**Back calculation:**

We Are Agrisolar, and we are looking for a software developer because we want to build our own software for calculation and simulation of solar pumping system. I will write a description of the software we need as much as I could.

P.S. this software will be web-based as the client will put some data and the software will make a selection between various items and do a simulation based on a suggested trial, then the customer will have the option to alter these number to some limit, and then the simulation will happen again based on that.

The items which will be selected and the simulation will be based on these inputs:

IN1 = water requirements through the day (m3/day)

IN2 = dynamic head (m)

**IN3= cable length.**

IN4 = location (from a drop menu with specific options)

IN5 = mounting structure (from a drop menu with specific options)

IN6 = modules to be used (from a drop menu) and one of the options is ass new module and if that’s the case 3 new inputs will appear:

IN6,1 = voltage open circuit (Voc)

IN6,2 = Voltage at max. Power point

IN6,3 = max power W.

The steps of the simulation will be divided into 3 process,

1st: selecting the pump:

**First step:**

* Q= IN1/(6.5 if fixed or 7.5 if tracking in IN5)
* Hd = IN2

**Second step:+++-**

Each pump will have a range of the two variables (Q and Hd) like this sample

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| pump Rang |  |  |  |  |
| Pump name | Q(min) | Q(Max) | H(max) | H(min) |
| 46-7 | 35 | 55 | 57 | 44 |
| 46-9 | 35 | 55 | 79 | 56 |
| 46-12 | 35 | 55 | 111 | 78 |
| 60-6 | 50 | 75 | 45 | 26 |
| 60-8 | 50 | 75 | 62 | 37 |
| 60-10 | 50 | 75 | 77 | 47 |
| 60-12 | 50 | 75 | 92 | 56 |
| 77-3 | 70 | 93 | 34 | 25.5 |
| 77-4 | 70 | 93 | 45.8 | 34 |
| 77-5 | 70 | 93 | 58 | 43.6 |
| 77-6 | 70 | 93 | 69 | 51.8 |

From these two number select the pumps that fall in those range-s (there could more than one, and up to four pumps) each pump will have several values at differents head like this:

H1=???

C5, C4, C3, C2, C1, C0 Qmax, Qmin , Pmax

H2=????

C5, C4, C3, C2, C1, C0 Qmax, Qmin , Pmax

**Third step:**

We select the value with the H = IN2, and if the IN2 is between two tables select the nearest, and a factor will be multiplying by Q and this factor will be (H/IN2)

Q=(H/IN2)\*((C5\*(P^5))+(C4\*(P^4))+(C3\*(p^3))+(C2\*(P^2))+(C1\*P)+C0)

These will be the equation after selecting radiation and configure the PVgen

2nd process: selecting the radiation data:

**Fourth step**:

For each location in IN3 there will be as many data as the options in IN4

And the table will look like this

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Avg |
| 5:22 | 0 | 0 | 0 | 0 | 0 | 34 | 45 | 0 | 0 | 0 | 0 | 0 | 7 |
| 5:37 | 0 | 0 | 0 | 0 | 44 | 53 | 62 | 0 | 0 | 0 | 0 | 0 | 13 |
| 5:52 | 0 | 0 | 0 | 0 | 63 | 70 | 98 | 40 | 0 | 0 | 0 | 0 | 23 |
| 6:07 | 0 | 0 | 0 | 63 | 99 | 107 | 141 | 69 | 0 | 0 | 0 | 0 | 40 |
| 6:22 | 0 | 0 | 52.08 | 103 | 140 | 151 | 190 | 109 | 68 | 0 | 0 | 0 | 68 |
| 6:37 | 0 | 0 | 101.37 | 148 | 186 | 199 | 241 | 156 | 113 | 39 | 0 | 0 | 99 |
| 6:52 | 0 | 67 | 152.52 | 199 | 235 | 250 | 295 | 208 | 164 | 110 | 0 | 0 | 140 |
| 7:07 | 83 | 120 | 209.25 | 253 | 286 | 302 | 350 | 263 | 220 | 166 | 36 | 0 | 191 |
| 7:22 | 144 | 175 | 267.84 | 308 | 338 | 356 | 405 | 320 | 278 | 226 | 111 | 43 | 248 |
| 7:37 | 199 | 232 | 327.36 | 364 | 390 | 409 | 460 | 379 | 338 | 287 | 165 | 145 | 308 |
| 7:52 | 254 | 290 | 386.88 | 420 | 441 | 462 | 514 | 437 | 398 | 348 | 222 | 200 | 364 |
| 8:07 | 308 | 349 | 445.47 | 475 | 491 | 514 | 566 | 495 | 458 | 409 | 280 | 256 | 421 |
| 8:22 | 360 | 406 | 502.2 | 528 | 540 | 565 | 616 | 551 | 516 | 468 | 339 | 311 | 475 |
| 8:37 | 409 | 462 | 557.07 | 579 | 586 | 613 | 664 | 606 | 572 | 525 | 398 | 365 | 528 |
| 8:52 | 456 | 515 | 609.15 | 628 | 630 | 659 | 710 | 658 | 626 | 580 | 454 | 417 | 579 |
| 9:07 | 500 | 566 | 657.51 | 674 | 672 | 703 | 752 | 708 | 676 | 631 | 508 | 467 | 626 |
| 9:22 | 541 | 614 | 703.08 | 717 | 710 | 743 | 791 | 754 | 724 | 679 | 560 | 513 | 671 |
| 9:37 | 579 | 658 | 744.93 | 757 | 746 | 780 | 827 | 797 | 768 | 724 | 608 | 557 | 712 |
| 9:52 | 613 | 698 | 783.06 | 793 | 778 | 814 | 859 | 836 | 808 | 764 | 652 | 596 | 750 |
| 10:07 | 643 | 734 | 817.47 | 826 | 807 | 845 | 887 | 871 | 844 | 800 | 692 | 632 | 783 |
| 10:22 | 670 | 766 | 847.23 | 855 | 833 | 872 | 912 | 903 | 876 | 832 | 728 | 663 | 813 |
| 10:37 | 693 | 794 | 873.27 | 879 | 855 | 895 | 932 | 930 | 903 | 860 | 759 | 691 | 839 |
| 10:52 | 713 | 817 | 895.59 | 900 | 873 | 915 | 949 | 952 | 926 | 883 | 785 | 714 | 860 |
| 11:07 | 728 | 836 | 912.33 | 917 | 888 | 931 | 961 | 970 | 945 | 902 | 806 | 732 | 877 |
| 11:22 | 740 | 850 | 925.35 | 929 | 899 | 942 | 969 | 984 | 959 | 916 | 822 | 746 | 890 |
| 11:37 | 748 | 859 | 930 | 938 | 906 | 950 | 973 | 993 | 968 | 925 | 832 | 756 | 898 |
| 11:52 | 752 | 864 | 939.3 | 942 | 910 | 954 | 973 | 998 | 973 | 930 | 838 | 760 | 903 |
| 12:07 | 752 | 864 | 939.3 | 942 | 910 | 954 | 969 | 998 | 973 | 930 | 838 | 760 | 902 |
| 12:22 | 748 | 859 | 930 | 938 | 906 | 950 | 961 | 993 | 968 | 925 | 832 | 756 | 897 |
| 12:37 | 740 | 850 | 925.35 | 929 | 899 | 942 | 949 | 984 | 959 | 916 | 822 | 746 | 888 |
| 12:52 | 728 | 836 | 912.33 | 917 | 888 | 931 | 932 | 970 | 945 | 902 | 806 | 732 | 875 |
| 13:07 | 713 | 817 | 895.59 | 900 | 873 | 915 | 912 | 952 | 926 | 883 | 785 | 714 | 857 |
| 13:22 | 693 | 794 | 873.27 | 879 | 855 | 895 | 887 | 930 | 903 | 860 | 759 | 691 | 835 |
| 13:37 | 670 | 766 | 847.23 | 855 | 833 | 872 | 859 | 903 | 876 | 832 | 728 | 663 | 809 |
| 13:52 | 643 | 734 | 817.47 | 826 | 807 | 845 | 827 | 871 | 844 | 800 | 692 | 632 | 778 |
| 14:07 | 613 | 698 | 783.06 | 793 | 778 | 814 | 791 | 836 | 808 | 764 | 652 | 596 | 744 |
| 14:22 | 579 | 658 | 744.93 | 757 | 746 | 780 | 752 | 797 | 768 | 724 | 608 | 557 | 706 |
| 14:37 | 541 | 614 | 703.08 | 717 | 710 | 743 | 710 | 754 | 724 | 679 | 560 | 513 | 664 |
| 14:52 | 500 | 566 | 657.51 | 674 | 672 | 703 | 664 | 708 | 676 | 631 | 508 | 467 | 619 |
| 15:07 | 456 | 515 | 609.15 | 628 | 630 | 659 | 616 | 658 | 626 | 580 | 454 | 417 | 571 |
| 15:22 | 409 | 462 | 557.07 | 579 | 586 | 613 | 566 | 606 | 572 | 525 | 398 | 365 | 520 |
| 15:37 | 360 | 406 | 502.2 | 528 | 540 | 565 | 514 | 551 | 516 | 468 | 339 | 311 | 467 |
| 15:52 | 308 | 349 | 445.47 | 475 | 491 | 514 | 460 | 495 | 458 | 409 | 280 | 256 | 412 |
| 16:07 | 254 | 290 | 386.88 | 420 | 441 | 462 | 405 | 437 | 398 | 348 | 222 | 200 | 355 |
| 16:22 | 199 | 232 | 327.36 | 364 | 390 | 409 | 350 | 379 | 338 | 287 | 165 | 145 | 299 |
| 16:37 | 144 | 175 | 267.84 | 308 | 338 | 356 | 295 | 320 | 278 | 226 | 111 | 88 | 242 |
| 16:52 | 83 | 120 | 209.25 | 253 | 286 | 302 | 241 | 263 | 220 | 166 | 60 | 44 | 187 |
| 17:07 | 24 | 67 | 152.52 | 199 | 235 | 250 | 190 | 208 | 164 | 110 | 25 | 0 | 135 |
| 17:22 | 0 | 22 | 101.37 | 148 | 186 | 199 | 141 | 156 | 113 | 57 | 0 | 0 | 94 |
| 17:37 | 0 | 0 | 52.08 | 103 | 140 | 151 | 98 | 109 | 68 | 22 | 0 | 0 | 62 |
| 17:52 | 0 | 0 | 19.53 | 63 | 99 | 107 | 62 | 69 | 32 | 0 | 0 | 0 | 38 |
| 18:07 | 0 | 0 | 0 | 33 | 63 | 70 | 45 | 35 | 0 | 0 | 0 | 0 | 21 |
| 18:22 | 0 | 0 | 0 | 0 | 44 | 53 | 27 | 20 | 0 | 0 | 0 | 0 | 12 |
| 18:37 | 0 | 0 | 0 | 0 | 22 | 34 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 18:52 | 0 | 0 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 5.1 | 5.8 | 6.8 | 7.1 | 7.2 | 7.5 | 7.6 | 7.5 | 7.1 | 6.5 | 5.3 | 4.8 | 6.5 |

3rd process PV configuration:

**Fifth step**:

P(pv) = (IN1\*IN2)\*1000/ (6.5\*368\*0.7\*0.7) W

this is the suggested power to be used

1ycalculate number of modules in a string and the number of strings:

Nm=19 or 16

**Data base of the no. of modules in a single string based on the max power of the module**

Nt= P)pv)/IN6,3

Ns=Nt/Nm

Nm,max = 21

Nm,min= 540/(IN5,2\*0.9)

pmax= P(motor) \*1.7

Pmin= P(motor)\*0.75

4th process: calculation Q for the entire years:

P=(IRR)\*(PVgen)\*(0.9\*0.9).

IRR: irradiance at a specific time from the radiation table

* Each 15 min there is different IRR hence every 15 there will be different P.

Q=(H/IN2)\*((C5\*(P^5))+(C4\*(P^4))+(C3\*(p^3))+(C2\*(P^2))+(C1\*P)+C0)

* Calculate Q from the above equation for every 15 min.
* Add up the 4 value for every hour and divide them by 4 to get the Water for each hour,
* Add up all the hours to get the water produce through the entire day.
* Do this for all the 12 months and the average of all the months.

**Seventh step:**

Match the recommended Motor cable from this chart:



Report Data:

1. Header

* Customer's Logo
* Customer's Address
* Contact Information
* date

1. Project Summary

* Location
* Pump name
* Average output daily (m3/day)
* Recommended cable
* Drive (option)
* Motor rating (HP)
* PVgen
* Output through the year (table)
* Average yearly output daily (table)

1. The months that the customer choose to appears( average output monthly)
2. P-Q curve of the pump
3. Datasheet