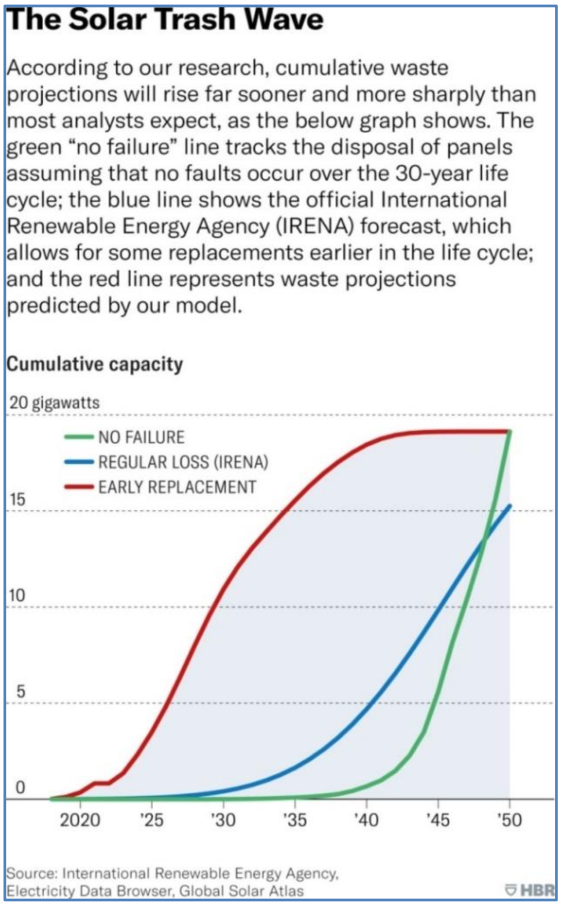
Source: [5]

Economic Incentives Encourage More Solar Installations – But Waste, Whose Responsibility? [11]

Economic incentives are rapidly aligning to encourage customersto trade their existing panels for newer, cheaper, more efficient models. In an industry where circularity solutions such as recycling remain woefully inadequate, the sheer volume of discarded panels will soon pose a risk of existentially damaging proportions.

To be sure, this is not the story one gets from official industry andgovernment sources. The International Renewable Energy Agency (IRENA)'s official projections assert that "*large amounts of annual waste are anticipated by the early 2030s"* and could total 78 million tons by the year 2050.

That's a staggering amount, undoubtedly. But with so many years to prepare, it describes a billion-dollar opportunity for the recapture of valuable materials rather than a dire threat. The threat is hidden by the fact that IRENA's predictions are premised upon customers keeping their panels in place for the entirety of their 20-30-year life cycle. They do not account for the possibility of widespread early replacement happening with tax credits.



But some findings suggest otherwise. Using real US data, incentives affecting consumers' decisions whether to replace under various scenarios are modelled. This surmised that 3 variables are particularly salient in determining replacement decisions: installation price, compensation rate (i.e., the going rate for solar energy sold to the grid), and module efficiency. We postulate that rational consumers will make the switch, regardless of whether their existing panels have lived out a full 20-30 years. Following except from the IRENA report quoted [*11*]:

If early replacements occur as predicted by established research, they can produce 50 times more waste in just 4 years than IRENA anticipates. That figure translates to around 315,000 metric tons of waste, based on an estimate of 90 tons per MW weight-to-power ratio. Alarming as they are, these statistics may not do full justice to the crisis, as this analysis is restricted to residential installations. With commercial and industrial panels added to the picture, the scale of replacements could be much, much larger.

The High Cost of Solar Trash

The industry's current circular capacity is woefully unprepared for the deluge of waste that is likely to come. The financial incentive to invest in recycling has never been very strong in solar. While panels contain small amounts of valuable materials such as silver, they are mostly made of glass, an extremely low-value material. The long lifespan of solar panels also serves to dis-incentivise innovation in this area.

As a result, the solar production boom has left its recycling infrastructure in the dust. To give some indication, First Solar is the sole U.S. panel manufacturer we know of with an up-and-running recycling initiative, which only applies to the company's products at a global capacity of two million panels per year.

With the current capacity, it costs in the US an estimated $20-30 to recycle one panel. Sending that same panel to a landfill would cost a mere $1-2.

The direct cost of recycling is only part of the end-of-life burden, however. Panels are delicate, bulky pieces of equipment usually installed on rooftops in the residential context. Specialized laboris required to detach and remove them, lest they shatter to smithereens before they make it onto the truck. In addition, somegovernments may classify solar panels as hazardous waste, due to the small amounts of heavy metals (cadmium, lead, etc.) they contain. This classification carries with it a string of expensive restrictions — hazardous waste can only be transported at designated times and via select routes, etc.

The totality of these unforeseen costs could crush industry competitiveness. If the future installations are plotted according to a logistic growth curve capped at 700 GW by 2050 (NREL's estimated ceiling for the U.S. residential market) alongside the early replacement curve, we see the volume of waste surpassingthat of new installations by the year 2031. By 2035, discarded panels would outweigh new units sold by 2.56 times. In turn, this would catapult the LCOE (Levelized costs of energy, a measure of the overall cost of an energy-producing asset over its lifetime) to four times the current projection. The economics of solar — so bright-seeming from the vantage point of 2021 — would darken quickly as the industry sinks under the weight of its trash.

Will the US develop Solar Waste Regulations like the EU has?

It will almost certainly fall to regulators to decide who will bear the cleanup costs. As waste from the first wave of early replacements piles up in the next few years, the U.S. government — starting with the states, but surely escalating to the federal level — will introduce solar panel recycling legislation.

Conceivably, future regulations in the U.S. will hopefully follow the European Union's WEEE Directive, a legal framework for recycling and disposal of electronic waste throughout EU member states. The U.S. states that have enacted electronics-recycling legislation have mostly cleaved to the WEEE model. (The Directive was amended in 2014 to include solar panels.) In the EU, recycling responsibilities for past (historic) waste have been apportioned to manufacturers based on current market share.

A first step to forestalling disaster may be for solar panel producers to start lobbying for similar legislation in the United States immediately, instead of waiting for solar panels to start clogging landfills.

In the case of solar, the problem is made even thornier by new rules out of Beijing that shave subsidies for solar panel producers, while increasing mandatory competitive bidding for new solar projects. In an industry dominated by Chinese players, this ramps up the uncertainty factor. With reduced support from the central government, some Chinese producers may fall out of the market. One of the reasons to push legislation now rather than later is to ensure that the responsibility for recycling the imminent first wave of waste is shared fairly by makers of the equipment concerned. If legislation comes too late, the remaining players may be forced to deal with the expensive mess that erstwhile Chinese producers left behind.

Solar panel waste in Japan

According to Environment Ministry Japan it is reported that About 770,000 tons worth of solar panels will end up in the garbage in fiscal 2040 after the end of their useful life. [14]

Amount of solar panel waste in Japan (in tons):
- in 2016: 7,000 t
- in 2020: 15,000 t
- in 2030: 200,000 t
- in 2040: 1,800,000 t
- in 2050: 6,500,000 t

Last November, Japan's Environment Ministry issued a stark warning: the amount of solar waste Japan produces every year will rise from 10,000 to 800,000 tons by 2040, and the nation has no plan for safely disposing of it.

Toxic Chemicals in Solar Panels [*12*]

Solar panels may be an appealing choice for clean energy, but they harbor their share of toxic chemicals. The toxic chemicals are a problem at the beginning of a solar panel's life – during its construction – and at the end of its life when it is disposed of. These two intervals are times when toxic chemicals can enter the environment.

The toxic chemicals in solar panels include **cadmium telluride**, **copper indium selenide**, **cadmium gallium (di)selenide**, **copper indium gallium (di)selenide**, **hexafluoroethane**, **lead**, and **polyvinyl fluoride**. Additionally, **silicon tetrachloride**, a byproduct of producing crystalline silicon, is highly toxic.

During manufacture and after the disposal of solar panels, they release hazardous chemicals including **cadmium compounds**, **silicon tetrachloride**, **hexa-fluoroethane,** and **lead**.

- **Cadmium telluride:** Cadmium telluride (CT) is a highly toxic chemical that is part of solar panels. The journal "Progress in Photovoltaics" reported that male and female rats that received CT through ingestion did not gain weight as they normally should have. This lack of weight gain occurred at low, moderate, and high doses. When inhaled, CT also prevented normal weight gain and caused lung inflammation and lung fibrosis, a hardening of lung tissue. From low to high doses of inhaled CT, the weight of the lungs increased. Moderate to high doses of inhaled CT proved lethal.

- **Copper indium selenide:** The study of rats in "Progress in Photovoltaics" showed that ingestion of moderate to high doses of copper indium selenide (CIS) prevented weight gain in females but not males. Moderate to high doses of inhaled CIS increased the weight of a rat's lungs and increased lung fibrosis. Lungs exposed to CIS produced high amounts of fluid. Another study of CIS on rats, reported in "Toxicology and Applied Pharmacology," revealed that inhaling CIS caused rats to develop abnormal growths in their lungs.

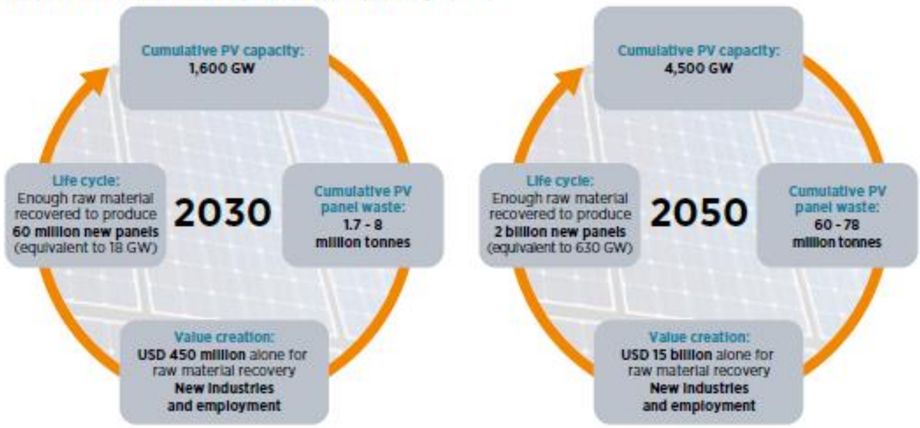
- **Cadmium indium gallium (di)selenide:** Cadmium indium gallium (di)selenide (CIGS) is another chemical in solar panels that is toxic to the lungs. The "Journal of Occupational Health" reported a study in which rats received doses of CIGS injected into the airway. Rats received CIGS three times a week for one week, and then researchers examined lung tissue until three weeks after that. The scientists used a low, moderate, and high dose of CIGS. All doses resulted in lungs that had spots that were inflamed, meaning they were damaged. Lungs also had spots that produced excessive fluid. These spots worsened as time went on after the one week of exposure.
- **Silicon tetrachloride:** One of the toxic chemicals involved with solar panels is not what's in the panels but is a byproduct of their production. Crystalline silicon is a key component of many solar panels. The production of crystalline silicon involves a byproduct called silicon tetrachloride. Silicon tetrachloride is highly toxic, killing plants and animals. Such environmental pollutants, which harm people, are a major problem for people in China and other countries. Those countries mass-produce "clean energy" solar panels but do not regulate how toxic waste is dumped into the environment. The country's inhabitants often pay the price.

Regulations and Value Addition by Recycling

At present, only the European Union (EU) has adopted PV-specific waste regulations. Most countries around the world classify PV panels as general or industrial waste. In limited cases, such as in Japan or the US, general waste regulations may include panel testing for hazardous material content as well as prescription or prohibition of specific shipment, treatment, recycling and disposal pathways. The EU, however, has pioneered PV electronic waste (e-waste) regulations, which cover PV-Specific collection, recovery and recycling targets. Based on the extended-producer responsibility principle, the EU Waste Electrical and Electronic Equipment (WEEE) Directive requires all producers supplying PV panels to the EU market (wherever they may be based) to finance the costs of collecting and recycling end-of-life PV panels put on the market in Europe. Lessons can be learned from the experience of the EU in creating its regulatory framework to help other countries develop locally appropriate approaches.

End-of-life management could become a significant component of the PV value chain. As the reports show, recycling PV panels at their end-of-life can unlock a large stock of raw materials and other valuable components. The recovered material injected back into the economy can serve for the production of new PV panels or be sold into global commodity markets, thus increasing the security of future raw material supply. Preliminary estimates suggest that the raw materials technically recoverable from PV panels could cumulatively yield a value of up to USD 450 million (in 2016 terms) by 2030. This is equivalent to the amount of raw materials currently needed to produce approximately 60 million new panels or 18 GW of power-generation capacity. By 2050, the recoverable value could cumulatively exceed USD 15 billion, equivalent to 2 billion panels, or 630 GW.

Potential value creation through PV end-of-life management



Source: [*11*]

New Industries by Solar Recycling

End-of-life management for PV panels will spawn new industries, can support considerable economic value creation, and is consistent with a global shift to sustainable long-term development.

New industries arising from global PV recycling can yield employment opportunities in the public and private sectors. In the public sector, jobs may be created in local governments responsible for waste management such as municipalities and public waste utilities, but also public research institutes. Solar PV producers and Specialized waste management companies may become the main employment beneficiaries in the private sector. Opportunities could also emerge in developing or transitioning economies, where waste collection and recycling services are often dominated by informal sectors. Here, PV waste management systems could generate additional employment, specifically in the repair/reuse and recycling/treatment industries, while encouraging better overall PV waste management practices.

It's Not Just Solar

The same problem is looming for other renewable-energy technologies. For example, barring a major increase in processing capability, experts expect that more than 720,000 tons worth of gargantuan wind turbine blades will end up in U.S. landfills over the next 20 years. According to prevailing estimates, only five per cent of electric-vehicle batteries are currently recycled – a lag that automakers are racing to rectify as sales figures for electric cars continues to rise as much as 40% year-on-year. The only essential difference between these green technologies and solar panels is that the latter doubles as a revenue-generating engine for the consumer. Two separate profit-seeking actors – panel producers and the end consumer – thus must be satisfied for adoption to occur at scale.

None of this should raise serious doubts about the future or necessity of renewables. The science is indisputable: Continuing to rely on fossil fuels to the extent we currently do will bequeath a damaged if not dying planet to future generations. Compared with all we stand to gain or lose, the four decades or so it will likely take for the economics of solar to stabilize to the point that consumers won't feel compelled to cut short the lifecycle of their panels seems decidedly small. But that lofty purpose doesn't make the shift to renewable energy any easier in reality. Of all sectors, sustainable technology can least afford to be short-sighted about the waste it creates. A strategy for entering the circular economy is absolutely essential – and the sooner, the better [*11*].

Section 5.0

SFC's Business Strategy

Business Strategy

Business Strategy is leveraged on the following global energy and environmental trends now established:

- The solar PV industry will continue its huge growth given the rightful place it has won in the fight against global warming and climate change.
- Solar PV has particularly gained popularity the world over as an effective carbon offsetting technology.
- The carbon credit system that has evolved over the years with various climate-based protocols and such as through the Paris Agreement favors using solar PV amongst other measures to offset emissions.
- The global installed cumulative solar capacity stood at over 600 GW in 2019 measures. These figures are likely to double by 2030 and will continue as high as 14,000 GW by 2050. (*Source: IRENA*)
- At the same time, solar waste will reach from the application side will double over one (MLN) tons in the US alone, and globally over 75M Tons by 2050.
- Solar waste control regulations are less uniformly developed and sometimes non-existent in many locations and countries. Quite surprisingly, solar waste anti-dump regulations are lax in the larger part of the USA (notable exception California) as a whole and a good number of countries do not impost controls to the extent that solar waste in dumpsites should be banned.
- By the time regulations are developed the waste stream that would be developed would be a case of *far too little far too late*.

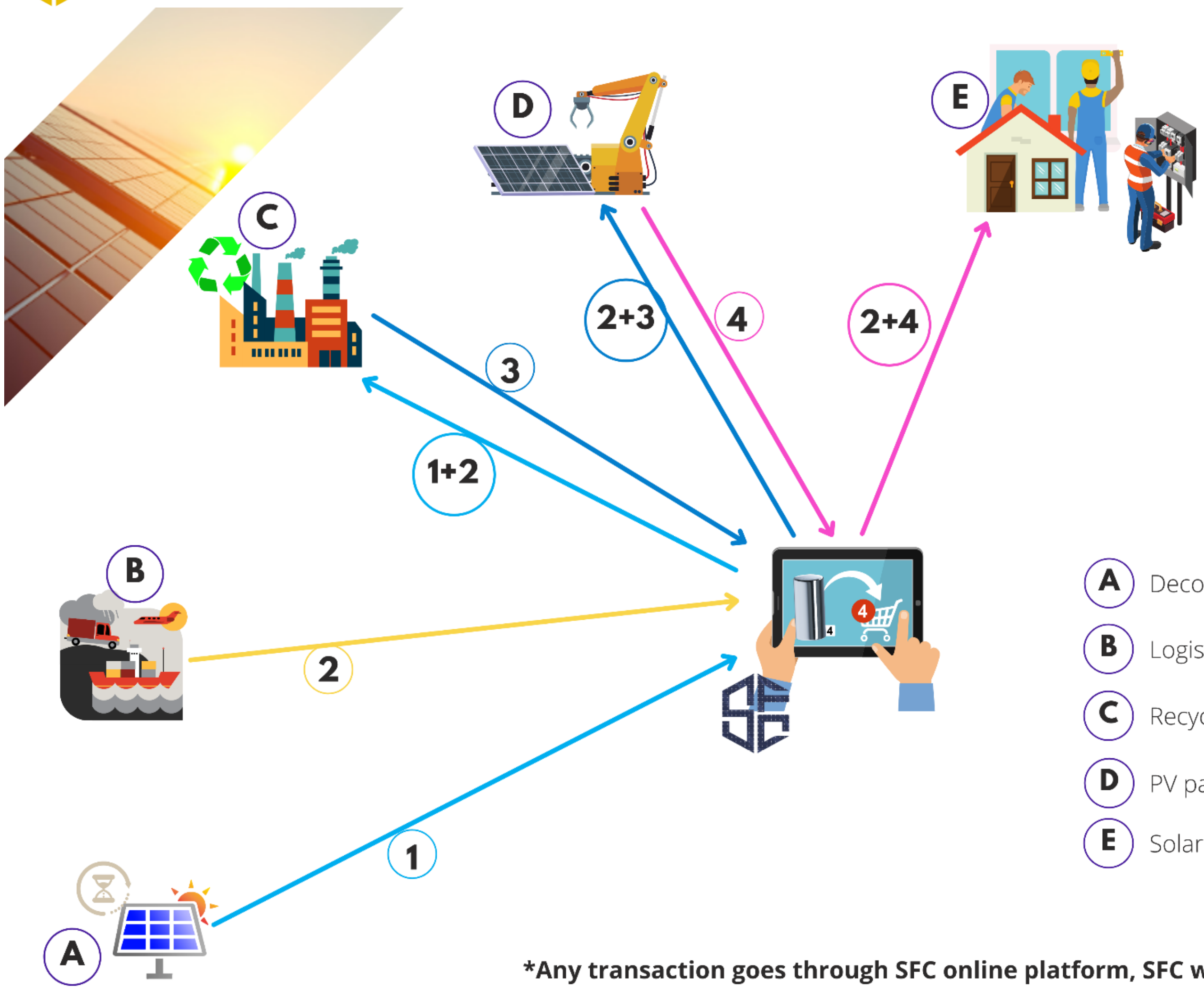
Source of Potential Solar PV Waste Streams

Solar PV Waste Steams will commonly generate from the following main outcomes or occurrences/scenarios:

1. Solar panels reach their rated lifetime of 20–30 years and the user does not settle for the recycle option and chooses to dump.
2. The user(s) choosing to replace the panels earlier than the typical lifetime due to various factors such as tax credit availability that will encourage the replacement of the application with a newer grade of solar equipment.
3. The occurrence of an environmental or manmade catastrophe; in the former case, one being for example an earthquake occurring over a specific geographic area or country.
4. Other factors that are not predictable fore-hand.

Due to any of these aforementioned occurrences, it is perceived solar waste panels would be generated.

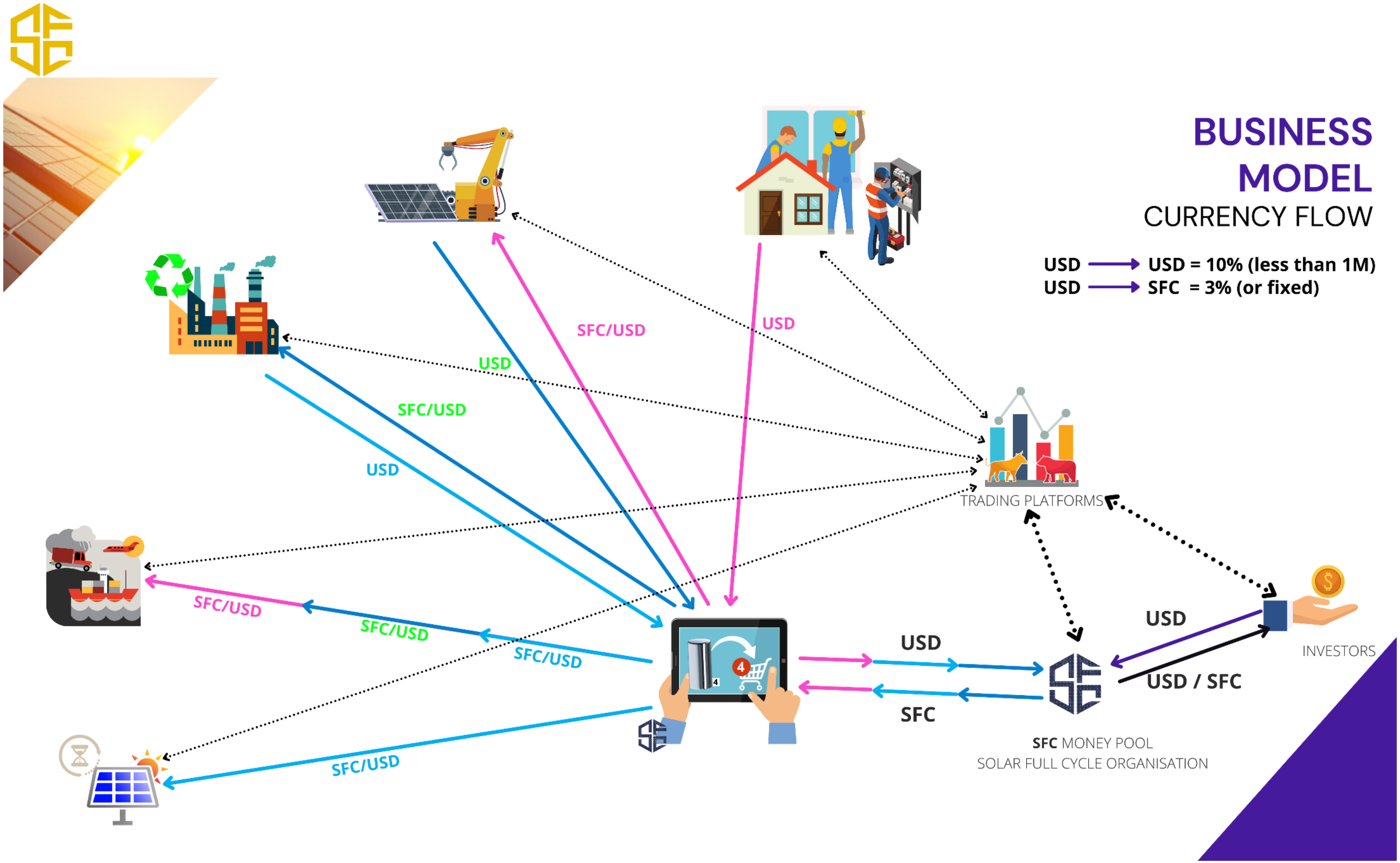
BUSINESS MODEL
DATA FLOW



1. Free will (agreement) / salvage price of solar plant
2. Logistics cost per A-C, C-D, D-E
3. Recycled raw material price
4. New Solar Panels from Recycled materials

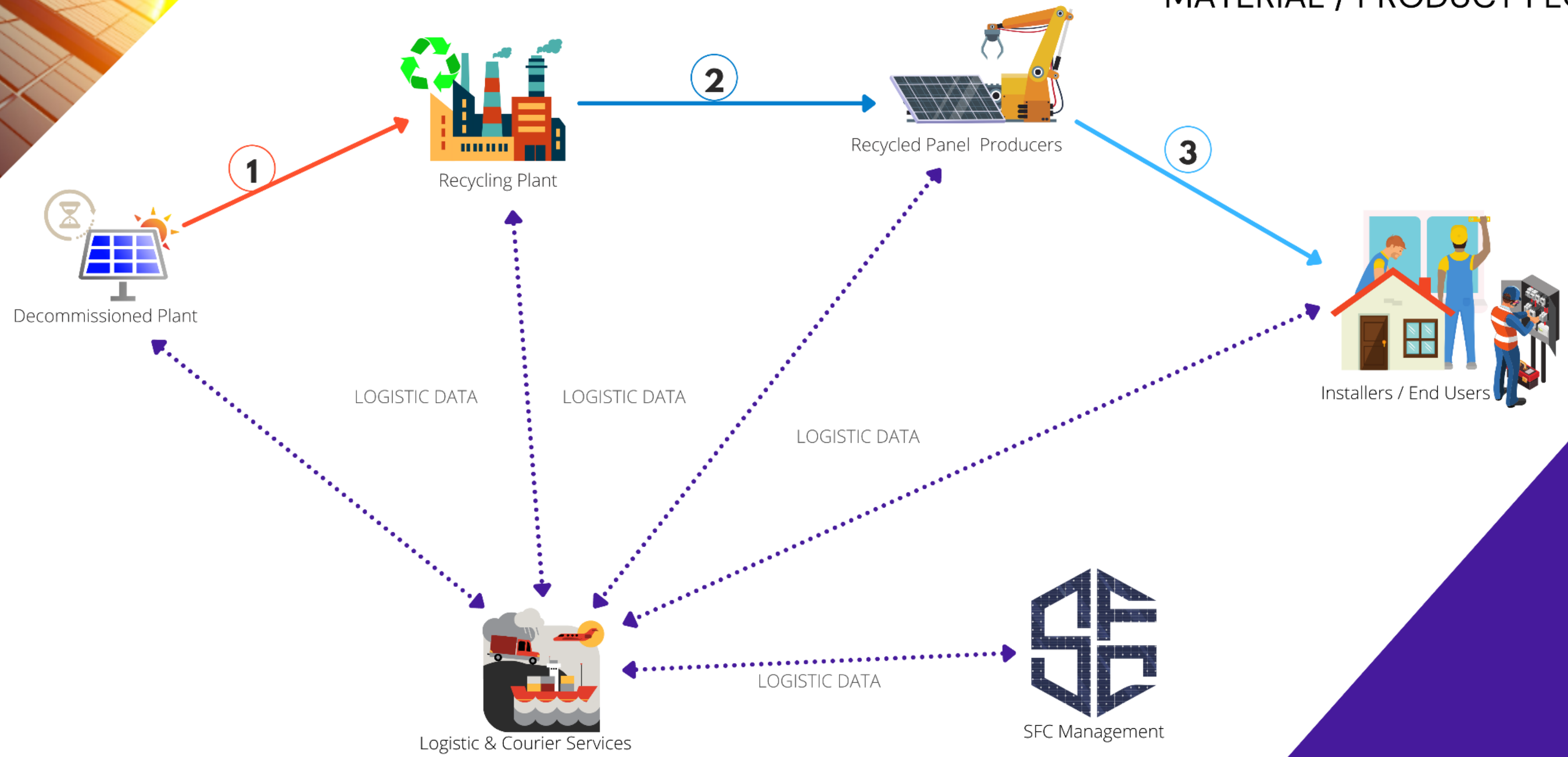
- A Decommissioning Solar power Plant
- B Logistics and other courier Services
- C Recycling Plants
- D PV panels, Inverter fabricators
- E Solar system Installers & country agents

***Any transaction goes through SFC online platform, SFC will charge a service fee as per the %**

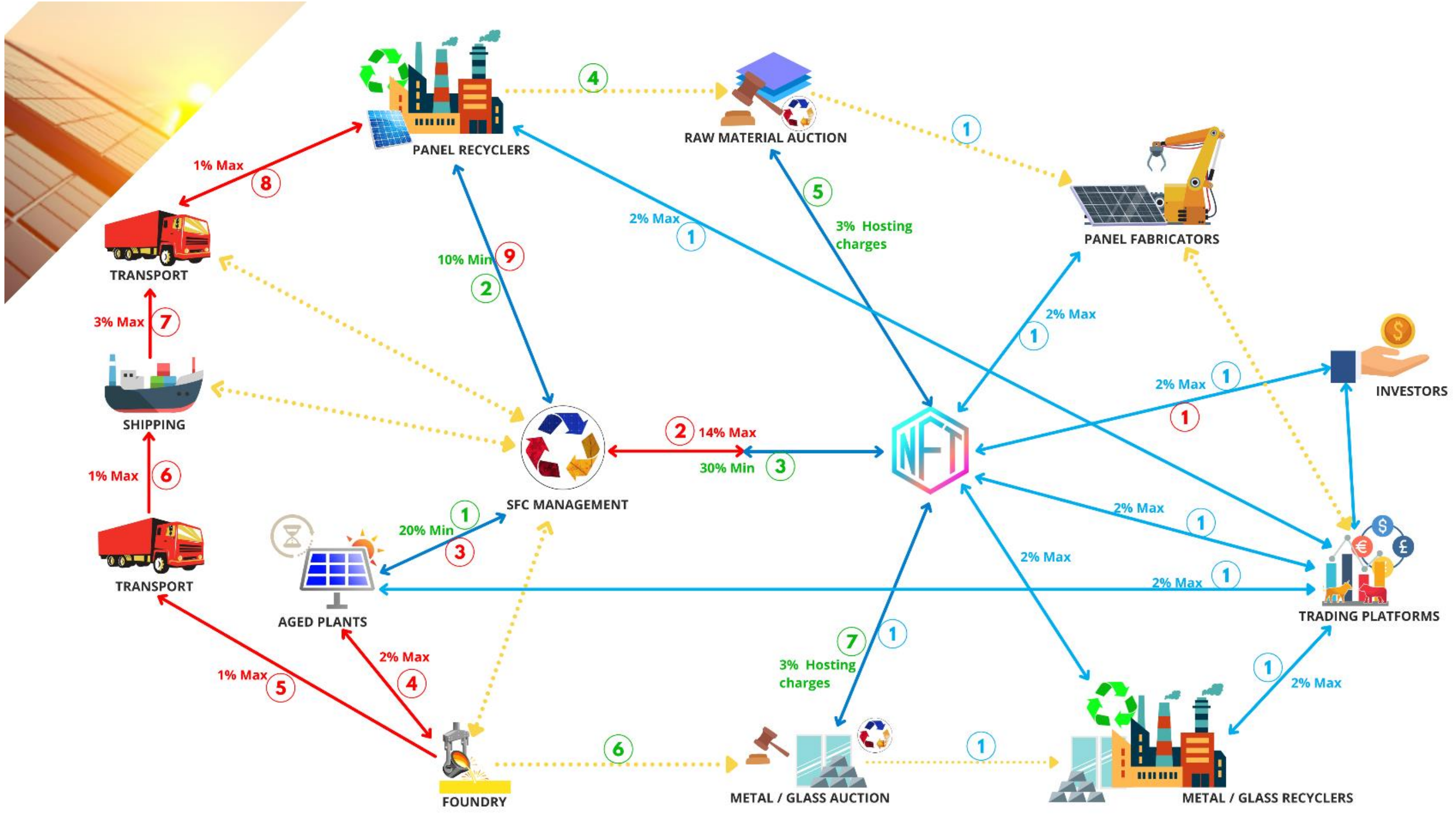

BUSINESS
MODEL
CURRENCY FLOW
USD → USD = 10% (less than 1M)
USD → SFC = 3% (or fixed)
SFC/USD
USD
USD
SFC/USD
USD
TRADING PLATFORMS
SFC/USD
SFC/USD
SFC/USD
SFC/USD
USD
SFC
USD
USD / SFC
INVESTORS
SFC MONEY POOL
SOLAR FULL CYCLE ORGANISATION

BUSINESS MODEL

MATERIAL / PRODUCT FLOW



BUSINESS MODEL
CASH FLOW



1 Token flow

1 Investment on project

2 Cash taken out from investment to manage the project

3 Expenses for visit site ownerships / management

4 Expenses for transport Panels for sorting

5 Local transport cost

6 Logistics and shipping

7 Transportation cost in foreign countries

8 Panels meet recyclers

9 Expenses for visit and register recycling companies

1 Income from plants panel management

2 Income from recycling plants

3 Investment return to NFT pool

4 Recycling co expend NFT for bidding

5 3% host charge for auction transaction

6 Elements listing on auction

7 Host charge for auction transaction

Use-Case Section

A use case for SFC

- Approach End of cycle solar power plants, Map/calculate salvage value, logistics and other fees (including taxes).
- Prepare an agreement between SFC and Solar Power Plant (SPP) ownership/ management on the block chain, in exchange token against agreement (locked-in account until plant dismantle date).
- Let recyclers acquire the plants' contracts with SFC tokens and also pre-sale of the capacity of the recycling plant in exchange tokens that even PV plants owners directly book and initiate the recycling process.
- Set up agreements with the Recycling Companies (RC) where SFC management can send and receive payments via SFC token and get the involvement of the RC owners/ management to trade in the SFC trading platform.
- Set up agreements with Logistic Service Providers (LSP) that SFC management can reserve shipments in cost-efficient ways and SFC management can make the payment via SFC token for the logistics payments.
- Introduce the SFC trading platform to the LSPs so that they can generate extra profits from the SFC token trading.
- Token holders can buy PV panels made out of recycled materials at a discounted price and pay for its after-sale services via tokens.
- PV panel manufacturers can buy recycled materials for their own manufacturing listed on SFC via tokens.
- SFC physical business profits will be turned back into a token by burning to tokens which is equal to the values of the profit.
- SFC management will take their salaries and other payments via tokens which is similar to the value of the USD on the payment date to keep the liquidity pool stable.
- SFC token holders can invest in proposed energy projects and receive rewards via tokens when it’s up and running, also a solution for reducing emission and slippage.
- SFCNFTs on a green blockchain with smart properties and linked to SFC tokens.

Tokenomics

As of November 2021, SFC has a circulating supply of 1,000,000,000 tokens. A breakdown of the SFC Tokenomics outlines that:

- 0%-5% of the transactions will be deposited to a wallet which will be used for marketing and other development costs

- 0%-5% of each transaction will be distributed to all holders as Reflective Holding Rewards, or Reflections. Basically it's a form of auto-staking, holders of the token receive an amount of $SFC proportional to the amount they have in their wallet for every transaction that takes place.

- 0%-5% of each transaction will be locked into liquidity – a pre-emptive measure in stabilizing
- the price ahead of potentially-larger transactions. As time goes on the price will become even more stable.

- Any combination of these taxes can be implemented as long as the total tax does not exceed 10% at any given time, and there can be different taxes for buying and selling the $SFC token.

- Initially, taxes will be set to 4% for buys and 8.5% for sales, and as we open on more DEXes and CEXes these taxes will be adjusted accordingly. Exact distribution of these taxes can be seen under the read contract tab on the blockchain explorers, and will also be made public in our socials.

- There are no taxes for wallet to wallet transfers, only interactions with smart contracts are taxed.

- $SFC will launch at an original price of $0.0003 per token on Binance Smart Chain and Polygon. There will be a Fair DxSale Presale conducted in which presale price will also be $0.0003 per token.

- $SPE holders eligible for the private sale of this SPEPad launch will be able to acquire a limited amount of tokens depending on which tier they are in, for $0.000275 per token.

- There will eventually be several bridge solutions for BSC and Polygon, and there are more blockchains we will be expanding to also in the future.

Section 6.0

Road Map

1st Phase [2021 (Q4 – Oct to Dec)]

- Series A fundraising for development.
- Assessment of large market of solar waste and opportunities for recycling.
- Record solar material dumping around the world in a time database.
- Develop different strategies to work with countries where recycling legislation is present and absent.
- Lining up solar industry list with highest (future) pollution load.
- launching on SPEPad.
- DxSale presale.
- Launch to BSC MainNet.
- Liquidity lock.
- Contract ownership with SPEPad team.
- In the waiting list for the industry-leading CertiK Audit.
- Seeking out multiple listing services, including but not limited to CoinGecko, CoinMarketCap.
- Application for multiple centralized exchanges.

2nd Phase [2022 (Q1 – Jan to Mar)]

- Development/rollout of Solar Full Cycle app (v1) for Android/iOS devices – featuring a variety of initial basic functions and ongoing updates.
- Development of Solar Full Cycle app (v2) for Android/iOS devices – rollout planned in early Q3, and will have the added features of locations/lifespan of solar farms and accrued SFC carbon credits.
- Establishment of carbon sequestration means/initiatives – explore the link between Global warming and Solar Waste.
- Partnerships with solar panel-operating corporations.
- Establishment of SFC merchandise, in which the proceeds will be used on more SFC initiatives.
- Applications for Tier 1 exchange listings.
- Develop a database on the lack of legislation on solar recycling in terms of pollution and problem areas around key solar use countries and locations involving potential pollution involving chromium, lead etcetera from after-use solar material and irresponsible dumping.
- Record solar material dumping around the world in a time database
- Develop different strategies to work with countries and locations where legislation is weakest and also where legislation is reasonably strong.

- Reach out to global and worldwide solar associations, industry and other places of interest to create awareness on the magnitude of the impending solar waste catastrophe.
- Focus on heavy and potential solar markets involving major countries of solar usage; Australia, USA, Europe.
- Informing the solar community worldwide on facilities offered by Solar Full Cycle (SFC) to avert pollution involving irresponsible solar dumping.
- Enacting willing solar power plant owners, retail solar (householders), solar associations so on to work on a cooperation basis.
- Develop a map of decommissioning plants with status. (https://www.google.com/maps/d/viewer?hl=en&mid=1wxbUEJ4F5LCOSbnV-CaLJ2teTXeGLqMZ&ll=9.350075086627694%2C25.74649131914805&z=2)

3rd Phase [2022 (Q2 – Apr to Jun)]

- The rollout of the Solar Full Cycle app (v2) for Android/iOS devices.
- Continuation of applications for Tier 1 exchange listings.
- Establishment of solar recycling means/initiatives.
- Establishment of offset incentives.
- Minting of original NFTs.
- Expanding partnership with third-party companies to further progress of solar recycling initiatives.

- Tying up solar users identified above with cooperation agreements for recycling.
- Developing a comprehensive operations cycle for solar panel and auxiliary items recycling.
- Planning digital trading and auction system involving metal recyclers and so on related to material from solar waste, and developing an IT-supported operations system.
- Initiate a process to enter into agreements with PV plant operators and also retail and bulk solar uses and custodian associations to obtain *'last will'* of plants to be de-commissioned.
- At the same time entering into agreements with Recycling Plants, Logistics, PV manufacturers along so that successful recycling of solar panel waste (de-commissioning) can be ensured.
- Initiate a digital platform for recycled material trading and auction the decommissioned PV plants by paying via SFC tokens (locked/unlocked wallets).
- Strengthen ties with Logistical Companies to transport solar waste material from end-of-service life status to recycling factories (Done, 152 countries network).
- Strengthen work with legislative bodies and the solar industry of the constructive role to be played by SFC in averting a huge solar waste-based pollution crisis.

4th Phase [2022 (Q3 – Jul to Sep)]

- Establishment and reinforcement of strategic connections.
- Global adoption/expansion of solar recycling initiatives.
- Establishment of future trading mechanisms.
- Continuation of ongoing applications for more Tier 1 exchanges, listings.

- SFC app develop to make it simpler to trade for investing community.
- Approach governments to legalize and make recycle all decommissioning PV pants with responsibility.
- Extensive travel and outreach to start pilot recycling countries and zones worldwide.
- Certification system implementation for committed PV plants.
- Audit SFC token and publish to the community for Transparency.
- News channels developed for articles and marketing purposes.
- Link with tier 1 Exchange for developing use case of the SFC token.
- Link locked tokens to PV panels previously recycled by the SFC platform so that the users can claim them by sending the panels to recyclers via the SFC platform again.

Section 7.0

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