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(72) Inventor; and

(71) Applicant : MYERS, Michael Alan [AU/AU]; 52
Grange Road, Glenhaven, New South Wales 2156 (AU).

(74) Agents: HIND, Raymond et al.; Davics Collision Cave, 1
Nicholson Street, Melbourne, Victoria 3000 (AU).

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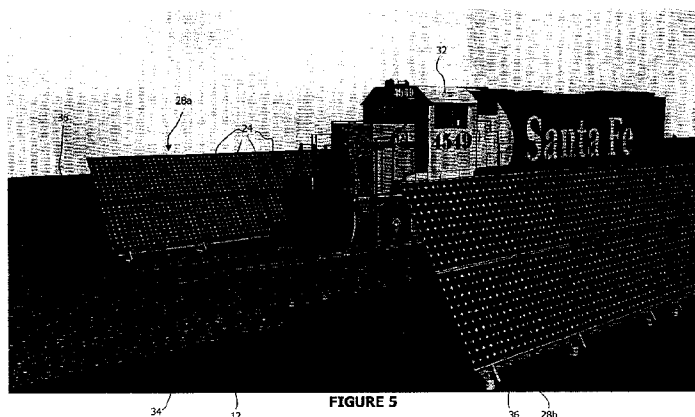
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(54) Title: SOLAR ENERGY SYSTEM ARRANGED ALONGSIDE A TRANSPORT ROUTE



(57) Abstract: A solar energy system, including an elongated array of photo-voltaic panels arranged alongside a railway line, wherein the array is connected to an electricity grid to supply electricity to the grid. A method of providing solar energy infrastructure to an electricity grid including the steps of installing a solar energy system having an elongated array of photo-voltaic panels arranged alongside a railway line, connecting the array to the electricity grid, and supplying electricity from the array to the grid.



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SOLAR ENERGY SYSTEM ARRANGED ALONGSIDE A TRANSPORT ROUTE**Field of the Invention**

5 The invention relates to a solar energy system, and more particularly, but not exclusively, to a solar energy system having an array of photo-voltaic panels which is sufficiently large to supply a significant proportion of the energy requirement of a medium to large size city or regional or remote community.

10 **Background of the Invention**

 In recent years there has been an increasing desire to use renewable energy as it does not involve the use of finite resources such as oil, gas and coal. Renewable energy sources include solar, wind, wave and ocean, hydro and biomass energy. Renewable
15 energy currently contributes approximately 10% of total electricity supply in Australia, and only minor contributions are currently made from solar photo-voltaic systems, which are often offered as replacement renewable alternatives to traditional fossil fuel generated electricity. It has been estimated that a 2% increase in the proportion of renewable energy in Australia would require in the order of \$3 billion investment in total over the next 10
20 years.

 The applicant has identified that there are significant limitations to existing proposals to implement solar energy, particularly in relation to environmental impact, visual impact and cost. More specifically, there are existing relatively small-scale solar
25 farm grid-connected systems in Australia however these systems supply a relatively small proportion of the country's electricity requirements. Furthermore, the applicant has identified that the cost of installation and maintenance of such systems are relatively high and do not make them feasible for supplying a large proportion of the country's electricity requirements. More specifically, there is the cost of the site on which the solar system is to
30 be built; the cost of connection to existing networks, and significant expense in ongoing

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maintenance. Additionally, as these systems are located in farms, they are limited by the availability of sun at that particular location.

The applicant has identified that it would be beneficial to provide an improved
5 solar energy system which would be suitable for countries like Australia which have the population concentrated at city centres located far apart, with long distances between the isolated electricity grids which service these cities.

Examples of the present invention seek to provide a solar energy system which
10 overcomes or at least alleviates one or more disadvantages associated with previous solar energy systems.

Summary of the Invention

15 In accordance with one aspect of the present invention, there is provided a solar energy system, including an elongated array of photo-voltaic panels arranged alongside a land transport route, wherein the array is connected to an electricity grid to supply electricity to the grid.

20 Preferably, the land transport route is a major established land transport route through a non-urban region. Alternatively, the land transport route may be a major established land transport route through an urban region or a new transport route being created through an non-urban area.

25 Preferably, the land transport route is a railway line.

Alternatively, the land transport route is a road.

In a different form, the route may be an existing element of infrastructure such as a
30 pipeline or electricity grid.

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Preferably, the photo-voltaic panels are arranged in succession alongside a substantial portion of the railway line.

Preferably, the railway line is an intercity railway line, and the photo-voltaic panels
5 are arranged in succession alongside a substantial portion in a rural area of the railway line.

In a preferred embodiment, the railway line is an existing railway line for a train powered by a form of energy other than electricity.

10 Preferably, the railway line extends away from the electricity grid to a destination having a separate electricity grid, and the elongated array is arranged to build the first grid closer to the second grid. More preferably, the elongated array is arranged to connect the first and second grids.

15 In a preferred example, one array of photo-voltaic panels is located along one side of the railway line, and another array of photo-voltaic panels is located along an opposite side of the railway line.

Preferably, the panels are oriented away from the tracks of the railway line.
20

Preferably, the panels are built on land alongside the railway line, and the land is already state-owned land.

Preferably, the array extends across time zones.
25

It is preferred that the panels are arranged in side-by-side relationship.

Preferably, the panels are arranged sufficiently close to the railway line to be cleaned by a train passing along the railway line.
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In one example, the panels are arranged at a substantially uniform distance from the railway line along the length of the array.

5 In accordance with another aspect of the present invention, there is provided a method of providing solar energy infrastructure to an electricity grid including the steps of installing a solar energy system having an elongated array of photo-voltaic panels arranged alongside a railway line, connecting the array to the electricity grid, and supplying electricity from the array to the grid.

10 Preferably, the railway line extends away from the electricity grid to a destination having a separate electricity grid, and the method further includes the step of installing the solar energy system such that the elongated array is arranged to build the first grid closer to the second grid.

15 In accordance with yet another aspect of the present invention, there is provided a solar energy system, including an elongated array of photo-voltaic panels arranged alongside a land route, wherein the array is connected to an electricity grid to supply electricity to the grid.

20 Preferably, the route is an existing element of infrastructure such as a pipeline or electricity grid.

Brief Description of the Drawings

25 The invention is described, by way of non-limiting example only, with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic representation of a map of Australia showing rail networks extending between the city centres;

- 5 -

Figure 2 shows an example of a railway line having large amounts of space at either side;

Figure 3 shows an example of a present implementation of photovoltaic panels;

5

Figure 4 shows one example of a solar energy system in accordance with the present invention;

Figure 5 shows another example of a solar energy system in accordance with the present invention; and

10

Figure 6 is a diagrammatic representation showing an example of the regions where arrays of photovoltaic panels may be located, in an example of the present invention;

15

Figure 7 shows example calculations of the potential power output from different configurations of solar energy systems of the present invention.

Detailed Description

20

It has occurred to the applicant that Australia is a natural solar collector, with existing rail and road networks which cross major desert areas. In particular, the applicant has identified that within Australia there is over 25,000 kilometres of railway line which does not pass through urban areas. He has also identified that, as Australia has a relatively large unoccupied land mass, it would take a relatively small proportion of that land mass to be covered with solar panels in order to provide enough energy from those solar panels to fulfil the whole, or a substantial part, of the country's electricity requirements. These considerations have been made in the context of the existing problems in implementing renewable energy, which include the problem of acquiring and servicing distant energy farms, as well as the problem of many people objecting to renewable energy farms being located where they will be highly visible adjacent to residential areas or locations of cultural significance.

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The applicant has determined that it may be possible to solve, or at least alleviate, many of these problems by implementing a solar energy system which uses currently available rail infrastructure and currently available solar technology to optimise Australia's environment to provide renewable energy at a relatively low cost without an adverse impact on the population.

With reference to Figures 1 to 3, there is shown a map of Australia 10 showing long railway lines 12 between city centres. More specifically, there is shown a first railway line 12a which extends between Perth 14 and Sydney 16, and a second railway line 12b which extends between Adelaide 18 and Darwin 20. Figure 2 shows a stretch of railway line 12 having vacant land 22 at either side. The vacant land 22 is state owned, as is the railway line 12.

Figure 3 shows solar photo-voltaic panels 24 mounted on a roof of a residence in an arrangement which is typical of many houses already existing in Australia and overseas. The applicant has identified that the arrangement shown in Figure 3 is less than optimal, as there is a high cost in installing and maintaining the panels 24, and the panels only provide a relatively small output.

20

Referring to Figures 4 to 7 of the drawings, there is shown a solar energy system 26 including an elongated array 28 of photo-voltaic panels 24 arranged alongside a railway line 12. The array 28 is connected to an electricity grid to supply electricity to the grid. For example, the electricity grid supplied with electricity may be that which supplies power to a major city, such as Sydney 16.

25

The photo-voltaic panels 24 may be arranged in succession alongside a substantial portion of the railway line 12. For example, as shown in Figure 6, the photo-voltaic panels 24 may be arranged in succession alongside a length of 2,000 kilometres on the railway line 12a between Perth 14 and Sydney 16. As this 2,000 kilometre long stretch of photo-voltaic panels 24 is located in a non-urban rural area 30 of the railway line 12a, the

30

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array 28 is not highly visible from a residential area or an area of cultural significance. In fact, the visual impact of the array 28 is minimal as it is located alongside an area already occupied by the railway line 12a.

5 The railway line 12 may be of a kind for a train 32 powered by a form of energy other than electricity. For example, the train 32 may be diesel powered. The tracks 34 may be used to transmit electricity from the panels 24 to the grid, or alternative transmission means may be used. For example, the panels 24 may be inter-connected such that the panels 24 themselves transmit the electricity to the ends of the array 28, or
10 additional cabling may be used.

 The panels 24 may be fixed to a structure 36 which supports the panels 24 in an orientation in which they are exposed to sunlight for the maximum possible duration per year. The panels 24 may be arranged in side-by-side relationship, with the array 28 being
15 the height of a single panel 24, or the array 28 may have the height of two or more panels 24, as shown in Figures 4 and 5.

 Where the railway line 12 extends away from the electricity grid to a destination having a separate electricity grid, the elongated array 28 may be arranged to build the first
20 grid closer to the second grid. For example, where the electricity grid supplied with energy from the array 28 is the electricity grid of Sydney 16, and the railway line 12a extends away from the electricity grid to Perth 14, the elongated array 28 may be arranged to interconnect the grid of Sydney with the grid of Perth. This may be achieved gradually by building the array 28 as funds become available, and may be facilitated by the panels 24
25 being "plug and play" type panels which may easily be added to the end of the array 28. Accordingly, the solar energy system 26 may achieve an additional significant goal of providing a national electricity network to facilitate the sharing of electricity between cities.

30 The solar energy system 26 shown in Figure 5 is similar to that shown in Figure 4, except with one array 28a of photo-voltaic panels 24 located along one side of the railway

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line 12, and another array 28b of photo-voltaic panels 24 located along an opposite side of the railway line 12. In this way, per length of railway line 12 the amount of solar energy that may be captured is doubled, by utilising vacant land 22 on both sides of the tracks 34, as is often available in rural areas (see for example Figure 2). The panels 24 may be
5 oriented away from the tracks 34, as shown in array 28b, so as to protect the panels 24 from debris which may be dispersed by trains as they pass. The panels 24 may also be provided with suitable protective means such that they are resistant to breakage.

Advantageously, where the solar energy system 26 extends alongside a large
10 portion of the railway line 12a between Sydney 16 and Perth 14, the array 28 may extend across time zones. This may provide additional benefits in that the array 28 is exposed to sun in a region closer to Perth 14 when Sydney 16 is already in darkness, such that energy is still able to be provided to the Sydney grid to supply electricity at peak usage at the end of each day.

15 As shown in Figures 4 and 5, the panels 24 may be arranged sufficiently close to the railway line, and at a substantially uniform distance from the railway line 12 along the length of the array 28, to facilitate cleaning of the panels 24 by a train which passes along the railway line 12. Such positioning of the panels 24 relative to the railway line 12 may
20 also facilitate inspection of the panels 24.

Figure 7 shows example calculations of the potential power output from different configurations of solar energy systems 26 in accordance with examples of the present invention. In one example, where the solar energy system 26 includes two panels high on
25 both sides of the track 12 along a distance of 2,000 kilometres, the system 26 may deliver more than 2,000 MW of energy at a cost of approximately \$2.3 billion. This is comparable to Eraring Power Station operating at full capacity.

Examples of the present invention may provide some or all of the following
30 advantages:

- 9 -

- Easy installation and maintenance
 - Staged Implementation
 - Installable off the back of a train
 - Maintainable off the back of a train
- 5 • Uses today's available technology
 - Easily replaceable with new technology
- The land is already owned and site-works carried out
- Energy coverage 3 hrs longer than sun set in Sydney
- Will facilitate the implementation of an national electricity grid
 - 10 – East to West & North to South
 - Indian Pacific Solar Route & Ghan Solar Route
- Operational Advantages
 - Reduced risk of supply due to weather
 - Reduced risk due to single point failure
 - 15 – Facilitates overlap of energy requirements.
- Runs along side the railway (or Roads)
 - Land is already owned
 - Allows for easy delivery to site
 - Distribution to site off the back of the train.
 - 20 – Allows for easy maintenance
 - Can be inspected from a moving train
 - Can be cleaned from a moving train
 - Installation could be broken into sections.
 - Easy to provide breaks in structure to allow crossing of tracks
 - 25 – Secure environment due to location
 - Not susceptible to terrorist or random attack.
- Plug and play energy Panels
 - If one panel fails it can be isolated and replaced
 - If new technology comes along the panels can be replaced.

30

- 10 -

While various embodiments of the present invention have been described above, it should be understood that they have been presented by way of example only, and not by way of limitation. It will be apparent to a person skilled in the relevant art that various changes in form and detail can be made therein without departing from the spirit and scope of the invention. Thus, the present invention should not be limited by any of the above described exemplary embodiments. In particular, although the example shown in the drawings is located on the Perth-Sydney and/or Darwin-Adelaide railway lines, it will be appreciated by those skilled in the art that alternative examples of the present invention may be located alongside other railway lines, including railway lines in the Pilbara region which are owned by mining companies – the solar energy system may provide an excellent energy source to power local communities. Also, it will be appreciated that although the example shown in the drawings is described as being located alongside a railway line, other examples may be located alongside other land transport routes such as major roads/highways.

15

Commercial opportunity

Systems in accordance with examples of the invention may have immediate commercial viability within the following environments:

- 20
- Generation of power for remote and regional communities
 - Generation of power for mine sites
 - Supplementary generation for existing network power requirements
 - Generation of power for use with utilities such as desalination where power generation out of sun hours is not a necessity.

25

Immediate opportunities exist in the Pilbara and Bowen Basin for generation of electricity to support the development of green fields mining communities.

The Newman to Port Hedland rail links provide up to 650km of rail network which could form a key component of an Elongated Array Solar Energy System able to generate large amounts of energy for the local communities and mine sites. As this rail line and its

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branches extend 600km there is significant opportunity to expand an Elongated Array Solar Systems.

5 The Bowen Basin rail links provides up to 3,000km of rail network which could form a key component of an Elongated Array Solar Energy System able to generate large amounts of energy for the local communities and mine sites. There is also a need for the desalination of water to feed the mine sites and processing operation attached to the port facility of this project.

10 Expanded opportunities exist in servicing any town or facility which is located near existing infrastructure, particularly rail. Larger opportunities exist for implementation of Elongated Systems along major rail links, sufficient to provide the majority of the country's day time power requirements.

15 Value Proposition

20 Elongated Array Solar Energy Systems are large scale solar collector installations which utilise existing rail and road infrastructure to provide both localised and large scale power generation. These systems have five primary advantages over traditional large scale solar farms being:

1. Reduced implementation costs,
2. Reduced maintenance cost,
3. Provision of energy close to the source of requirement,
4. Ease with which the systems can be expanded to meet growing demands,
- 25 5. Integration with existing infrastructure.

 In addition to the primary advantages Elongated Array Solar Energy Systems offer a range of additional advantages and benefits which include:

1. They utilise currently available solar technology
- 30 2. Are able to capture of energy over extended time zones,
3. Their layout reduces the influence localised weather conditions,

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4. They can be built in concert with new rail infrastructure developments and will aid in generating ROI from these projects.

5. Significant opportunity for involvement and jobs creation for the local community both in the installation and maintenance phases of the project.

5

These advantages are of particular interest to those organisations involved with the implementation and maintenance of large scale rail and road projects. One of the greatest limitations to the implementation of large scale solar arrays is the costs involved in the delivery to site, physical installation and connect to existing power grids. These can
10 involve over 50% of the cost of any project.

Elongated Arrays situated along side existing rail and road infrastructure offer significant advantages to reduce the cost of transportation, implementation and grid connection and hence increase return on investment.

15

On new rail infrastructure projects the implementation cost of both the supporting structures and the cabling to the grid can be laid as the rail line if laid. Elongated Arrays can fundamentally be installed off the back of the train.

20 The cabling requirements to wire up an elongated array are the no more than for any solar farm. Energy has to be draw from every panel to a single point from which a connection to a grid has to be made. This is no different with an elongated array. The only difference is that the panels are in one long line rather than being laid out in a grid pattern. It is the connection to the grid which is the most problematic for both layouts (farm vs
25 elongated).

What is different with an elongated Array is that the grid connection can be located anywhere along the length of the array and if one end of the array is located near a town or runs under an existing power grid the connection becomes very simple. Given that most
30 rail lines enter and leave towns there are many potential points for very simple connection which is why it is well suited to generating power for regional and remote areas.

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The potential of the elongated Arrays is only limited by the availability of existing infrastructure and the ease with which the systems can be connected to existing grids. There is inherently less wiring involved in the implementation of an Elongated Array than
5 there is in a solar farm.

If Power Grid connects were to be made between Adelaide and Perth, an elongated array would be a perfect complement. There is sufficient track between Ceduna and Kalgoorlie to theoretically provide 100% of Australia's energy needs.

10

The invention could utilise public funds already allocated for a grid connection between the east and west of Australia. If this grid connect takes place it would be logical to run it next to the east-west rail and hence also run an elongated array. In this configuration an Elongated Array would be able to provide up to 15 hrs of energy
15 generation.

In addition to the implementation cost, Elongated Arrays can dramatically reduce the costs involved in maintenance as these systems can be inspected, monitored and tested remotely by existing rail movements. Elongated Arrays can be cleaned off the back of a
20 train and monitored from the back of a train.

Elongated Arrays utilises standard commercially available solar panel technology for which there is significant amount of available engineering data in support of the implementation of this technology in an Elongated Array format. Each system may,
25 however, need to be constructed of different set of components to meet localised requirements.

There are certainly cost benefits to be gained from installing an elongated array as a new rail line is built. This is certainly new infrastructure rather than existing infrastructure
30 but given the opportunity to give rail infrastructure multiple ways of producing an ROI on investment.

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Elongated Array Solar Systems bring to the renewable energy market a cost effective solution which can be deployed and implemented rapidly and a significantly reduced cost to existing solar farms.

5

Australia is a natural solar collector with existing rail & road Networks cross major deserts with at least 25,000 km of rail line alone not passing through urban areas. The energy collection systems proposed by Elongated Array Solar Systems make the best use of Australia's natural resources and existing physical infrastructure to energy capture over
10 extended time zones.

National Benefits

By utilising this existing infrastructure Elongated Arrays provide, in addition to the
15 previously mentioned benefits, significant spill-over projects may bring economic advantage to Australia industry. At a national level they may provide the following:

- Optimisation of Australia's natural capacity as a solar collector,
- Locally managed Power Solutions for remote Australia along natural transportation corridors facilitating continued growth along existing rail networks,
- 20 • Solar Energy delivery with up to 15hr daily coverage – when the sun goes down in Sydney it continues to shine in Perth,
- Is extremely ease of implementation and achievement of operational outcomes,
- Energy delivery solution capable of supplying a large portion of Australia's the current daytime requirements,
- 25 • Complements the implementation of National power grid,
- Has limited environmental and visual impact,
- As the potential to provide significant local employment opportunities during both the implementation and maintenance phases.

30 The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an

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acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

- 5 Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A solar energy system, including an elongated array of photo-voltaic panels arranged alongside a land transport route, wherein the array is connected to an electricity grid to supply electricity to the grid.
5
2. A solar energy system as claimed in claim 1, wherein the land transport route is a major established land transport route through a non-urban region.
- 10 3. A solar energy system as claimed in claim 1 or claim 2, wherein the land transport route is a road.
4. A solar energy system as claimed in claim 1 or claim 2, wherein the land transport route is a railway line.
15
5. A solar energy system as claimed in claim 4, wherein the photo-voltaic panels are arranged in succession alongside a substantial portion of the railway line.
6. A solar energy system as claimed in claim 4 or claim 5, wherein the railway line is an intercity railway line, and the photo-voltaic panels are arranged in succession alongside a substantial portion in a rural area of the railway line.
20
7. A solar energy system as claimed in any one of claims 4 to 6, wherein the railway line is an existing railway line for a train powered by a form of energy other than electricity.
25
8. A solar energy system as claimed in any one of claims 4 to 7, wherein the railway line extends away from the electricity grid to a destination having a separate electricity grid, and the elongated array is arranged to build the first grid closer to the second grid.
30

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9. A solar energy system as claimed in claim 8, wherein the elongated array is arranged to connect the first and second grids.
10. A solar energy system as claimed in any one of claims 4 to 9, wherein one array of photo-voltaic panels is located along one side of the railway line, and another array of photo-voltaic panels is located along an opposite side of the railway line.
11. A solar energy system as claimed in any one of claims 4 to 10, wherein the panels are oriented away from the tracks of the railway line.
12. A solar energy system as claimed in any one of claims 4 to 11, wherein the panels are built on land alongside the railway line, and the land is already state-owned land.
13. A solar energy system as claimed in any one of claims 4 to 12, wherein the array extends across time zones.
14. A solar energy system as claimed in any one of claims 4 to 13, wherein the panels are arranged in side-by-side relationship.
15. A solar energy system as claimed in any one of claims 4 to 14, wherein the panels are arranged sufficiently close to the railway line to be cleaned by a train passing along the railway line.
16. A solar energy system as claimed in any one of claims 4 to 15, wherein the panels are arranged at a substantially uniform distance from the railway line along the length of the array.
17. A method of providing solar energy infrastructure to an electricity grid including the steps of installing a solar energy system having an elongated array of photo-

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voltaic panels arranged alongside a railway line, connecting the array to the electricity grid, and supplying electricity from the array to the grid.

18. A method of providing solar energy infrastructure to an electricity grid as claimed
5 in claim 17, wherein the railway line extends away from the electricity grid to a destination having a separate electricity grid, and wherein the method further includes the step of installing the solar energy system such that the elongated array is arranged to build the first grid closer to the second grid.
- 10 19. A solar energy system, including an elongated array of photo-voltaic panels arranged alongside a land route, wherein the array is connected to an electricity grid to supply electricity to the grid.
- 15 20. A solar energy system as claimed in claim 19, wherein the route is an existing element of infrastructure such as a pipeline or electricity grid.
21. A solar energy system substantially as hereinbefore described with reference to the accompanying drawings.
- 20 22. A method of providing solar energy infrastructure to an electricity grid substantially as hereinbefore described with reference to the accompanying drawings.

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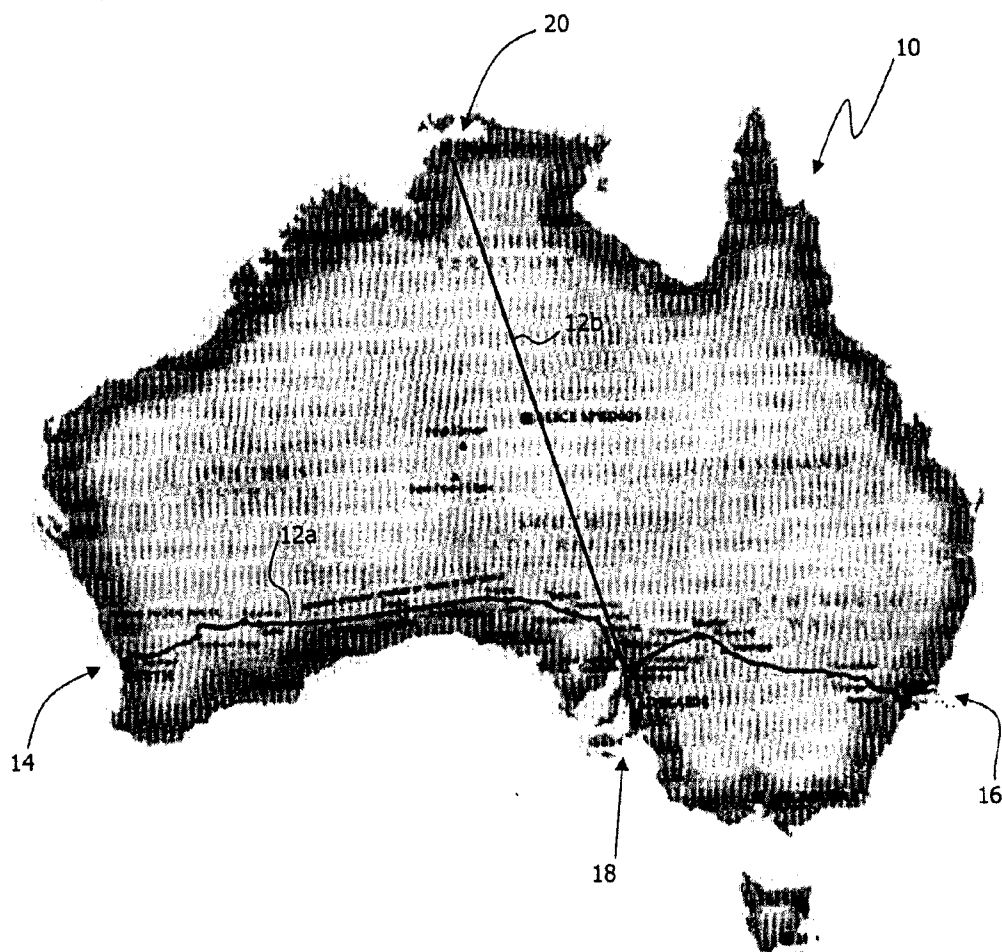


FIGURE 1

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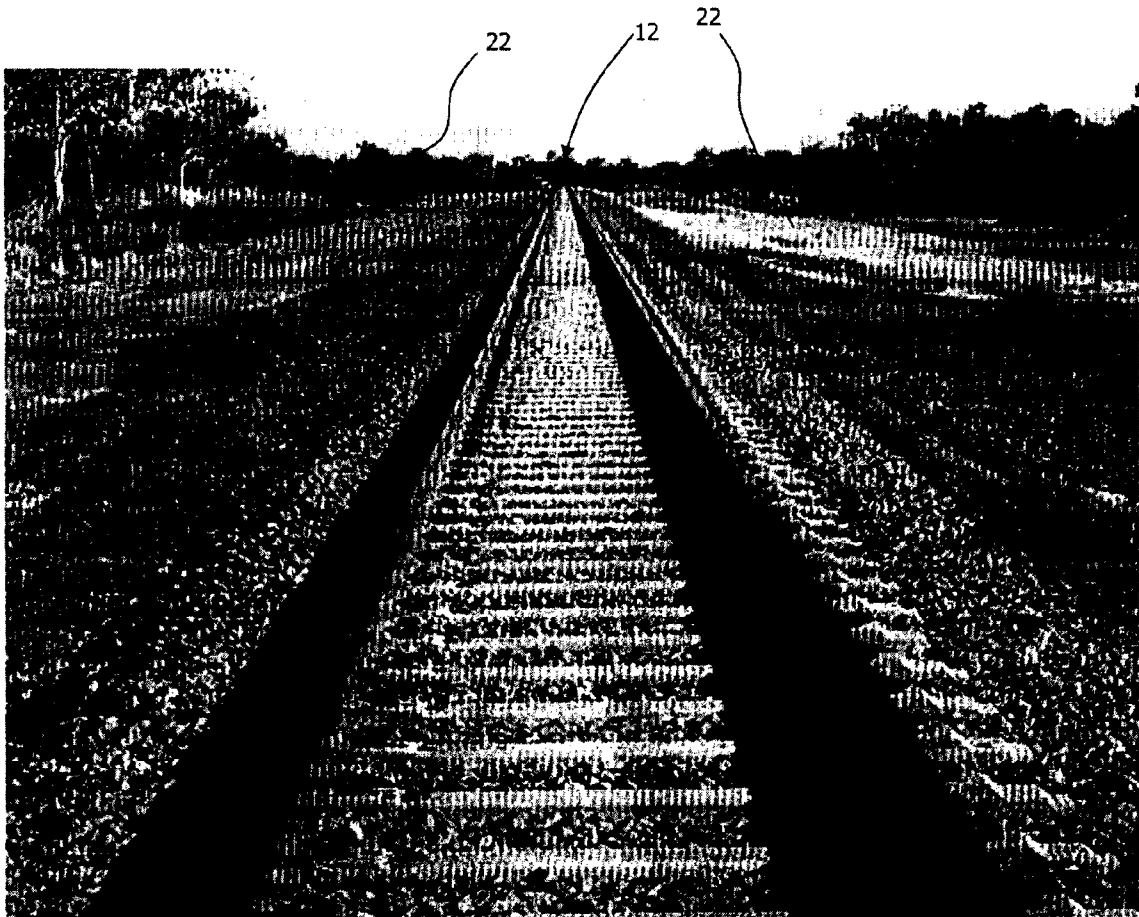


FIGURE 2

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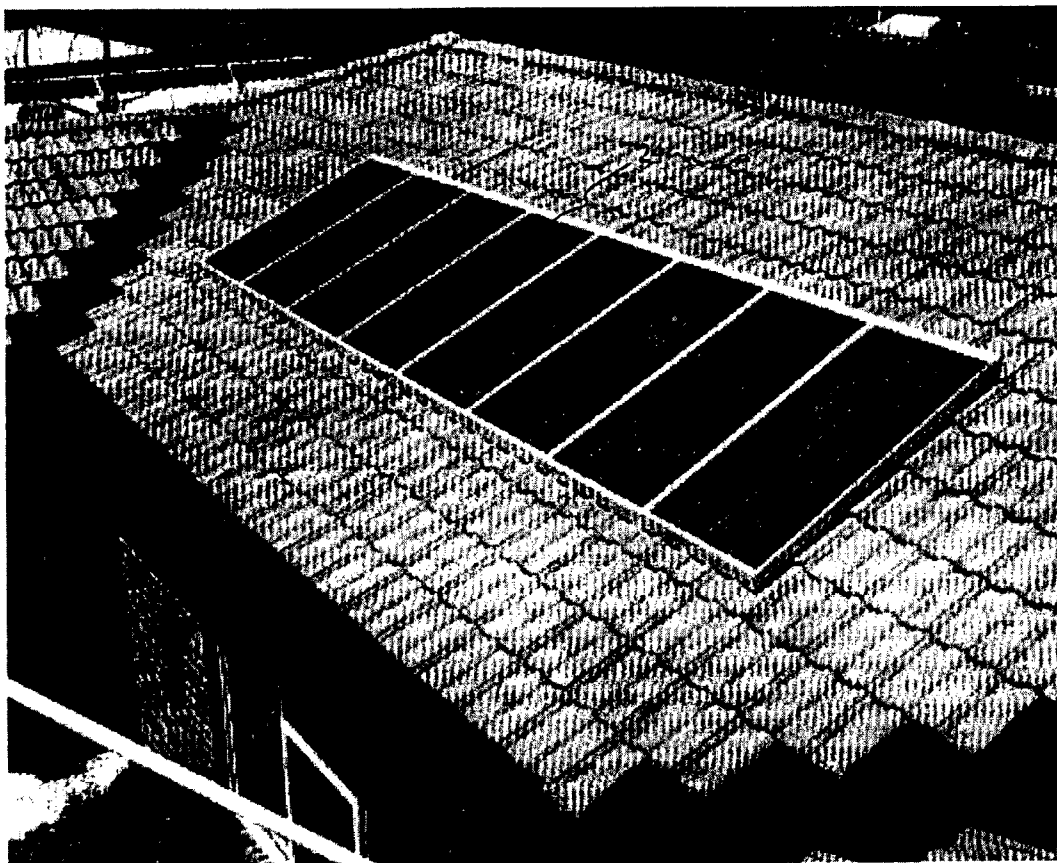


FIGURE 3

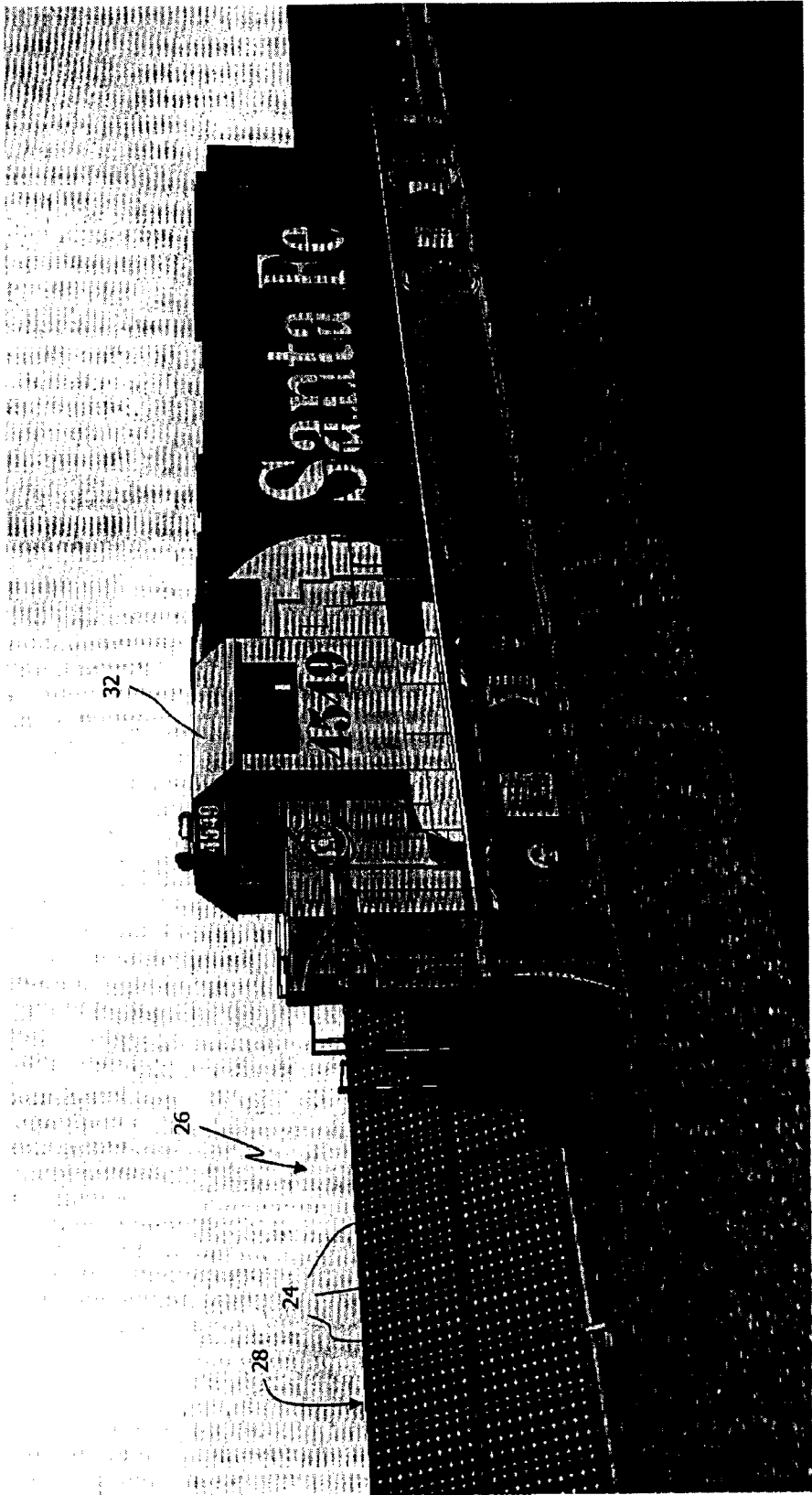


FIGURE 4

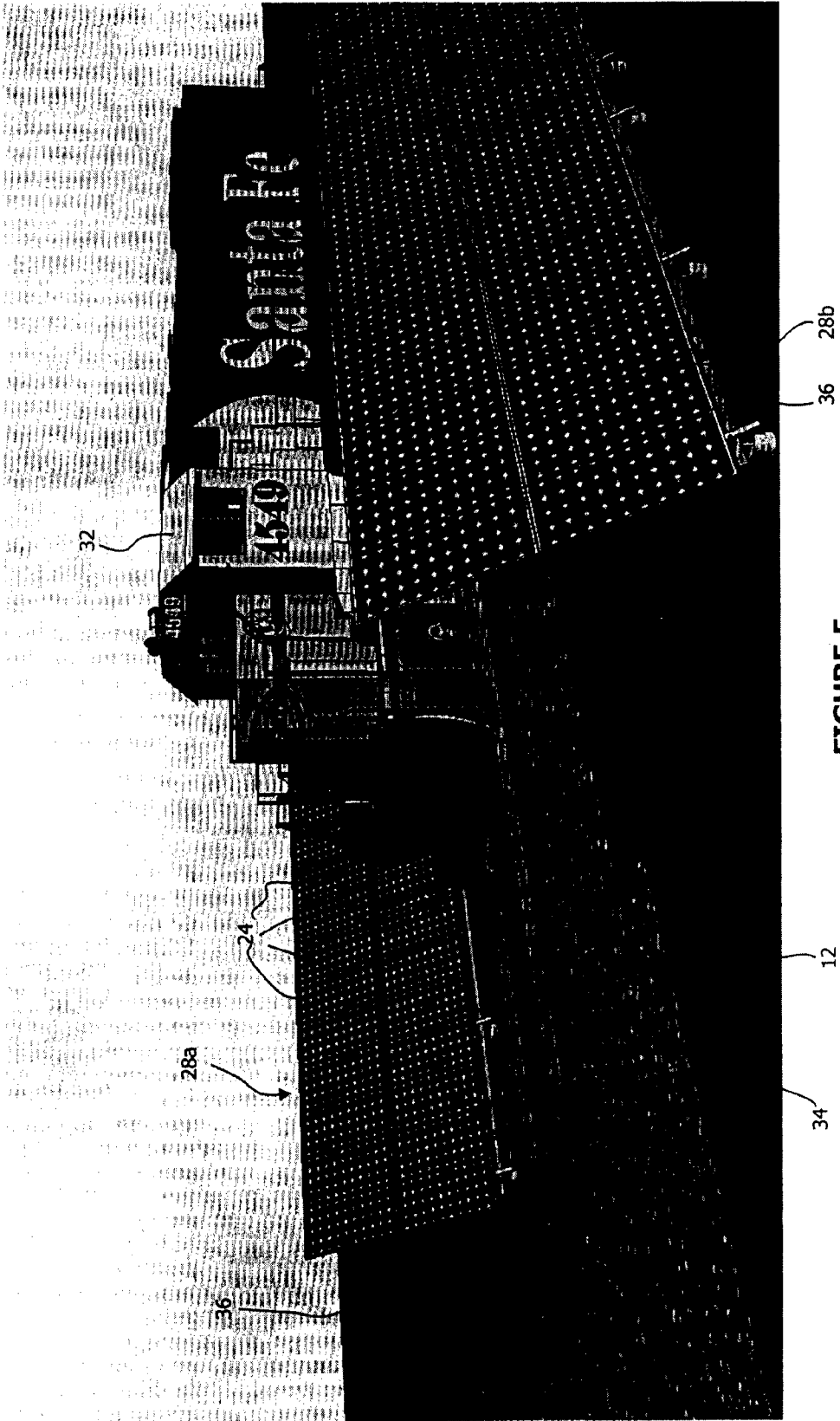


FIGURE 5

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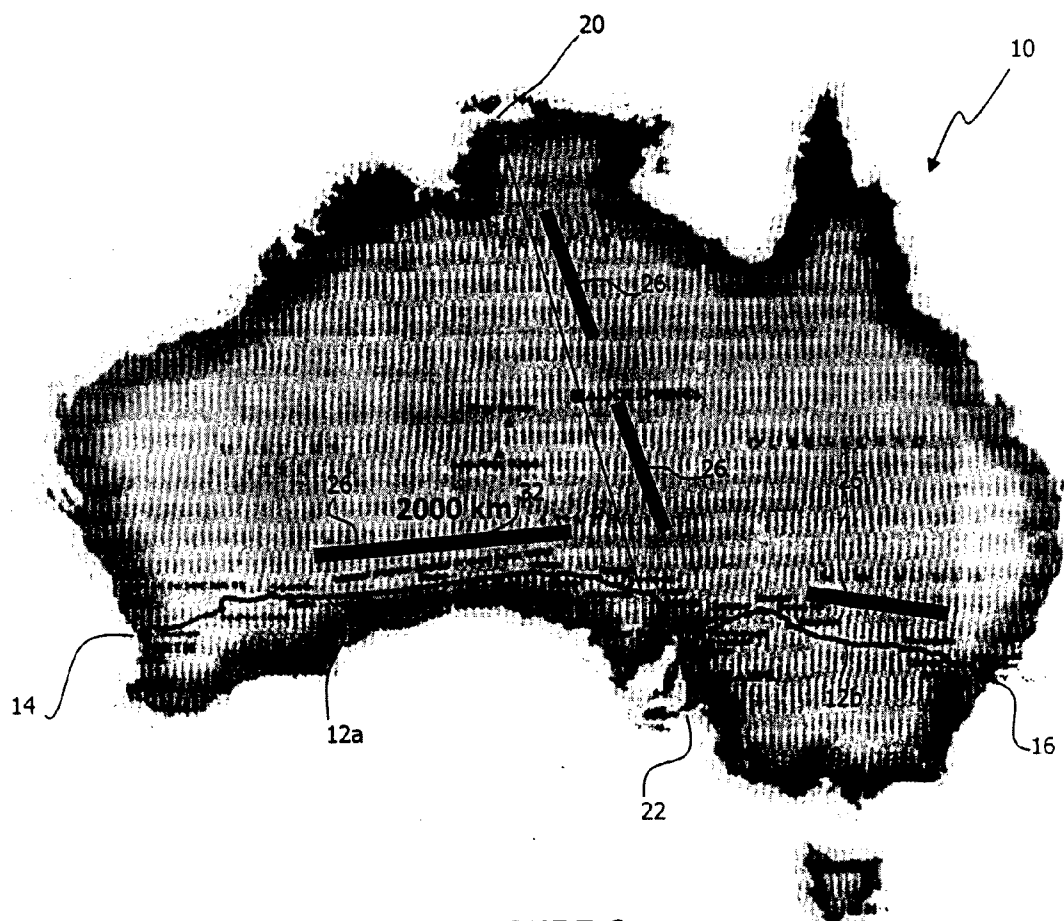


FIGURE 6

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1		Brand of Panel	Long	Wide	Deep	Watt	Cost
Single Side of Track	Single Panel	Kyocera	1500	0.808	36	130	1000
		Suntech	1425	0.652	35	170	750
	Double Panel	Kyocera	1500	0.808	36	130	1000
		Suntech	1425	0.652	35	170	750
	Triple Panel	Kyocera	4500	0.808	36	520	1000
		Suntech	4275	0.652	35	680	750
Double Side of Track	Single Panel	Kyocera	1500	0.808	36	130	1000
		Suntech	1425	0.652	35	170	750
	Double Panel	Kyocera	3000	0.808	36	260	1000
		Suntech	2850	0.652	35	340	750
	Triple Panel	Kyocera	4500	0.808	36	520	1000
		Suntech	4275	0.652	35	680	750

Eraring power Station Output

Generators	Generator Size in MW 660	Qty of Generators 4	Total Power MW 2640
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FIGURE 7a

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1	500000				1000000				2000000			
	500km		1000km		1000km		2000km		2000km		2000km	
	Qty	Output MW	Cost	Output MW	Qty	Output MW	Cost	Output MW	Qty	Output MW	Cost	Output MW
Single Side of Track	618,812	80	\$ 618,811,881	161	1,237,624	322	\$ 1,237,623,762	644	2,475,248	1,287	\$ 2,475,247,525	2,574
	766,871	130	\$ 575,153,374	261	1,533,742	521	\$ 1,150,306,748	1,043	3,067,485	2,086	\$ 2,300,613,497	4,172
	618,812	161	\$ 618,811,881	322	1,237,624	644	\$ 1,237,623,762	1,287	2,475,248	2,574	\$ 2,475,247,525	4,172
	766,871	261	\$ 575,153,374	521	1,533,742	1,043	\$ 1,150,306,748	2,086	3,067,485	4,172	\$ 2,300,613,497	4,172
	618,812	322	\$ 618,811,881	644	1,237,624	1,287	\$ 1,237,623,762	2,574	2,475,248	4,172	\$ 2,475,247,525	4,172
Double Side of Track	1,237,624	161	\$ 1,237,623,762	322	2,475,248	644	\$ 2,475,247,525	1,287	4,950,495	2,574	\$ 4,950,495,050	4,172
	1,533,742	261	\$ 1,150,306,748	521	3,067,485	1,043	\$ 2,300,613,497	2,086	6,134,969	4,172	\$ 4,601,226,994	4,172
	1,237,624	322	\$ 1,237,623,762	644	2,475,248	1,287	\$ 2,475,247,525	2,574	4,950,495	4,172	\$ 4,950,495,050	4,172
	1,533,742	521	\$ 1,150,306,748	1,043	3,067,485	2,086	\$ 2,300,613,497	4,172	6,134,969	4,172	\$ 4,601,226,994	4,172
	1,237,624	644	\$ 1,237,623,762	1,287	2,475,248	2,574	\$ 2,475,247,525	4,172	4,950,495	4,172	\$ 4,950,495,050	4,172

Figure 7b