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Innovation Challenge for 'New Idea/ Suggestion to improve the working of Indian Railways'

Abstract: Indian railway is sitting on mountains of untamed energy banks. The same energy is being wasted till date and we are exploring other alternatives without exploiting which can be very easily tamed. The overall energy generating potential of Indian railway is sufficient to supply it to half of the nation that to green energy. This project comprises of three forms of green energy which can be easily tamed and will produce other useful byproducts also. Strangely these methods are very common and emphasized by the govt. also but are not implemented on the largest energy hub of the nation. Those forms are:

1. **Solar power plant 166.9GW/Hour** - India is having total rail route length of 63112km (46904km single line and 16218Km double or multiple line) if we can cover above the electrical line of the railway track with the help of solar panel along with all the railway stations (India has more than 8000 stations) the power generated will be sufficient to supply it to half of India. The problem with solar power plants is they have huge area requirements. The area which is already utilized by railways will be reclaimed in this project. This can resolve all the power shortage issues of India. Even if the all other power plants are closed, only this power plant will be sufficient to supply to entire India. Without even using a single drop of conventional fuel the power requirement of half of the nation will be resolved. The best part is all the major stations will have individual power plant for their stretch of the track hence individual units for every city will be available. The transmission lines will travel below the solar panels and above the power cables of the trains for the small towns and villages near major stations. This project is the solution for all the energy requirements of India in future. No more coal, fossil fuel or nuclear fuels. Nuclear fuels can be used in the defense systems only may it be missiles, submarines, aircraft carriers, fighter planes, air war ships, etc. The power generated will be sufficient even for all the private vehicles. All two wheelers, four wheelers, etc will be converted into electrically charged vehicle hence no need to use even a single drop of solid, liquid or gaseous fuel of any kind. All the thermal plants will be obsolete. We can totally eliminate all the polluting harmful byproducts

from power generation and transportation industry. This will be the largest power plant which the world will ever see. The same can be used in all the metro lines and stations of India to increase the coverage to the maximum.

2. **Wind power plant –** The area covered with solar cells will have comparatively lower temperature with respect to surrounding hence the wind will flow due to pressure difference. And each time the train will pass high velocity wind flows. This kinetic energy can be easily trapped with the help of small fiber wind mills along the vertical face on either side of the train hanging from the solar cell edges.
3. **Biogas power plant (which also produces nutrient rich water and organic fertilizers both can be used for healthy agriculture)** - It is strange that we are sitting on a power plant 0f **241.5GWH (yearly)** capacity and exploring various fuels as energy sources. The sewerage waste attended by railway department yearly and cleared as waste is actually free source of fuel which is being wasted year after year. The ministry is emphasizing on biogas plants for fuel and electricity in cities and villages but the largest and the most easily tamed source is left unattended. The wagons are moveable hence the raw material can easily be transported at desired locations. The container to hold this fuel in the boggy are much cheaper than the bio-compost chambers attached, and it can be easily vacated on regular intervals.
4. **Regenerative brakes:** It is already being used in Delhi metro. As compared to delhi metro the total application of brakes in Indian railways as a whole is **thousand folds more.**

Explanation :

One by one the application are explained to depict their potential.

1. Solar power :
   The efficiency of photovoltaic cell now a days are 265W/1.6335sqm = 162.57w/sqm
   Total length of railway track = 63112km
   Minimum Width of the solar panel to be installed along the track = 5m
   Total area coverage = 63112 x 5 x 1000 =31,55,60,000 sqm
   Efficiency of solar panel per unit area = 162.57w/sqm

Total power generation = 315560000 x 162.57 = 51300589.2 x 1000 = 51300589.2KW = 51.3 GW

The total day time can be considered for 8 hours min = 51.3 X 8 X 365 = 149796GWH

= 149.796 TWH is the total power generated by covering the railway tracks only.

While placing the PVC we have to take in to consideration the aerodynamics and the effect of speed of train in the units. Since we are going to have bullet trains in the near future, so it will be better if we design the structure of PVC frames in such a way and in such a position so that it can bear the aerodynamic pressure of the high speed trains. We never know that in future by strengthening these tracks only we can use bullet trains. At that time these cells should not be a limitation for the developments to come.

Railway station coverage (min)

Area per platform minimum 2 platforms for every station – 500m x 10m x2 =10000sqm

Roughly 80000 stations in India, a lot of them stations are more than 10 times the area considered above still taking the minimum area = 10000 X 8000 = 8X10^7 sqm

Efficiency of solar panel per unit area = 162.57w/sqm

Total power generation = 80000000 (sqm) x 162.57(w/sqm) = 13005600000 w =13.0056 GW

The total day time can be considered for 8 hours min = 13.0056 X 8 X 365 GWH

= 37976.353 GWH

= 37.9763 TWH is the total power generated by covering the railway stations only.

So the total power generation by the railway will be =149.796 + 37.9763 = 187.7723 TWh per year

Indian railways alone can have solar power plant of capacity of 64.3GW with minimum coverage. We have considered railway tracks of single lane only hence the width is taken as 5 m. But in coming

future majority of the tracks will be of two lanes. And we have also considered the width of solar panels up to electrical poles only, where as we can have cantilever supports and further increase its width to another 5 m giving a total width of 15m and in all major station the tracks coverage is drastically high which we are not considering in our calculation. So rounding off railway has the potential of = 51.3 X 3 +13 = 166.9GW.

And railways alone can produce 50 % of the total power generated by the entire nation.
If all the railway quarters, tracks and railway stations are used to their full potential then railway alone can generated sufficient energy to the entire nation without any fuel to be used. And will generate huge job opportunities in terms of construction for next 20 years and in terms of maintenance for next 100 years. Becoming the world's largest power generating industry and will make hundreds of world records on multiple fronts. And that will be the beginning of the development of the railways and largest green initiative ever taken in the human history.

The second part will be doing similar type of project in National highway. We are having a national high with stretch of 96260.72Km
Total coverage area = 4 lanes that is 14 m of two way road with a pedestrian , drain, divider and taking 1 m extra on either side out the road width will be near about 17m.
Total coverage = 96260.72 x 17 x1000 = 1636432240 sqm.
Efficiency of solar panel per unit area = 162.57w/sqm
Total power generation KWh = 1636432240 x 162.57/1000 = 266034789.26 KWH

= 266.034GW

The total day time can be considered for 8 hours min = 266.034 X 8 X 365

= 776819.28GWh = 776.819TWh/year

Total power generating capacity with roads and railways will be = 776.819 + 187.7723

= 964.5913TWh/year

During the fiscal year 2015-16, the gross electricity generated by utilities in India was 1,116.84 TWh. The utility electricity sector in India has a National Grid with an installed capacity of 319.60 GW (as of 31 March 2017.). Renewable power plants constituted 30.3% of total installed capacity. That means renewable energy capacity is of 96.84GW.

Road ways can easily contribute up to 266.034GW with only 1.7%of the total road network of India. Now if we consider for both road ways and railways they have the potential more than the current overall power generation capacity of the nation i.e- 319.60GW.

Total potential of Railway and road solar power potential = 266.034 + 166.9 = 432.934 GW that too when we are not utilizing the railways and roadways to its full potential. Then why are these fuel based power plants required, since the fuels are already about to be exhausted.

National highways only constitute 1.7% of the total road network of India. So just imagine the potential on which we are sitting. This will also increase the lifespan of all the roads since the PVC will protect the roads from rain and save crores of rupees spend in the repair work.

2. **Wind power plant:**
   The area covered with solar cells will have comparatively lower temperature with respect to surrounding hence the wind will flow due to pressure difference. And each time the train will pass high velocity wind flows. This kinetic energy can be easily trapped with the help of small fiber wind mills along the vertical face on either side of the train hanging from the solar cell edges.
   There are two positions of wind mills as shown in the attached sketch depending on the position of sun and the orientation of the tracks.
   These wind turbines along the solar cells will help in reducing the pressure developed by the wind due to movement of the train.

3. **Bio gas plant:** As per survey conducted in 2012 and 2013, 842.1 crore people travel by train yearly. With an average daily fecal

production per person per day is near about 300gm. The total of raw material for bio gas plant = 8421000000 X 300gm = 2526300MT of fecal matter. As per the ongoing project in University of Agricultural Sciences-Bangalore campus 5MT of organic waste produces 320KWh. So the total energy potential with railways for producing energy is more than **161GWh**. This capacity is only of fecal matter generated, if we consider the organic waste generated by the passengers, restaurants and stalls at railway station then the capacity will be 50% more (with minimum wastage considered). It is strange that we are sitting on a power plant 0f **241.5GWH** capacity and exploring various fuels as energy sources. These plants can be established next to railway station in small villages or drought affected areas. It will help in developing small villages providing electricity to them and also giving very cheap and abundantly available organic fertilizers at their door steps. The byproduct water is also very rich in nutrients and can be used for irrigation in those areas. This project will give employment to lakhs of people (engineers, technician, skilled and unskilled labours) and we are also extracting electricity, fertilizers and nutrient rich irrigation water. It will also help in developing modern townships in the vicinity.

4. **Regenerative brakes:** It is already being used in Delhi metro. As compared to delhi metro the total application of brakes in Indian railways as a whole is thousand folds more. The huge momentum of high velocity trains are stopped by applying brakes. These brakes are releasing the energy in the form of friction and heat.If this can be converted into electricity then energy being wasted can be utilized.

Feasibility/Viability of seamless Implementation of the proposed idea/ suggestion in existing setup, explained –

1. Framework for holding the PV cells can be done with minor strengthening of the existing electrical poles. Less than 50% of tracks are electrified till date this project will help in 100% electrification of the entire rail network. The funds from power sector can also be diverted in railways for expediting the projects. The lines which will be electrified will also ensure that all those inferior areas which are not a part of power grid will also get connected through it and all the villages and small towns will also get continuous power supply.

2. In stations providing PVC are much more easy since the weight of PVC is very less hence they can be placed over the shed with minor framework to hold them and if required the structure can undergo minor strengthening. As per my estimate the station shed does not require any strengthening for PV cells installation and will prove to be very profitable business.

3. In stations where the sheds are not provided then it's more profitable since the frame work can be done and instead of sheeting, PV cells can directly be placed.

4. All the vertical columns to be installed. In case the structural columns are already installed then required strengthening to be done.

5. The columns along the tracks will be tied with structural beams on which the entire framework will rest.

6. The proposed horizontal frame work with solar panels to be installed are fabricated near the tracks then with the help of crane the frame is held in position and all the joints are welded/ bolted.

7. The welding will be done with high precaution and the spatter arrested will ensure that there are no threats to the passengers.

8. The beam and column network will ensure that during erection the framework will be held by the beams in case of failure of crane or any other worst case scenario.

9. In this way the functioning of the trains will not be hindered.

10. Power plants and distribution units will be installed in the remote area in order to develop those areas.

11. Between the two tracks suspended structural members will be fixed which will carry the HT transmission lines for all the cities, villages and townships.

12. A trench will run along the solar panels edge at the ground level .The rain water collected from the solar cell surface will be collected in the reservoirs or the ground water will be recharged with the help of rain water recharge pits.

13. After the successful completion and installing of the solar panel networks they will be connected to local power plants. From where the power will be further supplied to nearby dwellers.

Elaboration of stage-wise migration plan of the proposed idea/ suggestion with uninterrupted operation –

1. Initially it is better to take up those projects where electrical lines are not installed.
2. Here the erection work will be much easier and the risk factor will also be very less.
3. Structural columns will be erected over foundation after considering the load as per future expansion projects in mind.
4. The power line for trains will also be installed.
5. Then frame work will be fabricated with solar panels along with other utilities will be installed.
6. After completing the project on non electrified lines. The entire rail network will be electrified. Then similar process can be followed in existing electrified lines.

Originality of the proposed idea/ suggestion explaining how the proposed idea/suggestion is an original idea/suggestion:

1. This project is byproduct from the drawbacks of solar power plant construction, the huge area requirement of the plant make the project difficult to execute and the entire land remains useless. Hence making multiple use of the same land will incur large profits and both the sectors will be hugely be benefitted by each other.
2. In the gloomy weather when the solar panels will not be very effective, then these wind mills will compensate partially by the kinetic energy of the wind and the wind pushed by a moving train. The design is made in such a way that the windmill will rotate in both direction either due to suction or blowing of wind form.
3. All the problems faced by railway are actually a source of profit from one or the other form.
4. Like regenerative brakes.

Possible constraints anticipated in deployment to be explained -

1. The Solar panels may get stolen since guarding such a long stretch is difficult.
2. It will lead to blockage of the tracks by animals since during hot sunny days the animals will take shelter in the shed of solar panels aver the

tracks. Even humans will also take shelter under it and may lead to accidents. The positioning of the solar cells should be in such a way that its shed is always away from the track if possible or the tracks should be barricaded on either side.

3. The speed of train and the aerodynamics pressure may damage the PVC cell frame in the long run. The frame and cells to be provided in such a strategic position that high velocity wind formed by moving train can be diverted to generate electricity by small integrated wind mills. This is the second part of the project.
4. In case the project is scraped huge amount of semiconductor waste will be generated. This is still better than nuclear waste. It can be recycled.
5. The private industries with thermal and other power plants will be threatened and will cause hindrance in the project. Since the power generated will be of large amount and the cost of electricity will drop drastically affecting their business.

SWOT Analysis

1. Solar power project	
STRENGTH	WEAKNESS
1. Land is available for free. The area will be of multiple uses rather than being dedicated only for solar power plant as is the general case of all solar power plants. 2. The solar project will ensure that all the track lines will be converted into electrical lines. 3. Initial cost of Rs 7 crores will produce 1MW of energy and in 25 years the return will be 40 crores/MW. Indian railways have a potential of 64.3GW =64300MW, Total project cost Rs. 4,50,100 Crore and the return will be Rs 25,72,000 Crore in 25 years. 4. It's a low maintenance project. And can be fully automated. Employee are only required for maintenance and inspection. 5. Additional financial benefits can be obtained from government for the use of non conventional fuel for generating energy. 6. The railway network is spread throughout the nation, hence if we are generating power throughout the nation then it will be much easier to supply and cover the remote areas. Since the power source will be very close to them. 7. Having multiple power plant units including all the remote areas will save on transmission line projects. The same railway corridor will act as transmission line network also. This will	1. Project is to be executed while the railway is functional and continuously moving. 2. The transition will be on mega scale and will lead to major hindrances in daily functioning of railway. 3. The Solar panels may get stolen since guarding such a long stretch is difficult.

solve the issue of land acquisition for solar power plant and transmission lines. 8. The strengthening of poles for supporting of transmission lines can be done with the help of Power Grid of India. Since they will get much cheaper and well connected transmission line network for entire nation. 9. Even the energy requirements for running the trains will be generated by them so no need to get it from some other source. 10. The entire network will be self sustained and work as individual entity. 11. All the diesel and coal fed engines would not need any fuel for running the railway network. It will drastically reduce the conventional fuel consumption. Entire railway network will convert to pollution free industry or with zero carbon foot print. 12. If all the national highways and state highways are also considered for the same project then all the energy needs of INDIA can be easily met and India can further sell it to all our neighboring countries also. 13. In complementary with the above project if all automobiles are converted to electrically charge vehicles India can eliminate the use of conventional fuels to almost zero. This will be a big boon to INDIAN economy. 14. If done on roads it will	

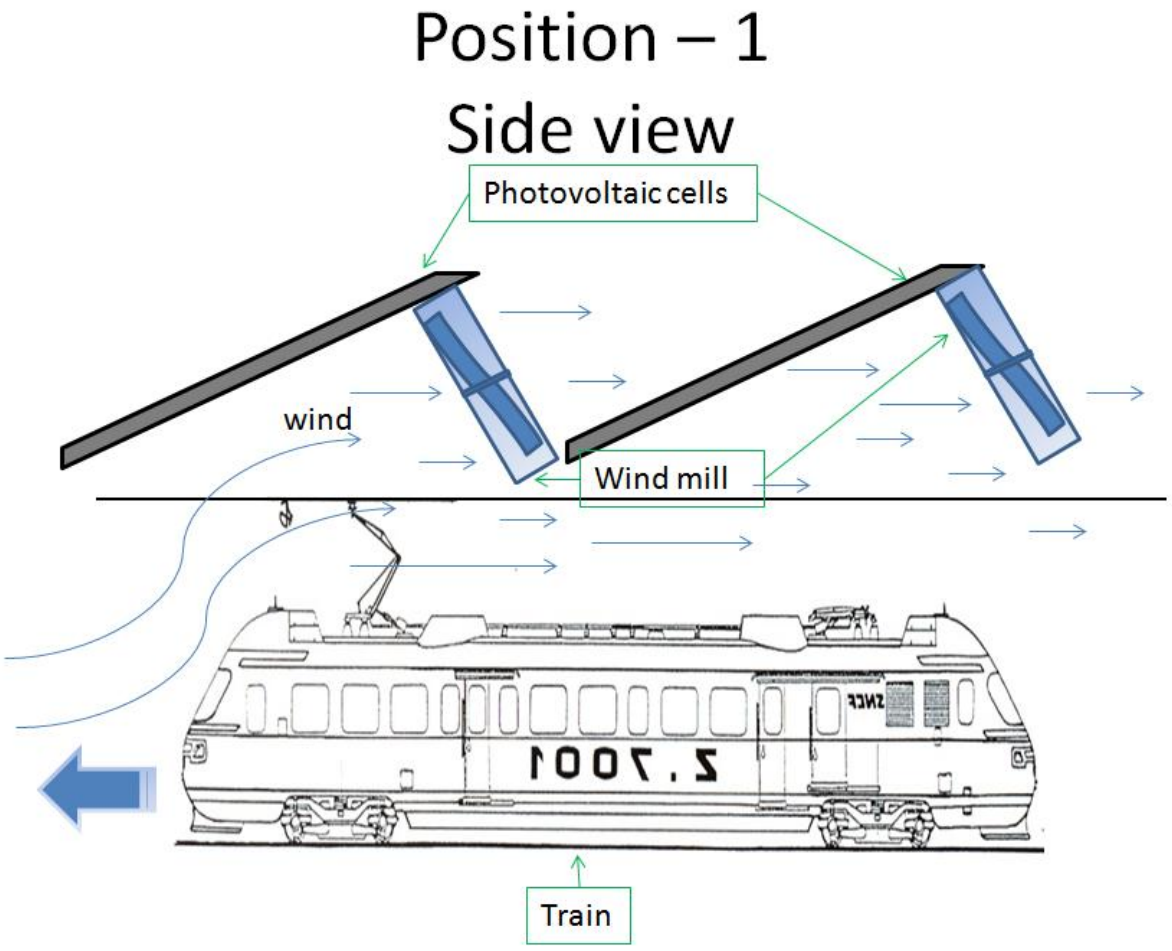
increase the life of the roads also since the solar cells will protect the road from damaged due to rain. 15. The road will not heat and reduce the accidents due to bursting of tires due to overheating on national high way. It will be much less.	
OPPORTUNITIES	THREATS
1. This will make Indian railways the first and the largest green railway network of the world. 2. This will also make Indian railways the world's largest solar power plant ever made in human history. 3. It will not only produce energy for itself but will provide it to half of the nation that too without any fuel consumption. 4. The left or right corridor can be used as the transmission line corridor, taking support from the same poles which will support the power lines for trains and will also hold the frames of solar panels. 5. The solar power plants can have multiple units for covering all areas which will generate numerous job opportunities as well as lead to development of modern town ships in all the remote places. 6. Once the railway tracks are covered then INDIA can easily transport top secret project material without being tracked by foreign country satellites.	1. It will lead to blockage of the tracks by animals since during hot sunny days the animals will take shelter in the shed of solar panels aver the tracks. Even humans will also take shelter under it and may lead to accidents. The positioning of the solar cells should be in such a way that its shed is always away from the track if possible or the tracks should be barricaded on either side. 2. The speed of train and the aerodynamics pressure may damage the PVC cell frame in the long run. 3. The frame and cells to be provided in such a strategic position that high velocity wind formed by moving train can be diverted to generate electricity by small integrated wind mills. This is the second part of the project. 4. In case the project is scraped huge amount of semiconductor waste will be generated. This is still better than nuclear waste. It can be recycled. 5. The private industries with thermal and other power plants will be threatened and will cause hindrance in the project.

2. Biogas Power Project	
STRENGTH	WEAKNESS
1) Continuous fuel supply available. 2) Hygienic conditions at station can be easily attained since all the wastage will be used as fuel. 3) Green and clean energy.	1. Collecting entire sewerage needs additional setup in all the trains 2. Mass transition from existing system.
OPPORTUNITIES	THREATS
1) Will generate tremendous amount of electricity. 2) Will produce Million tones of organic fertilizers every year. 3) Will also produce nutrient rich irrigation water for drought prone and dry areas. 4) Will play a vital role in Swacch Bharat Abhiyan. 5) Will generate lakhs of job opportunities throughout the nation.	1. All employees will not be comfortable to work in the environment. 2. The location of biogas plants may be objectionable for some localities. 3. Area for drying beds for byproduct is required, that why the plants to be installed in the remote areas.

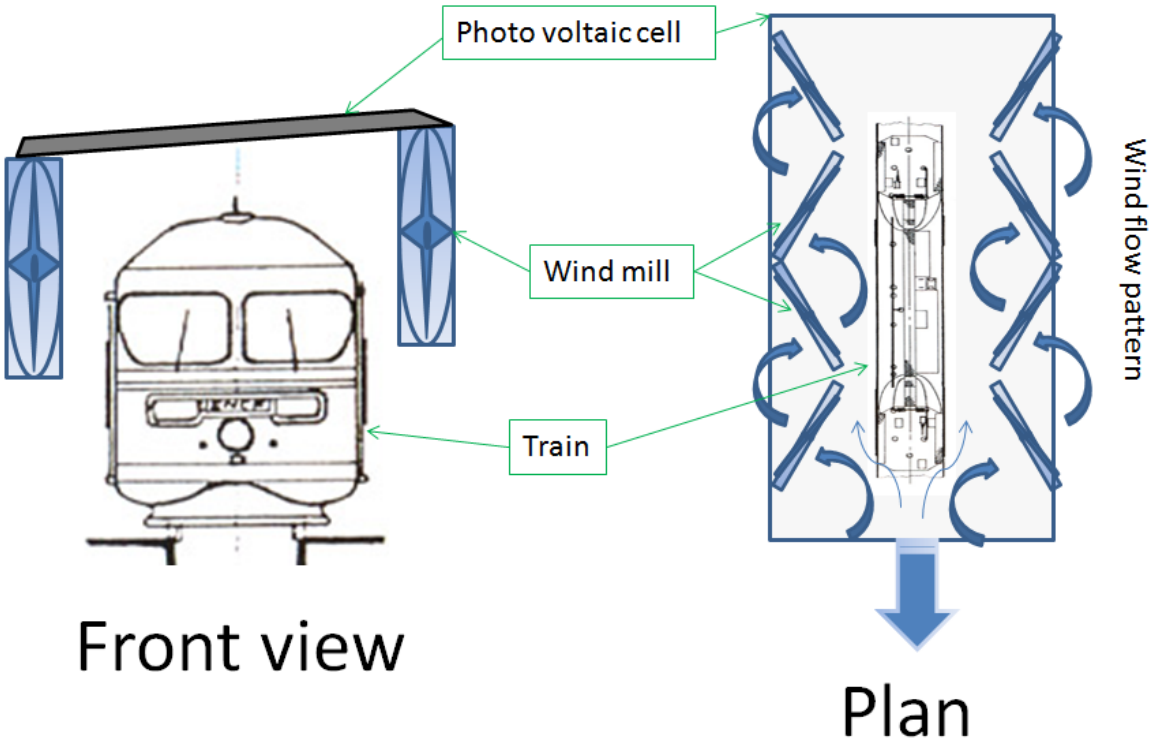
3. Wind Power Project	
STRENGTH	WEAKNESS
1. Free available energy. 2. Whenever the train passes it displaces a large amount of air with high velocity, this energy can be easily trapped with small wind turbines installed on either side of tracks. 3. If provided between the series of solar panels mounted above the track then it will help in reducing the wind pressure acting on the panels generated due to moving trains. 4. In case of gloomy weather or during night time when solar panels are not generating the electricity then wind turbines will	1. The installation cost will be very high. 2. The amount of energy generated will be less, but since the source of energy is free the installation charges will be recovered within a decade or less then profit can be gained from the project.

help in compensating with power requirements.	
OPPORTUNITIES	THREATS
1. These wind turbines will also convert the hot summer winds and thunder storm winds kinetic energy into electricity. 2. This project and its maintenance will also generate huge numbers of job opportunities for technicians, labours, engineers and many more.	1. Since the wind turbines will be installed all along the tracks it will be difficult to control against any theft of material.

Sketches indicating the position of solar panels and wind turbines



Position – 2



Front view

Plan