Application of Power System Economic Metrics to a Microgrid with Storage and Renewables

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Abstract

Interest in multisource microgrids is becoming more prevalent in areas without access to grid power. Many of these areas are currently served by groups of diesel generators. However, the high capital cost of storage and renewable sources makes the initial investment in multisource microgrids frightening.

This work is interested in examining the factors that can make a difference in whether or not these additional investments will reduce the total cost of ownership. To do so, this work uses the load and generation profiles of the MEHPS microgrid - a well-defined remote microgrid - and adds in the renewable resources of interest, solar, and storage in order to analyze the cost of the additions.

This work takes multiple variables that could have an effect on the final total cost of ownership into consideration, including the price of fuel, price of PV panels, price of batteries, location of installation of the microgrid, cost of pollution, duration of installation, and cost of capital. All of these factors are considered in order to suggest what will make a difference to whether or not additional investments will reduce the total cost of ownership. The results of this work offer suggestions to those planning to deploy multisource microgrid systems in remote areas around the world.

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List of Acronyms

AMMPS	Advanced Medium Mobile Power Source
Capex	Capital Expense
DOE	Department of Energy
DOE	Design of Experiment
DPM	Diesel Particulate Matter
ED	Economic Dispatch
EENS	Expected Energy Not Served
HOMER	Hybrid Optimization of Multiple Energy Resources
LCOE	Levelized Cost of Energy
LDC	Load Duration Curve
LOLP	Loss of Load Probability
MEHPS	Mobile Electric Hybrid Power Source
MENA	Middle East and North Africa
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NOAA	National Oceanic and Atmospheric Administration

NOX	Nitrogen Oxide
Opex	Operational Expense
PDF	Probability Density Function
PE	Power Electronics
SOC	State of Charge
TCO	Total Cost of Ownership
UC	Unit Commitment
Wp	Watt peak

List of Variables

A	Linear cost of power from a specified unit
crf	Annuity Factor
C^{LV}	Linear cost of power from a specified unit
C^{NL}	No load cost of running a specified unit
D	Debt
E	Total equity
E_{net}	Net energy provided by the generating equipment being used
G	Set of all generators, including diesel generators, solar, and storage equipment
g	Member of the set G
H	Squared cost of running the load
k_D	Cost of debt
k_E	Cost of equity
k_{ins}	Cost of insurance as a percent of capital
L	Generator minimum power
$load_t$	Total load at time t
nse_t	Unserved Energy at time t

p_{gt}	Power generated by set g at time t
T	Set of all time steps
t	Member of the set of t
u	The state (up or down) of a single generator during a single time interval
U	Generator maximum power
$WACC$	Weighted Average Cost of Capital

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Chapter 1

Introduction

Interest in multisource microgrids is becoming more prevalent in areas without access to grid power. Many of these areas are currently served by groups of diesel generators. However, the high capital cost of storage and renewable sources makes the initial investment in multisource microgrids frightening.

Much of the desire for remote microgrids has been either to increase reliability [2] or to decrease the cost of operation [3]. There is an area of research around economically efficient operation of grid connected generation equipment that has explored everything from natural gas combined heat and power systems, to solar, to different types of storage. The area of islanded microgrids grids is extremely different. If there is a grid available it is usually only internal combustion engine-driven generators so the existing power is usually higher cost and more variable in terms of both voltage and frequency.

There are many different metrics around the economics of power system operation. Each has a different purpose but there are commonalities to all of them. Unit Commitment and Economic Dispatch are used for scheduling. Production Cost is used to estimate the total operating and maintenance costs required to serve a load profile. Total Cost of Ownership (TCO) and Levelized Cost of Energy (LCOE) estimate the operating, maintenance, and capital cost necessary to serve a load. Loss of Load Probability (LOLP) and Expected Energy Not Served (EENS) are measures of the reliability of the power system, as such they are not economic metrics, but they are essential to planning power systems. TCO and LCOE are metrics that can be used when comparing the cost either to own or produce electrical energy from different microgrid configurations. To make these comparisons equal LOLP or EENS can be used as a reliability standard for your decision making.

A preliminary case study discussed further in Chapter 4 on determining the potential value of adding storage to existing primarily diesel generator served loads found that at the life of an inverter, savings can be found even over just operating the generators intelligently if the fully burdened cost of fuel is considered.

This work extends the preliminary case study by using statistical methods for determining price and reliability of a power grid to a well-defined remote microgrid. This work incorporates the latest research about operating and capital costs of microgrids, as well as reliability of photovoltaic and storage components in order to try and improve estimations of cost and availability of such systems. Wind was omitted in this research because we were working from a defined equipment profile. We also wish to understand how cost and availability interact when operating such a microgrid.

There is also great interest in incorporating new sources of energy, including renewable sources such as solar, wind, or storage, in microgrid systems. Therefore, it is important to understand how such sources impact operating costs and reliability of microgrid systems—especially how to balance the varied potential benefits of renewable sources with higher initial costs.

In performing this research, we are interested in investigating whether investments in storage and renewable resources will be recouped, and if so, when that value will be realized. We are interested in whether the value of air pollution reduction increases the potential value of the new sources. We are interested in the cost of attaining reliability, and whether the additional reliability from renewable and storage resources increase their value. Finally, we are interested in whether the capability of the power electronics affect reliability, and—therefore—the value of the new energy sources.

In order to answer the above questions, a case study was performed where a Monte Carlo Simulation was constructed that included both weather data and forced outage information of the unit commitment problem. This simulation was used to find the operating cost, runs hours of the generator, kWhrs charged and discharged from storage, fuel use, and a group of select pollutants. Using these values and an understanding of expected equipment lifetimes, an initial equipment profile as well as necessary replacement were found in order to calculate the capital cost of the microgrid. These costs were then compared to understand the effects of location, cost of fuel, expected life of the batteries, cost of batteries, desired reliability, and maturity of the power electronics controls over differing time periods and with differing costs of capital.

The results of this research indicate that the primary single factor in whether or not the investment was recouped was the price of fuel. Higher fuel costs were very strongly correlated with higher operating costs and higher TCOs. This is reasonable, as the places that are interested in adding microgrids with renewables and storage are remote, or even islands [4, 2]. In other word, places with high fuel costs. The other factor that seemed to make a difference was the load profile. This work and the work in the case studies show that matching the load profile to the generators is extremely important.

The factor that was most strongly correlated to payback time was fuel price. The higher the fuel price is, the shorter the payback time will be. The factor that was next most strongly correlated to payback time was the desired reliability. Higher desired reliability had a longer payback time. Another factor was the maximum power of the load profile. The payback time was longer with the higher load profile. Additionally, between five and ten years, the generators and batteries had to be replaced. Therefore, more of the five year runs than the ten year runs had sufficient operational time to pay off the higher capital expenses.

With the lowest cost of fuel, the cost of carbon results in the highest increase in the number of scenarios that reduced their total cost of ownership by adding solar and/or storage. This is reasonable, as adding the social cost of carbon effectively increases fuel price, which is the strongest driver of operating cost and total cost of ownership.

Both the operating cost and the total cost of ownership are higher with the higher required reliability. This shows up in both the reduced probability of lowering the total cost of ownership with renewable resources and higher average simple payback time with higher required reliability.

Adding storage to a low-reliability configuration improves the LOLP - increasing the reliability enough that it nearly meets the high reliability target. If there was a small amount of flexibility around the target reliability, there would be an opportunity for financial savings by adding storage - which would, in addition to increasing reliability, decrease the operating cost as well.

If the power electronics are only capable of being grid-following, there are almost no savings to adding either renewable sources or storage. At this penetration level, solar can be only grid-following - the most common control method for off the shelf solar inverters - without greatly increasing the operating cost. However, the storage inverter must be able to operate independently of the generators and provide a voltage reference for the solar inverter as well.

These results offer important lessons in making planning and operational decisions for microgrids with storage and renewables. While further research is needed, this work can offer suggestions to those planning to deploy microgrid systems in remote areas around the world.

This dissertation is organized as follows. Chapter 2 contains important background information on the topics of this research. Chapter 3 details related work. Chapter 4 discusses a preliminary case study and its results. Chapter 5 presents the details on the primary experiments. Chapter 6 explains the results of the experiments. Finally, Chapter 7 summarizes and concludes this work.

Chapter 2

Background

2.1 Microgrids

According to the US Department of Energy, the definition of a microgrid is:

A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected and island-mode.[5].

There are two major types of microgrids considered in the existing body of research.

- Stand alone microgrids - where there is not the option of buying or selling energy
- Interconnected microgrids - where there is utility energy available.

For the purpose of this thesis, we are only considering stand alone microgrids (the island-mode), so we will not consider grid-connected microgrids. For our purpose microgrids are small, multisource grids that can serve load independently of a larger grid. Historically, the microgrids that are being considered are nothing more than a collection of diesel generators, but these microgrids could include energy storage, renewable sources, or load management going forward.

Much of the existing research on stand alone microgrids focuses on either optimal scheduling, given the non dispatchable nature of renewable resources, or on planning the ideal equipment profile. This work is different, it looks at the total cost of ownership (TCO) of a stand alone microgrid with a limited portfolio of components - a metric very similar to levelized cost of ownership (LCOE) which is often considered in microgrids as a comparison to the cost of purchasing power - and this looks at the sensitivity of the TCO of a microgrid to requirements for availability which we have chosen to measure with loss of load probability (LOLP).

This work is also different because rather than showing that the microgrid is a candidate for optimization, it looks at different operating rules to show the cost of the tradeoffs with a given set of generating equipment and loads. An example of different considerations include the effect of the different capabilities of the power electronics or increased run time to show the increased cost of higher spinning reserve, or even the cost of having a full device of spinning reserve.

2.1.1 MEHPS Background

The US Marine Corp published their fully weighted fuel costs and a yearlong load profile [1]. The MEHPS configuration has an extremely low penetration of renewable energy, this was because of the non electrical limitations of the MEHPS system, including space limitations, transportation limitations, visibility limitations, and limitations from starting with existing equipment.

The MEHPS network was predefined and the definition and usage profile included such things as portability and compatibility with existing equipment in its definition. It was also interesting in that it was a microgrid defined independently of a physical location, which would mean that the renewable resources are not optimized to the available energy sources, this is partially because of the requirements for portability and the ability to be redeployed, so average equipment was a better option. The other interesting limitation of the MEHPS microgrid also stems from its portability, there is a limit to the amount of space that can be occupied by the power system and a limit to the amount of equipment that can be be placed on a trailer, both of these facts mean that the MEHPS network has far lower solar penetration than is usually seen in microgrids designed for stationary use and with known weather patterns.

2.2 Power System Economic Metrics

The different economic metrics for a power system have different uses and different restrictions

2.2.1 Unit Commitment/Economic Dispatch

Economic dispatch (ED) and unit commitment (UC) are optimization problems that try to minimize the total cost of power over a given demand and generation portfolio. Both economic dispatch and unit commitment are complex optimization problems with non-smooth optimization regions. Additionally, unit commitment optimizes over discrete states making it extremely difficult to find a truly optimal solution. Unit commitment is not a convex problem. Its optimization variable is a binary variable describing whether a unit is on or off.

Unit Commitment and Economic Dispatch are used to schedule what units need to be running (unit commitment) and at what load (economic dispatch). These two metrics are being grouped together for the purpose of this paper because they are often grouped together in when solving these problems. This is necessary because for most costs you need both the units that are running and load that each unit is running. Unit Commitment and Economic Dispatch generally have the largest number of constraints, but because they are schedules they do not include random failures.

The cost function includes the economic dispatch for the given time step plus all start-up costs a non convex function based on the unit transitioning from off to on. The constraints include minimum on and off time a non-convex constraint because to meet the minimum on or off time is a combinatoric problem. One method that can look at such combinatoric problems is state enumeration, an NP-hard solving method. There are other methods available, but either the methods do not guarantee the global optimum or there is a risk of complete enumeration of the problem.

This work uses the unit commitment problem formulation suggested in ”Tight and Compact MILP Formulation for the Thermal Unit Commitment Problem” [6] with the additions for the stochastic nature of renewable resources from ”Unified Stochastic and Robust Unit Commitment” [7] without the addition of the buses that were used in that paper. The formulation follows:

$$min \sum_{g \in G} \sum_{t \in T} C_g^{NL} * u_{gt} + C_g^{LV} * p_{gt} + \sum_{s \in S} C_{gs}^{SU} * v_{gst} + C_g^{SD} * w_{gt} + C^{NSE} * nse_t \quad (2.1)$$

Equation 2.1 is the objective function of the Unit Commitment formulation. This formulation includes economic dispatch even though it is from unit commitment literature. The economic dispatch is implied by including the exact power at which each generator is operating included in the cost function. This objective function includes start up costs , shutdown costs, and the cost of non served energy.

$$\sum_{g \in G} (L_g * u_{gt} + p_{gt}) = Load_t - nse_t \qquad \forall t \tag{2.2}$$

$$\sum_{g \in G} r_{gt} = R_t \qquad \forall t \tag{2.3}$$

The constraints in 2.2 show that the load summed over all generators at each time period must equal the load at that time period minus the unserved energy. The constraints in 2.3 state that the available reserve across all generators over all time must equal the required reserve.

$$\sum_{i-TU_g+1}^{p} v_{g,i} \leq u_{g,t} \qquad \forall g, t \in [TU_g, N_T] \tag{2.4}$$

$$\sum_{i-TD_g+1}^{p} w_{g,i} \leq 1 - u_{g,t} \qquad \forall g, t \in [TD_g, N_T] \tag{2.5}$$

$$u_{g,t} - u_{g,t-1} = v_{g,t} - w_{g,t} \qquad \forall t \tag{2.6}$$

The constraint in 2.4 is to show over the minimum up time, TU, the sum of starts, $v_{g,i}$, is less than or equal to the current on/off status, $u_{g,i}$, which means that the generator can not have started more times than its current status. The constraint in 2.5 (find me)

$$p_{g,t} + r_{g,t} \leq (L_g - U_g)u_{g,t} - (U_g - RU_g)v_{g,t} \qquad \forall g \in \mathbf{G1}, t \tag{2.7}$$

$$p_{g,t} + r_{g,t} \leq (L_g - U_g)u_{g,t} - (U_g - RD_g)w_{g,t} \qquad \forall g \in \mathbf{G1}, t \tag{2.8}$$

The constraint in 2.7 is to reflect the maximum power that can be produced by an individual generator at a time period. It includes constraints about both the maximum the generator can produce overall and the ramp rate. The constraint in 2.8 is the minimum power that can be produced by a generator at a given time. It includes whether the generator is committed or not and if it is committed both the overall minimum and the ramp rate constraint for that time period.

$$(p_{g,t} + r_{g,t}) - p_{g,t-1} \leq RU_g \qquad \forall g, t \tag{2.9}$$

$$-p_{g,t} + p_{g,t-1} \leq RD_g \qquad \forall g, t \tag{2.10}$$

These constraints define the ramp rates. Equation 2.9 is constraint that shows the current power and reserve must have increased less than the ramp up rate from the previous power output. Similarly, equation 2.10 shows that the output power at the current time can not have decreased more than the ramp down rate from the previous time step.

Also included in this work's definition of unit commitment was energy storage. Pozo et al [8] suggested a technology neutral definition for including energy storage in the unit commitment problem.

$$\begin{aligned} min \sum_{g \in G} \sum_{t \in T} C_g^{NL} * u_{gt} + C_g^{LV} * p_{gt} + \sum_{s \in S} C_{gs}^{SU} * v_{gst} + C_g^{SD} * w_{gt} + C^{NSE} * nse_t \\ + \sum_{s \in S} \sum_{t \in T} (C_{st}^{charge} p_{st}^{charge} + C_{st}^{discharge} p_{st}^{discharge} \end{aligned} \tag{2.11}$$

The system in this thesis included energy storage. Pozo et al [8] defined generic and ideal storage as:

- *There are no up or down ramps. A unit can go from not producing anything to full power instantly.*
- *There are no stored energy losses. For example, losses by evaporation or filtration in pumping stations or load losses in batteries.*
- *There is no hysteresis in loading or discharging, i.e., no loops due to a dynamic lag between storage and production.*
- *Storage devices have conversion losses. This means there are efficiency rates of direct (production) and reverse (storage) energy transformation. These rates are given with*

respect to the energy measured at the node connected to the storage unit.

- *There are only production and storage costs. In general, production costs tend to be close to zero and storage costs should be related with the market price at the time that the energy is purchased to be stored in the unit.*
- *Storage/production costs are the same for any level of storage/production.*
- *Energy storage/production occurs at constant power for the minimum period of study (typically one hour).*

These definitions describe the battery energy storage over a short period extremely closely, there are conversion losses and medium losses when charging or discharging but the self discharge does not apply over periods of hours. With well controlled power electronics, storage can move from charging to discharging or vise versa within a single line cycle and the power electronics can change load as soon as the control can command it accurately.

The two that it does not necessarily meet are the last two. Storage and production costs are not necessarily the same - depending on how it is measured - for all level of storage or production, the energy lost will be the same, but the price in dollars is not the same to generate at all times as there can be variation in the availability of renewable resources and generator loading. The energy storage and production occurs at constant power is not necessarily true either, as it might not be the most efficient way to power a load, but could act as an uninterruptible power supply so there are not interruptions in the event of the failure of another source on the network, which would mean it could provide power for a much shorter period of time. The definition with the minimum period was used for calculating the TCO, but the energy storage could be more capable.

Equation 2.11 adds the cost of storing and using energy from storage into the value equation for unit commitment. It defines two separate costs for charging and discharging to represent the efficiency of the technology to insert or remove energy from the storage. The other option that is represented in the literature is to look at the efficiency for storing and using energy from your energy storage rather than assigning a price in dollars. Wood et al [9] used this method for pumped storage hydro. This method has the advantage of having the price to store vary with the current production price of energy rather than just having the cost of power vary with time.

$$SOC_{batt,t} = SOC_{batt,t-1} + eff_{batt}^{charge} * p_{batt,t}^{charge} \tag{2.12}$$

$$SOC_{batt,t} = SOC_{batt,t-1} - eff_{batt}^{discharge} * p_{batt,t}^{discharge} \tag{2.13}$$

Compared to 2.11, the equations 2.12 and 2.13 have another advantage. If the eff^{charge} and $eff^{discharge}$ are the same then the unit commitment formulation only needs a single power variable for the energy storage elements. Otherwise it needs a problem formulation with separate charge and discharge powers. With the formulation for state of charge, the limits of the available energy storage capacity are also taken into consideration.

In equations 2.12 and 2.13 , the amount of energy stored at the beginning of time period t is defined in relation to the previous period. For the purpose of this work, negative powers are charging the battery. This is important because it means that the power for charging is effectively added to the load power in the load power. With equations 2.12 and 2.13 and 2.2, the load constraint becomes:

$$\sum_{g \in G}(L_g * u_{gt} + p_{gt} + p^d ischarge_{batt,t} - p_{batt,t}^{charge}) = Load_t - nse_t \qquad \forall t \tag{2.14}$$

2.2.2 Production Cost

Production cost models are used to determine the cost for a utility to meet its demand, the requirements for energy importing, availability of energy for export, and estimating fuel consumption. This information is used for system planning, fuel budgets, and rate setting [9].

Production Cost is the total cost to serve a given load profile over a given time with a defined generation portfolio. Production cost is sensitive to the probability of generator failure over the given time but does not include most of the constraints from Unit Commitment and Economic Dispatch.

Because Production Cost is calculated over the period of many years, the reduction in constraints is not the only simplification that is made. The following simplifications have been made to make the problem solvable over a period of years at Midcontinent Independent System

Operator (MISO): aggregation of generation and priority lists for dispatch rather than optimizing the dispatched generation.

Historically production cost was solved using a recursive calculation that built a probability distribution of available power and price and this was convolved with the expected load distribution, a distribution that reflected the total time at each load without regard to when the loading would occur [10]. The time based weaknesses are especially challenging in cases that include energy limited generation like wind or solar.

Monte Carlo Simulation rose from both the weaknesses of the recursive method, like the inability to look at non-average scenarios and it increased number of constraints that could be considered [11] and it improved the ability to estimate the cost of including renewable resources [12], and the increased availability of computing power. Monte Carlo Simulation generates a large number of scenarios and computes the cost of each scenario. From these samples an average and best and worst cases can be determined.

With the increasing use of renewable resources, there is more interest in not only simulating probable outages but also different weather patterns. Ehnberg [13] is a good example of this addition to the literature.

2.2.3 TCO/LCOE

The Total Cost of Ownership (TCO) and Levelized Cost of Energy (LCOE) are metrics that are gaining prominence with the interest in renewable energy. TCO and LCOE are the only metrics in this group that take into account the capital involved in generating power.

LCOE is defined by Bryer et al [14] as: This definition includes:

- $Capex$ is the capital expense
- crf is the annuity factor
- $Opex$ is the operating expense of the equipment
- E_{net} is the net energy provided by the generating equipment being used
- $WACC$ is Weighted Average Cost of Capital
- E is the total equity
- D is the debt

- k_D is the cost of debt
- k_E is the cost of equity
- k_{ins} is the cost of insurance as a percent of capital

$$LCOE = \frac{Capex * crf + Opex}{E_{net}} \tag{2.15}$$

$$crf = \frac{WACC * (1 + WACC)^N}{(1 + WACC)^N - 1} + k_{ins} \tag{2.16}$$

$$crf = \frac{E}{D + E} * k_D + \frac{D}{D + E} * k_E \tag{2.17}$$

LCOE is frequently used to compare the cost of owning generation equipment to the cost of grid power. A large segment of the literature looks at the comparison between LCOE (add cites) with different input configurations and costs of utility power to see if it is cost effective to add the microgrid equipment or how to run the equipment most inexpensively.

TCO is the sum of the operating cost and capital cost with the time value of value of money that the organization considering the equipment uses for their decision making. It is very similar to 2.15. There are two differences however. First, the cost is not divided by the total energy produced, and second, because this is a common metric for many different applications and industries [15] there are many different metrics for the time value of money. For the purpose of this thesis, net present value of the total cost with the initial purchase of all equipment made at the beginning of the study and the net operating cost found annually at the beginning of each year.

The other difference in the way that this thesis considers TCO is by changing the $Opex$ for the statistical production cost. This is a valid substitution because production cost is a measure of the probable operating expense to meet the load given the reliability of the generating portfolio.

2.2.4 LOLP/EENS

Loss of Load Probability (LOLP) and Expected Energy Not Served (EENS) are slightly different than the previously discussed metrics in that they do not relate to the cost of providing power. They are both metrics describing reliability including availability of resources and the probability of random outages. Loss of Load Probability is the probability that there is insufficient power available to serve the load during a given time period. Expected Energy Not Served is the sum of all shortfalls over all time periods in the study.

LoLP and EENS are both important to the development of microgrids because they provide a constraint or at least a point that should be considered. Different loads need to be served with a different degree of reliability, and a high reliability requirement can drive higher costs in the form of increased redundancy requirements.

Loss of Load Probability historically was calculated very similarly to production cost. A table of the probable availability of generation was built and convolved with the probable loads to determine the percent probability that the generator portfolio was not able to sufficiently provide for the load. This had the same limitations that were seen in the production cost. This method was insensitive to both time based loads and generation sources.

The definition of EENS is taken from [9]

$$EENS = \sum_{tinT} -1 * (Load - \sum_{ginG} p) \qquad \forall Load - sum_{ginG} p \leq 0 \tag{2.18}$$

2.3 Diesel Generators

There are two primary types of diesel generators: fixed speed diesel generators and variable speed diesel generators. Variable speed diesel generators use permanent magnet alternators to generate an output power waveform that varies in both frequency and magnitude that is then rectified to DC by power electronics and then inverted to AC by power electronics. Despite the two additional conversions, these generators tend to be quieter and more efficient at lower loads as a function of the generator's nominal power, however they are uncommon and tend to be only used in smaller applications because of the price and availability of large semi conductor devices, though this might change in the future.

Fixed speed diesel generators are more common. They use an induction machine as an alternator, so in order to achieve a constant frequency the generators have to run at a fixed speed, usually measured in RPM for engine applications. This speed is a multiplier of the number of windings of the alternator and the number of seconds in a minute. This extremely rigid speed requirement means that the frictional losses of the engine are constant over all loads.

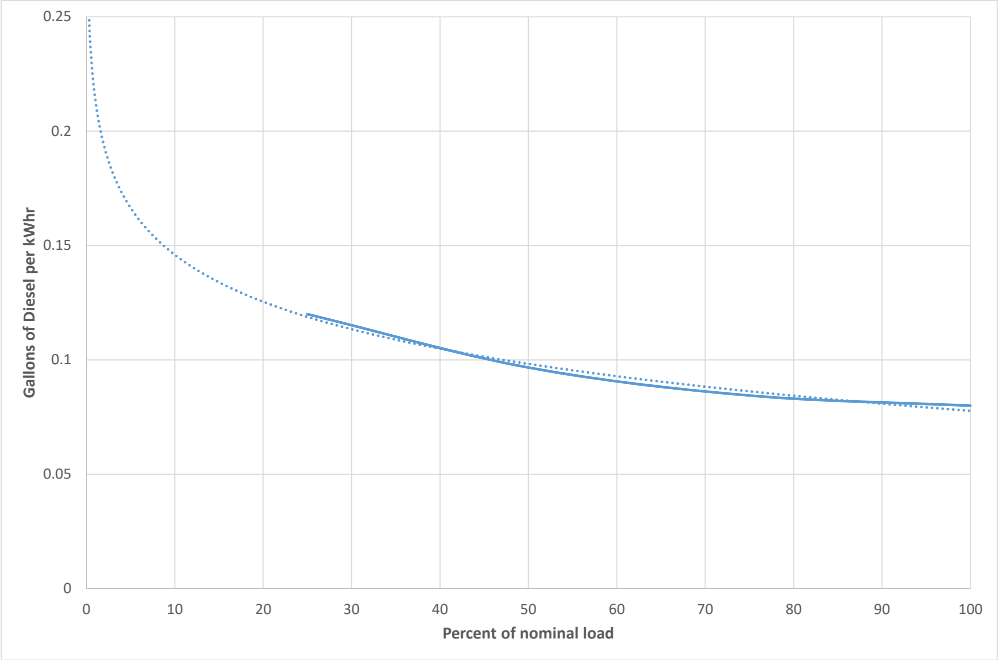

Figure 2.1: Efficiency in Gals/kW hour versus percent load of a fixed speed generator

In addition there are losses to combustion inefficiencies, which are theoretically limited by the Carnot Limit or 73 percent, these losses increase with the total amount of power being used, by the compression ratio of the engine, the ratio of volume displaced at top dead center vs the volume displace at bottom dead center. This loss includes the fact the atmosphere is approximately 21 percent oxygen. The fixed frictional losses dominate the shape of the efficiency curve. At extremely low loads the efficiency becomes extremely high because of the small amount of load the frictional loss is spread across. [16]

Diesel engines are used for generators because of their relative efficiency compared to gasoline engines. Because diesel is compression ignited rather than spark ignited, knocking - premature fuel detonation - is not a problem. Functionally they have to knock to run, this means that diesel engines can have a higher compression ratio, forcing more oxygen into combustion process than gasoline engines can have.

Diesel engines have become more brittle with the addition of many of the newest emissions controls. The two most brittle are the Diesel Particulate Filter (DPF) which needs to remain at an average high temperature to run because it reacts the unburned diesel fuel with the heat from the exhaust which comes from the combustion inefficiencies which as discussed above are related to load. If the temperatures are not maintained, the DPF will plug and will have to be recharged by having fuel injected directly into it to increase its temperature.

The other emissions control method that is vulnerable to underloading is the NOX reaction with the urea (which is commercially referred to Diesel Emission Fluid (DEF)) also requires high emission temperature for the NOX+DEF reaction to occur. These restrictions demonstrate the greater need for effective use of diesel generators in remote loads - if they have these emissions control mechanisms which, depending on the age of the equipment, many do not. Even without the emissions controls equipment, underloading can cause wet stacking - a condition where unburned fuel passes into the exhaust from insufficient heat in the cylinder during the combustion process. Because these restrictions are temperature based, the worst operating scenarios do not happen immediately. Even with this equipment diesel generators are still capable of running anywhere between 0 and 100 percent of their ratings.

Chapter 3

Related Work

3.1 Power System Economics

All of the methods used for reference in this dissertation did not have their first use in microgrids. This section will cover the references for methods that were used in this dissertation that emerged in the context of larger power systems

Morales-Espana et al [6] suggested a mixed integer linear programming formulation of the unit commitment problem. The linear programming formulation was ideal for the high turn on cost of the diesel generators and the Morales-Espana et al were thorough enough with both their equations and their variable definitions that this paper gave usable guidance for a unit commitment formulation.

Pozo et al [8] suggested a method to include storage in the unit commitment problem formulation. The interesting thing that this paper included that others trying to define storage did not is a definition of what makes ideal storage. Including this definition allowed the problem formulation to be modified for the difference between real and ideal storage.

Tang and Che [17] suggested a method for incorporating the cost of CO2 in generation scheduling. Like Morales-Espana et al, Tang and Che assumed that the unit commitment would be solved with a mixed integer linear program. As such, the suggested CO2 penalty factor had multiple different sections each with its own binary variable that depended on the efficiency curve of the generator that was being used. This would have incorporated very well with the problem formulation that was suggested by Morales-Espana. However as there are no active CO2 penalties for the MEHPS microgrid, this research chose to calculate the cost of CO2 based on the diesel fuel used to see if that would change any of the financial results.

Another method that was considered for including the cost of the externalities of pollution was described by Munksgaard and Ramskov [18]. They looked at the externalities of pollution of different types of fuels as described by the ExternE [1] study, a study that calculated the costs of the externalities including SO2 and NOX but omitted estimating a cost of CO2, and a separate cost for CO2. The authors then calculated the increase in electricity price if these costs were included on the fuel as a tax. This was similar to how this thesis chose to treat CO2. Munksgaard and Ramskov further calculated the effect that this would happen if only one country choose to do this and the two countries in Northern Europe that if both instituted the tax would have the largest change in pollution. Those last calculations were not similar to the work in this thesis as it was interested in remote microgrids where importing power would not be an option.

Production costing is the estimation of the cost to produce power over a longer period of time given the probability of failures. Marwali et al [19] looked at estimating the production cost for adding photovoltaic generation to an existing thermal generation system on Nusa Penida, an Indonesian island. Marwali et al built a probability density function (PDF) based on the solar radiation, temperature, and wind speed. The photovoltaic generation was then added to the merit ordered commitment and convolved with the Load Duration Curve (LDC), from this convolution both the probabilistic production cost and the expected energy not served are found. Marwali et al then suggest sizing the storage to a fraction of the expected energy not served.

Marwali et al [19] presented an excellent example of the production cost calculation by convolution, however by averaging the available photovoltaic power across the day is a very good example of the weakness in this method for time varying sources or load that was mentioned in the Background chapter. This weakness was acceptable because this method was more accurate than using the peak rating and was still computable given the available computing.

Lim et al [20] extended this by showing that multi state probability density functions increase the accuracy of the convolution methods by using several islands that had renewable generation as case studies. Even those this increased the accuracy, this method was still limited to not including time of day. Lim et al also showed that their method was accurate for estimating LOLP.

Malik and Cory [21] proposed a method to add pumped storage hydro to the probabilistic production cost estimation method. The method separates pumped storage into two different

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[1] The results of the ExternE were used in [18], the initial study was not read.

modes: pumping and generating. Each mode is added to the LDC to fill in gaps in the capability of the generators, either by filling out their dispatch amount or by removing a generator from operation. This method was similar to how storage was used in the case study in this thesis, but the calculation was different as this thesis used Monte Carlo rather than the convolution.

In more recent years, Monte Carlo estimation has started to gain prominence in probabilistic production costing as computing power has increased. Valenzuela and Mazumdar [11] showed that Monte Carlo simulation can provide results that converge to the convolution methods with no additional restrictions. Valenzuela and Mazumdar then showed that the larger set of unit commitment constraints could be represented in the Monte Carlo production cost calculations. Bertoldi et al [22] showed that Monte Carlo simulations could be even be accurately used for planning studies that included power flow.

For this reason, we chose to use Monte Carlo methods rather than convolution. For microgrids these methods are especially powerful as microgrids are small enough that the calculations can run in reasonable amounts of time on consumer grade computers, less than a half hour for the simulations run for this thesis.

A more complete explanation of how to conduct a Monte Carlo simulation of a power system for reliability was written by Billinton and Li [23]. This book expanded Billinton's previous work on power system reliability [10] that had used the convolution method to include Monte Carlo simulation. Reliability was one segment of the work in this thesis and the framework to consider reliability is similar in form to probabilistic production cost as is seen in Wood et al's book [9].

3.2 Microgrid Cost Estimation

There has been a large amount of research around microgrid cost estimation and schedule optimization. The most famous example of a microgrid cost estimation tool is HOMER [24]. HOMER was originally developed by the National Renewable Energy Lab but was later commercialized by HOMER Energy LLC. HOMER is a fully featured tool for estimating and optimizing a microgrids. HOMER has an extensive library of components, both from industry and idealized. It has the ability to estimate the power production from both wind and solar based on the location of the microgrid. HOMER estimates the life of the batteries based on the amount of power in and out of the battery, the capacity rate - the percent of the batteries nominal capacity in either AHrs or kWHrs - at which the battery is charged or discharged, and the temperature profile of location of the microgrid. It has the ability to estimate generator fuel use of diesel and natural gas generators and to calculate end of life with run hours. All of these sources would be useless without load, HOMER can change a given load profile with an annual inflation factor or it can use the load profile as given. All of these features go into an optimizer that allows it to minimize total cost to serve the load by selecting from a user chosen portfolio of generation assets .

HOMER's weakness is in its lack of randomized outages for microgrid equipment. It can include predicted maintenance in its schedule but can not estimate LOLP and does not have any tools for estimating the effect of stochastic outages [24]. This is a major shortcoming because while it can change the generation portfolio to meet a minimum availability based on the probable resources and show the effect of the choice of the availability requirement, it can not estimate to cost of ensuring availability with equipment with random outages.

HOMER is so prevalent that it is frequently the only methodology for published experiments. Aris and Shabani [25] studied extending capability of remote cell phone towers using HOMER. As Aris and Shabani used HOMER, they only looked at costing not at reliability. Aris and Shabani considered both photovoltaics and battery storage, primarily lead acid - the most mature technology but not the most energy dense. This paper primarily concluded that there were options for hybridization but did not include recommendations for which technologies were the most likely to lead to cost reductions, just that there were many ways to achieve that.

Another HOMER experiment in this area was conducted by Bhandari et al [26]. Bhandari et al had a very good definition of generator cycling, using batteries to most efficiently load the generator and to shut the generator off when it can not be run efficiently. Bhandari et al showed that PV could potentially increase the operating cost if it was used to push generators into less efficient operating areas.

There has also been a large amount of academic research into optimizing microgrid equipment profiles. Fathima and Palanisamy [27] cover optimization of sizing of solar, wind, diesel, and energy storage along with different methods to optimize the dispatch of each. This paper did a very good job in reviewing the research in microgrid optimization. Fathima and Palanisamy show that a broad selection of heuristic optimization methods have been used: including ant colony optimization, evolutionary algorithms, genetic algortihms, and particle swarm optimization. However the diesel section demonstrated a misunderstanding of the fuel use of internal combustion engines and did not cover how different efficiency is across the operating curve that persisted through a large portion of the literature..

Fathima and Palanisamy employed a linear relationship between fuel and power, which ignores the fixed frictional losses [16], implying that the next kW from the generator will take less fuel than the current kW. The other issue with the assumption that diesel generator fuel use is linear across their entire operating spectrum is the possibility of pollution control equipment damage from running with insufficient heat. This can result in filter plugging which can increase either fuel use many modern diesel engines inject fuel into the diesel particulate filter to heat the filter in order to remove plugging or maintenance costs associated with replacing filters. That brings out the other weakness in the research documented in [27] - it has focused entirely on the operating cost of the microgrid rather than examining the total cost of ownership necessary to serve the load. Fathima and Palanisamy weighed the cost of power electronics and batteries against the fuel and maintenance savings achieved by having them, in the existing research, photovoltaic and wind equipment were treated as if they were free. Because of this fact, [27] did not look at the payoff times or the time value of the capital.

Hu et al [28] also looked into microgrid equipment profile optimization. The situation that was considered in that paper was the inclusion of pumped storage hydro in an island microgrid along with diesel generation, solar, and some possibility of demand response. This scenario was compared to a similar microgrid without demand response and to a similar scenario with deep cycle batteries rather than pumped storage hydro. The biggest difference between this scenario and the MEHPS scenario that was considered in this work was MEHPS is designed to be transportable. The scenario considered by Hu et al. was designed with the geography of Zhu Hai, China in mind. Because of the existing geography and the cost of building height of the storage was one of the factors that was optimized with particle swarm optimization in this paper. This paper concluded that if the geography is amenable, pumped storage hydro is more economically efficient than batteries.

Nayar et al [2] looked into the equipment profile optimization and control of a remote microgrid. This paper was about the experience of designing a microgrid with high renewable penetration on Uligam Island in the Maldives. The goals were to improve power quality and to augment the capability of the diesel generators that currently power the island with wind, storage, and solar. The authors got weather data and from NASA and NREL to estimate the available wind and solar resources. They then used HOMER to estimate the capital cost to provide the expansion. One notable thing was that Nayar did not treat the diesel generators as a linear function for fuel use, meaning that their controls were similar to the ones that would be suggested in this thesis where the diesel generator was tried to be run at full load. The two things that this paper lacked were a reliability measurement and discussion of the capability of the power electronics that were going to be used. Nayar said that all resources were coupled on the AC side, but did not say what was capable of running independently and what would need an external voltage reference.

Liu and Qu [4] had a similar situation a remote microgrid with no grid connection. Liu and Qu optimized around the size of their energy storage taking into account a variable load and variable sources, something that HOMER does very well. It is similar to the situation that we considered in that the load had to be met by the existing sources, in our case that was the diesel generators, in theirs it was renewables. The purpose of the energy storage was different, Liu and Qu were optimizing the amount of energy storage to add to create availability at all times with the lowest possible levelized cost of energy with variable sources. It is different in that Liu and Qu had already made their decision to add storage, the economic optimization was around how much storage to add with the assumption that storage was going to be added, as a part of the assumptions we used a fixed (much smaller) amount of energy storage but were looking at whether it is economically efficient to add storage. The other difference was in the operating philosophies, in this paper the batteries were the only dispatchable , so Liu and Qu require much more storage capacity than the operating philosophy we considered where the batteries were used for generator cycling [2] in a network with low renewable penetration which meant that there always had to be generators available.

Showing again that much of the work has been in sizing rather than in estimating cost, Notton et al [29] considered how to best size a solar hybrid on the island of Corsica considering LOLP. This work is similar to ours in that it was not grid tied and considered LOLP as an important metric for how the end user would like their microgrid to behave. It was different in that it was sizing for the result and was looking at maximizing the renewable penetration given the desired performance, in fact Notton et al ended up with a 75 percent solar penetration.

Museli et al [3] looked at a how to optimize the size of the PV, storage, and backup up diesel units for remote loads to decrease the cost of operation. This work considered the diesel generators back up to the photovoltaic and storage. This was different than how the MEHPS

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[2] The best definition of this was found in [26]

system treated the diesel generators.

Many of the same optimization techniques that were used for unit commitment have been tried for the optimization of microgrid equipment. Sobu and Wu [30] used particle swarm optimization to consider optimal planning given the unpredictability of renewable resource variability. It found that particle swarm optimization gave similar results to deterministic methods. This is different than the work in this thesis, this thesis used Matlab's linear programming solver for convex optimization.

3.3 Reliability Estimation

Bakkiyaraj and Kumarappan [31] looked at whether Latin Hypercube sampling would extend its benefits, including convergence with fewer samples and better sampling of the extrema, to the reliability of power systems. They compared the technique to larger random samples and to state enumeration. Bakkiyaraj and Kumarappan found that the benefits of Latin Hypercube sampling for Monte Carlo simulations worked for reliability questions in power systems. For this reason, we choose to use this sampling technique for the research described in this thesis.

Billinton and Bagen discussed the changes that including wind, solar, and energy storage in the grid would require for estimating the reliability of the grid in ”Reliability considerations in the utilization of wind energy, solar energy and energy storage in electric power systems” [32]. It showed that the primary driver of reliability of wind and solar power systems is in the availability of energy. The case that was studied that included a commercial wind turbine with a forced outage rate of .04 and solar panels with a forced outage rate of .03, this is comparable to the conventional generators in the Roy Billinton Test case, the test case that was used for all of this data. Billinton and Bagen drew several conclusions in this work. First, adding renewable generation will increase the reliability, but not as much as adding similarly sized conventional generation. Second, adding renewables will increase the annual peak load capacity with the same reliability. Third, the LOLP will remain relatively flat while the size of the new renewable resources increase. Fourth, there is an idea of a renewable risk based equivalent capacity ratio. This ratio is the ratio of additional renewable generation that has to be added to replace the loss of a fixed amount of conventional generation. For solar in Saskatoon and Regina, the is approximately just over eight meaning that more than 40 MW of solar generation would have to be added for every 5 MW of conventional generation removed. This paper was very interesting because it had good examples of the questions that could be asked of reliability data and had examples of the calculations.

Other papers address the idea of dependable capacity for renewable resources exclusively. Naksrisuk and Audomvongseree [33] calculated the maximal penetration of wind and solar with target LOLPs. Naksrisuk and Audomvongseree used weather data of the area they were considering and paired it with expected forced outage rates of both traditional generation and the weather, and therefore the output power, and the forced outage rates of the renewable resources that were being considered. This available power was compared to a normal distribution representation of the load. The method demonstrated in [33] was extremely comprehensive and gave a good reference for a similar Monte Carlo simulation in the research for this thesis. The primary difference was that rather than building simulated solar data, we chose to use historical data for the locations of interest.

3.4 Renewable Resources

Breyer [14] was a very good demonstration of the LCOE calculation with comparisons to both any existing grid power in the Middle East/North Africa (MENA) region. It looked at fuel prices and the composition of the current grid sources to use climactic data to estimate when grid parity would occur. This paper was a very good example of using average climatic data to estimate costs, which is a very good efficient strategy for long term estimations of cost. Breyer also did not look at the value of reliability - something that could be of great interest in the developing world. Breyer's work differs from our work because of the addition of reliability in our work. That meant that our work had to calculate costs at a higher resolution in order account for the presence or absence of the renewable resource.

Rehman et al [34] looked at the solar potential between several remote areas of Saudi Arabia. Rehman et al discussed the effect of both solar irradiance and temperature on the output and longevity of solar panels and the associated power electronics. Rehman et al then compared cash flow and internal rate of return on these potential installations. Rehman et al had a more detailed look at equipment aging than was used in the research in this thesis. To move forward with a hybrid reliability and total cost of ownership tool, better aging models would be needed. The economic analyses that Rehman et al used were very different than the ones used to estimate total cost of ownership, the economics tools that were used were very appropriate for the authors' use of determining the location to place power generation that was intended to generate power for sale.

Ehnberg and Bollen [13] demonstrated a mathematical simulation of solar radiation estimation independent of location. Ehnberg and Bollen described a Markov chain seeded with the location and the tilt of the earth as well as local distributions of cloud coverage. The output of this Markov chain is the direct and indirect solar radiation which was used to show the amount of power that was available at different angles of installation per meter squared of installed solar power. This information was used to understand the National Oceanic and Atmospheric Administration (NOAA) average solar data file and was therefore used to build the Monte Carlo simulation of the weather solar for solar installed parallel to the ground.

Zweibel et al [35] was a back of the envelope calculation describing the amount of land, the amount and type of storage that would be appropriate for that amount of energy, and the cost and research that would go into making a large solar plant capable of supplying the majority of the US's energy. Among other estimates that Zweibel made were degradation of the PV panels were at between .5 and 1 percent per year and were warranted for 1 percent per year.

Our research did not use degradation rates for the photovoltaics as the longest time period considered was ten years. Skoczek et al [36] studied the results of longer term degradation of performance of the solar panels, showing that between nineteen and twenty-three years in use solar panels would suffer degradation in output power, open circuit voltage, and short circuit current. For the purposes of our reasearch, only the power would be the only of interest as it is the only factor studied that would have a cost. However, the loss of open circuit voltage would be of interest in designing inverters.

3.5 Batteries

For the purpose of this thesis, the primary interest in batteries was in their cost and expected lifetime, a factor in how much it will cost to own the batteries.

Gaines and Cuenca [37] studied the cost of lithium ion batteries for transportation into the future. This was of interest because one of the larger potential markets for large lithium ion batteries is transportation. They found that depending on commodities prices by 2020 the price should be between 250 and 706 dollars/kWh. This fits well with the quotes for completed packs are running between 400 and 500 dollars/kWh. For the MEHPS application new batteries would be more ideal because the application is designed to be tranported. However Neubauer and Pesaran [38] detailed how to calculate the value of second use transportation batteries. These would be ideal for stationary customers who are price sensitive.

Battke et al [39] looked at a variety of batteries including lead-acid, lithium-ion, sodium-sulfur, and vanadium redox flow batteries in stationary applications including Utility Energy Time-shift, Energy Management (community scale), Transmission and Distribution, Investment Deferral, Increase of Self-consumption, Area and Frequency Regulation, and Support of Voltage Regulation. The chemistry that was considered in this thesis was lithium-ion. The applications most similar to the microgrid are energy time-shift and community scale energy management. Battke et al provided analyzed data with a minimum and maximum life cycle estimate based on other research.

3.6 Power Electronics

Lopez et al. [40] did a power electronics control development for a diesel and storage hybrid. Lopez et al. developed the control for a bidirectional inverter paired with two 330V transit batteries in series to develop a 660V DC bus. This paper covered many of the challenges of paralleling storage to diesel generators.

The first challenge that was covered in Lopez was uneven distribution of the loads across the three phases when the storage inverter was in grid forming mode, where the inverter provides its own internal voltage reference. The solution that was found to that challenge was to connect the neutral of the three phase Y output to a neutral created between the two batteries with the result that it has better line to line voltage regulation with uneven phase loading than the generator did.

The second challenge that was covered in Lopez was the fact that modern diesel generators parallel *isochronously* meaning that they run at the same operating speed at all times and both real and reactive load share data is shared over separate data lines rather than as a function of the power output waveforms. This was adapted to by using the generator output waveforms as the voltage reference waveform and controlling to an input or output current - remembering that this was about controlling a bidirectional inverter.

The third challenge that was covered in Lopez was balancing the two battery packs. This challenge was a result of the solution to the challenge of supporting unbalanced three phase loads and used the same neutral connection. The authors used the neutral between the batteries to control the current to each battery individually. This was controlled by a feedback loop based on the difference between the states of charge (SOC) of the batteries to rapidly equalize the SOCs without exceeding the total AC power the inverter was to draw from the microgrid.

The fourth challenge was a result of the two different voltage reference sources. To reduce the usage of the generators, the inverter had to be able to switch back and fourth between the two voltage references seamlessly. To do this Lopez et al looked at the effect on the voltage and current waveforms of starting and stopping the generators.

This work was very explanatory in the challenges around good power electronics controls in parallel with generators. This inspired the questions around the maturity of the power electronics effecting the total cost of ownership.

Guo et al [41] also considered this problem and came up with a different solution. Guo et al proposed a control that included both the storage inverter and the diesel generators. They demonstrated very good theoretical control, but introduced the problem of the inclusion of a central control to the microgrid. Central controls can act as a single point of failure, reducing the reliability of the microgrid.

In ”Power Electronics and Reliability in Renewable Energy Systems” Blaabjerg et al [42] discussed the current state of power electronics in renewable and how it can effect reliability. For solar inverters, the highest reliability configuration is the string inverter. String inverters are inverters smaller than the total power demand that are paralleled to the grid on the AC side. They are often single phase and 120 degrees out of phase if three phase is desired. A more extreme version of this is the modular solar panel, a solar panel combined with an inverter, increasing the the power per panel by increasing the accuracy of the maximum power point tracking. Both of these concepts increase the reliability of the whole system by giving multiple points of failure before there is a total of power and the ability to operate in a derated state with fewer inverters. In the MEHPS system, there is interest in running generators in parallel for reliability, but that interest does not extend to the storage inverter. Even though there is only a single storage inverter, the concept of increasing reliability through modularity is specified in by paralleling it to the existing network on the AC side.

Chapter 4

Preliminary Work

4.1 Motivation

The availability of the MEHPS load profiles and my professional experience with the generators that are currently powering this load provided a good opportunity to look at the cost and benefit of adding power electronics and storage as there are a lot of RFP/RFQs currently available for this. The MEHPS was used to calculate TCO from five different scenarios over a ten year period, which is an estimate on the expected life of an inverter [43] using an Microsoft Excel based tool designed for this purpose

- The first scenario was business as usual - all sets sharing load equally
- The second scenario was intelligent operation - only running the number of sets needed to meet the load and a small percent spinning reserve, it is important to note that intelligent operation does not require any additional equipment
- The third scenario was a high spinning reserve version of intelligent operation always have at least a full generator of spinning reserve so a generator could fail without causing any load to be unsupported, this was only calculated for the three hundred kW load profile only
- The fourth scenario was a first cut hybrid where batteries only support the load when the system is extremely lightly loaded

- The fifth scenario was a more advanced hybrid where the energy storage and the power electronics act as the spinning reserve.

The information that the initial estimates for TCO included:

- The initial investment in generators, inverter, and batteries.
- The cost of fuel.
- Number of battery cycles informs battery replacement.
- Number of run hours informs generator replacement and maintenance.

Previous generator experience has suggested that generator efficiency is a logarithmic function because of the fixed amount of losses to friction at a fixed engine operating speed. Therefore the amount of fuel needed was calculated by fitting a logarithmic curve to the generator fuel use estimates [44]. Once the number of gallons were estimated, the total price of fuel was found over the course of a year using a variety of fully burdened costs of fuel coming from the military liquid fuels cost estimates. As a lower bound on fuel cost was needed, we took the price from a local supplier.

The other information that this Excel tool calculated was pollution - CO2, NOX, and DPM were all calculated. CO2 was looked at because of the cumulative effects on climate and was calculated from fuel used. NOX and DPM were calculated from the method explained by Trozzi[45]. DPM is considered a toxic substance and previous recommendation such as running on a platform [46] do not easily work for this application so reduction through better use is important.

In all of the scenarios, run hours were also calculated. This generated a surprising amount of savings in generator replacement costs. Generators lives are defined by run hours much as cars lives are defined by miles. With fewer annual run hours the expected generator life increased the more complex the microgrid was.

Since diesel generators are currently the only power source for this load, the generators have more run hours and more fuel consumption annually than backup generators which makes operating cost for these scenarios higher than capital costs, the results would not be generalizable to back up generation.

The largest category of fuel use for the military during war time is generator fuel. Each forward operating base needs electrical power and to provide it there is a generator or generators

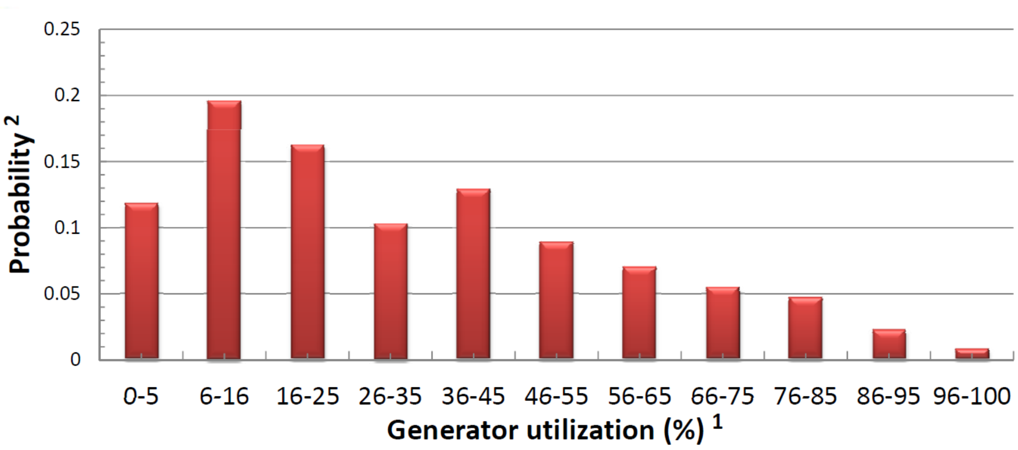


Figure 4.1: Histogram of the percent of the time existing generators were used at different loads (figure from [1])

sized to meet the peak load running continuously. Looking at the profile of the generators used and the two load profiles, sixty kW generators were the most appropriate for the 100 kW peak and 300 kW peak. Because generators have a logarithmic efficiency, fuel use was found at 25, 50, 75, and 100 percent, these data were used to fit a curve that in shape matched previous work on generator efficiency. There was no information about fuel usage at 0 percent because usually there is no need to run the generator at that load and running at that load can cause damage to the emissions controls equipment of the generator2.3.

Efficiency is calculated in gallons of diesel/kWHr of electricity produced, in other words, how efficiently the system converts from chemical to electrical energy. This measure of efficiency is very useful for estimating the amount of fuel used with an hourly load profile because each kW load step can be converted to kWHr because it is known that a load of that kW is run for that hour.

Because of the variable load, the generators are not always operating efficiently. Figure 4.1 shows how little load the generators traditionally operate, usually than 50 percent loaded more than half of their operating hours. As discussed in 2.3, this means that the generators are not running at their most efficient points in traditional operating scenarios.

This work tried several different methods of operation including: There were multiple different configurations of the generation and storage as described below:

Original Configuration

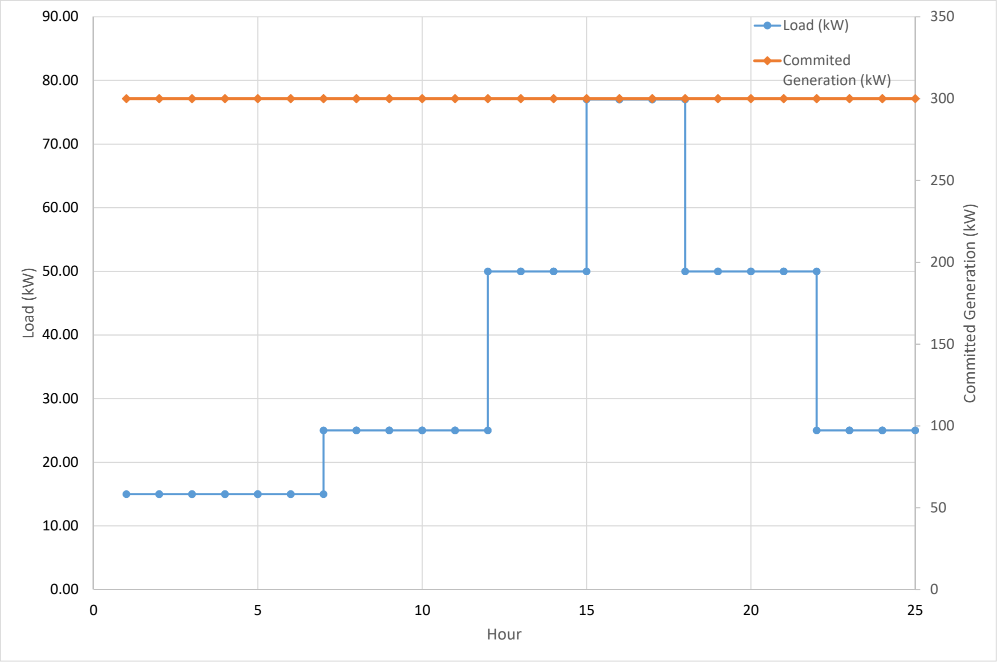


Figure 4.2: Committed Generation over a Fall Day with the 300 kW Load Profile Under the Original Operating Parameters

In the original configuration all generators (two 60 kW generators for the 100 kW case and six 60 kW generators for the 300 kW case) were run dividing the load equally over the generators. This meant that wear was equally spread across the generators and all generators would have to be replaced at the same time.

This configuration resulted in the lowest utilization and highest fuel consumption but gave a good baseline for how generators are currently being run and gave a good estimate of the cost to provide the power to the load.

Intelligent Operation

The first change that was considered was to operate the same generators in a more efficient manner. The rule of generator operation were as follows: for each 50 kW of load a 60 kW generator would be used to the maximum number of generators (2 for the 100 kW case and 5 for the 300 kW case). This rule takes into account the two conflicting requirements - the more

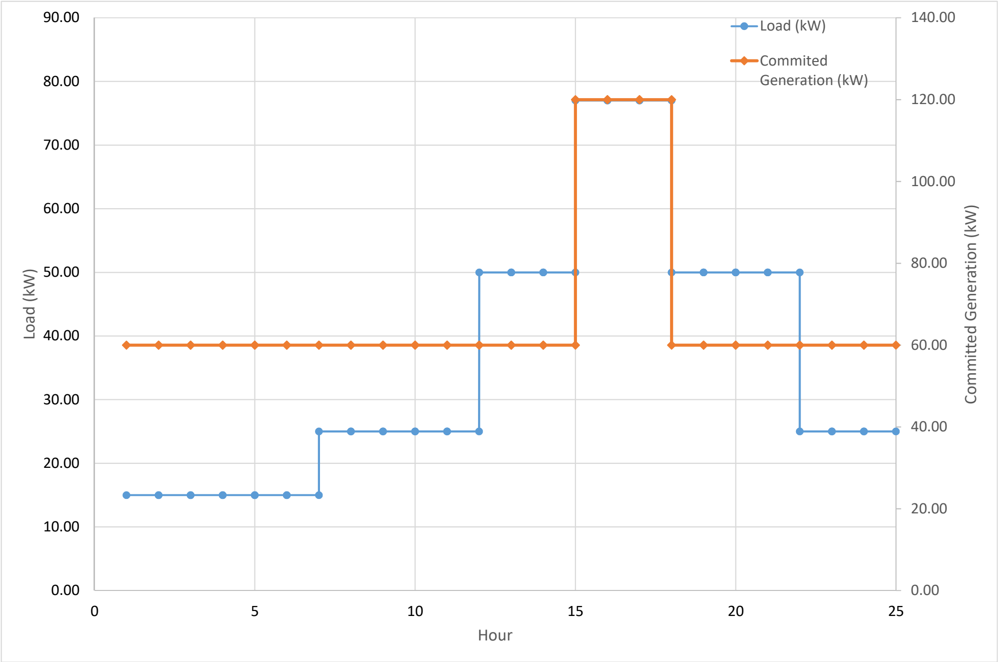


Figure 4.3: Committed Generation over a Fall Day with the 300 kW Load Profile Under the Intelligent Operation Model

the generators are loaded the more efficient they are and the more excess generator capacity there is the more load security there is. Different spinning reserves would result in different fuel consumptions.

There were also changes to the capital expenditures in this scenario. The total run hours were calculated in this scenario and divided by the estimated number of run hours in a generator life multiplied by the number of generators to get an estimated frequency in number of years in which the generator would have to be replaced. It was assumed that run hours would be equally shared among all generators, which means that all generators would have to be replaced at the same estimated time.

High Spinning Reserve

The high spinning reserve case differed from intelligent operation by having a minimum spinning reserve equal to a single generator worth of load. Because of the comparatively high

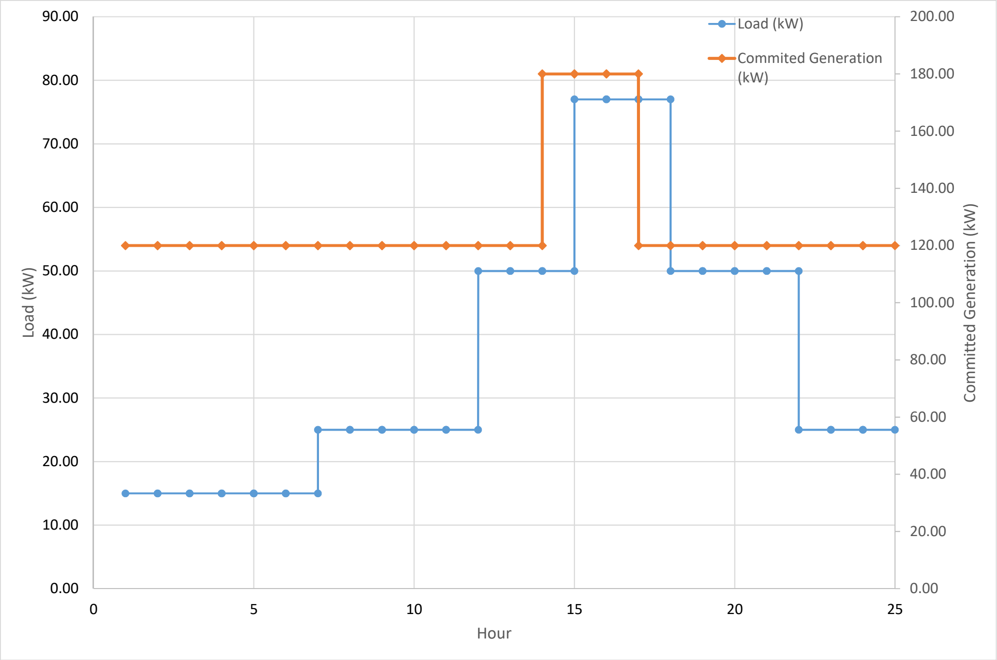


Figure 4.4: Committed Generation over a Fall Day with the 300 kW Load Profile Under the High Spinning Reserve Model

forced outage rate of generation compared to transmission (cite conference) a higher spinning reserve for microgrids is a reasonable precaution.

The high spinning reserve case kept the changes to the capital cost that were made in the intelligent operation scenario. It did not add any additional equipment, it changed the run hours of the generators and the fuel consumed. The suggestion of this scenario by an end user suggested the sensitivity to power outages was important and became the foundation of the other major tool developed for this dissertation.

Hybrid 1

The simpler hybrid was an extension of the intelligent operation or high spinning reserve scenarios - generators would not be loaded to more than 50 kW before the next generator would be started. The primary difference would be that if there was sufficient state of charge and the total load was sufficiently low, in this example below 25 percent - the approximate location of the point of inflection of efficiency curve the system would run only on the battery, not running any generators at all.

All of the estimates on total fuel used, were estimated with a 90 percent efficiency on both charging and discharging. Even with the losses, there was still less overall fuel used in all cases. The logarithmic fuel efficiency means that because the hybrid can prevent the generator from running at extremely low loads and can increase the overall load when the state of charge and the load are low, which will move the generator to a more efficient operating point.

The major difference between the Intelligent Operation capital expense estimates and the Hybrid 1 capital expense estimates are the addition of the inverter and batteries. The battery cycles were kept track of to estimate the time between battery replacements with an estimated battery life in number of cycles coming from data center back up equipment [47]. These batteries were selected to match the energy storage equipment that was being built to meet the MEHPS RFPs. Generator run hours were estimated in this configuration as well.

One thing to observe in both Figure 4.5 and Figure 4.6 is that there are times when the generated power is lower than the load. At those times, the load is still being met, however rather than being met by the diesel generators it is being met by the energy storage. This when combined with the information presented in 2.1 illustrates how the two hybrid configurations are able to save fuel - the times when the generators are shut off are times when the load is so low that the generator would run extremely inefficiently.

Hybrid 2

The second hybrid is a deviation from intelligent operation and the first hybrid as it would provide the spinning reserve rather than having it provided by the generator. The second hybrid would require a more complex control system for the inverter to be able to act as the spinning reserve. The fuel savings differences between the two hybrid configurations is extremely dependent on the load profile with a much higher percent saved with the 300 kW case than with the 100 kW case.

For this configuration the efficiencies were kept the same for all cost estimates as in the Hybrid 1 configuration, however an additional term was added to the battery cycles. The new term was estimated generator failures per year based on the MTBF from the AMMPS product description [48] and the number of hours per year. This term decreases estimated battery life because it increases the number of cycles per year.

The second thing to observe in both Figure 4.5 and Figure 4.6 is that for a standard day,

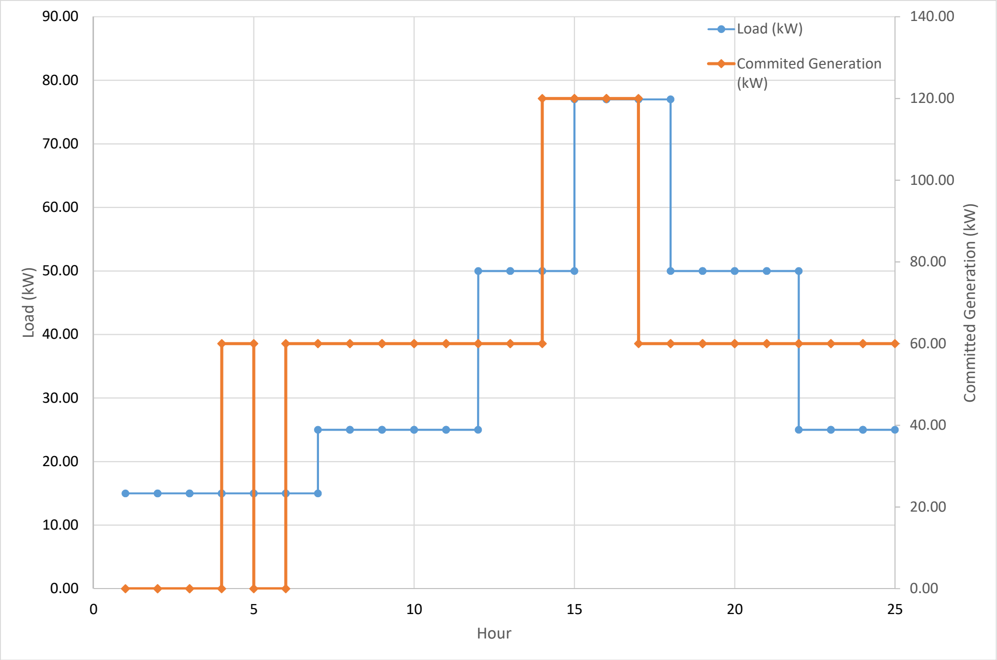


Figure 4.5: Committed Generation over a Fall Day with the 300 kW Load Profile Under the Simple Hybrid Model

because they each have the same equipment, the committed generation is the same. The difference between **Hybrid 1** and **Hybrid 2** is in the controls for the power electronics. Hybrid 2 is capable of being the spinning reserve for the microgrid. This is actually challenging for two reasons. Most modern diesel generators parallel *isochronously* (cite), meaning that the generators are controlled to operate at the same engine speed, frequency, and voltage magnitude. These generators are easy to parallel to if, like the majority of solar inverters, the power electronics get their sine wave reference from an external source (cite). Most inverters that are designed to parallel and use an internal sine wave reference use droop to govern (cite). When using droop to govern, a device will increase or decrease its frequency and voltage magnitude in response to the load that it is supplying.

To be able to switch between using the an external sine wave reference and using the internal sine wave reference is crucial for this application. In the microgrid that we built [40], we used

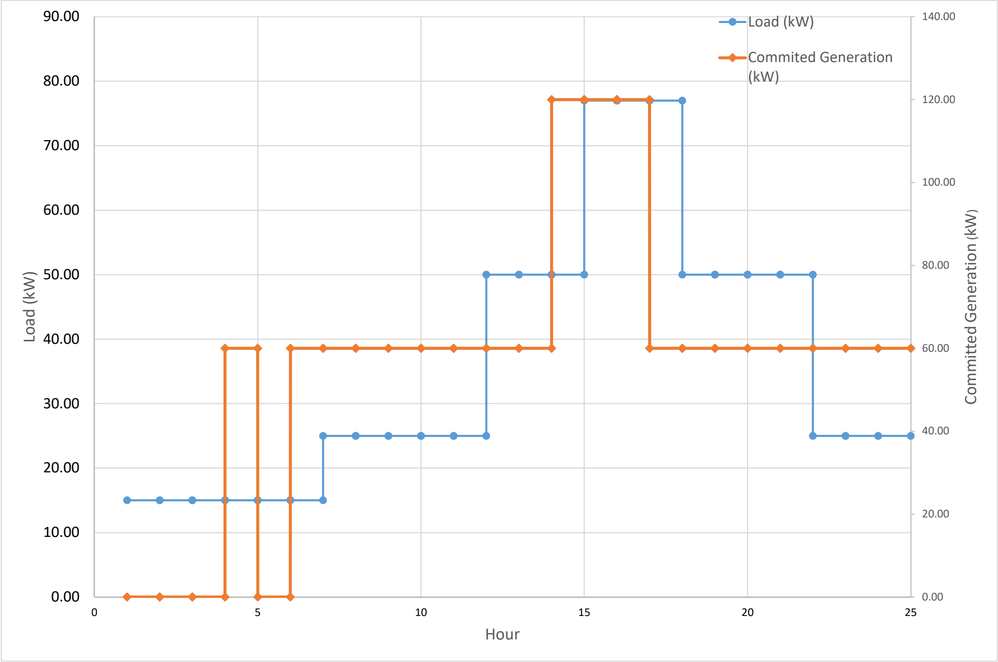


Figure 4.6: Committed Generation over a Fall Day with the 300 kW Load Profile Under the Complex Hybrid Model

neutral current between battery packs both to provide for an unbalanced three phase load and to diagnose when the power electronics needed to change their operating mode.

4.2 Results

All of the conclusions are based on the assumptions stated above, that the longest life item is the power electronics at around ten years, that generator life is twenty thousand run hours, and that LiIon batteries are capable of 2500 charge cycles. The data on fuel prices was from a report on fully weighted cost of fuel to the military and from gas station observations recorded in October 2015 in Minneapolis, MN.

All of the comparisons are the net present value of the cost to meet the load over the expected life of the inverter even in cases where there was not an inverter present. The net present value was calculated at 0, 1, and 5 percent discount rates. The rates were chosen to show the pure

Table 4.1: Total Costs of Ownership for the 100 kW Low Fuel Cost, High Battery Cost Cases

Discount Rate (%)	**0**	**1**	**5**
Original Configuration ($)	1,287,848.10	1,200,312.03	984,058.03
Intelligent Operation ($)	1,085,392.80	991,694.26	817,379.67
Hybrid 1 ($)	1,054,086.47	948,141.74	875,918.57
Hybrid 2 ($)	1,036,777.60	1,028,623.62	855,159.30

dollar cost of the microgrid which over ten years would be weighted towards operating and maintenance costs and to show the present value with a much higher sensitivity to capital costs, the one percent was a compromise point that discounted operation and maintenance increasing sensitivity to capital costs but at a lower enough rate that operation and maintenance would still affect the net present value.

Cost Data

Low Fuel Cost, High Battery Cost

The low fuel cost, high battery cost cases will be the most sensitive to the differences in the capital costs, in other words the cost of the power electronics and batteries because it combine the low operation and maintenance cost with the high capital cost. The total costs with 0, 1, and 5 percent discount rates are compared below for both the 100 kW load profile and the 300 kW load profile *100 kW Low Fuel Cost, High Battery Cost*

The sensitivity to the higher capital costs is very obvious in this case. With no discount rate the hybrids are less expensive over ten years than operating the generators intelligently, if there is any time value of money operating the generators intelligently is the optimal way to run this microgrid. Because of how close the TCO is for this configuration, if it is likely to be running for less than ten years, intelligent operation is the optimal operation for this combination of load profile, battery cost, and fuel cost.

300 kW Low Fuel Cost, High Battery Cost

This case is similar to the 100 kW case with Low Fuel and High Battery Costs in that it is very sensitive to the change in capital costs. In all cases Intelligent Operation is the most cost effective way to serve the load. However, the High Spinning Reserve cases is cheaper than the original configuration and provides more load security. The high spinning reserve case is more expensive than either of the hybrid cases. The best option would depend on the tolerance for risk of loss of load or if it was an option intelligent distribution equipment though that would

Table 4.2: Total Costs of Ownership for the 300 kW Low Fuel Cost, High Battery Cost Cases

Discount Rate (%)	**0**	**1**	**5**
Original Configuration ($)	3,205,86.70	2,987,488.47	2,449,308.73
Intelligent Operation ($)	2,404,390.80	2,160,185.35	1,785,585.66
High Spinning Reserve ($)	2,686,101.60	2,472,936.36	2,047,255.53
Hybrid 1 ($)	2,512,314.06	2,259,872.85	1,885,000.89
Hybrid 2 ($)	2,413,553.74	2,185,172.82	1,814,210.49

Table 4.3: Total Costs of Ownership for the 100 kW Low Fuel Cost, Low Battery Cost Cases

Discount Rate	**0**	**1**	**5**
Original Configuration ($)	1,287,848.10	1,200,312.03	984,058.03
Intelligent Operation ($)	1,085,392.80	991,694.26	817,379.67
Hybrid 1 ($)	1,065,841.50	1,000,952.11	828,142.12
Hybrid 2 ($)	1,006,197.30	975,489.26	807,382.85

also add capital cost.

Conclusion

With the low operating costs and the high capital costs, these two separate load profiles were economically served by operating the generators intelligently. The hybrids should only be considered if the installation is very certain that it will have at least ten years of installed time or if there is very little tolerance for a potential loss of load as the hybrid is a way to decrease the possibility of lost load without increasing generator run time and therefore operating cost.

Low Fuel Cost, Low Battery Cost

The following two cases reflect the lower of the battery cost estimates 250 dollars/kWh and still use the gas station cost for fuel. The batteries are the largest capital expense for the hybrid so these cases represent an optimal case for the microgrid operator: low operation and maintenance and low capital costs.

100 kW Low Fuel Cost, Low Battery Cost

The lower capital costs are reflected in the following two examples:

These cases illustrate the margin at which the microgrid would operate. It is always less expensive to own and operate the more complicated hybrid, but with a high time value of money (a discount rate of 5 percent) it is less expensive to own the generators and operate them to suit the load than it is to own and operate the less complicated hybrid.

Table 4.4: Total Costs of Ownership for 300 kW Low Fuel Cost, Low Battery Cost Cases

Discount Rate (%)	**0**	**1**	**5**
Original Configuration ($)	3,205,86.70	2,987,488.47	2,449,308.73
Intelligent Operation ($)	2,404,390.80	2,160,185.35	1,785,585.66
High Spinning Reserve ($)	2,686,101.60	2,472,936.36	2,047,255.53
Hybrid 1 ($)	2,445,117.90	2,206,480.75	1,836,203.62
Hybrid 2 ($)	2,343,761.69	2,132,038.46	1,766,434.04

Table 4.5: Total Costs of Ownership for 100 kW High Fuel Cost, High Battery Cost Cases

Discount Rate (%)	**0**	**1**	**5**
Original Configuration ($)	3,159,384.30	3,029,728.78	2,475,539.08
Intelligent Operation ($)	2,754,038.40	2,628,947.15	2,152,193.98
Hybrid 1 ($)	2,574,984.74	2,594,919.02	2,132,123.61
Hybrid 2 ($)	2,609,852.20	2,518,530.48	2,069,845.81

300 kW Low Fuel Cost, Low Battery Cost

The lower capital cost places intelligent operation as more expensive than the more advanced hybrid in all cases but less expensive than the simple hybrid. High spinning reserve is always more expensive than either hybrid option. The difference between high spinning reserve and intelligent operation clearly illustrates the cost of ensuring continuous operation for all loads. This would be another place that intelligent distribution equipment could also be used to increase reliability capital cost lower than that of the hybrids.

Conclusion

These cases still only show a marginal benefit of hybridization compared to intelligent operation. The value again would be in cases where there was a need for extremely high reliability making the comparison not between either of the hybrids and intelligent operation but between in the case of the 100 kW load profile between the original configuration and the hybrid or in the 300 kW case between intelligent operation and the hybrid.

High Fuel Cost, High Battery Cost

For the high fuel cost, column we are looking at the nine dollar per gallon fuel. It is approximately the same ratio as the low and high cost batteries the highest cost case does not give much data because of the relative rarity of forty-five dollar per gallon diesel.

100 kW High Fuel Cost, High Battery Cost

Table 4.6: Total Costs of Ownership for 300 kW High Fuel Cost, High Battery Cost Cases

Discount Rate (%)	**0**	**1**	**5**
Original Configuration ($)	8,006,360.10	7,534,447.15	6,156,338.70
Intelligent Operation ($)	6,350,792.40	5,897,942.49	4,832,892.37
High Spinning Reserve ($)	6,988,444.80	6,547,816.63	5,369,410.90
Hybrid 1 ($)	6,428,329.86	5,928,546.58	4,875,654.32
Hybrid 2 ($)	6,178,610.74	5,751,172.96	4,721,487.71

Table 4.7: Total Costs of Ownership for 100 kW High Fuel Cost, Low Battery Cost Cases

Discount Rate (%)	**0**	**1**	**5**
Original Configuration ($)	3,159,384.30	3,029,728.78	2,475,539.08
Intelligent Operation ($)	2,754,038.40	2,628,947.15	2,152,193.98
Hybrid 1 ($)	2,692,684.50	2,541,784.66	2,084,347.16
Hybrid 2 ($)	2,579,271.90	2,465,396.13	2,022,069.36

Even with the less complicated hybrid solution and a high time value of money, the hybrid is less expensive than intelligently operating the generator.

300 kW High Fuel Cost, High Battery Cost

In all cases intelligent operation is more expensive than the advanced hybrid but less expensive than the simple hybrid. High spinning reserve is always more expensive than either hybrid option.

Conclusion

In both of these cases, the more complex hybrid always has the lowest TCO. This emphasizes the need for engineering development to allow the largest degree of utility from the batteries. The ability to reliably include storage as part of the spinning reserve decreases the TCO to the point that it is always the lowest cost option over these configurations, even with the highest potential battery cost.

High Fuel Cost, Low Battery Cost

In these two configurations, the fuel cost is a larger percentage of the cost because fuel is more expensive while the capital costs are lower. The combination of high operation and maintenance and low capital costs make these the configurations that you would expect to give the highest savings for the hybrid configurations.

100 kW High Fuel Cost, Low Battery Cost

Table 4.8: Total Costs of Ownership for 300 kW High Fuel Cost, Low Battery Cost Cases

Discount Rate (%)	**0**	**1**	**5**
Original Configuration ($)	8,006,360.10	7,534,447.15	6,156,338.70
Intelligent Operation ($)	6,350,792.40	5,897,942.49	4,832,892.37
High Spinning Reserve ($)	6,988,444.80	6,547,816.63	5,369,410.90
Hybrid 1 ($)	6,361,133.70	5,901,186.58	4,848,294.32
Hybrid 2 ($)	6,108,818.69	5,698,038.60	4,673,711.25

Table 4.9: Pollution for all 100kW Cases

	CO2 (lbs)	**NOx (lbs)**	**DPM(lbs)**
Original Configuration	720463.11	19444.13	1368.18
Intelligent Operation	644784.58	17401.7	1224.46
Hybrid 1	606812.42	16376.89	1152.35
Hybrid 2	586756.87	15835.61	1114.27

In all cases the total cost of ownership of the hybrid is less than the cost of intelligent operation.

300 kW High Fuel Cost, Low Battery Cost

In all cases the total cost of ownership of the hybrid is less than the cost of intelligent operation

Conclusion

This is the most obvious of any of the cases, if you have high operation and maintenance costs and low capital costs a hybrid is worth the higher initial cost.

Pollution Differences

In addition to the cost differences in running in different configurations, there are significant differences in the amount of pollution produced when running more intelligently or even as a hybrid. Because the amount of many of the pollutants is directly related to the amount of fuel used, if there is a value in avoided pollution it will increase the value of avoided fuel use that is seen in the economic analysis.

100 kW

300 kW

Estimation of Cost Change with Carbon

With the amount of CO2 calculated in the previous section and EPAs social cost of carbon

Table 4.10: Pollution for all 300kW Cases

	CO2 (lbs)	**NOx (lbs)**	**DPM(lbs)**
Original Configuration ($)	1790688.48	48327.78	3400.55
Intelligent Operation ($)	1472007.7	39727.11	2795.37
High Spinning Reserve ($)	1604773.93	43310.25	3047.49
Hybrid 1 ($)	1460673.89	39421.23	2773.84
Hybrid 2 ($)	1404366.14	37901.57	2666.91

Table 4.11: Total Costs of Ownership of the 100 kW Cases including the Social Cost of Carbon

Discount Rate (%)	**0**	**1**	**5**
Original Configuration ($)	1,302,584.85	1,214,269.65	995,437.35
Intelligent Operation ($)	1,098,581.58	1,004,185.75	827,563.69
Hybrid 1 ($)	1,066,498.54	959,897.59	885,502.84
Hybrid 2 ($)	1,048,779.45	1,039,990.93	864,426.81

[49] estimate, we calculated the total costs with the differences in the amount of carbon produced in in the 100 kW low fuel cost, high battery cost case the case where there is the least justification for hybridization to see if it changes the conclusions.

It does not change the fact that with any cost of capital it is more expensive to run a hybrid than it is to run the network more efficiently, which is what would be expected from the orders of magnitude. With closer total costs of ownership, it would make a difference.

The above table is the Low Cost of Fuel, Low Cost of Batteries scenario. Including the cost of CO2 increases the difference in the prices which means that it decreases the amount of time for new technology to pay off.

Conclusion

The pollution differences between the different operating configurations is in the tens of

Table 4.12: Low Cost of Fuel, Low Cost of Batteries for 100kW load profile including cost of CO2

Discount Rate (%)	**0**	**1**	**5**
Original Configuration ($)	1,302,584.85	1,214,269.65	995,437.35
Intelligent Operation ($)	1,098,581.58	1,004,185.75	827,563.68
Hybrid 1 ($)	1,078,253.57	1,012,707.96	837,726.39
Hybrid 2 ($)	1,018,199.15	986,856.57	816,650.36

thousands of pounds of pollution per pollutant. The operating cost differences between the different operating configurations were - in the more obvious configurations - in the hundreds of thousands of dollars. If there were polluting costs it would not change the outcome in obvious cases, but in the marginal cases it could have a difference, for example in the case where with two of the three of the discount rates the TCO of the hybrid is lower than intelligent operation increasing the operating cost even marginally would change the result.

Chapter 5

Case Studies

The previous chapter discussed a quick experiment to determine the potential value of adding storage to existing primarily diesel generator served loads versus just operating the generators intelligently. The overall conclusion was that at the life of an inverter, keeping in mind that they can be moved to a new network if the installation is not going to be in use for the full inverter life, savings can be found even over just operating the generators intelligently if the fully burdened cost of fuel is considered - see section 4.2.

This work extends the experiment discussed in the previous chapter by using existing statistical methods for determining price and reliability of a power grid by applying them to a well-defined remote microgrid. This work incorporates the latest research about operating and capital costs of microgrids, as well as reliability of photovoltaic and storage components in order to try and improve estimations of cost and availability of such systems. We also wish to understand how cost and availability interact when operating a microgrid.

There is great interest in incorporating new sources of energy, including renewable sources such as solar, wind, or storage, in microgrid systems. Therefore, it is important to understand how such sources impact operating costs and reliability of microgrid systems—especially how to balance the varied potential benefits of renewable sources with higher initial costs. Renewable energy sources and storage have the potential, if operated well, to decrease fuel use and increase times between maintenance or replacement in remote microgrids. However the pure financial benefits are not the only benefit that is possible by including storage and renewable generation. Adding any type of additional generation will improve the reliability of the total network. The improvement unique to renewable sources and energy storage is also in decreasing the amount of pollutants from the generators including DPM, NOX, and CO2.

The capability of the renewable source and the energy storage to accomplish any of these tasks is limited by the capability of the power electronics being used. In this work, three different capabilities were considered: the first is the power electronics were perfectly capable, the renewable and storage sources could run alone or in parallel to the diesel grid; the second is that the storage was capable of running alone or with the diesel grid but a commercial photovoltaic inverter was used, meaning that the solar could only run if it had the storage or a diesel generator to provide a voltage reference, the third was the least capable, both the storage and the photovoltaic inverters needed an external voltage reference. This is an interesting question because it opens the question of whether or not this is problem can be solved by purchasing and integrating off the shelf equipment or whether inverter controls will need to be developed to meet the task. This is especially interesting as the majority of existing research assumes the existence of perfect power electronics controls, or at least does not state what the operational limitations of the power electronics are.

In performing this research, we are particularly interested in the following questions:

1. Will investments in storage and renewable resources be recouped?
2. If so, at what time period is that value realized?
3. Does the value of air pollution increase the potential value of the new sources?
4. What is the cost of attaining reliability?
5. Does the additional reliability from renewable and storage resources increase their value?
6. Does the capability of the power electronics affect reliability, and—therefore—the value of the new energy sources?

In order to answer the above questions, we have performed the following case study:

1. We have identified data sources and defined assumptions for the costs and availabilities of resources of interest. This process, and our results, are described in Section 5.1.
2. This data was then used to build a Monte Carlo Simulation that included both weather data and forced outage information of the unit commitment problem.

Table 5.1: Problem Dimensions

Factor	**Unit**	**Case A**	**Case B**	**Case C**
Fuel Price	**$/Gallon**	3	15	50
Required LOLP		0.001	0.00001	
Storage Presence		No	Yes	
Battery Price	**$/kWh**	250	706	
Battery Life	**Cycles**	5000	15000	
Solar Presence		No	Yes	
Solar Price	**$/Wp**	5.9	7.5	
Microgrid Life	**years**	1	5	10
Cost of Capital	**%**	0	1	5

3. This simulation was used to find the operating cost, runs hours of the generator, kWhrs charged and discharged from storage, fuel use, and a group of select pollutants.

4. Using these values and an understanding of expected equipment lifetimes, an initial equipment profile as well as necessary replacement were found in order to calculate the capital cost of the microgrid.

5. These costs are then compared to try and understand the effects of location, cost of fuel, expected life of the batteries, cost of batteries, desired reliability, and maturity of the power electronics controls over differing time periods and with differing costs of capital.

5.1 Data Sources

In this work, we wanted to explore the many dimensions that could affect the total cost of ownership. We considered factors that would affect the operating cost like fuel price, battery life, and required reliability. We considered factors that would affect the capital cost such as battery price, storage presence, solar price, and solar presence. Lastly, we included the capital expenses like cost of capital and the expected lifetime of the microgrid.

5.2 Load Profile

The Marine Corps is interested in energy storage for several different reasons [1]. The publication of these load profiles and the desired equipment to provide the power was an excellent opportunity to apply many of the economic tools to a real network both to quantify what is there and to use the optimizers available to set boundaries for determining minimum cost for the equipment. The Marine Corps are interested in maintaining the reliability of running multiple generators while actually only running a single generator, which would result in fuel savings and less frequent required maintenance - which is an excellent application for the looking at LOLP as a method of quantifying the availability of the existing network. They are interested in fuel savings through the optimization of generator loads - an excellent opportunity to apply UC in a manner to find production costs of the network.

The Marine Corps are also interested in the relative silence of running a battery/inverter combination compared to running a generator. Finally, they are interested in the relatively light weight of small batteries and inverters to make electrical power small and light enough to be portable by people. These were not something that were considered in this work. Those traits have value, but are extremely hard to assign a cost.

To help address these questions for a microgrid, the US Marine Corps have published the load and equipment profiles from their microgrids for industrial and research use. In this work, we have used these load profiles, as we are similarly interested in the first and second reasons for including energy storage—they are the reasons that will save money. Silent operation and man portability have value, but not a cost.

The most obvious feature of the load profiles in 5.1 and 5.2 is the large difference between the Spring/Fall load profile and the Summer and Winter profiles. This difference is the reason for these load profiles to have so much potential for a reduced cost to support the load without decreasing the reliability. Henceforth, we refer to these load profiles as the MEHPS load profiles or scenarios.

5.3 Electrical Sources

In this work, we use many different electrical sources—diesel generators, solar panels connected to an inverter, and lithium ion batteries connected to inverters. In this subsection, we will detail the source and assumptions made on their data. Some data and assumptions can be used from existing literature, while others could not.

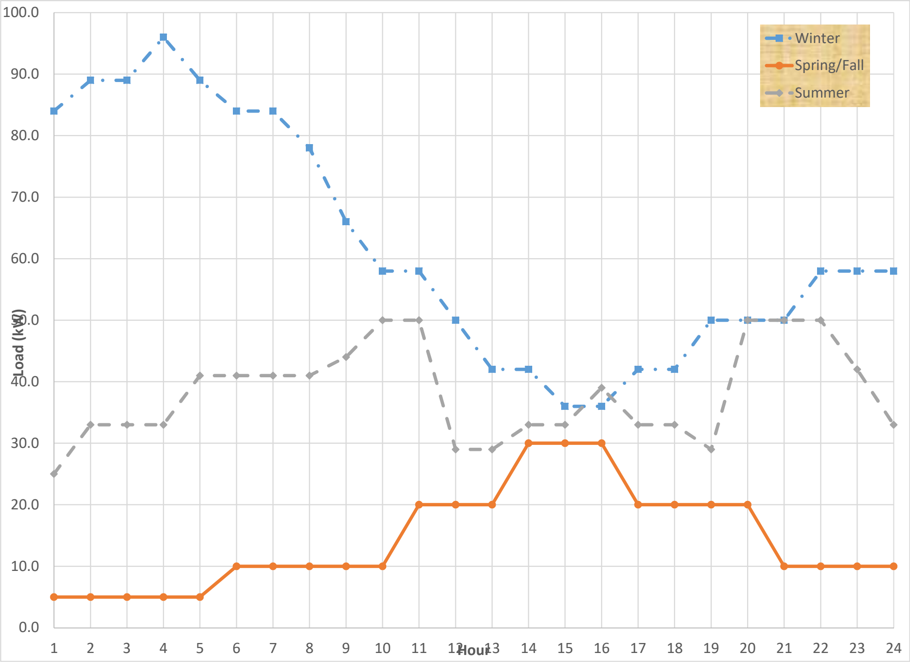


Figure 5.1: MEHPS 100kW 24 Hour Load Profile

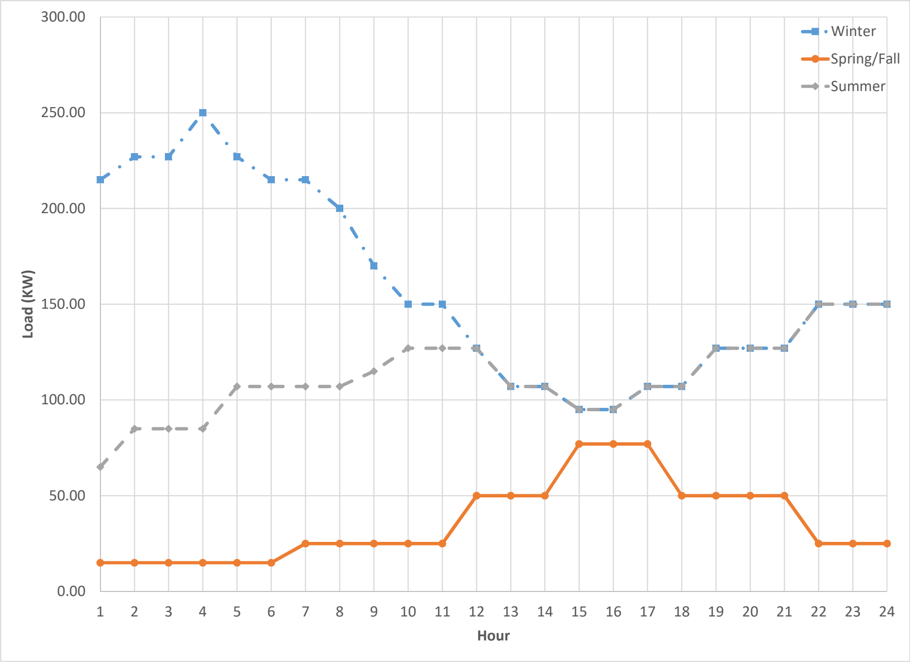


Figure 5.2: MEHPS 300kW 24 Hour Load Profile

5.4 Solar Data and Assumptions

From Breyer [14], the assumption was made that the operation and maintenance expense for the solar inverter would be .01 dollars per kWhr. This was the only paper that included an estimated operating expenses. Branker et al [50] discussed the capital cost of solar looking at factors such as location, size of installation, and the composition of the solar panel. Branker also discussed the effects of solar panel aging, though that was minimal enough, .5 - 1 percent per year, to not have a significant effect in the one to ten year low penetration installation that was being considered in this work.

The cost of solar inverters were extrapolated from the work of Rehman et al [34]. Rehman's work dealt with five megawatt systems installed in multiple locations in Saudi Arabia, assigning a one million dollar replacement cost for the inverters. We have extrapolated for a kilowatt scale system by calculating the cost per kW and using the five kW maximum that was suggested in the MEHPS situation description. The estimated prices of solar in terms of installed prices of solar panels were found for the United States in sub five kW installations by Branker et al [50] to be 7.50 $/Wp at the capacity weighted average and 5.90 $/Wp for residential sized installation.

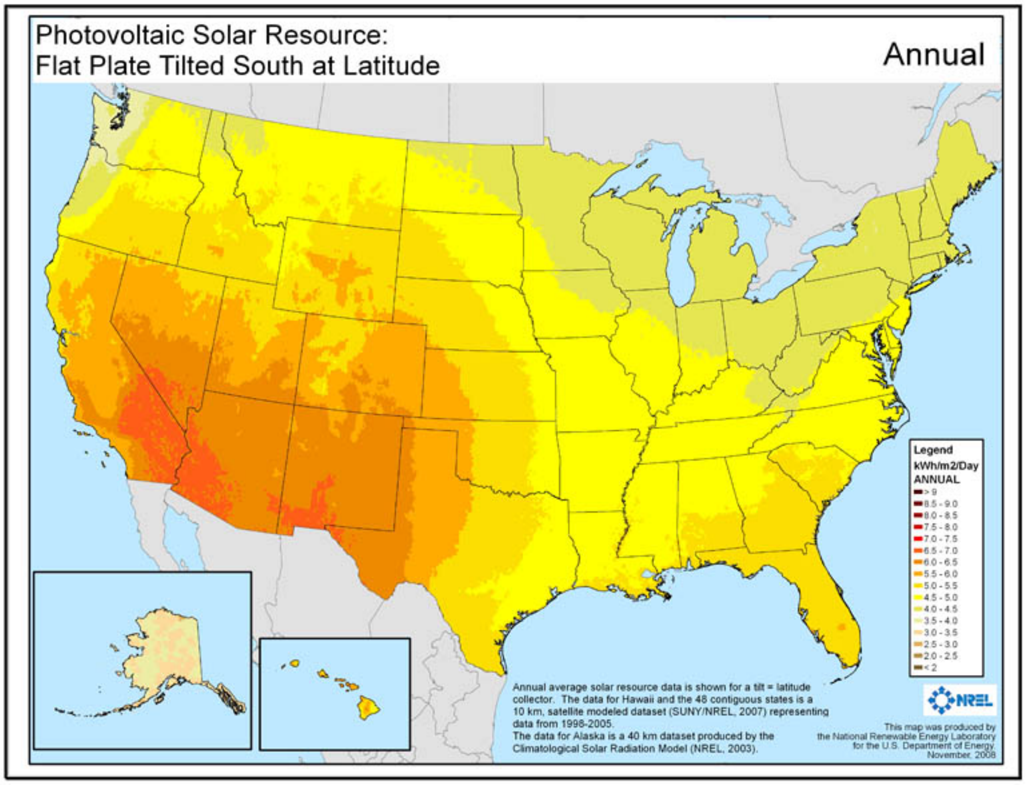
Estimations of the available solar power were taken from NOAA's typical year data. Four different locations across the US were used, each from an area of the United States with very different solar potential, New York, Minneapolis, Columbia, and San Diego. The solar panels were assumed to be installed perpendicular to the normal vector of solar radiation as the panels that are discussed do not have a specialized installations to maximize the solar exposure.

5.5 Battery Data and Assumptions

From *Costs of Lithium-Ion Batteries for Vehicles*, the projected battery cost per kWhr was found to be between 250 and 706 dollars. This matches well with what is being seen in large scale quoting of new Lithium Ion batteries. Many stationary system will be built from batteries that have lost enough capacity that they are no longer useful for transportation—these batteries might be less expensive [38].

From Battke [39], the projected number of battery cycles was found to be between five-thousand and fifteen-thousand assuming an 80 percent depth of discharge.

The projected cost of purchasing the batteries and projected cycle life along with the defined



Photovoltaic Solar Resource:
Flat Plate Tilted South at Latitude

Annual

Annual average solar resource data is shown for a tilt = latitude collector. The data for Hawaii and the 48 contiguous states is a 10 km, satellite modeled dataset (SUNY/NREL, 2007) representing data from 1998-2005.
The data for Alaska is a 40 km dataset produced by the Climatological Solar Radiation Model (NREL, 2003).

This map was produced by
the National Renewable Energy Laboratory
for the U.S. Department of Energy.
November, 2008

Figure 5.3: US Photovoltaic Energy Potential

energy of the batteries is used to calculate a cost per kWhr of *using* the batteries. This usage cost is used in this case study in determining the cost to serve the load along with the .01 dollar estimated operating cost of solar and the linear term for the efficiency of the generators.

There are many more complicated battery life models explored in the literature. The one we have employed is suitable for proving the ideas that were represented by the conducted case studies, but would be inappropriate for a commercial tool. More complex models include temperature—higher temperatures will exhaust the battery more rapidly. Such models also include charge and discharge rate. Higher charge and discharge rates will also exhaust the battery more rapidly, and can have a different depth of discharge, the more deeply discharged a battery the more rapidly the battery will exhaust

5.6 Fuel Cost Data and Assumptions

The estimations of fuel cost came from Schwartz et al [51] and from diesel fuel cost observations collected in Minneapolis, MN, USA in October 2015. These estimations—along with an estimated fuel use table for sixty kW diesel generators [44]—were used to provide the quadratic term that is used in determining the cost to serve the load. As discussed in 2.3, the efficiency of fuel use for diesel generators is not linear. The equation for fuel use by load that was found through quadratic regression in Matlab matched the table with a high degree of confidence.

The equation was found to be:

$$2 * 10^{-5} * p_{gt}^2 - 0.0025 * p_{gt} + 0.1519 \tag{5.1}$$

5.7 Diesel Generator Data and Assumptions

In addition to operating costs, we have also included capital costs of generator ownership. The cost of the AMMPS 60 kW generator— $40,115 [52]—is publicly available on the GSA schedule, an equipment pricing list used by United States governmental entities. The maximum number of hours that could be expected of a generator or a point at which the total maintenance expenses is expected to be 25000 hours. This value was found be talking to the engineers who designed the set and the engineers who are working on the warranty claims for the AMMPS product.

The forced outage rate of the AMMPS generator was calculated from the MTTR and MTBF which were found in the GSA description of the generator [52].

$$ForcedOutage = \frac{MTTR}{MTTR + MTBF} \tag{5.2}$$

$$ForcedOutage = \frac{1.5}{1.5 + 750} \tag{5.3}$$

5.8 Problem Setup

For this thesis, I chose to use TCO rather than LCOE to compare the costs of the microgrids that were being considered because of the remote nature of the loads that are being considered. These loads have no existing price of energy beyond the initial purchase cost of the and the cost of the diesel fuel. This meant there was nothing that could be compared with a cost per kilowatt hour, whereas a single TCO could be compared to the cost of a generator or to other configurations.

For this thesis, I chose to calculate both LOLP and EENS as measures of reliability. LoLP is the primary metric of interest in for remote loads with high reliability requirements. Currently, for high reliability loads the Marine Corps operates two generators are run at all times for a load that could be served by a single generator as the requirement is for zero down time (which cannot be reached with a single generator of backup, but as the generator that is being used has a forced outage rate of approximately $2 * 10^{-3}$, it is a relatively good approximation).

The TCO was calculated with a target LOLP of $1 * 10^{-5}$ and $1 * 10^{-3}$, the target reliability of the data centers and utility grid respectively /cite. The LOLP was exceeded in both cases because the small number of generators that were needed to meet the load profiles meant that there was not enough equipment for any piece of equipment to have a small effect on LOLP. The reliability requirements of data centers are currently driving research into new equipment for both on and off-grid microgrid equipment and configurations. (Optimization of data center battery storage investments for microgrid cost savings, emissions reduction, and reliability enhancement)

EENS is of secondary interest in these cases. If the microgrid is reliable to failure—for example, it sheds load rather than collapsing, if it has very strong low voltage/low frequency ride through characteristics, or if the equipment has a UPS that separates sensitive equipment from the grid in event of low voltage/low frequency event, EENS is useful for estimating the amount of load that would need to be separated, which could be used as an estimate for the amount of secondary backup that would be necessary. EENS could be used with costing of intelligent power management and UPSs to find a secondary cost for reliability.

Interestingly, EENS and LCOE both have more theoretical value in cases where there is a utility option. EENS has an easy value to a utility or any application where there is a price per unit electrical energy provided. LCOE is useful for comparing to an existing price of energy. This lack of a price means that there is no direct comparison for LCOE and therefore, while it could be used to evaluate different configurations, it would not be as exact as TCO.

The version of the equations that were used in this paper were different than the equations defined in 2.2.1 as there are some differences between the microgrid scenarios that are considered in this work and the larger grid scenario that is considered in the majority of UC/ED literature. The largest change is the assumption that the generators would be designed to meet NFPA 110, a standard for emergency and standby power systems [53]. NFPA 110 is a very common design criterion for diesel generators, and states that the maximum time to turn on a generator and have it able to accept full load is ten seconds. This means that the ramp rate constraints discussed in equations 2.7 and 2.8 with time periods in hours are unnecessary. The lack of a need to include minimum on and off times and ramp rates is more true with power electronics based sources. The load being supported can be changed, within the limit of the source, in a single line cycle.

The other feature of internal combustion engine generators that is different than with larger generators in the UC/ED problem definitions is the assumption in the UC/ED problem formulation that the generators are unable to run at extremely low percents of the generator's rated capacity. The zero minimum that is accessible with both internal combustion generators and power electronics further simplifies the equations that were already simplified by being able to omit minimum on and off times and ramp rates.

The other choice that went into the problem formulation for this thesis was to treat the operating costs as quadratic. It is not a perfect match for the equipment operating cost as discussed in 2.3 but it was far closer than a linear cost and did not have the dimensionality increase that using linear segments creates. Both quadratic and linear equations are convex

[54], meaning that they are can be solved in linear time.

The NP-Hard part of the unit commitment problem is the inclusion of integer constraints [54]. There are many different options for solving problems with integer constraints. The technique that Matlab and CPLEX use is known as Branch and Bound, or Branch and Cut. Branch and bound works by breaking the problem into pieces and solving each piece by relaxing the integer constraint [55]. The problem is further divided with each better option worked until it is complete. Integer solutions that are better then their relaxed comparisons can be used the eliminate the entire relaxed branch. This method has the potential of enumerating all states, but is guaranteed to reach the global optimum.

Because of the risk of a complete enumeration of a problem, applying heuristic search algorithms to the unit commitment problems has become popular in the literature. Simulated annealing [56], TABU search [57] [58] [59] [60], ant colony optimization [61] [62] [63], particle swarm optimization [64] [65], genetic algorithms [66] [67], greedy random adaptive search procedure (GRASP) [68], artificial neural networks [69], and hybrids of other methods [70] all have been used in literature but have not been used in scheduling for electric utilities. These often have better run times with similar results. Previously, ISOs used Lagrange Relaxation, a technique separate from both Branch and Bound and heuristic searches that had high speed performance and reasonable results. Now, CPlex has become the standard for scheduling at the ISO level because while total result is similar it can have very different results for individual generators which make the global optimum a necessity for fair results for the equipment owners in the region.

For this thesis, I did not use any of the above methods for comparing the costs of adding equipment or changing the insolation of the system. Lagrangian relaxation needs all generators to have a non constant first derivative, which the cost estimates for the power electronics sources did not have. The heuristics would have been a good option, but they have been tested separately for unit commitment and the repetition of those tests would not answer any new questions about system level performance.

For this thesis, a convex relaxation of the unit commitment problem with an integer projection as the last step [54] was used both for its solve time and the efficient preexisting implementation of many convex solvers in many different languages. Solve time was important for this application because it included a Monte Carlo Simulation on a multi dimensional experiment setup, which by definition will have many trials of the problem, almost five-thousand different

Monte Carlo Simulations were run.

In addition, for testing the effect of differing power electronics control strategies, we used a mixed integer linear programming solver that did use branch and bound. The precision, especially of the states of each device, was important enough to make the lower precision costs worth it. It was assumed that the percent difference in the TCO, the sensitivity of cost to the power electronic control capability, could be extrapolated to other solvers.

While there were changes for differing power electronics configurations, the final general equations that were used for all of the configurations end up being.

$$\sum_{g\in G}\sum_{t\in T} p_{gt} * H * p_{gt} + A * p_{gt} + C * u_{gt} \tag{5.4}$$

$$\sum_{g\in G}(p_{gt} * u_{gt}) = Load_t - nse_t \qquad \forall t \tag{5.5}$$

$$\begin{gathered} \sum_{g\in G} r_{gt} = R_t \qquad \forall t \\ where \quad r_{gt} = U_{gt} * u_{gt} - p_{gt} \end{gathered} \tag{5.6}$$

$$\begin{aligned} p_{gt} &\geq L_g \\ p_{gt} &\leq U_g \end{aligned} \tag{5.7}$$

$$\begin{aligned} u_{gt} &\geq 0 \\ u_{gt} &\leq 1 \end{aligned} \tag{5.8}$$

$$p_{gt} \leq u_{gt} * U_g \tag{5.9}$$

$$soc_{gt} = soc_{g(t-1)} - \frac{p_{gt}}{efficiencyg} \tag{5.10}$$

At the end of the optimization, u was projected to the integer values.

The changes that were made to reflect the different inverter capabilities tried to reflect the differing capabilities of power electronics controls. The three capabilities that were reflected were:

- Ideal power electronics - meaning could meet any power requirements either alone or with other power electronics or the generators
- Ideal storage power electronics - mean that the storage was capable of behaving ideally, it could charge or discharge off of solar, or parallel to the generators but the solar was limited to operating when there was voltage reference source, a very common control method for solar inverters, either the generator or the storage
- Voltage reference necessary power electronics - this assumed that the neither the power electronics for the storage nor the power electronics for solar have a means of generating an internal voltage reference which means that for any of the power electronics sources to be operating a generator needs to operate as well.

The reference was the only control option in the power electronics that was considered. It was assumed that the power electronics for the solar and the storage would control to the optimal power, but how this would be done is outside the scope of this thesis. The equations above are representative of this installation with ideal power electronics. The following equations were added to represent the other scenarios.

The way that Ideal Storage Power Electronics were represented for the purpose of the optimization was:

$$\sum u_{GensandBatteries} \geq \sum \frac{u_{solar}}{numbersolar} \qquad \forall t \tag{5.11}$$

The way that Voltage Reference Necessary Power electronics was represented was:

$$\sum u_{Gens} \geq \sum \frac{u_{solar}}{numbersolarandbatteries} \qquad \forall t \tag{5.12}$$

In addition, if the storage inverters require an external voltage reference, storage can not be used for spinning reserve (in this small of a network, in a larger network where spinning reserve would still have a voltage reference, that would not be the case) so the spinning reserve definition becomes:

$$\sum_{g \in G} r_{gt} = R_t \qquad \forall t where g is only generators \tag{5.13}$$

All of these methods are much more sensitive to the exact on and off states of the equipment so rather than testing each scenario as was done with the convex relaxation, a scenario with all of the power electronics was tested three times to compare the effect of just the control. In that regard, the control methods were not part of the large multidimensional Monte Carlo simulation, this was a separate experiment.

Chapter 6

Results

In this chapter, we will address each of our research questions. As a reminder, here's what we will be looking at.

1. Will investments in storage and renewable resources be recouped? - Section 6.2 addresses this question and all of the data is found in Appendix A
2. If so, at what time period is that value realized? - Section 6.3 addresses this questions and the full set of calculated data is found in Appendix B
3. Does the value of air pollution increase the potential value of the new sources? - Section 6.4 addresses these questions
4. What is the cost of attaining reliability? - Section 6.5 address this question from the TCO data found in Appendix A
5. Does the additional reliability from renewable and storage resources increase their value? - Section 6.5 address this question. This question depends on the answer to the previous question as well as the additional reliability calculated
6. Does the capability of the power electronics affect reliability, and—therefore—the value of the new energy sources? - Section 6.7 addresses this question. This was the only one of these questions that had to have a separate experiment run to answer it. The full results can be found in Appendix D.

Table 6.1: Average annual OPEX and TCO of the original configurations

	Annual OPEX	**TCO**
Original Configurations	1053210.39	5420958.7

Table 6.2: Return on investment based on fuel price

Fuel Cost	**Paid Back**	**Total**
3	141	1620
15	834	1620
50	1357	1620
400	1479	1620

6.1 Original Configuration

The MEHPS load profiles were originally calculated using a group of paralleled AMMPS generators. As a reminder, the AMMPS generator is the fixed speed diesel generator that is currently being used to provide power for the cases described in the MEHPS load profile. In order to make comparisons to configurations involving storage and renewables, we present the average of all of original configurations in Table 6.1. Even restricting the generation portfolio to only the original generators, there are multiple configurations. There were two load profiles, three fuel costs, three time periods, and three costs of capital. The average of all of these data points is included to help make comparisons to the data we will present in subsequent sections.

6.2 Recouping Investments in Storage and Renewable Resources

All of the total cost of ownership data is in Appendix A. In this sections parts of it are summarized or averaged for easier comparison.

The idea of recouping the investment made in additional resources is crucial to the adoption of solar and storage. Because of this, a large portion of this work focused on getting recent cost estimations for both capital and operating costs for the equipment. From this data, total costs of ownership were calculated for 2430 different equipment, cost, time, and cost of capitals for each of two different load profiles, resulting in a total of 4860 experiments. Of these cases, 2860 had a lower TCO than the original configurations.

The primary single factor in whether or not the investment was recouped was the price of

Table 6.3: Return on investment based on load profile

Max Power	Pays off	Total
100	1720	2160
300	873	2160

fuel. Table 6.2 lists the proportion of cases that pay back for each fuel price. Clearly, as fuel prices rises, more configurations pay off. However this is limited to cases where fuel use was reduced. There were cases were the operating cost remained the same or increased, generally when only solar was added.

The Spearman Correlation test was applied to both the operating cost and the TCO with each factor individually. Higher fuel costs were very strongly correlated (0.9428107) with higher operating costs. This result makes sense, the inverter operating costs that were used for both storage and solar were both flat and extremely low. Higher fuel costs were also strongly correlated (0.7394612) with higher TCOs as well. This also follows as operating cost is a large portion of total cost of ownership.

This is borne out in the literature as the places that are interested in adding microgrids with renewables and storage are remote, or even islands [4, 2]. In other word, places with high fuel costs.

With the high correlation to fuel price to the operating costs, it is not surprising that it is highly unlikely given that observations of total return on investment with and without renewables are not from the same distribution. Each of the factors was tested with a proportions (probabilities of success) test -specifically Pearson's chi square test [71]. This test can be used to determine the probability that two samples have the same proportion of successes and failures.

For fuel price - given the extreme difference between each proportion - the probability that the TCO being less than the original configuration was not related to fuel price was less than $2.2 * 10^{-16}$. This means that if you just studied the fuel price, there would be different distributions of whether or not the configuration would be likely to reduce the TCO.

The other factor that seemed to make a difference was the load profile. Table 6.2 lists the proportion of cases that pay back for each load profile. More configurations pay off for the lower max power.

Table 6.4: Operating Cost with Differing Generator Portfolios

Generators	**Opex, fuel 3**	**Opex, fuel 15**	**Opex, fuel 50**
2 60 kW Gens	1015.828	4973.716	16737.56
4 30 kW Gens	1331.032	6605.14	22422.23

Using the Spearman correlation test, it was found that load profile had a weak-to-low correlation to both operating cost (0.2886756) and total cost of ownership (0.2986221). This fact makes sense as the amount of generation that is needed and, therefore, how much fuel will be used is based on the load.

Another proportions test was used to compare the number of configurations that had a lower total cost of ownership than the original configuration between the two load profiles. Again, these had an extremely low probability - less than $2.2 * 10^{-16}$ - that the load profile does not affect whether or not adding capability to the microgrid is likely to reduce the total cost of ownership.

This work and the work in the case studies show that matching the load profile to the generators is extremely important. If, like in the case of MEHPS, there is a limit on the options of equipment that can be used using a variety of generators, it can be impossible to match exactly. But, for example, a sixty kW and two thirty kW AMMPS generators could a lower operating cost than using two sixty kW AMMPS generators.

A hypothesis is that this is because the three hundred kW maximum profile was a larger portion of the available generators (100 percent) than the one hundred kW maximum profile (83 percent). This would push more of the generation time into the steep portion of the the graph shown in 2.1. This means that alternate energy sources or even moving the generation into larger batches - the effect of adding storage - could make a large difference in the operating cost.

A quick experiment was run to test this hypothesis, with the results summarized in Table 6.4. It was found that - in this case - simply moving to more smaller generators had a higher operating cost. That shows that, given the fuel use tables in [44], the closer match of the generator to the load was not enough to compensate for having to run up to four engines instead of two.

There is a limit to the amount of electrical energy that can be extracted from a unit of fuel. This is related both to the energy content of the fuel and the efficiency of the method by which it

Table 6.5: Return on investment with and without solar

Has solar	**Pays off**	**Total**	**Percent**
Yes	2593	4320	60.02
No	267	540	49.44

Table 6.6: Return on investment with and without storage

Has storage	**Pays off**	**Total**	**Percent**
Yes	2401	3888	61.75
No	459	972	47.22

is converted to electricity. Storage can help optimize the use of fuel, but to break the limit, other sources of electrical energy have to be added. The MEHPS had only very low solar penetration, with a higher penetration of renewable sources. With a higher solar penetration, the operating cost could have been further reduced. That leads into the second major question in this work - what are the expectable payback times? With higher renewable penetrations, the fuel savings will be different.

With higher renewable energy penetration, questions about the capability of power electronics would be more important than they were for the original configuration. Because the penetration was so low, there were not times that the load could be handled by the photovoltaics and their inverters alone. The photovoltaics would need to work with either the storage or the generators. This means that off the shelf solar inverters would be capable in this load profile. In profiles where there is sufficient solar power, the cost reduction technique of only following an external sine wave reference would mean that either a generator would have to run or the storage inverter would have to provide the sine reference which would change the operating cost if energy had to be wasted just to provide a reference voltage.

The factors that had less difference on whether the configuration paid off were the presence or absence of solar and the presence or absence or storage. The number of cases where the inclusion or exclusion of solar pays off are listed in Table 6.5. The number of cases where the inclusion or exclusion of storage pays off are listed in Table 6.6.

In the correlation testing, the presence or absence of solar only had a very low correlation to operating cost (0.03972867) and to TCO (0.008108031). A higher penetration of solar - this experiment was only looking at up to five kW peak of solar into a one-hundred or three-hundred kW peak load profile - might have had a more definitive effect.

Table 6.7: Average TCO and OPEX with and without storage or solar

		TCO	**Annual Opex**
Storage	**Unavailable**	5398370	1042576
	Available	5300691	1020303
Solar	**Unavailable**	5330433	1032877
	Available	5318951	1023743

Despite the low correlation to the TCO and the operating cost, the number of configurations where increased equipment in the microgrid decreased the TCO of the installation from the initial configuration were compared using a proportions test. This test found a probability that the presence or absence of solar did not affect whether or not the additional equipment decreased the TCO of $3.112 * 10^{-6}$. This means that, while it is unlikely that the presence or absence of solar did not affect whether or not the additional equipment decreased the TCO, it is the most likely of all of these scenarios - fuel price, load distribution, including solar, and including storage - to have no affect on the outcome.

Interestingly, there was no difference in the number of microgrids with solar that had a lower TCO than the initial microgrid based on the location where they were installed, nor was there any significant difference in the operating cost or the total cost of ownership. This is despite the fact that the locations had extremely different insulation profiles (see figure 5.3).

The presence or absence of storage was also only weakly correlated with both operating cost (0.05933888) and with TCO (0.004406465). However, even with the weak correlation, a proportion test determines that the probability that whether a run where storage was present pay offs and whether a run where storage was excluded pays off are drawn from the same distribution was only $2.442 * 10^{-16}$.

The difference in correlation between the operating cost and TCO as compared to the likelihood that that the presence or absence of storage would effect whether or not the TCO would be lower with additional capability could because the TCOs were relatively close. They had the same number of significant figures. Additionally, this could be because the presence or absence of storage for the purpose of the correlation tests was represented by a zero or a one, again too small to show much difference.

Machine learning is often used to classify new data based the previous observations that were used to make up the training set. Treatment learning functions the opposite way. It looks for patterns in previously classified data sets. Treatment learning is used to find which factors most strongly to the classification of interest - in this case, where the addition of either solar or storage reduced the total cost of ownership. Treatment learners produce a treatment - a small set of attributes and value ranges that, if imposed, will identify a subset of the original data that skews toward the target classification [72].

To find the scenarios that had the highest number of new configurations that had a lower total cost of ownership than the initial configuration, a treatment learner was applied to the calculated total costs of ownership as compared to their initial total cost of ownership. Using TAR3 ten treatments were found with the highest percentages of lowering the total cost of ownership.

- Fuel Price = 50 and Max Power = 100 - With this combination, 91 percent of the new microgrids had a lower TCO than the initial microgrids
- Lifetime = 5 and Max Power = 100 - With this combination, 90 percent of the new microgrids had a lower TCO than the initial microgrids
- Fuel Price = 50 and Solar Price = 5.9 - With this combination, 88 percent of the new microgrids had a lower TCO than the initial microgrids
- Fuel Price = 50 and Reliability = L - With this combination, 88 percent of the new microgrids had a lower TCO than the initial microgrids
- Fuel Price = 50 - With this combination, 84 percent of the new microgrids had a lower TCO than the initial microgrids
- Max Power = 100 and Lifetime = 10 - With this combination, 81 percent of the new microgrids had a lower TCO than the initial microgrids
- Solar Price = 5.9 and Max Power = 100 - With this combination, 81 percent of the new microgrids had a lower TCO than the initial microgrids
- Max Power = 100 - With this combination, 77 percent of the new microgrids had a lower TCO than the initial microgrids
- Fuel Price = 50 and Lifetime = 10 - With this combination, 95 percent of the new microgrids had a lower TCO than the initial microgrids
- Reliability = L and Lifetime = 5 - With this combination, 74 percent of the new microgrids had a lower TCO than the initial microgrids

This reinforces the importance of fuel price to reducing the total cost of ownership. The highest fuel price was included in half of the treatments and was the only single factor treatment. This also reinforces the importance of the load profile to reducing the total cost of ownership, the 100 kW profile appears in half of the treatments and the 300 kW profile is not represented in the treatments. The lower reliability also appears in the treatment while the higher reliability does not. The higher reliability has a higher capital cost and less difference in the operating cost, see section 6.5 for the complete discussion. Lifetime is divided between 5 and 10 years, with the single year lifetime not appearing in any of the treatments.

6.3 Time Period of Value Realization

The full data in this function is found in Appendix B. In this section that data has been made easier to read and compare.

There are two methods of looking at the time in which the value of new generation can be realized. The net present value method is used to calculate TCO including the cost of capital and expected lifetime of the microgrid. The net present value uses the capital expense as as the down payment and the annual operating cost as the payment series. The equation to calculate this TCO is:

$$TCO = capex + opex * \frac{(1 + cost\ of\ capital)^{lifetime\ of\ microgrid} - 1}{cost\ of\ capital(1 + cost\ of\ capital)^{lifetime\ of\ microgrid}} \tag{6.1}$$

This calculation shows the effect of time both in terms of the number of payments and in the cost of capital on the total cost of ownership for the microgrid.

The other way time can be looked at is the simple payback. The form of simple payback that was chosen was to look at the difference between the new capital cost and the original capital cost divided by the difference in the annual operating expense. This equation can be defined as:

$$Payback\ Time = \frac{New\ Capex - Original\ Capex}{Original\ Opex - New\ Opex} \tag{6.2}$$

This equation gives the amount of time, in years, that paying back the initial capital cost would take given the lower operating costs. It should be noted that negative values are smaller

Table 6.8: Return on investment with time in service

Time Period	Paid Back	Total
1	682	1620
5	1112	1620
10	1066	1620

than positive values, but do not represent a faster payback time. Instead, negative values represent cases where there is no simple payback. Therefore, care must be taken in interpreting the resulting values as many forms of mathematical analysis will interpret negative values as being better - having a shorter payback time - than the values that actually payback - small, positive payback values.

All of the methods of comparing total prices, whether using TCO or LCOE, are dependent on the time period over which the prices are compared. In this work, the numbers of scenarios where the additional capability reduced the total cost of ownership was compared between three different durations of installation. The proportion of scenarios that pay off are listed in Table 6.8 for each of the installation durations.

One interesting feature of the MEHPS data was that between five and ten years, the generators and batteries had to be replaced. Therefore, in Table 6.8, more of the five year runs than the ten year runs had sufficient operational time to pay off the higher capital expenses. A proportion test found that the probability that duration of installation did not affect the TCO reduction of additional capability was less than $2.2 * 10^{-16}$. Therefore, it can be clearly seen that duration had an impact on TCO reduction of additional capability.

In addition to calculating the number of configurations that pay back given each operating life that included cost of capital, a simple payback was also calculated using equation 6.2. These values were then sorted to only include positive payback numbers, as negative payback times represent microgrids where it is not possible for the pay back to happen. Simple payback becomes impossible either because the capital was lower in the new microgrid, which is not possible in these cases as we were only studying adding equipment, or because the operating cost of the new microgrid was higher. Table 6.9 lists the average number of years until simple pay back with storage, solar, or both.

These calculations were then analyzed using the Spearman correlation to each of the scenarios to see the largest contributor. The factor that was most strongly correlated to payback time

Table 6.9: Average number of years until simple pay back with storage or solar

	Years to payback
Storage	13.56
Solar	14.58
Both	14.02

was fuel price, with a correlation of -0.789299. The correlation between fuel price and payback time, while negative, is strong. The negative value suggests that the higher the fuel price is, the shorter the payback time will be.

The factor that was next most strongly correlated to payback time was the desired reliability, with a correlation of 0.3417688. The correlation is moderate-to-low. It is positive, meaning that higher desired reliability had a longer payback time. This was somewhat surprising, because as is shown in table 6.13, higher reliability configurations have higher average operating costs (the denominator in equation 6.2). This means that the expectation would be a lower payback time. The difference must be smaller than in the lower reliability scenarios.

Another factor was the maximum power of the load profile, with a correlation of 0.2160514. The correlation is weak-to-low. It is positive, meaning that the payback time was longer with the higher load profile. This makes sense, given that in the previous section, we demonstrated that the adding solar or storage to the higher load profile was less likely to have a lower TCO than the lower load profile. Therefore, that it should also correlate to having higher payback times follows.

Two factors that had low correlations to payback time were the presence or absence of solar (0.1776693) and the presence or absence of storage (-0.1062788). These correlations are opposite signs, meaning that the presence of solar resulted in a longer payback time, while the presence of batteries resulted in a shorter payback time. This makes sense as solar had a larger initial investment than batteries did. The units of price of solar are in dollars per Wp, while batteries are priced in dollars per kWh. This implies a higher initial investment for solar, and therefore, a longer payback than with batteries.

6.4 Impact of the Value of Air Pollution

Beyond financial reasons, another reason for increasing interest in microgrids and renewable sources is the potential to reduce pollution. This can have financial benefits if any of the pollutants have a cost, like a carbon price or an exchange price for category pollutants like NOX. Reducing pollution, however is not guaranteed to have a financial advantage.

Table 6.10 lists the fuel usage and subsequent pollution from the original configurations. Table 6.11 lists the fuel use and pollution from the lowest operating expense scenario.

Table 6.10: Fuel Usage and Pollution from the Original Configurations

Load Profile	**Diesel (gal)**	**CO2 (lbs)**	**DPM (lbs)**	**NOX (lbs)**
100 kW Max	27434	617265	1163	16538
300 kW Max	65850	1481625	2792	39697

Table 6.11: Fuel Usage and Pollution from the Lowest Opex Scenario

Load Profile	**Diesel (gal)**	**CO2 (lbs)**	**DPM (lbs)**	**NOX (lbs)**
100 kW Max	26826	599490	1138	16172
300 kW Max	65632	1466700	2785	39565

The scenario illustrated in Table 6.11 is the one with the lowest operating cost, and therefore, the lowest fuel usage. In this case, the difference in pollution is not large enough that pollution costing would make a significant difference. The pollution is approximately eight metric tons of CO2 per year. This is approximately 360 dollars per year by estimates for the social cost of carbon [49]. This value is two orders of magnitude smaller than the average difference between the original operating method and the operating method with storage or solar, however if you include the social cost of carbon and recalculate the total cost of ownerships different numbers are going to reduce the total cost of ownership than without the included cost of carbon. To see the full data that is summarized in Table 6.12

With the lowest cost of fuel, the cost of carbon results in the highest percent, and absolute, increase in the number of scenarios that reduced their total cost of ownership by adding solar and/or storage. This makes sense as adding the social cost of carbon effectively increases fuel price, which is the strongest driver of operating cost and total cost of ownership. The cost of carbon increases the cost of fuel by a fixed amount, which is a higher percentage of the three dollar fuel price than of the fifty dollar fuel price. The other consideration is that in the

Table 6.12: Lower TCO with and without Cost of Carbon

Cost of Fuel	Original	With Social Cost of Carbon	Percent Increase
3	141	284	101.4
15	834	965	15.7
50	1357	1373	1.1

Table 6.13: Average annual Opex and TCO by required reliability

	Annual Opex	TCO
Low	1005397.84	5195561.22
High	1044117.13	5444892.14

fifty dollar fuel price scenario, there are fewer microgrids that do not lower the total cost of ownership than in the three dollar fuel scenario.

6.5 The Cost of Attaining Reliability

As higher reliability configurations have additional generation resources that could be counted on, they also carry higher capital costs. We have extended details about the reliability of solar inverters to apply to storage inverters.

Table 6.13 lists the average annual operating expenses and TCO by required reliability for the load. Both the operating cost and the total cost of ownership are higher with the higher required reliability.

The difference between the high and low reliability case's average total cost of ownership and the difference between the high and low reliability case's average operating cost is approximately ten times higher. This shows up in both the reduced probability of lowering the total cost of ownership with renewable resources and higher average simple payback time with higher required reliability.

6.6 Increase in Value from the Additional Reliability of Renewable and Storage

Table 6.14 lists the LOLP of lower reliability microgrids, controlled for the addition of storage or solar. A lower LOLP is better. The LOLP with storage is lower than with solar, which is

Table 6.14: Effect of New Sources on the LOLP in lower reliability microgrids

	LOLP
Original	$5.95293 * 10^{-5}$
Storage	$1.23457 * 10^{-5}$
Solar	$5.93750 * 10^{-5}$

slightly lower than the original.

While none of these meet the high LOLP ($1 * 10^{-5}$) specified as the high reliability target, adding storage did increase the reliability enough that it was nearly met. This matches previous research into reliability in isolated diesel generator-powered microgrids [73]. If there was a small amount of flexibility around the target reliability, there would be an opportunity for financial savings by adding storage - which would, in addition to increasing reliability, would decrease the operating cost as well. This could be done instead of just increasing the number of generators.

The magnitude of the improved reliability with the addition of solar was smaller than expected. Billinton and Bagen found that adding renewable generation improved network reliability [32]. However, the generation that they were adding was comparable in size to the other nodes on the network that they were studying. In the MEHPS case, the solar was approximately one-tenth the size of the other generators.

Calculations were not performed on the difference between the original equipment profile and the equipment profile with the additional solar or storage as with those resources, the LOLP calculation in the Monte Carlo simulation run for this work would come out to be zero for many cases either because there were not enough samples to capture the LOLP given the large amount of additional generation available.

6.7 Effect of the Capability of the Power Electronics on Reliability and Value of New Energy Sources

Each of the different maturity levels of controls of the power electronics has a different annual operating cost. More mature controls can switch between an internal and external voltage reference. The ability for the storage to run without an external voltage reference makes a significant difference in the operating cost.

Table 6.15: Annual Opex with different fuel costs by PE controls capability

	Annual Opex 3 dollar fuel	**Annual Opex 15 dollar fuel**	**Annual Opex 50 dollar fuel**
Original Configuration	66476.78	332383.91	1106838.40
Perfect PE Controls	58168.4	289761.92	963659.53
Solar Grid Following	58246	290390.67	964802.21
All PE Grid Following	65071	325077.59	1078587.97

When the storage is not able to run without an external voltage reference, battery cycling is made possible. Battery cycling is when batteries are drained and refilled to serve an extremely low load when, otherwise, the generator would be running in its very inefficient area. The batteries can serve a sufficient load to move the generator to a more efficient area of its operating curve when they are being recharged. With low solar penetration, battery cycling and other uses of storage are going to be the largest source of energy savings.

In Table 6.15, the annual operating expenses are listed with different fuel costs by the PE controls maturity. For all three fuel prices, perfect controls represent the lowers costs. This is followed by solar grid following - which require an external voltage reference. Then, all PE grid following - where both solar and storage inverters require an external voltage reference. Finally, the most expensive are the original configuration.

What is most immediately obvious in the annual operating cost is that if the power electronics are only capable of being grid-following, there are almost no savings. That means that there is almost no margin to reduce the TCO with the lowered operating cost. In turn, this means that solar and storage would never pay off.

This means that if you were planning one of these systems, at this penetration level, solar can be only grid-following - the most common control method for off the shelf solar inverters - without greatly increasing the operating cost. However, the storage inverter must be able to operate independently of the generators and provide a voltage reference for the solar inverter as well. Ideally, in higher penetration applications, the storage would also be able to provide the reference and charge off of the solar, but as the peak rating is lower than the lowest load, that is not important to these load profiles.

6.8 Threats to Validity

This work and the suggestions represented in it are based on the MEHPS load profile and the defined generation portfolio. This generation portfolio had extremely low solar penetration. In cases where the microgrid could have a higher solar penetration, or could have other resources - such as pumped storage hydro or an alternative renewable resource - the conclusions may not generalize. However, a similar study could be conducted for other microgrid configurations. We offer a template for performing further studies of microgrid economics.

If this was a stationary application without a predefined generation portfolio, starting at defining the generation portfolio would result in a much more open search space. The steps that were considered in this paper would be too extensive, as a larger portfolio of options would multiply the search space by each additional dimension to be considered. For example, adding battery pack size, solar array size, altitude of pumped storage hydro. To address that limitation, either average values could be taken for prices, or the lifetime and cost of capital could be fixed to those of the organization interested in the microgrid. The other option is that screening software, such as HOMER, could be used and then the stochastic outages could be calculated independently as were shown several times in paper [74].

Another threat to validity is that fuel prices are more extreme in the MEHPS case than they would be in many microgrids. However, high fuel prices are likely in remote areas, so showing the extreme sensitivity of the total cost of ownership to fuel prices is valid.

A general threat to validity of the results is that all of the conclusions were drawn without a prior knowledge of the distribution. We have favored non-parametric methods for correlation testing and sample percentage testing.

Chapter 7

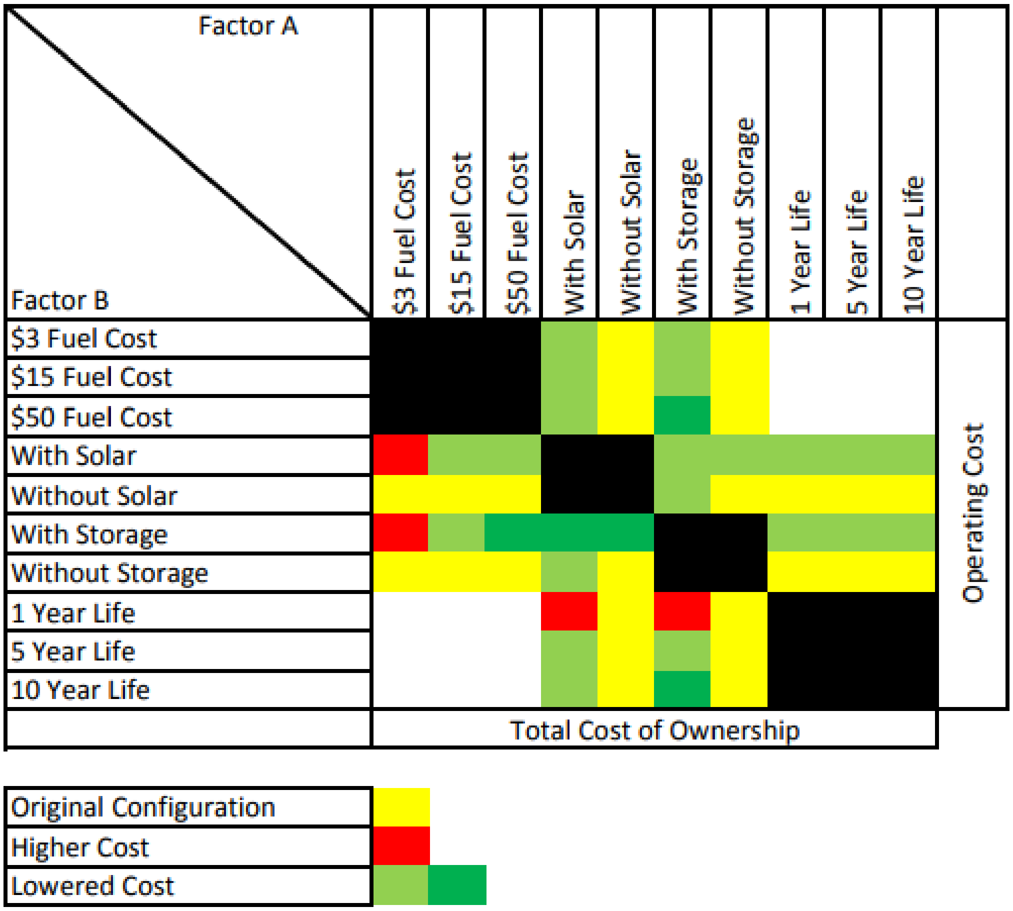
Conclusions

This work examined the factors that can make a difference in whether or not investments in renewable resources, solar, and storage will reduce the total cost of ownership for a microgrid. The experiments considered multiple variables that could have an effect on the final total cost of ownership into consideration, including the price of fuel, price of PV panels, price of batteries, location of installation of the microgrid, cost of pollution, duration of installation, and cost of capital. All of these factors are considered in order to suggest what will make a difference as to whether or not additional investments will reduce the total cost of ownership.

The different effect of new technology at different fuel costs and lengths in service is visualized in 7.1.

The results of this work offer suggestions to those planning to deploy multisource microgrid systems in remote areas around the world. The primary single factor in whether or not the investment was recouped was the price of fuel. Higher fuel costs were very strongly correlated with higher operating costs and higher TCOs. The other factor that seemed to make a difference was the load profile. Matching the load profile to the generators is extremely important, which will make general guidance for microgrid planning difficult.

Beyond total cost of ownership, other factors that could influence decision making were considered. The first factor was simple payback time. The factor that was most strongly correlated to payback time was fuel price. The higher the fuel price is, the shorter the payback time will be. The factor that was next most strongly correlated to payback time was the desired reliability. Profiles that had a higher desired reliability had a longer payback time. The payback



Factor A / Factor B	$3 Fuel Cost	$15 Fuel Cost	$50 Fuel Cost	With Solar	Without Solar	With Storage	Without Storage	1 Year Life	5 Year Life	10 Year Life
$3 Fuel Cost	⬛	⬛	⬛	🟩	🟨	🟩	🟨			
$15 Fuel Cost	⬛	⬛	⬛	🟩	🟨	🟩	🟨			
$50 Fuel Cost	⬛	⬛	⬛	🟩	🟨	🟢	🟨			
With Solar	🟥	🟩	🟩	⬛	⬛	🟩	🟩	🟩	🟩	🟩
Without Solar	🟨	🟨	🟨	⬛	⬛	🟩	🟨	🟨	🟨	🟨
With Storage	🟥	🟩	🟢	🟢	🟢	⬛	⬛	🟩	🟩	🟩
Without Storage	🟨	🟨	🟨	🟩	🟨	⬛	⬛	🟨	🟨	🟨
1 Year Life				🟥	🟨	🟥	🟨	⬛	⬛	⬛
5 Year Life				🟩	🟨	🟩	🟨	⬛	⬛	⬛
10 Year Life				🟩	🟨	🟢	🟨	⬛	⬛	⬛

Original Configuration	🟨
Higher Cost	🟥
Lowered Cost	🟩 🟢

Figure 7.1: Visualization of different factors on TCO and OPEX: Black is mutually exclusive, Yellow is original, Red is increase, Green is decrease

time was longer with the higher load profile. Additionally, between five and ten years, the generators and batteries had to be replaced. Therefore, more of the five year runs than the ten year runs had sufficient operational time to pay off the higher capital expenses, showing that longer time in service does not necessarily guarantee payback.

Pollution was also considered. With the lowest cost of fuel, the cost of carbon results in the highest increase in the number of scenarios that reduced their total cost of ownership by adding solar and/or storage. Adding the social cost of carbon effectively increases fuel price, which is the strongest driver of operating cost and total cost of ownership. For future work, including the cost of pollution in the optimization of the generator use could decrease fuel use or if it was a more open ended microgrid could drive more renewable resources.

To show that TCO needed reliability as a bounds, TCO with two different required reliabilities was calculated. Both the operating cost and the total cost of ownership are higher with the higher required reliability. Adding storage to the low-reliability configuration improves the LOLP - increasing the reliability enough that it nearly meets the high reliability target. If there was a small amount of flexibility around the target reliability, there would be an opportunity for financial savings by adding storage - which would, in addition to increasing reliability, decrease the operating cost as well.

To show that the capability of the controls of any included power electronics need to be considered for any economic calculations that depend on sources that need power electronics, a massive gap in the literature, we completed the same optimization with the capabilities of the power electronics restricted. If the power electronics are only capable of being grid-following, there are almost no savings to adding either renewable sources or storage. At this penetration level, solar can be only grid-following - the most common control method for off the shelf solar inverters - without greatly increasing the operating cost. However, the storage inverter must be able to operate independently of the generators and provide a voltage reference for the solar inverter as well.

These results offer important lessons in making planning and operational decisions for microgrids with storage and renewables. While further research is needed, this work can offer suggestions to those planning to deploy microgrid systems in remote areas around the world.

There are several opportunities for extending the results of this work. The first would be to use this method of analysis on other microgrids with higher renewable penetration levels. It would be interesting to see if the renewables would continue to have less effect on operating cost than storage at higher penetrations. Another opportunity to extend the result of this work would be to add new sources. Doing a total cost of ownership and reliability analysis for fuel cell-powered data centers, with the required reliability that is implied, would be an excellent opportunity to look at the effect of both the number of paralleled fuel cell-inverter combinations and the reliability of the components.

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Appendix A

TCO Results

Table A.1: TCO Data

Max Power (kW)	Reliability	Location	Fuel Price ($/gal)	Battery ($/kWh)	Battery Cost	Battery Life	Solar ($/Wp)	Solar Price (years)	Lifetime (%)	Cost of Capital	Lolp	CAPEX	Annual Opex	TCO
100	H	0	3	0	0	0	0	0	1	0	0	132000	82301.57	214301.5749
100	H	0	3	0	0	0	0	0	1	1	0	132000	82301.57	213486.7078
100	H	0	3	0	0	0	0	0	1	5	0	132000	82301.57	210382.4523
100	H	0	3	0	0	0	0	0	5	0	0	132000	82301.57	543507.8744
100	H	0	3	0	0	0	0	0	5	1	0	132000	82301.57	531445.0346
100	H	0	3	0	0	0	0	0	5	5	0	132000	82301.57	488322.7484
100	H	0	3	0	0	0	0	0	10	0	0	264000	82301.57	1087015.749
100	H	0	3	0	0	0	0	0	10	1	0	264000	82301.57	1043503.279
100	H	0	3	0	0	0	0	0	10	5	0	264000	82301.57	899510.9456
100	H	0	3	1	250	5000	0	0	1	0	0	144000	81438.43	225438.4277
100	H	0	3	1	250	5000	0	0	1	1	0	144000	81438.43	224632.1066
100	H	0	3	1	250	5000	0	0	1	5	0	144000	81438.43	221560.4073
100	H	0	3	1	250	5000	0	0	5	0	0	144000	81438.43	551192.1383
100	H	0	3	1	250	5000	0	0	5	1	0	144000	81438.43	539255.8089
100	H	0	3	1	250	5000	0	0	5	5	0	144000	81438.43	496585.7727
100	H	0	3	1	250	5000	0	0	10	0	0	276000	81438.43	1090384.277
100	H	0	3	1	250	5000	0	0	10	1	0	276000	81438.43	1047328.149
100	H	0	3	1	250	5000	0	0	10	5	0	276000	81438.43	904845.9515
100	H	0	3	1	706	5000	0	0	1	0	0	144000	81443.56	225443.5645
100	H	0	3	1	706	5000	0	0	1	1	0	144000	81443.56	224637.1926
100	H	0	3	1	706	5000	0	0	1	5	0	144000	81443.56	221565.2995
100	H	0	3	1	706	5000	0	0	5	0	0	144000	81443.56	551217.8224
100	H	0	3	1	706	5000	0	0	5	1	0	144000	81443.56	539280.7401
100	H	0	3	1	706	5000	0	0	5	5	0	144000	81443.56	496608.0124
100	H	0	3	1	706	5000	0	0	10	0	0	276000	81443.56	1090435.645
100	H	0	3	1	706	5000	0	0	10	1	0	276000	81443.56	1047376.801
100	H	0	3	1	706	5000	0	0	10	5	0	276000	81443.56	904885.6167
100	H	0	3	1	250	15000	0	0	1	0	0	144000	81393.80	225393.8015
100	H	0	3	1	250	15000	0	0	1	1	0	144000	81393.80	224587.9223
100	H	0	3	1	250	15000	0	0	1	5	0	144000	81393.80	221517.9062
100	H	0	3	1	250	15000	0	0	5	0	0	144000	81393.80	550969.0075
100	H	0	3	1	250	15000	0	0	5	1	0	144000	81393.80	539039.2188
100	H	0	3	1	250	15000	0	0	5	5	0	144000	81393.80	496392.5647
100	H	0	3	1	250	15000	0	0	10	0	0	276000	81393.80	1089938.015
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100	H	0	3	1	706	15000	0	0	1	0	0	144000	81421.73	225421.733
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100	H	0	3	1	706	15000	0	0	5	1	0	144000	81421.73	539174.7824

100	H	0	3	1	706	15000	0	0	5	5	0	144000	81421.73	496513.4934
100	H	0	3	1	706	15000	0	0	10	0	0	276000	81421.73	1090217.33
100	H	0	3	1	706	15000	0	0	10	1	0	276000	81421.73	1047170.028
100	H	0	3	1	706	15000	0	0	10	5	0	276000	81421.73	904717.0395
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100	H	San Diego	3	0	0	0	1	5.9	1	1	0	161500	80477.02	241180.2216
100	H	San Diego	3	0	0	0	1	5.9	1	5	0	161500	80477.02	238144.7846
100	H	San Diego	3	0	0	0	1	5.9	5	0	0	161500	80477.02	563885.1193
100	H	San Diego	3	0	0	0	1	5.9	5	1	0	161500	80477.02	552089.7017
100	H	San Diego	3	0	0	0	1	5.9	5	5	0	161500	80477.02	509923.3973
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100	H	San Diego	3	1	250	5000	1	5.9	1	1	0	173500	79484.01	252197.0421
100	H	San Diego	3	1	250	5000	1	5.9	1	5	0	173500	79484.01	249199.0595
100	H	San Diego	3	1	250	5000	1	5.9	5	0	0	173500	79484.01	570920.0625
100	H	San Diego	3	1	250	5000	1	5.9	5	1	0	173500	79484.01	559270.1893
100	H	San Diego	3	1	250	5000	1	5.9	5	5	0	173500	79484.01	517624.1778
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100	H	San Diego	3	1	706	5000	1	5.9	1	0	0	173500	79463.32	252963.3191
100	H	San Diego	3	1	706	5000	1	5.9	1	1	0	173500	79463.32	252176.5536
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100	H	San Diego	3	1	706	5000	1	5.9	10	1	0	305500	79463.32	1058121.294
100	H	San Diego	3	1	706	5000	1	5.9	10	5	0	305500	79463.32	919094.6867
100	H	San Diego	3	1	250	15000	1	5.9	1	0	0	173500	79487.95	252987.9456
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100	H	San Diego	3	1	706	15000	1	5.9	1	1	0	173500	79526.56	252239.1721
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100	H	San Diego	3	0	0	0	1	7.5	1	0	0	169500	80479.30	249979.303
100	H	San Diego	3	0	0	0	1	7.5	1	1	0	169500	80479.30	249182.4782
100	H	San Diego	3	0	0	0	1	7.5	1	5	0	169500	80479.30	246146.9553
100	H	San Diego	3	0	0	0	1	7.5	5	0	0	169500	80479.30	571896.5151
100	H	San Diego	3	0	0	0	1	7.5	5	1	0	169500	80479.30	560100.7634
100	H	San Diego	3	0	0	0	1	7.5	5	5	0	169500	80479.30	517933.2649
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100	H	San Diego	3	1	250	5000	1	7.5	1	1	0	181500	79528.53	260241.1149
100	H	San Diego	3	1	250	5000	1	7.5	1	5	0	181500	79528.53	257241.4534
100	H	San Diego	3	1	250	5000	1	7.5	5	0	0	181500	79528.53	579142.6301
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100	H	San Diego	3	1	250	5000	1	7.5	10	1	0	313500	79528.53	1066738.889
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100	H	San Diego	3	1	706	5000	1	7.5	1	0	0	181500	79471.70	260971.6958
100	H	San Diego	3	1	706	5000	1	7.5	1	1	0	181500	79471.70	260184.8474
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100	H	San Diego	3	1	706	5000	1	7.5	5	0	0	181500	79471.70	578858.4792
100	H	San Diego	3	1	706	5000	1	7.5	5	1	0	181500	79471.70	567210.4112
100	H	San Diego	3	1	706	5000	1	7.5	5	5	0	181500	79471.70	525570.8531
100	H	San Diego	3	1	706	5000	1	7.5	10	0	0	313500	79471.70	1108216.958
100	H	San Diego	3	1	706	5000	1	7.5	10	1	0	313500	79471.70	1066200.633
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100	H	San Diego	3	1	250	15000	1	7.5	1	0	0	181500	79508.66	261008.6587
100	H	San Diego	3	1	250	15000	1	7.5	1	1	0	181500	79508.66	260221.4443
100	H	San Diego	3	1	250	15000	1	7.5	1	5	0	181500	79508.66	257222.5321
100	H	San Diego	3	1	250	15000	1	7.5	5	0	0	181500	79508.66	579043.2935
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100	H	San Diego	3	1	706	15000	1	7.5	5	1	0	181500	79488.17	567290.3762

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100	H	South Carolina	3	0	0	0	1	5.9	1	0	0	161500	79065.38	240565.377
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100	H	South Carolina	3	0	0	0	1	5.9	10	1	0	293500	79065.38	1042352.263
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100	H	South Carolina	3	1	250	5000	1	5.9	1	1	0	173500	78355.13	251079.3341
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100	H	South Carolina	3	1	250	5000	1	5.9	5	0	0	173500	78355.13	565275.6373
100	H	South Carolina	3	1	250	5000	1	5.9	5	1	0	173500	78355.13	553791.2234
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100	H	South Carolina	3	1	706	5000	1	5.9	5	1	0	173500	78354.34	553787.3896
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100	H	South Carolina	3	1	706	15000	1	5.9	10	1	0	305500	78351.28	1047588.794
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100	H	South Carolina	3	1	706	5000	1	7.5	10	0	0	313500	78377.71	1097277.093
100	H	South Carolina	3	1	706	5000	1	7.5	10	1	0	313500	78377.71	1055839.153
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100	H	South Carolina	3	1	250	15000	1	7.5	1	0	0	181500	78357.86	259857.8597
100	H	South Carolina	3	1	250	15000	1	7.5	1	1	0	181500	78357.86	259082.0393
100	H	South Carolina	3	1	250	15000	1	7.5	1	5	0	181500	78357.86	256126.533
100	H	South Carolina	3	1	250	15000	1	7.5	5	0	0	181500	78357.86	573289.2985
100	H	South Carolina	3	1	250	15000	1	7.5	5	1	0	181500	78357.86	561804.4841
100	H	South Carolina	3	1	250	15000	1	7.5	5	5	0	181500	78357.86	520748.5255
100	H	South Carolina	3	1	250	15000	1	7.5	10	0	0	313500	78357.86	1097078.597
100	H	South Carolina	3	1	250	15000	1	7.5	10	1	0	313500	78357.86	1055651.152
100	H	South Carolina	3	1	250	15000	1	7.5	10	5	0	313500	78357.86	918558.6222
100	H	South Carolina	3	1	706	15000	1	7.5	1	0	0	181500	78368.59	259868.5908
100	H	South Carolina	3	1	706	15000	1	7.5	1	1	0	181500	78368.59	259092.6642
100	H	South Carolina	3	1	706	15000	1	7.5	1	5	0	181500	78368.59	256136.7531
100	H	South Carolina	3	1	706	15000	1	7.5	5	0	0	181500	78368.59	573342.954
100	H	South Carolina	3	1	706	15000	1	7.5	5	1	0	181500	78368.59	561856.5668

100	H	South Carolina	3	1	706	15000	1	7.5	5	5	0	181500	78368.59	520794.9856
100	H	South Carolina	3	1	706	15000	1	7.5	10	0	0	313500	78368.59	1097185.908
100	H	South Carolina	3	1	706	15000	1	7.5	10	1	0	313500	78368.59	1055752.789
100	H	South Carolina	3	1	706	15000	1	7.5	10	5	0	313500	78368.59	918641.485
100	H	New York	3	0	0	0	1	5.9	1	0	0	161500	79939.33	241439.3298
100	H	New York	3	0	0	0	1	5.9	1	1	0	161500	79939.33	240647.8513
100	H	New York	3	0	0	0	1	5.9	1	5	0	161500	79939.33	237632.6951
100	H	New York	3	0	0	0	1	5.9	5	0	0	161500	79939.33	561196.6491
100	H	New York	3	0	0	0	1	5.9	5	1	0	161500	79939.33	549480.0406
100	H	New York	3	0	0	0	1	5.9	5	5	0	161500	79939.33	507595.4635
100	H	New York	3	0	0	0	1	5.9	10	0	0	293500	79939.33	1092893.298
100	H	New York	3	0	0	0	1	5.9	10	1	0	293500	79939.33	1050629.737
100	H	New York	3	0	0	0	1	5.9	10	5	0	293500	79939.33	910770.3152
100	H	New York	3	1	250	5000	1	5.9	1	0	0	173500	79144.58	252644.584
100	H	New York	3	1	250	5000	1	5.9	1	1	0	173500	79144.58	251860.9743
100	H	New York	3	1	250	5000	1	5.9	1	5	0	173500	79144.58	248875.7943
100	H	New York	3	1	250	5000	1	5.9	5	0	0	173500	79144.58	569222.9201
100	H	New York	3	1	250	5000	1	5.9	5	1	0	173500	79144.58	557622.7965
100	H	New York	3	1	250	5000	1	5.9	5	5	0	173500	79144.58	516154.6301
100	H	New York	3	1	250	5000	1	5.9	10	0	0	305500	79144.58	1096945.84
100	H	New York	3	1	250	5000	1	5.9	10	1	0	305500	79144.58	1055102.457
100	H	New York	3	1	250	5000	1	5.9	10	5	0	305500	79144.58	916633.4989
100	H	New York	3	1	706	5000	1	5.9	1	0	0	173500	79170.49	252670.4904
100	H	New York	3	1	706	5000	1	5.9	1	1	0	173500	79170.49	251886.6241
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100	H	New York	3	1	706	5000	1	5.9	5	0	0	173500	79170.49	569352.4519
100	H	New York	3	1	706	5000	1	5.9	5	1	0	173500	79170.49	557748.5313
100	H	New York	3	1	706	5000	1	5.9	5	5	0	173500	79170.49	516266.7911
100	H	New York	3	1	706	5000	1	5.9	10	0	0	305500	79170.49	1097204.904
100	H	New York	3	1	706	5000	1	5.9	10	1	0	305500	79170.49	1055347.824
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100	H	New York	3	1	250	15000	1	5.9	1	1	0	173500	79116.54	251833.2055
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100	H	New York	3	1	250	15000	1	5.9	5	0	0	173500	79116.54	569082.6876
100	H	New York	3	1	250	15000	1	5.9	5	1	0	173500	79116.54	557486.6748
100	H	New York	3	1	250	15000	1	5.9	5	5	0	173500	79116.54	516033.2035
100	H	New York	3	1	250	15000	1	5.9	10	0	0	305500	79116.54	1096665.375
100	H	New York	3	1	250	15000	1	5.9	10	1	0	305500	79116.54	1054836.82
100	H	New York	3	1	250	15000	1	5.9	10	5	0	305500	79116.54	916416.9313
100	H	New York	3	1	706	15000	1	5.9	1	0	0	173500	79144.40	252644.402
100	H	New York	3	1	706	15000	1	5.9	1	1	0	173500	79144.40	251860.7941
100	H	New York	3	1	706	15000	1	5.9	1	5	0	173500	79144.40	248875.621
100	H	New York	3	1	706	15000	1	5.9	5	0	0	173500	79144.40	569222.0101
100	H	New York	3	1	706	15000	1	5.9	5	1	0	173500	79144.40	557621.9132

100	H	New York	3	1	706	15000	1	5.9	5	5	0	173500	79144.40	516153.8421
100	H	New York	3	1	706	15000	1	5.9	10	0	0	305500	79144.40	1096944.02
100	H	New York	3	1	706	15000	1	5.9	10	1	0	305500	79144.40	1055100.733
100	H	New York	3	1	706	15000	1	5.9	10	5	0	305500	79144.40	916632.0935
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100	H	New York	3	0	0	0	1	7.5	1	1	0	169500	79937.01	248645.558
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100	H	New York	3	0	0	0	1	7.5	5	0	0	169500	79937.01	569185.0679
100	H	New York	3	0	0	0	1	7.5	5	1	0	169500	79937.01	557468.7989
100	H	New York	3	0	0	0	1	7.5	5	5	0	169500	79937.01	515585.4354
100	H	New York	3	0	0	0	1	7.5	10	0	0	301500	79937.01	1100870.136
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100	H	New York	3	0	0	0	1	7.5	10	5	0	301500	79937.01	918752.4299
100	H	New York	3	1	250	5000	1	7.5	1	0	0	181500	79128.64	260628.642
100	H	New York	3	1	250	5000	1	7.5	1	1	0	181500	79128.64	259845.1901
100	H	New York	3	1	250	5000	1	7.5	1	5	0	181500	79128.64	256860.6114
100	H	New York	3	1	250	5000	1	7.5	5	0	0	181500	79128.64	577143.21
100	H	New York	3	1	250	5000	1	7.5	5	1	0	181500	79128.64	565545.4231
100	H	New York	3	1	250	5000	1	7.5	5	5	0	181500	79128.64	524085.6096
100	H	New York	3	1	250	5000	1	7.5	10	0	0	313500	79128.64	1104786.42
100	H	New York	3	1	250	5000	1	7.5	10	1	0	313500	79128.64	1062951.466
100	H	New York	3	1	250	5000	1	7.5	10	5	0	313500	79128.64	924510.3989
100	H	New York	3	1	706	5000	1	7.5	1	0	0	181500	79153.58	260653.5762
100	H	New York	3	1	706	5000	1	7.5	1	1	0	181500	79153.58	259869.8774
100	H	New York	3	1	706	5000	1	7.5	1	5	0	181500	79153.58	256884.3583
100	H	New York	3	1	706	5000	1	7.5	5	0	0	181500	79153.58	577267.8811
100	H	New York	3	1	706	5000	1	7.5	5	1	0	181500	79153.58	565666.4395
100	H	New York	3	1	706	5000	1	7.5	5	5	0	181500	79153.58	524193.5616
100	H	New York	3	1	706	5000	1	7.5	10	0	0	313500	79153.58	1105035.762
100	H	New York	3	1	706	5000	1	7.5	10	1	0	313500	79153.58	1063187.625
100	H	New York	3	1	706	5000	1	7.5	10	5	0	313500	79153.58	924702.9343
100	H	New York	3	1	250	15000	1	7.5	1	0	0	181500	79157.99	260657.987
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100	H	New York	3	1	250	15000	1	7.5	5	0	0	181500	79157.99	577289.9351
100	H	New York	3	1	250	15000	1	7.5	5	1	0	181500	79157.99	565687.8471
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100	H	New York	3	1	250	15000	1	7.5	10	0	0	313500	79157.99	1105079.87
100	H	New York	3	1	250	15000	1	7.5	10	1	0	313500	79157.99	1063229.401
100	H	New York	3	1	250	15000	1	7.5	10	5	0	313500	79157.99	924736.9933
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100	H	New York	3	1	706	15000	1	7.5	5	0	0	181500	79147.63	577238.138
100	H	New York	3	1	706	15000	1	7.5	5	1	0	181500	79147.63	565637.5683

100	H	New York	3	1	706	15000	1	7.5	5	5	0	181500	79147.63	524167.8072
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100	H	New York	3	1	706	15000	1	7.5	10	1	0	313500	79147.63	1063131.284
100	H	New York	3	1	706	15000	1	7.5	10	5	0	313500	79147.63	924657.0006
100	H	Minneapolis	3	0	0	0	1	5.9	1	0	0	161500	81391.32	242891.3194
100	H	Minneapolis	3	0	0	0	1	5.9	1	1	0	161500	81391.32	242085.4648
100	H	Minneapolis	3	0	0	0	1	5.9	1	5	0	161500	81391.32	239015.5423
100	H	Minneapolis	3	0	0	0	1	5.9	5	0	0	161500	81391.32	568456.597
100	H	Minneapolis	3	0	0	0	1	5.9	5	1	0	161500	81391.32	556527.1722
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100	H	Minneapolis	3	0	0	0	1	5.9	10	0	0	293500	81391.32	1107413.194
100	H	Minneapolis	3	0	0	0	1	5.9	10	1	0	293500	81391.32	1064381.972
100	H	Minneapolis	3	0	0	0	1	5.9	10	5	0	293500	81391.32	921982.194
100	H	Minneapolis	3	1	250	5000	1	5.9	1	0	0	173500	79984.60	253484.5987
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100	H	Minneapolis	3	1	250	5000	1	5.9	5	0	0	173500	79984.60	573422.9934
100	H	Minneapolis	3	1	250	5000	1	5.9	5	1	0	173500	79984.60	561699.7499
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100	H	Minneapolis	3	1	250	5000	1	5.9	10	0	0	305500	79984.60	1105345.987
100	H	Minneapolis	3	1	250	5000	1	5.9	10	1	0	305500	79984.60	1063058.492
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100	H	Minneapolis	3	1	706	5000	1	5.9	1	0	0	173500	80005.66	253505.665
100	H	Minneapolis	3	1	706	5000	1	5.9	1	1	0	173500	80005.66	252713.5297
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100	H	Minneapolis	3	1	706	5000	1	5.9	5	0	0	173500	80005.66	573528.3249
100	H	Minneapolis	3	1	706	5000	1	5.9	5	1	0	173500	80005.66	561801.9937
100	H	Minneapolis	3	1	706	5000	1	5.9	5	5	0	173500	80005.66	519882.66
100	H	Minneapolis	3	1	706	5000	1	5.9	10	0	0	305500	80005.66	1105556.65
100	H	Minneapolis	3	1	706	5000	1	5.9	10	1	0	305500	80005.66	1063258.017
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100	H	Minneapolis	3	1	250	15000	1	5.9	1	0	0	173500	80026.76	253526.7565
100	H	Minneapolis	3	1	250	15000	1	5.9	1	1	0	173500	80026.76	252734.4123
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100	H	Minneapolis	3	1	250	15000	1	5.9	5	0	0	173500	80026.76	573633.7823
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100	H	Minneapolis	3	1	706	15000	1	5.9	1	1	0	173500	79999.22	252707.1497
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100	H	Minneapolis	3	1	706	15000	1	5.9	5	0	0	173500	79999.22	573496.1061
100	H	Minneapolis	3	1	706	15000	1	5.9	5	1	0	173500	79999.22	561770.7194

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100	H	Minneapolis	3	1	706	15000	1	5.9	10	0	0	305500	79999.22	1105492.212
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100	H	Minneapolis	3	1	706	15000	1	5.9	10	5	0	305500	79999.22	923232.7807
100	H	Minneapolis	3	0	0	0	1	7.5	1	0	0	169500	81382.16	250882.157
100	H	Minneapolis	3	0	0	0	1	7.5	1	1	0	169500	81382.16	250076.3931
100	H	Minneapolis	3	0	0	0	1	7.5	1	5	0	169500	81382.16	247006.8162
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100	H	Minneapolis	3	0	0	0	1	7.5	5	1	0	169500	81382.16	564482.7032
100	H	Minneapolis	3	0	0	0	1	7.5	5	5	0	169500	81382.16	521842.1502
100	H	Minneapolis	3	0	0	0	1	7.5	10	0	0	301500	81382.16	1115321.57
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100	H	Minneapolis	3	0	0	0	1	7.5	10	5	0	301500	81382.16	929911.4444
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100	H	Minneapolis	3	1	250	5000	1	7.5	1	5	0	181500	80011.98	257701.8833
100	H	Minneapolis	3	1	250	5000	1	7.5	5	0	0	181500	80011.98	581559.8873
100	H	Minneapolis	3	1	250	5000	1	7.5	5	1	0	181500	80011.98	569832.6309
100	H	Minneapolis	3	1	250	5000	1	7.5	5	5	0	181500	80011.98	527909.9898
100	H	Minneapolis	3	1	250	5000	1	7.5	10	0	0	313500	80011.98	1113619.775
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100	H	Minneapolis	3	1	250	5000	1	7.5	10	5	0	313500	80011.98	931331.2811
100	H	Minneapolis	3	1	706	5000	1	7.5	1	0	0	181500	80002.63	261502.6338
100	H	Minneapolis	3	1	706	5000	1	7.5	1	1	0	181500	80002.63	260710.5285
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100	H	Minneapolis	3	1	706	5000	1	7.5	5	1	0	181500	80002.63	569787.2819
100	H	Minneapolis	3	1	706	5000	1	7.5	5	5	0	181500	80002.63	527869.5364
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100	H	Minneapolis	3	1	250	15000	1	7.5	1	0	0	181500	80004.71	261504.7133
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100	H	Minneapolis	3	1	250	15000	1	7.5	5	1	0	181500	80004.71	569797.3746
100	H	Minneapolis	3	1	250	15000	1	7.5	5	5	0	181500	80004.71	527878.5396
100	H	Minneapolis	3	1	250	15000	1	7.5	10	0	0	313500	80004.71	1113547.133
100	H	Minneapolis	3	1	250	15000	1	7.5	10	1	0	313500	80004.71	1071249.003
100	H	Minneapolis	3	1	250	15000	1	7.5	10	5	0	313500	80004.71	931275.1889
100	H	Minneapolis	3	1	706	15000	1	7.5	1	0	0	181500	80012.72	261512.7211
100	H	Minneapolis	3	1	706	15000	1	7.5	1	1	0	181500	80012.72	260720.516
100	H	Minneapolis	3	1	706	15000	1	7.5	1	5	0	181500	80012.72	257702.5916
100	H	Minneapolis	3	1	706	15000	1	7.5	5	0	0	181500	80012.72	581563.6057
100	H	Minneapolis	3	1	706	15000	1	7.5	5	1	0	181500	80012.72	569836.2403

100	H	Minneapolis	3	1	706	15000	1	7.5	5	5	0	181500	80012.72	527913.2095
100	H	Minneapolis	3	1	706	15000	1	7.5	10	0	0	313500	80012.72	1113627.211
100	H	Minneapolis	3	1	706	15000	1	7.5	10	1	0	313500	80012.72	1071324.848
100	H	Minneapolis	3	1	706	15000	1	7.5	10	5	0	313500	80012.72	931337.0235
100	L	0	3	0	0	0	0	0	1	0	0.00040625	88000	82562.30	170562.3003
100	L	0	3	0	0	0	0	0	1	1	0.00040625	88000	82562.30	169744.8517
100	L	0	3	0	0	0	0	0	1	5	0.00040625	88000	82562.30	166630.7622
100	L	0	3	0	0	0	0	0	5	0	0.00040625	88000	82562.30	500811.5013
100	L	0	3	0	0	0	0	0	5	1	0.00040625	88000	82562.30	488710.4473
100	L	0	3	0	0	0	0	0	5	5	0.00040625	88000	82562.30	445451.5529
100	L	0	3	0	0	0	0	0	10	0	0.00040625	176000	82562.30	1001623.003
100	L	0	3	0	0	0	0	0	10	1	0.00040625	176000	82562.30	957972.6885
100	L	0	3	0	0	0	0	0	10	5	0.00040625	176000	82562.30	813524.1978
100	L	0	3	1	250	5000	0	0	1	0	0	100000	75185.47	175185.4662
100	L	0	3	1	250	5000	0	0	1	1	0	100000	75185.47	174441.0556
100	L	0	3	1	250	5000	0	0	1	5	0	100000	75185.47	171605.2059
100	L	0	3	1	250	5000	0	0	5	0	0	100000	75185.47	475927.3309
100	L	0	3	1	250	5000	0	0	5	1	0	100000	75185.47	464907.4903
100	L	0	3	1	250	5000	0	0	5	5	0	100000	75185.47	425513.7218
100	L	0	3	1	250	5000	0	0	10	0	0	188000	75185.47	939854.6618
100	L	0	3	1	250	5000	0	0	10	1	0	188000	75185.47	900104.4464
100	L	0	3	1	250	5000	0	0	10	5	0	188000	75185.47	768562.2403
100	L	0	3	1	706	5000	0	0	1	0	4.16667E-05	100000	76371.08	176371.0769
100	L	0	3	1	706	5000	0	0	1	1	4.16667E-05	100000	76371.08	175614.9276
100	L	0	3	1	706	5000	0	0	1	5	4.16667E-05	100000	76371.08	172734.3589
100	L	0	3	1	706	5000	0	0	5	0	4.16667E-05	100000	76371.08	481855.3844
100	L	0	3	1	706	5000	0	0	5	1	4.16667E-05	100000	76371.08	470661.7703
100	L	0	3	1	706	5000	0	0	5	5	4.16667E-05	100000	76371.08	430646.7956
100	L	0	3	1	706	5000	0	0	10	0	4.16667E-05	188000	76371.08	951710.7687
100	L	0	3	1	706	5000	0	0	10	1	4.16667E-05	188000	76371.08	911333.7264
100	L	0	3	1	706	5000	0	0	10	5	4.16667E-05	188000	76371.08	777717.2119
100	L	0	3	1	250	15000	0	0	1	0	0.00003125	100000	76101.18	176101.1756
100	L	0	3	1	250	15000	0	0	1	1	0.00003125	100000	76101.18	175347.6986
100	L	0	3	1	250	15000	0	0	1	5	0.00003125	100000	76101.18	172477.3101
100	L	0	3	1	250	15000	0	0	5	0	0.00003125	100000	76101.18	480505.8781
100	L	0	3	1	250	15000	0	0	5	1	0.00003125	100000	76101.18	469351.8231
100	L	0	3	1	250	15000	0	0	5	5	0.00003125	100000	76101.18	429478.2645
100	L	0	3	1	250	15000	0	0	10	0	0.00003125	188000	76101.18	949011.7562
100	L	0	3	1	250	15000	0	0	10	1	0.00003125	188000	76101.18	908777.4094
100	L	0	3	1	250	15000	0	0	10	5	0.00003125	188000	76101.18	775633.1059
100	L	0	3	1	706	15000	0	0	1	0	1.04167E-05	100000	75468.82	175468.825
100	L	0	3	1	706	15000	0	0	1	1	1.04167E-05	100000	75468.82	174721.6089
100	L	0	3	1	706	15000	0	0	1	5	1.04167E-05	100000	75468.82	171875.0714
100	L	0	3	1	706	15000	0	0	5	0	1.04167E-05	100000	75468.82	477344.1249
100	L	0	3	1	706	15000	0	0	5	1	1.04167E-05	100000	75468.82	466282.7527

100	L	0	3	1	706	15000	0	0	5	5	1.04167E-05	100000	75468.82	426740.5171
100	L	0	3	1	706	15000	0	0	10	0	1.04167E-05	188000	75468.82	942688.2498
100	L	0	3	1	706	15000	0	0	10	1	1.04167E-05	188000	75468.82	902788.2239
100	L	0	3	1	706	15000	0	0	10	5	1.04167E-05	188000	75468.82	770750.2619
100	L	San Diego	3	0	0	0	1	5.9	1	0	0.000375	117500	80964.47	198464.4692
100	L	San Diego	3	0	0	0	1	5.9	1	1	0.000375	117500	80964.47	197662.8408
100	L	San Diego	3	0	0	0	1	5.9	1	5	0.000375	117500	80964.47	194609.0183
100	L	San Diego	3	0	0	0	1	5.9	5	0	0.000375	117500	80964.47	522322.3461
100	L	San Diego	3	0	0	0	1	5.9	5	1	0.000375	117500	80964.47	510455.4842
100	L	San Diego	3	0	0	0	1	5.9	5	5	0.000375	117500	80964.47	468033.7806
100	L	San Diego	3	0	0	0	1	5.9	10	0	0.000375	205500	80964.47	1015144.692
100	L	San Diego	3	0	0	0	1	5.9	10	1	0.000375	205500	80964.47	972339.1441
100	L	San Diego	3	0	0	0	1	5.9	10	5	0.000375	205500	80964.47	830686.17
100	L	San Diego	3	1	250	5000	1	5.9	1	0	2.08333E-05	129500	74553.31	204053.3094
100	L	San Diego	3	1	250	5000	1	5.9	1	1	2.08333E-05	129500	74553.31	203315.1579
100	L	San Diego	3	1	250	5000	1	5.9	1	5	2.08333E-05	129500	74553.31	200503.1518
100	L	San Diego	3	1	250	5000	1	5.9	5	0	2.08333E-05	129500	74553.31	502266.5472
100	L	San Diego	3	1	250	5000	1	5.9	5	1	2.08333E-05	129500	74553.31	491339.361
100	L	San Diego	3	1	250	5000	1	5.9	5	5	2.08333E-05	129500	74553.31	452276.8139
100	L	San Diego	3	1	250	5000	1	5.9	10	0	2.08333E-05	217500	74553.31	963033.0944
100	L	San Diego	3	1	250	5000	1	5.9	10	1	2.08333E-05	217500	74553.31	923617.0975
100	L	San Diego	3	1	250	5000	1	5.9	10	5	2.08333E-05	217500	74553.31	793180.8936
100	L	San Diego	3	1	706	5000	1	5.9	1	0	1.04167E-05	129500	74265.07	203765.0713
100	L	San Diego	3	1	706	5000	1	5.9	1	1	1.04167E-05	129500	74265.07	203029.7736
100	L	San Diego	3	1	706	5000	1	5.9	1	5	1.04167E-05	129500	74265.07	200228.6394
100	L	San Diego	3	1	706	5000	1	5.9	5	0	1.04167E-05	129500	74265.07	500825.3567
100	L	San Diego	3	1	706	5000	1	5.9	5	1	1.04167E-05	129500	74265.07	489940.4172
100	L	San Diego	3	1	706	5000	1	5.9	5	5	1.04167E-05	129500	74265.07	451028.8938
100	L	San Diego	3	1	706	5000	1	5.9	10	0	1.04167E-05	217500	74265.07	960150.7134
100	L	San Diego	3	1	706	5000	1	5.9	10	1	1.04167E-05	217500	74265.07	920887.1067
100	L	San Diego	3	1	706	5000	1	5.9	10	5	1.04167E-05	217500	74265.07	790955.1954
100	L	San Diego	3	1	250	15000	1	5.9	1	0	0	129500	73969.95	203469.9549
100	L	San Diego	3	1	250	15000	1	5.9	1	1	0	129500	73969.95	202737.5791
100	L	San Diego	3	1	250	15000	1	5.9	1	5	0	129500	73969.95	199947.5761
100	L	San Diego	3	1	250	15000	1	5.9	5	0	0	129500	73969.95	499349.7744
100	L	San Diego	3	1	250	15000	1	5.9	5	1	0	129500	73969.95	488508.0898
100	L	San Diego	3	1	250	15000	1	5.9	5	5	0	129500	73969.95	449751.194
100	L	San Diego	3	1	250	15000	1	5.9	10	0	0	217500	73969.95	957199.5488
100	L	San Diego	3	1	250	15000	1	5.9	10	1	0	217500	73969.95	918091.9688
100	L	San Diego	3	1	250	15000	1	5.9	10	5	0	217500	73969.95	788676.3843
100	L	San Diego	3	1	706	15000	1	5.9	1	0	1.04167E-05	129500	74264.06	203764.0569
100	L	San Diego	3	1	706	15000	1	5.9	1	1	1.04167E-05	129500	74264.06	203028.7693
100	L	San Diego	3	1	706	15000	1	5.9	1	5	1.04167E-05	129500	74264.06	200227.6733
100	L	San Diego	3	1	706	15000	1	5.9	5	0	1.04167E-05	129500	74264.06	500820.2847
100	L	San Diego	3	1	706	15000	1	5.9	5	1	1.04167E-05	129500	74264.06	489935.4959

100	L	San Diego	3	1	706	15000	1	5.9	5	5	1.04167E-05	129500	74264.06	451024.502
100	L	San Diego	3	1	706	15000	1	5.9	10	0	1.04167E-05	217500	74264.06	960140.5694
100	L	San Diego	3	1	706	15000	1	5.9	10	1	1.04167E-05	217500	74264.06	920877.499
100	L	San Diego	3	1	706	15000	1	5.9	10	5	1.04167E-05	217500	74264.06	790947.3625
100	L	San Diego	3	0	0	0	1	7.5	1	0	0.000427083	125500	82368.96	207868.9556
100	L	San Diego	3	0	0	0	1	7.5	1	1	0.000427083	125500	82368.96	207053.4214
100	L	San Diego	3	0	0	0	1	7.5	1	5	0.000427083	125500	82368.96	203946.6244
100	L	San Diego	3	0	0	0	1	7.5	5	0	0.000427083	125500	82368.96	537344.778
100	L	San Diego	3	0	0	0	1	7.5	5	1	0.000427083	125500	82368.96	525272.0622
100	L	San Diego	3	0	0	0	1	7.5	5	5	0.000427083	125500	82368.96	482114.4716
100	L	San Diego	3	0	0	0	1	7.5	10	0	0.000427083	213500	82368.96	1037189.556
100	L	San Diego	3	0	0	0	1	7.5	10	1	0.000427083	213500	82368.96	993641.4623
100	L	San Diego	3	0	0	0	1	7.5	10	5	0.000427083	213500	82368.96	849531.2415
100	L	San Diego	3	1	250	5000	1	7.5	1	0	2.08333E-05	137500	74562.09	212062.0891
100	L	San Diego	3	1	250	5000	1	7.5	1	1	2.08333E-05	137500	74562.09	211323.8506
100	L	San Diego	3	1	250	5000	1	7.5	1	5	2.08333E-05	137500	74562.09	208511.5135
100	L	San Diego	3	1	250	5000	1	7.5	5	0	2.08333E-05	137500	74562.09	510310.4457
100	L	San Diego	3	1	250	5000	1	7.5	5	1	2.08333E-05	137500	74562.09	499381.9727
100	L	San Diego	3	1	250	5000	1	7.5	5	5	2.08333E-05	137500	74562.09	460314.8254
100	L	San Diego	3	1	250	5000	1	7.5	10	0	2.08333E-05	225500	74562.09	971120.8914
100	L	San Diego	3	1	250	5000	1	7.5	10	1	2.08333E-05	225500	74562.09	931700.2527
100	L	San Diego	3	1	250	5000	1	7.5	10	5	2.08333E-05	225500	74562.09	801248.6881
100	L	San Diego	3	1	706	5000	1	7.5	1	0	1.04167E-05	137500	74257.69	211757.6898
100	L	San Diego	3	1	706	5000	1	7.5	1	1	1.04167E-05	137500	74257.69	211022.4652
100	L	San Diego	3	1	706	5000	1	7.5	1	5	1.04167E-05	137500	74257.69	208221.6094
100	L	San Diego	3	1	706	5000	1	7.5	5	0	1.04167E-05	137500	74257.69	508788.4492
100	L	San Diego	3	1	706	5000	1	7.5	5	1	1.04167E-05	137500	74257.69	497904.5916
100	L	San Diego	3	1	706	5000	1	7.5	5	5	1.04167E-05	137500	74257.69	458996.9358
100	L	San Diego	3	1	706	5000	1	7.5	10	0	1.04167E-05	225500	74257.69	968076.8984
100	L	San Diego	3	1	706	5000	1	7.5	10	1	1.04167E-05	225500	74257.69	928817.1942
100	L	San Diego	3	1	706	5000	1	7.5	10	5	1.04167E-05	225500	74257.69	798898.1974
100	L	San Diego	3	1	250	15000	1	7.5	1	0	2.08333E-05	137500	74556.96	212056.9649
100	L	San Diego	3	1	250	15000	1	7.5	1	1	2.08333E-05	137500	74556.96	211318.7772
100	L	San Diego	3	1	250	15000	1	7.5	1	5	2.08333E-05	137500	74556.96	208506.6333
100	L	San Diego	3	1	250	15000	1	7.5	5	0	2.08333E-05	137500	74556.96	510284.8247
100	L	San Diego	3	1	250	15000	1	7.5	5	1	2.08333E-05	137500	74556.96	499357.1027
100	L	San Diego	3	1	250	15000	1	7.5	5	5	2.08333E-05	137500	74556.96	460292.6403
100	L	San Diego	3	1	250	15000	1	7.5	10	0	2.08333E-05	225500	74556.96	971069.6494
100	L	San Diego	3	1	250	15000	1	7.5	10	1	2.08333E-05	225500	74556.96	931651.7198
100	L	San Diego	3	1	250	15000	1	7.5	10	5	2.08333E-05	225500	74556.96	801209.1204
100	L	San Diego	3	1	706	15000	1	7.5	1	0	1.04167E-05	137500	74240.41	211740.4123
100	L	San Diego	3	1	706	15000	1	7.5	1	1	1.04167E-05	137500	74240.41	211005.3587
100	L	San Diego	3	1	706	15000	1	7.5	1	5	1.04167E-05	137500	74240.41	208205.1546
100	L	San Diego	3	1	706	15000	1	7.5	5	0	1.04167E-05	137500	74240.41	508702.0615
100	L	San Diego	3	1	706	15000	1	7.5	5	1	1.04167E-05	137500	74240.41	497820.73[illegible]3

100	L	San Diego	3	1	706	15000	1	7.5	5	5	1.04167E-05	137500	74240.41	458922.1331
100	L	San Diego	3	1	706	15000	1	7.5	10	0	1.04167E-05	225500	74240.41	967904.123
100	L	San Diego	3	1	706	15000	1	7.5	10	1	1.04167E-05	225500	74240.41	928653.5533
100	L	San Diego	3	1	706	15000	1	7.5	10	5	1.04167E-05	225500	74240.41	798764.7848
100	L	South Carolina	3	0	0	0	1	5.9	1	0	0.000416667	117500	81824.17	199324.1653
100	L	South Carolina	3	0	0	0	1	5.9	1	1	0.000416667	117500	81824.17	198514.0251
100	L	South Carolina	3	0	0	0	1	5.9	1	5	0.000416667	117500	81824.17	195427.7765
100	L	South Carolina	3	0	0	0	1	5.9	5	0	0.000416667	117500	81824.17	526620.8267
100	L	South Carolina	3	0	0	0	1	5.9	5	1	0.000416667	117500	81824.17	514627.9602
100	L	South Carolina	3	0	0	0	1	5.9	5	5	0.000416667	117500	81824.17	471755.8149
100	L	South Carolina	3	0	0	0	1	5.9	10	0	0.000416667	205500	81824.17	1023741.653
100	L	South Carolina	3	0	0	0	1	5.9	10	1	0.000416667	205500	81824.17	980481.5879
100	L	South Carolina	3	0	0	0	1	5.9	10	5	0.000416667	205500	81824.17	837324.5155
100	L	South Carolina	3	1	250	5000	1	5.9	1	0	2.08333E-05	129500	73834.23	203334.2278
100	L	South Carolina	3	1	250	5000	1	5.9	1	1	2.08333E-05	129500	73834.23	202603.1958
100	L	South Carolina	3	1	250	5000	1	5.9	1	5	2.08333E-05	129500	73834.23	199818.3122
100	L	South Carolina	3	1	250	5000	1	5.9	5	0	2.08333E-05	129500	73834.23	498671.139
100	L	South Carolina	3	1	250	5000	1	5.9	5	1	2.08333E-05	129500	73834.23	487849.3477
100	L	South Carolina	3	1	250	5000	1	5.9	5	5	2.08333E-05	129500	73834.23	449163.5668
100	L	South Carolina	3	1	250	5000	1	5.9	10	0	2.08333E-05	217500	73834.23	955842.278
100	L	South Carolina	3	1	250	5000	1	5.9	10	1	2.08333E-05	217500	73834.23	916806.4563
100	L	South Carolina	3	1	250	5000	1	5.9	10	5	2.08333E-05	217500	73834.23	787628.3358
100	L	South Carolina	3	1	706	5000	1	5.9	1	0	4.16667E-05	129500	74447.69	203947.6895
100	L	South Carolina	3	1	706	5000	1	5.9	1	1	4.16667E-05	129500	74447.69	203210.5837
100	L	South Carolina	3	1	706	5000	1	5.9	1	5	4.16667E-05	129500	74447.69	200402.5614
100	L	South Carolina	3	1	706	5000	1	5.9	5	0	4.16667E-05	129500	74447.69	501738.4475
100	L	South Carolina	3	1	706	5000	1	5.9	5	1	4.16667E-05	129500	74447.69	490826.7419
100	L	South Carolina	3	1	706	5000	1	5.9	5	5	4.16667E-05	129500	74447.69	451819.5349
100	L	South Carolina	3	1	706	5000	1	5.9	10	0	4.16667E-05	217500	74447.69	961976.8951
100	L	South Carolina	3	1	706	5000	1	5.9	10	1	4.16667E-05	217500	74447.69	922616.7389
100	L	South Carolina	3	1	706	5000	1	5.9	10	5	4.16667E-05	217500	74447.69	792365.3245
100	L	South Carolina	3	1	250	15000	1	5.9	1	0	1.04167E-05	129500	73552.43	203052.4278
100	L	South Carolina	3	1	250	15000	1	5.9	1	1	1.04167E-05	129500	73552.43	202324.1859
100	L	South Carolina	3	1	250	15000	1	5.9	1	5	1.04167E-05	129500	73552.43	199549.9312
100	L	South Carolina	3	1	250	15000	1	5.9	5	0	1.04167E-05	129500	73552.43	497262.139
100	L	South Carolina	3	1	250	15000	1	5.9	5	1	1.04167E-05	129500	73552.43	486481.6508
100	L	South Carolina	3	1	250	15000	1	5.9	5	5	1.04167E-05	129500	73552.43	447943.5202
100	L	South Carolina	3	1	250	15000	1	5.9	10	0	1.04167E-05	217500	73552.43	953024.278
100	L	South Carolina	3	1	250	15000	1	5.9	10	1	1.04167E-05	217500	73552.43	914137.4426
100	L	South Carolina	3	1	250	15000	1	5.9	10	5	1.04167E-05	217500	73552.43	785452.3508
100	L	South Carolina	3	1	706	15000	1	5.9	1	0	2.08333E-05	129500	73825.85	203325.8473
100	L	South Carolina	3	1	706	15000	1	5.9	1	1	2.08333E-05	129500	73825.85	202594.8983
100	L	South Carolina	3	1	706	15000	1	5.9	1	5	2.08333E-05	129500	73825.85	199810.3307
100	L	South Carolina	3	1	706	15000	1	5.9	5	0	2.08333E-05	129500	73825.85	498629.2364
100	L	South Carolina	3	1	706	15000	1	5.9	5	1	2.08333E-05	129500	73825.85	487808.6735

100	L	South Carolina	3	1	706	15000	1	5.9	5	5	2.08333E-05	129500	73825.85	449127.2835
100	L	South Carolina	3	1	706	15000	1	5.9	10	0	2.08333E-05	217500	73825.85	955758.4728
100	L	South Carolina	3	1	706	15000	1	5.9	10	1	2.08333E-05	217500	73825.85	916727.0818
100	L	South Carolina	3	1	706	15000	1	5.9	10	5	2.08333E-05	217500	73825.85	787563.6236
100	L	South Carolina	3	0	0	0	1	7.5	1	0	0.000322917	125500	79564.19	205064.1857
100	L	South Carolina	3	0	0	0	1	7.5	1	1	0.000322917	125500	79564.19	204276.4215
100	L	South Carolina	3	0	0	0	1	7.5	1	5	0.000322917	125500	79564.19	201275.415
100	L	South Carolina	3	0	0	0	1	7.5	5	0	0.000322917	125500	79564.19	523320.9287
100	L	South Carolina	3	0	0	0	1	7.5	5	1	0.000322917	125500	79564.19	511659.3046
100	L	South Carolina	3	0	0	0	1	7.5	5	5	0.000322917	125500	79564.19	469971.286
100	L	South Carolina	3	0	0	0	1	7.5	10	0	0.000322917	213500	79564.19	1009141.857
100	L	South Carolina	3	0	0	0	1	7.5	10	1	0.000322917	213500	79564.19	967076.6329
100	L	South Carolina	3	0	0	0	1	7.5	10	5	0.000322917	213500	79564.19	827873.5522
100	L	South Carolina	3	1	250	5000	1	7.5	1	0	1.04167E-05	137500	73533.05	211033.0495
100	L	South Carolina	3	1	250	5000	1	7.5	1	1	1.04167E-05	137500	73533.05	210304.9996
100	L	South Carolina	3	1	250	5000	1	7.5	1	5	1.04167E-05	137500	73533.05	207531.4758
100	L	South Carolina	3	1	250	5000	1	7.5	5	0	1.04167E-05	137500	73533.05	505165.2477
100	L	South Carolina	3	1	250	5000	1	7.5	5	1	1.04167E-05	137500	73533.05	494387.5998
100	L	South Carolina	3	1	250	5000	1	7.5	5	5	1.04167E-05	137500	73533.05	455859.6225
100	L	South Carolina	3	1	250	5000	1	7.5	10	0	1.04167E-05	225500	73533.05	960830.4955
100	L	South Carolina	3	1	250	5000	1	7.5	10	1	1.04167E-05	225500	73533.05	921953.9053
100	L	South Carolina	3	1	250	5000	1	7.5	10	5	1.04167E-05	225500	73533.05	793302.7171
100	L	South Carolina	3	1	706	5000	1	7.5	1	0	1.04167E-05	137500	73543.03	211043.0342
100	L	South Carolina	3	1	706	5000	1	7.5	1	1	1.04167E-05	137500	73543.03	210314.8854
100	L	South Carolina	3	1	706	5000	1	7.5	1	5	1.04167E-05	137500	73543.03	207540.985
100	L	South Carolina	3	1	706	5000	1	7.5	5	0	1.04167E-05	137500	73543.03	505215.171
100	L	South Carolina	3	1	706	5000	1	7.5	5	1	1.04167E-05	137500	73543.03	494436.0597
100	L	South Carolina	3	1	706	5000	1	7.5	5	5	1.04167E-05	137500	73543.03	455902.8509
100	L	South Carolina	3	1	706	5000	1	7.5	10	0	1.04167E-05	225500	73543.03	960930.3421
100	L	South Carolina	3	1	706	5000	1	7.5	10	1	1.04167E-05	225500	73543.03	922048.4731
100	L	South Carolina	3	1	706	5000	1	7.5	10	5	1.04167E-05	225500	73543.03	793379.8161
100	L	South Carolina	3	1	250	15000	1	7.5	1	0	2.08333E-05	137500	73835.80	211335.7964
100	L	South Carolina	3	1	250	15000	1	7.5	1	1	2.08333E-05	137500	73835.80	210604.7489
100	L	South Carolina	3	1	250	15000	1	7.5	1	5	2.08333E-05	137500	73835.80	207819.8061
100	L	South Carolina	3	1	250	15000	1	7.5	5	0	2.08333E-05	137500	73835.80	506678.9818
100	L	South Carolina	3	1	250	15000	1	7.5	5	1	2.08333E-05	137500	73835.80	495856.9607
100	L	South Carolina	3	1	250	15000	1	7.5	5	5	2.08333E-05	137500	73835.80	457170.3578
100	L	South Carolina	3	1	250	15000	1	7.5	10	0	2.08333E-05	225500	73835.80	963857.9637
100	L	South Carolina	3	1	250	15000	1	7.5	10	1	2.08333E-05	225500	73835.80	924821.3127
100	L	South Carolina	3	1	250	15000	1	7.5	10	5	2.08333E-05	225500	73835.80	795640.4479
100	L	South Carolina	3	1	706	15000	1	7.5	1	0	4.16667E-05	137500	74416.49	211916.4905
100	L	South Carolina	3	1	706	15000	1	7.5	1	1	4.16667E-05	137500	74416.49	211179.6936
100	L	South Carolina	3	1	706	15000	1	7.5	1	5	4.16667E-05	137500	74416.49	208372.8481
100	L	South Carolina	3	1	706	15000	1	7.5	5	0	4.16667E-05	137500	74416.49	509582.4527
100	L	South Carolina	3	1	706	15000	1	7.5	5	1	4.16667E-05	137500	74416.49	498675.3199

100	L	South Carolina	3	1	706	15000	1	7.5	5	5	4.16667E-05	137500	74416.49	459684.4597
100	L	South Carolina	3	1	706	15000	1	7.5	10	0	4.16667E-05	225500	74416.49	969664.9054
100	L	South Carolina	3	1	706	15000	1	7.5	10	1	4.16667E-05	225500	74416.49	930321.244
100	L	South Carolina	3	1	706	15000	1	7.5	10	5	4.16667E-05	225500	74416.49	800124.4143
100	L	New York	3	0	0	0	1	5.9	1	0	0.0004375	117500	82259.59	199759.5917
100	L	New York	3	0	0	0	1	5.9	1	1	0.0004375	117500	82259.59	198945.1403
100	L	New York	3	0	0	0	1	5.9	1	5	0.0004375	117500	82259.59	195842.4683
100	L	New York	3	0	0	0	1	5.9	5	0	0.0004375	117500	82259.59	528797.9587
100	L	New York	3	0	0	0	1	5.9	5	1	0.0004375	117500	82259.59	516741.2723
100	L	New York	3	0	0	0	1	5.9	5	5	0.0004375	117500	82259.59	473640.9834
100	L	New York	3	0	0	0	1	5.9	10	0	0.0004375	205500	82259.59	1028095.917
100	L	New York	3	0	0	0	1	5.9	10	1	0.0004375	205500	82259.59	984605.644
100	L	New York	3	0	0	0	1	5.9	10	5	0.0004375	205500	82259.59	840686.7628
100	L	New York	3	1	250	5000	1	5.9	1	0	4.16667E-05	129500	74575.07	204075.0687
100	L	New York	3	1	250	5000	1	5.9	1	1	4.16667E-05	129500	74575.07	203336.7017
100	L	New York	3	1	250	5000	1	5.9	1	5	4.16667E-05	129500	74575.07	200523.875
100	L	New York	3	1	250	5000	1	5.9	5	0	4.16667E-05	129500	74575.07	502375.3436
100	L	New York	3	1	250	5000	1	5.9	5	1	4.16667E-05	129500	74575.07	491444.9682
100	L	New York	3	1	250	5000	1	5.9	5	5	4.16667E-05	129500	74575.07	452371.0203
100	L	New York	3	1	250	5000	1	5.9	10	0	4.16667E-05	217500	74575.07	963250.6872
100	L	New York	3	1	250	5000	1	5.9	10	1	4.16667E-05	217500	74575.07	923823.1863
100	L	New York	3	1	250	5000	1	5.9	10	5	4.16667E-05	217500	74575.07	793348.913
100	L	New York	3	1	706	5000	1	5.9	1	0	1.04167E-05	129500	73725.28	203225.2835
100	L	New York	3	1	706	5000	1	5.9	1	1	1.04167E-05	129500	73725.28	202495.3302
100	L	New York	3	1	706	5000	1	5.9	1	5	1.04167E-05	129500	73725.28	199714.5557
100	L	New York	3	1	706	5000	1	5.9	5	0	1.04167E-05	129500	73725.28	498126.4173
100	L	New York	3	1	706	5000	1	5.9	5	1	1.04167E-05	129500	73725.28	487320.5939
100	L	New York	3	1	706	5000	1	5.9	5	5	1.04167E-05	129500	73725.28	448691.8948
100	L	New York	3	1	706	5000	1	5.9	10	0	1.04167E-05	217500	73725.28	954752.8346
100	L	New York	3	1	706	5000	1	5.9	10	1	1.04167E-05	217500	73725.28	915774.6113
100	L	New York	3	1	706	5000	1	5.9	10	5	1.04167E-05	217500	73725.28	786787.0965
100	L	New York	3	1	250	15000	1	5.9	1	0	5.20833E-05	129500	74901.05	204401.0548
100	L	New York	3	1	250	15000	1	5.9	1	1	5.20833E-05	129500	74901.05	203659.4602
100	L	New York	3	1	250	15000	1	5.9	1	5	5.20833E-05	129500	74901.05	200834.3379
100	L	New York	3	1	250	15000	1	5.9	5	0	5.20833E-05	129500	74901.05	504005.2742
100	L	New York	3	1	250	15000	1	5.9	5	1	5.20833E-05	129500	74901.05	493027.1194
100	L	New York	3	1	250	15000	1	5.9	5	5	5.20833E-05	129500	74901.05	453782.3695
100	L	New York	3	1	250	15000	1	5.9	10	0	5.20833E-05	217500	74901.05	966510.5483
100	L	New York	3	1	250	15000	1	5.9	10	1	5.20833E-05	217500	74901.05	926910.7
100	L	New York	3	1	250	15000	1	5.9	10	5	5.20833E-05	217500	74901.05	795866.0913
100	L	New York	3	1	706	15000	1	5.9	1	0	0.00003125	129500	74296.48	203796.481
100	L	New York	3	1	706	15000	1	5.9	1	1	0.00003125	129500	74296.48	203060.8723
100	L	New York	3	1	706	15000	1	5.9	1	5	0.00003125	129500	74296.48	200258.5533
100	L	New York	3	1	706	15000	1	5.9	5	0	0.00003125	129500	74296.48	500982.4051
100	L	New York	3	1	706	15000	1	5.9	5	1	0.00003125	129500	74296.48	490092.8619

100	L	New York	3	1	706	15000	1	5.9	5	5	0.00003125	129500	74296.48	451164.8813
100	L	New York	3	1	706	15000	1	5.9	10	0	0.00003125	217500	74296.48	960464.8101
100	L	New York	3	1	706	15000	1	5.9	10	1	0.00003125	217500	74296.48	921184.5972
100	L	New York	3	1	706	15000	1	5.9	10	5	0.00003125	217500	74296.48	791197.7326
100	L	New York	3	0	0	0	1	7.5	1	0	0.000322917	125500	79157.21	204657.2054
100	L	New York	3	0	0	0	1	7.5	1	1	0.000322917	125500	79157.21	203873.4707
100	L	New York	3	0	0	0	1	7.5	1	5	0.000322917	125500	79157.21	200887.8147
100	L	New York	3	0	0	0	1	7.5	5	0	0.000322917	125500	79157.21	521286.0272
100	L	New York	3	0	0	0	1	7.5	5	1	0.000322917	125500	79157.21	509684.0537
100	L	New York	3	0	0	0	1	7.5	5	5	0.000322917	125500	79157.21	468209.2743
100	L	New York	3	0	0	0	1	7.5	10	0	0.000322917	213500	79157.21	1005072.054
100	L	New York	3	0	0	0	1	7.5	10	1	0.000322917	213500	79157.21	963221.9986
100	L	New York	3	0	0	0	1	7.5	10	5	0.000322917	213500	79157.21	824730.9582
100	L	New York	3	1	250	5000	1	7.5	1	0	0.00003125	137500	74304.54	211804.5352
100	L	New York	3	1	250	5000	1	7.5	1	1	0.00003125	137500	74304.54	211068.8467
100	L	New York	3	1	250	5000	1	7.5	1	5	0.00003125	137500	74304.54	208266.224
100	L	New York	3	1	250	5000	1	7.5	5	0	0.00003125	137500	74304.54	509022.676
100	L	New York	3	1	250	5000	1	7.5	5	1	0.00003125	137500	74304.54	498131.9524
100	L	New York	3	1	250	5000	1	7.5	5	5	0.00003125	137500	74304.54	459199.7517
100	L	New York	3	1	250	5000	1	7.5	10	0	0.00003125	225500	74304.54	968545.3521
100	L	New York	3	1	250	5000	1	7.5	10	1	0.00003125	225500	74304.54	929260.881
100	L	New York	3	1	250	5000	1	7.5	10	5	0.00003125	225500	74304.54	799259.9249
100	L	New York	3	1	706	5000	1	7.5	1	0	2.08333E-05	137500	74018.00	211517.9962
100	L	New York	3	1	706	5000	1	7.5	1	1	2.08333E-05	137500	74018.00	210785.1448
100	L	New York	3	1	706	5000	1	7.5	1	5	2.08333E-05	137500	74018.00	207993.3297
100	L	New York	3	1	706	5000	1	7.5	5	0	2.08333E-05	137500	74018.00	507589.9811
100	L	New York	3	1	706	5000	1	7.5	5	1	2.08333E-05	137500	74018.00	496741.2551
100	L	New York	3	1	706	5000	1	7.5	5	5	2.08333E-05	137500	74018.00	457959.1878
100	L	New York	3	1	706	5000	1	7.5	10	0	2.08333E-05	225500	74018.00	965679.9621
100	L	New York	3	1	706	5000	1	7.5	10	1	2.08333E-05	225500	74018.00	926546.9829
100	L	New York	3	1	706	5000	1	7.5	10	5	2.08333E-05	225500	74018.00	797047.3467
100	L	New York	3	1	250	15000	1	7.5	1	0	0.00003125	137500	74312.92	211812.9159
100	L	New York	3	1	250	15000	1	7.5	1	1	0.00003125	137500	74312.92	211077.1444
100	L	New York	3	1	250	15000	1	7.5	1	5	0.00003125	137500	74312.92	208274.2056
100	L	New York	3	1	250	15000	1	7.5	5	0	0.00003125	137500	74312.92	509064.5793
100	L	New York	3	1	250	15000	1	7.5	5	1	0.00003125	137500	74312.92	498172.6274
100	L	New York	3	1	250	15000	1	7.5	5	5	0.00003125	137500	74312.92	459236.0356
100	L	New York	3	1	250	15000	1	7.5	10	0	0.00003125	225500	74312.92	968629.1587
100	L	New York	3	1	250	15000	1	7.5	10	1	0.00003125	225500	74312.92	929340.2567
100	L	New York	3	1	250	15000	1	7.5	10	5	0.00003125	225500	74312.92	799324.6381
100	L	New York	3	1	706	15000	1	7.5	1	0	4.16667E-05	137500	74598.31	212098.3112
100	L	New York	3	1	706	15000	1	7.5	1	1	4.16667E-05	137500	74598.31	211359.7141
100	L	New York	3	1	706	15000	1	7.5	1	5	4.16667E-05	137500	74598.31	208546.0107
100	L	New York	3	1	706	15000	1	7.5	5	0	4.16667E-05	137500	74598.31	510491.5561
100	L	New York	3	1	706	15000	1	7.5	5	1	4.16667E-05	137500	74598.31	499557.7741

100	L	New York	3	1	706	15000	1	7.5	5	5	4.16667E-05	137500	74598.31	460471.6481
100	L	New York	3	1	706	15000	1	7.5	10	0	4.16667E-05	225500	74598.31	971483.1123
100	L	New York	3	1	706	15000	1	7.5	10	1	4.16667E-05	225500	74598.31	932043.3231
100	L	New York	3	1	706	15000	1	7.5	10	5	4.16667E-05	225500	74598.31	801528.3855
100	L	Minneapolis	3	0	0	0	1	5.9	1	0	0.00046875	117500	83738.84	201238.8417
100	L	Minneapolis	3	0	0	0	1	5.9	1	1	0.00046875	117500	83738.84	200409.7442
100	L	Minneapolis	3	0	0	0	1	5.9	1	5	0.00046875	117500	83738.84	197251.2778
100	L	Minneapolis	3	0	0	0	1	5.9	5	0	0.00046875	117500	83738.84	536194.2083
100	L	Minneapolis	3	0	0	0	1	5.9	5	1	0.00046875	117500	83738.84	523920.7101
100	L	Minneapolis	3	0	0	0	1	5.9	5	5	0.00046875	117500	83738.84	480045.3614
100	L	Minneapolis	3	0	0	0	1	5.9	10	0	0.00046875	205500	83738.84	1042888.417
100	L	Minneapolis	3	0	0	0	1	5.9	10	1	0.00046875	205500	83738.84	998616.0704
100	L	Minneapolis	3	0	0	0	1	5.9	10	5	0.00046875	205500	83738.84	852109.1386
100	L	Minneapolis	3	1	250	5000	1	5.9	1	0	0.00003125	129500	74930.41	204430.4127
100	L	Minneapolis	3	1	250	5000	1	5.9	1	1	0.00003125	129500	74930.41	203688.5274
100	L	Minneapolis	3	1	250	5000	1	5.9	1	5	0.00003125	129500	74930.41	200862.2978
100	L	Minneapolis	3	1	250	5000	1	5.9	5	0	0.00003125	129500	74930.41	504152.0634
100	L	Minneapolis	3	1	250	5000	1	5.9	5	1	0.00003125	129500	74930.41	493169.6056
100	L	Minneapolis	3	1	250	5000	1	5.9	5	5	0.00003125	129500	74930.41	453909.4736
100	L	Minneapolis	3	1	250	5000	1	5.9	10	0	0.00003125	217500	74930.41	966804.1267
100	L	Minneapolis	3	1	250	5000	1	5.9	10	1	0.00003125	217500	74930.41	927188.757
100	L	Minneapolis	3	1	250	5000	1	5.9	10	5	0.00003125	217500	74930.41	796092.7848
100	L	Minneapolis	3	1	706	5000	1	5.9	1	0	1.04167E-05	129500	74348.85	203848.8494
100	L	Minneapolis	3	1	706	5000	1	5.9	1	1	1.04167E-05	129500	74348.85	203112.7221
100	L	Minneapolis	3	1	706	5000	1	5.9	1	5	1.04167E-05	129500	74348.85	200308.428
100	L	Minneapolis	3	1	706	5000	1	5.9	5	0	1.04167E-05	129500	74348.85	501244.2468
100	L	Minneapolis	3	1	706	5000	1	5.9	5	1	1.04167E-05	129500	74348.85	490347.0281
100	L	Minneapolis	3	1	706	5000	1	5.9	5	5	1.04167E-05	129500	74348.85	451391.6088
100	L	Minneapolis	3	1	706	5000	1	5.9	10	0	1.04167E-05	217500	74348.85	960988.4935
100	L	Minneapolis	3	1	706	5000	1	5.9	10	1	1.04167E-05	217500	74348.85	921680.5937
100	L	Minneapolis	3	1	706	5000	1	5.9	10	5	1.04167E-05	217500	74348.85	791602.107
100	L	Minneapolis	3	1	250	15000	1	5.9	1	0	1.04167E-05	129500	74374.74	203874.7428
100	L	Minneapolis	3	1	250	15000	1	5.9	1	1	1.04167E-05	129500	74374.74	203138.3592
100	L	Minneapolis	3	1	250	15000	1	5.9	1	5	1.04167E-05	129500	74374.74	200333.0884
100	L	Minneapolis	3	1	250	15000	1	5.9	5	0	1.04167E-05	129500	74374.74	501373.7139
100	L	Minneapolis	3	1	250	15000	1	5.9	5	1	1.04167E-05	129500	74374.74	490472.7
100	L	Minneapolis	3	1	250	15000	1	5.9	5	5	1.04167E-05	129500	74374.74	451503.7137
100	L	Minneapolis	3	1	250	15000	1	5.9	10	0	1.04167E-05	217500	74374.74	961247.4278
100	L	Minneapolis	3	1	250	15000	1	5.9	10	1	1.04167E-05	217500	74374.74	921925.8382
100	L	Minneapolis	3	1	250	15000	1	5.9	10	5	1.04167E-05	217500	74374.74	791802.0492
100	L	Minneapolis	3	1	706	15000	1	5.9	1	0	2.08333E-05	129500	74667.61	204167.6092
100	L	Minneapolis	3	1	706	15000	1	5.9	1	1	2.08333E-05	129500	74667.61	203428.3259
100	L	Minneapolis	3	1	706	15000	1	5.9	1	5	2.08333E-05	129500	74667.61	200612.0087
100	L	Minneapolis	3	1	706	15000	1	5.9	5	0	2.08333E-05	129500	74667.61	502838.0458
100	L	Minneapolis	3	1	706	15000	1	5.9	5	1	2.08333E-05	129500	74667.61	491894.1069

100	L	Minneapolis	3	1	706	15000	1	5.9	5	5	2.08333E-05	129500	74667.61	452771.6719
100	L	Minneapolis	3	1	706	15000	1	5.9	10	0	2.08333E-05	217500	74667.61	964176.0917
100	L	Minneapolis	3	1	706	15000	1	5.9	10	1	2.08333E-05	217500	74667.61	924699.665
100	L	Minneapolis	3	1	706	15000	1	5.9	10	5	2.08333E-05	217500	74667.61	794063.4858
100	L	Minneapolis	3	0	0	0	1	7.5	1	0	0.00040625	125500	82035.67	207535.6658
100	L	Minneapolis	3	0	0	0	1	7.5	1	1	0.00040625	125500	82035.67	206723.4315
100	L	Minneapolis	3	0	0	0	1	7.5	1	5	0.00040625	125500	82035.67	203629.2055
100	L	Minneapolis	3	0	0	0	1	7.5	5	0	0.00040625	125500	82035.67	535678.3289
100	L	Minneapolis	3	0	0	0	1	7.5	5	1	0.00040625	125500	82035.67	523654.463
100	L	Minneapolis	3	0	0	0	1	7.5	5	5	0.00040625	125500	82035.67	480671.5011
100	L	Minneapolis	3	0	0	0	1	7.5	10	0	0.00040625	213500	82035.67	1033856.658
100	L	Minneapolis	3	0	0	0	1	7.5	10	1	0.00040625	213500	82035.67	990484.773
100	L	Minneapolis	3	0	0	0	1	7.5	10	5	0.00040625	213500	82035.67	846957.6659
100	L	Minneapolis	3	1	250	5000	1	7.5	1	0	0.0000625	137500	75842.85	213342.8469
100	L	Minneapolis	3	1	250	5000	1	7.5	1	1	0.0000625	137500	75842.85	212591.9276
100	L	Minneapolis	3	1	250	5000	1	7.5	1	5	0.0000625	137500	75842.85	209731.2828
100	L	Minneapolis	3	1	250	5000	1	7.5	5	0	0.0000625	137500	75842.85	516714.2346
100	L	Minneapolis	3	1	250	5000	1	7.5	5	1	0.0000625	137500	75842.85	505598.0425
100	L	Minneapolis	3	1	250	5000	1	7.5	5	5	0.0000625	137500	75842.85	465859.8364
100	L	Minneapolis	3	1	250	5000	1	7.5	10	0	0.0000625	225500	75842.85	983928.4692
100	L	Minneapolis	3	1	250	5000	1	7.5	10	1	0.0000625	225500	75842.85	943830.6997
100	L	Minneapolis	3	1	250	5000	1	7.5	10	5	0.0000625	225500	75842.85	811138.3602
100	L	Minneapolis	3	1	706	5000	1	7.5	1	0	1.04167E-05	137500	74365.77	211865.7749
100	L	Minneapolis	3	1	706	5000	1	7.5	1	1	1.04167E-05	137500	74365.77	211129.4801
100	L	Minneapolis	3	1	706	5000	1	7.5	1	5	1.04167E-05	137500	74365.77	208324.5475
100	L	Minneapolis	3	1	706	5000	1	7.5	5	0	1.04167E-05	137500	74365.77	509328.8746
100	L	Minneapolis	3	1	706	5000	1	7.5	5	1	1.04167E-05	137500	74365.77	498429.1751
100	L	Minneapolis	3	1	706	5000	1	7.5	5	5	1.04167E-05	137500	74365.77	459464.8876
100	L	Minneapolis	3	1	706	5000	1	7.5	10	0	1.04167E-05	225500	74365.77	969157.7492
100	L	Minneapolis	3	1	706	5000	1	7.5	10	1	1.04167E-05	225500	74365.77	929840.9009
100	L	Minneapolis	3	1	706	5000	1	7.5	10	5	1.04167E-05	225500	74365.77	799732.8017
100	L	Minneapolis	3	1	250	15000	1	7.5	1	0	1.04167E-05	137500	74362.81	211862.8061
100	L	Minneapolis	3	1	250	15000	1	7.5	1	1	1.04167E-05	137500	74362.81	211126.5406
100	L	Minneapolis	3	1	250	15000	1	7.5	1	5	1.04167E-05	137500	74362.81	208321.72
100	L	Minneapolis	3	1	250	15000	1	7.5	5	0	1.04167E-05	137500	74362.81	509314.0303
100	L	Minneapolis	3	1	250	15000	1	7.5	5	1	1.04167E-05	137500	74362.81	498414.7659
100	L	Minneapolis	3	1	250	15000	1	7.5	5	5	1.04167E-05	137500	74362.81	459452.034
100	L	Minneapolis	3	1	250	15000	1	7.5	10	0	1.04167E-05	225500	74362.81	969128.0605
100	L	Minneapolis	3	1	250	15000	1	7.5	10	1	1.04167E-05	225500	74362.81	929812.7819
100	L	Minneapolis	3	1	250	15000	1	7.5	10	5	1.04167E-05	225500	74362.81	799709.8769
100	L	Minneapolis	3	1	706	15000	1	7.5	1	0	4.16667E-05	137500	75247.99	212747.99
100	L	Minneapolis	3	1	706	15000	1	7.5	1	1	4.16667E-05	137500	75247.99	212002.9604
100	L	Minneapolis	3	1	706	15000	1	7.5	1	5	4.16667E-05	137500	75247.99	209164.7524
100	L	Minneapolis	3	1	706	15000	1	7.5	5	0	4.16667E-05	137500	75247.99	513739.9499
100	L	Minneapolis	3	1	706	15000	1	7.5	5	1	4.16667E-05	137500	75247.99	502710.9453

100	L	Minneapolis	3	1	706	15000	1	7.5	5	5	4.16667E-05	137500	75247.99	463284.4172
100	L	Minneapolis	3	1	706	15000	1	7.5	10	0	4.16667E-05	225500	75247.99	977979.8999
100	L	Minneapolis	3	1	706	15000	1	7.5	10	1	4.16667E-05	225500	75247.99	938196.6285
100	L	Minneapolis	3	1	706	15000	1	7.5	10	5	4.16667E-05	225500	75247.99	806545.0326
300	H	0	3	0	0	0	0	0	1	0	0	264000	197551.14	461551.1412
300	H	0	3	0	0	0	0	0	1	1	0	264000	197551.14	459595.1893
300	H	0	3	0	0	0	0	0	1	5	0	264000	197551.14	452143.944
300	H	0	3	0	0	0	0	0	5	0	0	264000	197551.14	1251755.706
300	H	0	3	0	0	0	0	0	5	1	0	264000	197551.14	1222800.88
300	H	0	3	0	0	0	0	0	5	5	0	264000	197551.14	1119293.057
300	H	0	3	0	0	0	0	0	10	0	0	528000	197551.14	2503511.412
300	H	0	3	0	0	0	0	0	10	1	0	528000	197551.14	2399067.019
300	H	0	3	0	0	0	0	0	10	5	0	528000	197551.14	2053437.548
300	H	0	3	1	250	5000	0	0	1	0	0	276000	197604.44	473604.4358
300	H	0	3	1	250	5000	0	0	1	1	0	276000	197604.44	471647.9562
300	H	0	3	1	250	5000	0	0	1	5	0	276000	197604.44	464194.7008
300	H	0	3	1	250	5000	0	0	5	0	0	276000	197604.44	1264022.179
300	H	0	3	1	250	5000	0	0	5	1	0	276000	197604.44	1235059.542
300	H	0	3	1	250	5000	0	0	5	5	0	276000	197604.44	1131523.795
300	H	0	3	1	250	5000	0	0	10	0	0	540000	197604.44	2516044.358
300	H	0	3	1	250	5000	0	0	10	1	0	540000	197604.44	2411571.788
300	H	0	3	1	250	5000	0	0	10	5	0	540000	197604.44	2065849.074
300	H	0	3	1	706	5000	0	0	1	0	0	276000	197608.93	473608.9305
300	H	0	3	1	706	5000	0	0	1	1	0	276000	197608.93	471652.4065
300	H	0	3	1	706	5000	0	0	1	5	0	276000	197608.93	464198.9814
300	H	0	3	1	706	5000	0	0	5	0	0	276000	197608.93	1264044.653
300	H	0	3	1	706	5000	0	0	5	1	0	276000	197608.93	1235081.357
300	H	0	3	1	706	5000	0	0	5	5	0	276000	197608.93	1131543.255
300	H	0	3	1	706	5000	0	0	10	0	0	540000	197608.93	2516089.305
300	H	0	3	1	706	5000	0	0	10	1	0	540000	197608.93	2411614.359
300	H	0	3	1	706	5000	0	0	10	5	0	540000	197608.93	2065883.781
300	H	0	3	1	250	15000	0	0	1	0	0	276000	197616.15	473616.1542
300	H	0	3	1	250	15000	0	0	1	1	0	276000	197616.15	471659.5586
300	H	0	3	1	250	15000	0	0	1	5	0	276000	197616.15	464205.8611
300	H	0	3	1	250	15000	0	0	5	0	0	276000	197616.15	1264080.771
300	H	0	3	1	250	15000	0	0	5	1	0	276000	197616.15	1235116.416
300	H	0	3	1	250	15000	0	0	5	5	0	276000	197616.15	1131574.529
300	H	0	3	1	250	15000	0	0	10	0	0	540000	197616.15	2516161.542
300	H	0	3	1	250	15000	0	0	10	1	0	540000	197616.15	2411682.776
300	H	0	3	1	250	15000	0	0	10	5	0	540000	197616.15	2065939.56
300	H	0	3	1	706	15000	0	0	1	0	0	276000	197630.92	473630.9226
300	H	0	3	1	706	15000	0	0	1	1	0	276000	197630.92	471674.1807
300	H	0	3	1	706	15000	0	0	1	5	0	276000	197630.92	464219.9262
300	H	0	3	1	706	15000	0	0	5	0	0	276000	197630.92	1264154.613
300	H	0	3	1	706	15000	0	0	5	1	0	276000	197630.92	1235188.093

300	H	0	3	1	706	15000	0	0	5	5	0	276000	197630.92	1131638.469
300	H	0	3	1	706	15000	0	0	10	0	0	540000	197630.92	2516309.226
300	H	0	3	1	706	15000	0	0	10	1	0	540000	197630.92	2411822.652
300	H	0	3	1	706	15000	0	0	10	5	0	540000	197630.92	2066053.598
300	H	San Diego	3	0	0	0	1	5.9	1	0	0	293500	196894.85	490394.8468
300	H	San Diego	3	0	0	0	1	5.9	1	1	0	293500	196894.85	488445.3929
300	H	San Diego	3	0	0	0	1	5.9	1	5	0	293500	196894.85	481018.9017
300	H	San Diego	3	0	0	0	1	5.9	5	0	0	293500	196894.85	1277974.234
300	H	San Diego	3	0	0	0	1	5.9	5	1	0	293500	196894.85	1249115.6
300	H	San Diego	3	0	0	0	1	5.9	5	5	0	293500	196894.85	1145951.646
300	H	San Diego	3	0	0	0	1	5.9	10	0	0	557500	196894.85	2526448.468
300	H	San Diego	3	0	0	0	1	5.9	10	1	0	557500	196894.85	2422351.054
300	H	San Diego	3	0	0	0	1	5.9	10	5	0	557500	196894.85	2077869.816
300	H	San Diego	3	1	250	5000	1	5.9	1	0	0	305500	196985.48	502485.4843
300	H	San Diego	3	1	250	5000	1	5.9	1	1	0	305500	196985.48	500535.133
300	H	San Diego	3	1	250	5000	1	5.9	1	5	0	305500	196985.48	493105.2232
300	H	San Diego	3	1	250	5000	1	5.9	5	0	0	305500	196985.48	1290427.422
300	H	San Diego	3	1	250	5000	1	5.9	5	1	0	305500	196985.48	1261555.503
300	H	San Diego	3	1	250	5000	1	5.9	5	5	0	305500	196985.48	1158344.059
300	H	San Diego	3	1	250	5000	1	5.9	10	0	0	569500	196985.48	2539354.843
300	H	San Diego	3	1	250	5000	1	5.9	10	1	0	569500	196985.48	2435209.51
300	H	San Diego	3	1	250	5000	1	5.9	10	5	0	569500	196985.48	2090569.695
300	H	San Diego	3	1	706	5000	1	5.9	1	0	0	305500	197009.32	502509.3161
300	H	San Diego	3	1	706	5000	1	5.9	1	1	0	305500	197009.32	500558.7288
300	H	San Diego	3	1	706	5000	1	5.9	1	5	0	305500	197009.32	493127.9201
300	H	San Diego	3	1	706	5000	1	5.9	5	0	0	305500	197009.32	1290546.581
300	H	San Diego	3	1	706	5000	1	5.9	5	1	0	305500	197009.32	1261671.169
300	H	San Diego	3	1	706	5000	1	5.9	5	5	0	305500	197009.32	1158447.238
300	H	San Diego	3	1	706	5000	1	5.9	10	0	0	569500	197009.32	2539593.161
300	H	San Diego	3	1	706	5000	1	5.9	10	1	0	569500	197009.32	2435435.229
300	H	San Diego	3	1	706	5000	1	5.9	10	5	0	569500	197009.32	2090753.718
300	H	San Diego	3	1	250	15000	1	5.9	1	0	0	305500	197028.10	502528.1002
300	H	San Diego	3	1	250	15000	1	5.9	1	1	0	305500	197028.10	500577.3269
300	H	San Diego	3	1	250	15000	1	5.9	1	5	0	305500	197028.10	493145.8097
300	H	San Diego	3	1	250	15000	1	5.9	5	0	0	305500	197028.10	1290640.501
300	H	San Diego	3	1	250	15000	1	5.9	5	1	0	305500	197028.10	1261762.337
300	H	San Diego	3	1	250	15000	1	5.9	5	5	0	305500	197028.10	1158528.563
300	H	San Diego	3	1	250	15000	1	5.9	10	0	0	569500	197028.10	2539781.002
300	H	San Diego	3	1	250	15000	1	5.9	10	1	0	569500	197028.10	2435613.138
300	H	San Diego	3	1	250	15000	1	5.9	10	5	0	569500	197028.10	2090898.763
300	H	San Diego	3	1	706	15000	1	5.9	1	0	0	305500	197004.18	502504.1757
300	H	San Diego	3	1	706	15000	1	5.9	1	1	0	305500	197004.18	500553.6393
300	H	San Diego	3	1	706	15000	1	5.9	1	5	0	305500	197004.18	493123.0245
300	H	San Diego	3	1	706	15000	1	5.9	5	0	0	305500	197004.18	1290520.878
300	H	San Diego	3	1	706	15000	1	5.9	5	1	0	305500	197004.18	1261646.221

300	H	San Diego	3	1	706	15000	1	5.9	5	5	0	305500	197004.18	1158424.983
300	H	San Diego	3	1	706	15000	1	5.9	10	0	0	569500	197004.18	2539541.757
300	H	San Diego	3	1	706	15000	1	5.9	10	1	0	569500	197004.18	2435386.542
300	H	San Diego	3	1	706	15000	1	5.9	10	5	0	569500	197004.18	2090714.025
300	H	San Diego	3	0	0	0	1	7.5	1	0	0	301500	196894.91	498394.9059
300	H	San Diego	3	0	0	0	1	7.5	1	1	0	301500	196894.91	496445.4514
300	H	San Diego	3	0	0	0	1	7.5	1	5	0	301500	196894.91	489018.958
300	H	San Diego	3	0	0	0	1	7.5	5	0	0	301500	196894.91	1285974.53
300	H	San Diego	3	0	0	0	1	7.5	5	1	0	301500	196894.91	1257115.887
300	H	San Diego	3	0	0	0	1	7.5	5	5	0	301500	196894.91	1153951.902
300	H	San Diego	3	0	0	0	1	7.5	10	0	0	565500	196894.91	2534449.059
300	H	San Diego	3	0	0	0	1	7.5	10	1	0	565500	196894.91	2430351.615
300	H	San Diego	3	0	0	0	1	7.5	10	5	0	565500	196894.91	2085870.272
300	H	San Diego	3	1	250	5000	1	7.5	1	0	0	313500	196984.66	510484.6615
300	H	San Diego	3	1	250	5000	1	7.5	1	1	0	313500	196984.66	508534.3183
300	H	San Diego	3	1	250	5000	1	7.5	1	5	0	313500	196984.66	501104.4395
300	H	San Diego	3	1	250	5000	1	7.5	5	0	0	313500	196984.66	1298423.307
300	H	San Diego	3	1	250	5000	1	7.5	5	1	0	313500	196984.66	1269551.51
300	H	San Diego	3	1	250	5000	1	7.5	5	5	0	313500	196984.66	1166340.496
300	H	San Diego	3	1	250	5000	1	7.5	10	0	0	577500	196984.66	2547346.615
300	H	San Diego	3	1	250	5000	1	7.5	10	1	0	577500	196984.66	2443201.716
300	H	San Diego	3	1	250	5000	1	7.5	10	5	0	577500	196984.66	2098563.341
300	H	San Diego	3	1	706	5000	1	7.5	1	0	0	313500	197001.83	510501.832
300	H	San Diego	3	1	706	5000	1	7.5	1	1	0	313500	197001.83	508551.3189
300	H	San Diego	3	1	706	5000	1	7.5	1	5	0	313500	197001.83	501120.7924
300	H	San Diego	3	1	706	5000	1	7.5	5	0	0	313500	197001.83	1298509.16
300	H	San Diego	3	1	706	5000	1	7.5	5	1	0	313500	197001.83	1269634.846
300	H	San Diego	3	1	706	5000	1	7.5	5	5	0	313500	197001.83	1166414.836
300	H	San Diego	3	1	706	5000	1	7.5	10	0	0	577500	197001.83	2547518.32
300	H	San Diego	3	1	706	5000	1	7.5	10	1	0	577500	197001.83	2443364.344
300	H	San Diego	3	1	706	5000	1	7.5	10	5	0	577500	197001.83	2098695.928
300	H	San Diego	3	1	250	15000	1	7.5	1	0	0	313500	197006.01	510506.009
300	H	San Diego	3	1	250	15000	1	7.5	1	1	0	313500	197006.01	508555.4545
300	H	San Diego	3	1	250	15000	1	7.5	1	5	0	313500	197006.01	501124.7705
300	H	San Diego	3	1	250	15000	1	7.5	5	0	0	313500	197006.01	1298530.045
300	H	San Diego	3	1	250	15000	1	7.5	5	1	0	313500	197006.01	1269655.119
300	H	San Diego	3	1	250	15000	1	7.5	5	5	0	313500	197006.01	1166432.92
300	H	San Diego	3	1	250	15000	1	7.5	10	0	0	577500	197006.01	2547560.09
300	H	San Diego	3	1	250	15000	1	7.5	10	1	0	577500	197006.01	2443403.906
300	H	San Diego	3	1	250	15000	1	7.5	10	5	0	577500	197006.01	2098728.181
300	H	San Diego	3	1	706	15000	1	7.5	1	0	0	313500	196984.82	510484.8242
300	H	San Diego	3	1	706	15000	1	7.5	1	1	0	313500	196984.82	508534.4794
300	H	San Diego	3	1	706	15000	1	7.5	1	5	0	313500	196984.82	501104.5945
300	H	San Diego	3	1	706	15000	1	7.5	5	0	0	313500	196984.82	1298424.121
300	H	San Diego	3	1	706	15000	1	7.5	5	1	0	313500	196984.82	1269552.299

300	H	San Diego	3	1	706	15000	1	7.5	5	5	0	313500	196984.82	1166341.201
300	H	San Diego	3	1	706	15000	1	7.5	10	0	0	577500	196984.82	2547348.242
300	H	San Diego	3	1	706	15000	1	7.5	10	1	0	577500	196984.82	2443203.258
300	H	San Diego	3	1	706	15000	1	7.5	10	5	0	577500	196984.82	2098564.597
300	H	South Carolina	3	0	0	0	1	5.9	1	0	1.04167E-05	293500	197700.18	491200.1799
300	H	South Carolina	3	0	0	0	1	5.9	1	1	1.04167E-05	293500	197700.18	489242.7524
300	H	South Carolina	3	0	0	0	1	5.9	1	5	1.04167E-05	293500	197700.18	481785.8856
300	H	South Carolina	3	0	0	0	1	5.9	5	0	1.04167E-05	293500	197700.18	1282000.899
300	H	South Carolina	3	0	0	0	1	5.9	5	1	1.04167E-05	293500	197700.18	1253024.229
300	H	South Carolina	3	0	0	0	1	5.9	5	5	1.04167E-05	293500	197700.18	1149438.317
300	H	South Carolina	3	0	0	0	1	5.9	10	0	1.04167E-05	557500	197700.18	2534501.799
300	H	South Carolina	3	0	0	0	1	5.9	10	1	1.04167E-05	557500	197700.18	2429978.61
300	H	South Carolina	3	0	0	0	1	5.9	10	5	1.04167E-05	557500	197700.18	2084088.385
300	H	South Carolina	3	1	250	5000	1	5.9	1	0	0	305500	197090.08	502590.076
300	H	South Carolina	3	1	250	5000	1	5.9	1	1	0	305500	197090.08	500638.6891
300	H	South Carolina	3	1	250	5000	1	5.9	1	5	0	305500	197090.08	493204.8343
300	H	South Carolina	3	1	250	5000	1	5.9	5	0	0	305500	197090.08	1290950.38
300	H	South Carolina	3	1	250	5000	1	5.9	5	1	0	305500	197090.08	1262063.132
300	H	South Carolina	3	1	250	5000	1	5.9	5	5	0	305500	197090.08	1158796.886
300	H	South Carolina	3	1	250	5000	1	5.9	10	0	0	569500	197090.08	2540400.76
300	H	South Carolina	3	1	250	5000	1	5.9	10	1	0	569500	197090.08	2436200.13
300	H	South Carolina	3	1	250	5000	1	5.9	10	5	0	569500	197090.08	2091377.324
300	H	South Carolina	3	1	706	5000	1	5.9	1	0	0	305500	197091.70	502591.6963
300	H	South Carolina	3	1	706	5000	1	5.9	1	1	0	305500	197091.70	500640.2934
300	H	South Carolina	3	1	706	5000	1	5.9	1	5	0	305500	197091.70	493206.3775
300	H	South Carolina	3	1	706	5000	1	5.9	5	0	0	305500	197091.70	1290958.482
300	H	South Carolina	3	1	706	5000	1	5.9	5	1	0	305500	197091.70	1262070.996
300	H	South Carolina	3	1	706	5000	1	5.9	5	5	0	305500	197091.70	1158803.901
300	H	South Carolina	3	1	706	5000	1	5.9	10	0	0	569500	197091.70	2540416.963
300	H	South Carolina	3	1	706	5000	1	5.9	10	1	0	569500	197091.70	2436215.477
300	H	South Carolina	3	1	706	5000	1	5.9	10	5	0	569500	197091.70	2091389.836
300	H	South Carolina	3	1	250	15000	1	5.9	1	0	0	305500	197055.61	502555.6056
300	H	South Carolina	3	1	250	15000	1	5.9	1	1	0	305500	197055.61	500604.56
300	H	South Carolina	3	1	250	15000	1	5.9	1	5	0	305500	197055.61	493172.0054
300	H	South Carolina	3	1	250	15000	1	5.9	5	0	0	305500	197055.61	1290778.028
300	H	South Carolina	3	1	250	15000	1	5.9	5	1	0	305500	197055.61	1261895.832
300	H	South Carolina	3	1	250	15000	1	5.9	5	5	0	305500	197055.61	1158647.647
300	H	South Carolina	3	1	250	15000	1	5.9	10	0	0	569500	197055.61	2540056.056
300	H	South Carolina	3	1	250	15000	1	5.9	10	1	0	569500	197055.61	2435873.651
300	H	South Carolina	3	1	250	15000	1	5.9	10	5	0	569500	197055.61	2091111.153
300	H	South Carolina	3	1	706	15000	1	5.9	1	0	0	305500	197081.24	502581.235
300	H	South Carolina	3	1	706	15000	1	5.9	1	1	0	305500	197081.24	500629.9357
300	H	South Carolina	3	1	706	15000	1	5.9	1	5	0	305500	197081.24	493196.4143
300	H	South Carolina	3	1	706	15000	1	5.9	5	0	0	305500	197081.24	1290906.175
300	H	South Carolina	3	1	706	15000	1	5.9	5	1	0	305500	197081.24	1262020.223

300	H	South Carolina	3	1	706	15000	1	5.9	5	5	0	305500	197081.24	1158758.609
300	H	South Carolina	3	1	706	15000	1	5.9	10	0	0	569500	197081.24	2540312.35
300	H	South Carolina	3	1	706	15000	1	5.9	10	1	0	569500	197081.24	2436116.394
300	H	South Carolina	3	1	706	15000	1	5.9	10	5	0	569500	197081.24	2091309.056
300	H	South Carolina	3	0	0	0	1	7.5	1	0	0	301500	196908.87	498408.868
300	H	South Carolina	3	0	0	0	1	7.5	1	1	0	301500	196908.87	496459.2752
300	H	South Carolina	3	0	0	0	1	7.5	1	5	0	301500	196908.87	489032.2552
300	H	South Carolina	3	0	0	0	1	7.5	5	0	0	301500	196908.87	1286044.34
300	H	South Carolina	3	0	0	0	1	7.5	5	1	0	301500	196908.87	1257183.651
300	H	South Carolina	3	0	0	0	1	7.5	5	5	0	301500	196908.87	1154012.35
300	H	South Carolina	3	0	0	0	1	7.5	10	0	0	565500	196908.87	2534588.68
300	H	South Carolina	3	0	0	0	1	7.5	10	1	0	565500	196908.87	2430483.854
300	H	South Carolina	3	0	0	0	1	7.5	10	5	0	565500	196908.87	2085978.084
300	H	South Carolina	3	1	250	5000	1	7.5	1	0	0	313500	197068.37	510568.3674

Appendix B

Payback Results

Table B.1: Payback Time Data

Max Power	Reliability	Location	Fuel Price ($/Gal)	Battery	Battery Cost ($/kWh)	Battery Life (Cycles)	Solar	Solar Price ($/Wp)	Capital ($)	Annual Opex ($)	Payback Time (Year)
100	H	0	3	1	250	5000	0	0	144000	81438.43	13.90
100	H	0	3	1	250	5000	0	0	276000	81438.43	13.90
100	H	0	3	1	706	5000	0	0	144000	81443.56	13.99
100	H	0	3	1	706	5000	0	0	276000	81443.56	13.99
100	H	0	3	1	250	15000	0	0	144000	81393.80	13.22
100	H	0	3	1	250	15000	0	0	276000	81393.80	13.22
100	H	0	3	1	706	15000	0	0	144000	81421.73	13.64
100	H	0	3	1	706	15000	0	0	276000	81421.73	13.64
100	H	San Diego	3	0	0	0	1	5.9	161500	80477.02	16.17
100	H	San Diego	3	0	0	0	1	5.9	293500	80477.02	16.17
100	H	San Diego	3	1	250	5000	1	5.9	173500	79484.01	14.73
100	H	San Diego	3	1	250	5000	1	5.9	305500	79484.01	14.73
100	H	San Diego	3	1	706	5000	1	5.9	173500	79463.32	14.62
100	H	San Diego	3	1	706	5000	1	5.9	305500	79463.32	14.62
100	H	San Diego	3	1	250	15000	1	5.9	173500	79487.95	14.75
100	H	San Diego	3	1	250	15000	1	5.9	305500	79487.95	14.75
100	H	San Diego	3	1	706	15000	1	5.9	173500	79526.56	14.95
100	H	San Diego	3	1	706	15000	1	5.9	305500	79526.56	14.95
100	H	San Diego	3	0	0	0	1	7.5	169500	80479.30	20.58
100	H	San Diego	3	0	0	0	1	7.5	301500	80479.30	20.58
100	H	San Diego	3	1	250	5000	1	7.5	181500	79528.53	17.85
100	H	San Diego	3	1	250	5000	1	7.5	313500	79528.53	17.85
100	H	San Diego	3	1	706	5000	1	7.5	181500	79471.70	17.49
100	H	San Diego	3	1	706	5000	1	7.5	313500	79471.70	17.49
100	H	San Diego	3	1	250	15000	1	7.5	181500	79508.66	17.72
100	H	San Diego	3	1	250	15000	1	7.5	313500	79508.66	17.72
100	H	San Diego	3	1	706	15000	1	7.5	181500	79488.17	17.59
100	H	San Diego	3	1	706	15000	1	7.5	313500	79488.17	17.59
100	H	South Carolina	3	0	0	0	1	5.9	161500	79065.38	9.12

100	H	South Carolina	3	0	0	0	1	5.9	293500	79065.38	9.12
100	H	South Carolina	3	1	250	5000	1	5.9	173500	78355.13	10.52
100	H	South Carolina	3	1	250	5000	1	5.9	305500	78355.13	10.52
100	H	South Carolina	3	1	706	5000	1	5.9	173500	78354.34	10.51
100	H	South Carolina	3	1	706	5000	1	5.9	305500	78354.34	10.51
100	H	South Carolina	3	1	250	15000	1	5.9	173500	78375.91	10.57
100	H	South Carolina	3	1	250	15000	1	5.9	305500	78375.91	10.57
100	H	South Carolina	3	1	706	15000	1	5.9	173500	78351.28	10.51
100	H	South Carolina	3	1	706	15000	1	5.9	305500	78351.28	10.51
100	H	South Carolina	3	0	0	0	1	7.5	169500	79025.91	11.45
100	H	South Carolina	3	0	0	0	1	7.5	301500	79025.91	11.45
100	H	South Carolina	3	1	250	5000	1	7.5	181500	78368.40	12.59
100	H	South Carolina	3	1	250	5000	1	7.5	313500	78368.40	12.59
100	H	South Carolina	3	1	706	5000	1	7.5	181500	78377.71	12.62
100	H	South Carolina	3	1	706	5000	1	7.5	313500	78377.71	12.62
100	H	South Carolina	3	1	250	15000	1	7.5	181500	78357.86	12.55
100	H	South Carolina	3	1	250	15000	1	7.5	313500	78357.86	12.55
100	H	South Carolina	3	1	706	15000	1	7.5	181500	78368.59	12.59
100	H	South Carolina	3	1	706	15000	1	7.5	313500	78368.59	12.59
100	H	New York	3	0	0	0	1	5.9	161500	79939.33	12.49
100	H	New York	3	0	0	0	1	5.9	293500	79939.33	12.49
100	H	New York	3	1	250	5000	1	5.9	173500	79144.58	13.15
100	H	New York	3	1	250	5000	1	5.9	305500	79144.58	13.15
100	H	New York	3	1	706	5000	1	5.9	173500	79170.49	13.25
100	H	New York	3	1	706	5000	1	5.9	305500	79170.49	13.25
100	H	New York	3	1	250	15000	1	5.9	173500	79116.54	13.03
100	H	New York	3	1	250	15000	1	5.9	305500	79116.54	13.03
100	H	New York	3	1	706	15000	1	5.9	173500	79144.40	13.14
100	H	New York	3	1	706	15000	1	5.9	305500	79144.40	13.14
100	H	New York	3	0	0	0	1	7.5	169500	79937.01	15.86
100	H	New York	3	0	0	0	1	7.5	301500	79937.01	15.86
100	H	New York	3	1	250	5000	1	7.5	181500	79128.64	15.60
100	H	New York	3	1	250	5000	1	7.5	313500	79128.64	15.60

100	H	New York	3	1	706	5000	1	7.5	181500	79153.58	15.72
100	H	New York	3	1	706	5000	1	7.5	313500	79153.58	15.72
100	H	New York	3	1	250	15000	1	7.5	181500	79157.99	15.75
100	H	New York	3	1	250	15000	1	7.5	313500	79157.99	15.75
100	H	New York	3	1	706	15000	1	7.5	181500	79147.63	15.69
100	H	New York	3	1	706	15000	1	7.5	313500	79147.63	15.69
100	H	Minneapolis	3	0	0	0	1	5.9	161500	81391.32	32.41
100	H	Minneapolis	3	0	0	0	1	5.9	293500	81391.32	32.41
100	H	Minneapolis	3	1	250	5000	1	5.9	173500	79984.60	17.91
100	H	Minneapolis	3	1	250	5000	1	5.9	305500	79984.60	17.91
100	H	Minneapolis	3	1	706	5000	1	5.9	173500	80005.66	18.08
100	H	Minneapolis	3	1	706	5000	1	5.9	305500	80005.66	18.08
100	H	Minneapolis	3	1	250	15000	1	5.9	173500	80026.76	18.24
100	H	Minneapolis	3	1	250	15000	1	5.9	305500	80026.76	18.24
100	H	Minneapolis	3	1	706	15000	1	5.9	173500	79999.22	18.03
100	H	Minneapolis	3	1	706	15000	1	5.9	305500	79999.22	18.03
100	H	Minneapolis	3	0	0	0	1	7.5	169500	81382.16	40.79
100	H	Minneapolis	3	0	0	0	1	7.5	301500	81382.16	40.79
100	H	Minneapolis	3	1	250	5000	1	7.5	181500	80011.98	21.62
100	H	Minneapolis	3	1	250	5000	1	7.5	313500	80011.98	21.62
100	H	Minneapolis	3	1	706	5000	1	7.5	181500	80002.63	21.53
100	H	Minneapolis	3	1	706	5000	1	7.5	313500	80002.63	21.53
100	H	Minneapolis	3	1	250	15000	1	7.5	181500	80004.71	21.55
100	H	Minneapolis	3	1	250	15000	1	7.5	313500	80004.71	21.55
100	H	Minneapolis	3	1	706	15000	1	7.5	181500	80012.72	21.63
100	H	Minneapolis	3	1	706	15000	1	7.5	313500	80012.72	21.63
100	L	0	3	1	250	5000	0	0	100000	75185.47	1.63
100	L	0	3	1	250	5000	0	0	188000	75185.47	1.63
100	L	0	3	1	706	5000	0	0	100000	76371.08	1.94
100	L	0	3	1	706	5000	0	0	188000	76371.08	1.94
100	L	0	3	1	250	15000	0	0	100000	76101.18	1.86
100	L	0	3	1	250	15000	0	0	188000	76101.18	1.86
100	L	0	3	1	706	15000	0	0	100000	75468.82	1.69

100	L	0	3	1	706	15000	0	0	188000	75468.82	1.69
100	L	San Diego	3	0	0	0	1	5.9	117500	80964.47	18.46
100	L	San Diego	3	0	0	0	1	5.9	205500	80964.47	18.46
100	L	San Diego	3	1	250	5000	1	5.9	129500	74553.31	5.18
100	L	San Diego	3	1	250	5000	1	5.9	217500	74553.31	5.18
100	L	San Diego	3	1	706	5000	1	5.9	129500	74265.07	5.00
100	L	San Diego	3	1	706	5000	1	5.9	217500	74265.07	5.00
100	L	San Diego	3	1	250	15000	1	5.9	129500	73969.95	4.83
100	L	San Diego	3	1	250	15000	1	5.9	217500	73969.95	4.83
100	L	San Diego	3	1	706	15000	1	5.9	129500	74264.06	5.00
100	L	San Diego	3	1	706	15000	1	5.9	217500	74264.06	5.00
100	L	San Diego	3	0	0	0	1	7.5	125500	82368.96	193.95
100	L	San Diego	3	0	0	0	1	7.5	213500	82368.96	193.95
100	L	San Diego	3	1	250	5000	1	7.5	137500	74562.09	6.19
100	L	San Diego	3	1	250	5000	1	7.5	225500	74562.09	6.19
100	L	San Diego	3	1	706	5000	1	7.5	137500	74257.69	5.96
100	L	San Diego	3	1	706	5000	1	7.5	225500	74257.69	5.96
100	L	San Diego	3	1	250	15000	1	7.5	137500	74556.96	6.18
100	L	San Diego	3	1	250	15000	1	7.5	225500	74556.96	6.18
100	L	San Diego	3	1	706	15000	1	7.5	137500	74240.41	5.95
100	L	San Diego	3	1	706	15000	1	7.5	225500	74240.41	5.95
100	L	South Carolina	3	0	0	0	1	5.9	117500	81824.17	39.97
100	L	South Carolina	3	0	0	0	1	5.9	205500	81824.17	39.97
100	L	South Carolina	3	1	250	5000	1	5.9	129500	73834.23	4.75
100	L	South Carolina	3	1	250	5000	1	5.9	217500	73834.23	4.75
100	L	South Carolina	3	1	706	5000	1	5.9	129500	74447.69	5.11
100	L	South Carolina	3	1	706	5000	1	5.9	217500	74447.69	5.11
100	L	South Carolina	3	1	250	15000	1	5.9	129500	73552.43	4.61
100	L	South Carolina	3	1	250	15000	1	5.9	217500	73552.43	4.61
100	L	South Carolina	3	1	706	15000	1	5.9	129500	73825.85	4.75
100	L	South Carolina	3	1	706	15000	1	5.9	217500	73825.85	4.75
100	L	South Carolina	3	0	0	0	1	7.5	125500	79564.19	12.51
100	L	South Carolina	3	0	0	0	1	7.5	213500	79564.19	12.51

100	L	South Carolina	3	1	250	5000	1	7.5	137500	73533.05	5.48
100	L	South Carolina	3	1	250	5000	1	7.5	225500	73533.05	5.48
100	L	South Carolina	3	1	706	5000	1	7.5	137500	73543.03	5.49
100	L	South Carolina	3	1	706	5000	1	7.5	225500	73543.03	5.49
100	L	South Carolina	3	1	250	15000	1	7.5	137500	73835.80	5.67
100	L	South Carolina	3	1	250	15000	1	7.5	225500	73835.80	5.67
100	L	South Carolina	3	1	706	15000	1	7.5	137500	74416.49	6.08
100	L	South Carolina	3	1	706	15000	1	7.5	225500	74416.49	6.08
100	L	New York	3	0	0	0	1	5.9	117500	82259.59	97.45
100	L	New York	3	0	0	0	1	5.9	205500	82259.59	97.45
100	L	New York	3	1	250	5000	1	5.9	129500	74575.07	5.20
100	L	New York	3	1	250	5000	1	5.9	217500	74575.07	5.20
100	L	New York	3	1	706	5000	1	5.9	129500	73725.28	4.70
100	L	New York	3	1	706	5000	1	5.9	217500	73725.28	4.70
100	L	New York	3	1	250	15000	1	5.9	129500	74901.05	5.42
100	L	New York	3	1	250	15000	1	5.9	217500	74901.05	5.42
100	L	New York	3	1	706	15000	1	5.9	129500	74296.48	5.02
100	L	New York	3	1	706	15000	1	5.9	217500	74296.48	5.02
100	L	New York	3	0	0	0	1	7.5	125500	79157.21	11.01
100	L	New York	3	0	0	0	1	7.5	213500	79157.21	11.01
100	L	New York	3	1	250	5000	1	7.5	137500	74304.54	5.99
100	L	New York	3	1	250	5000	1	7.5	225500	74304.54	5.99
100	L	New York	3	1	706	5000	1	7.5	137500	74018.00	5.79
100	L	New York	3	1	706	5000	1	7.5	225500	74018.00	5.79
100	L	New York	3	1	250	15000	1	7.5	137500	74312.92	6.00
100	L	New York	3	1	250	15000	1	7.5	225500	74312.92	6.00
100	L	New York	3	1	706	15000	1	7.5	137500	74598.31	6.22
100	L	New York	3	1	706	15000	1	7.5	225500	74598.31	6.22
100	L	Minneapolis	3	1	250	5000	1	5.9	129500	74930.41	5.44
100	L	Minneapolis	3	1	250	5000	1	5.9	217500	74930.41	5.44
100	L	Minneapolis	3	1	706	5000	1	5.9	129500	74348.85	5.05
100	L	Minneapolis	3	1	706	5000	1	5.9	217500	74348.85	5.05
100	L	Minneapolis	3	1	250	15000	1	5.9	129500	74374.74	5.07

100	L	Minneapolis	3	1	250	15000	1	5.9	217500	74374.74	5.07
100	L	Minneapolis	3	1	706	15000	1	5.9	129500	74667.61	5.26
100	L	Minneapolis	3	1	706	15000	1	5.9	217500	74667.61	5.26
100	L	Minneapolis	3	0	0	0	1	7.5	125500	82035.67	71.21
100	L	Minneapolis	3	0	0	0	1	7.5	213500	82035.67	71.21
100	L	Minneapolis	3	1	250	5000	1	7.5	137500	75842.85	7.37
100	L	Minneapolis	3	1	250	5000	1	7.5	225500	75842.85	7.37
100	L	Minneapolis	3	1	706	5000	1	7.5	137500	74365.77	6.04
100	L	Minneapolis	3	1	706	5000	1	7.5	225500	74365.77	6.04
100	L	Minneapolis	3	1	250	15000	1	7.5	137500	74362.81	6.04
100	L	Minneapolis	3	1	250	15000	1	7.5	225500	74362.81	6.04
100	L	Minneapolis	3	1	706	15000	1	7.5	137500	75247.99	6.77
100	L	Minneapolis	3	1	706	15000	1	7.5	225500	75247.99	6.77
10/26/1900	H	San Diego	3	0	0	0	1	5.9	293500	196894.85	44.95
10/26/1900	H	San Diego	3	0	0	0	1	5.9	557500	196894.85	44.95
10/26/1900	H	San Diego	3	1	250	5000	1	5.9	305500	196985.48	73.37
10/26/1900	H	San Diego	3	1	250	5000	1	5.9	569500	196985.48	73.37
10/26/1900	H	San Diego	3	1	706	5000	1	5.9	305500	197009.32	76.59
10/26/1900	H	San Diego	3	1	706	5000	1	5.9	569500	197009.32	76.59
10/26/1900	H	San Diego	3	1	250	15000	1	5.9	305500	197028.10	79.34
10/26/1900	H	San Diego	3	1	250	15000	1	5.9	569500	197028.10	79.34
10/26/1900	H	San Diego	3	1	706	15000	1	5.9	305500	197004.18	75.87
10/26/1900	H	San Diego	3	1	706	15000	1	5.9	569500	197004.18	75.87
10/26/1900	H	San Diego	3	0	0	0	1	7.5	301500	196894.91	57.14
10/26/1900	H	San Diego	3	0	0	0	1	7.5	565500	196894.91	57.14
10/26/1900	H	San Diego	3	1	250	5000	1	7.5	313500	196984.66	87.38
10/26/1900	H	San Diego	3	1	250	5000	1	7.5	577500	196984.66	87.38
10/26/1900	H	San Diego	3	1	706	5000	1	7.5	313500	197001.83	90.11
10/26/1900	H	San Diego	3	1	706	5000	1	7.5	577500	197001.83	90.11
10/26/1900	H	San Diego	3	1	250	15000	1	7.5	313500	197006.01	90.80
10/26/1900	H	San Diego	3	1	250	15000	1	7.5	577500	197006.01	90.80
10/26/1900	H	San Diego	3	1	706	15000	1	7.5	313500	196984.82	87.41
10/26/1900	H	San Diego	3	1	706	15000	1	7.5	577500	196984.82	87.41

10/26/1900	H	South Carolina	3	1	250	5000	1	5.9	305500	197090.08	90.01
10/26/1900	H	South Carolina	3	1	250	5000	1	5.9	569500	197090.08	90.01
10/26/1900	H	South Carolina	3	1	706	5000	1	5.9	305500	197091.70	90.33
10/26/1900	H	South Carolina	3	1	706	5000	1	5.9	569500	197091.70	90.33
10/26/1900	H	South Carolina	3	1	250	15000	1	5.9	305500	197055.61	83.75
10/26/1900	H	South Carolina	3	1	250	15000	1	5.9	569500	197055.61	83.75
10/26/1900	H	South Carolina	3	1	706	15000	1	5.9	305500	197081.24	88.32
10/26/1900	H	South Carolina	3	1	706	15000	1	5.9	569500	197081.24	88.32
10/26/1900	H	South Carolina	3	0	0	0	1	7.5	301500	196908.87	58.39
10/26/1900	H	South Carolina	3	0	0	0	1	7.5	565500	196908.87	58.39
10/26/1900	H	South Carolina	3	1	250	5000	1	7.5	313500	197068.37	102.53
10/26/1900	H	South Carolina	3	1	250	5000	1	7.5	577500	197068.37	102.53
10/26/1900	H	South Carolina	3	1	706	5000	1	7.5	313500	197081.34	105.36
10/26/1900	H	South Carolina	3	1	706	5000	1	7.5	577500	197081.34	105.36
10/26/1900	H	South Carolina	3	1	250	15000	1	7.5	313500	197053.81	99.53
10/26/1900	H	South Carolina	3	1	250	15000	1	7.5	577500	197053.81	99.53
10/26/1900	H	South Carolina	3	1	706	15000	1	7.5	313500	197062.84	101.37
10/26/1900	H	South Carolina	3	1	706	15000	1	7.5	577500	197062.84	101.37
10/26/1900	H	New York	3	0	0	0	1	5.9	293500	196549.47	29.45
10/26/1900	H	New York	3	0	0	0	1	5.9	557500	196549.47	29.45
10/26/1900	H	New York	3	1	250	5000	1	5.9	305500	196684.38	47.88
10/26/1900	H	New York	3	1	250	5000	1	5.9	569500	196684.38	47.88
10/26/1900	H	New York	3	1	706	5000	1	5.9	305500	196683.82	47.85
10/26/1900	H	New York	3	1	706	5000	1	5.9	569500	196683.82	47.85
10/26/1900	H	New York	3	1	250	15000	1	5.9	305500	196666.32	46.90
10/26/1900	H	New York	3	1	250	15000	1	5.9	569500	196666.32	46.90
10/26/1900	H	New York	3	1	706	15000	1	5.9	305500	196650.49	46.08
10/26/1900	H	New York	3	1	706	15000	1	5.9	569500	196650.49	46.08
10/26/1900	H	New York	3	0	0	0	1	7.5	301500	197332.44	171.46
10/26/1900	H	New York	3	0	0	0	1	7.5	565500	197332.44	171.46
10/26/1900	H	New York	3	1	250	5000	1	7.5	313500	196683.05	57.02
10/26/1900	H	New York	3	1	250	5000	1	7.5	577500	196683.05	57.02
10/26/1900	H	New York	3	1	706	5000	1	7.5	313500	196672.57	56.34

10/26/1900	H	New York	3	1	706	5000	1	7.5	577500	196672.57	56.34
10/26/1900	H	New York	3	1	250	15000	1	7.5	313500	196673.97	56.43
10/26/1900	H	New York	3	1	250	15000	1	7.5	577500	196673.97	56.43
10/26/1900	H	New York	3	1	706	15000	1	7.5	313500	196693.20	57.70
10/26/1900	H	New York	3	1	706	15000	1	7.5	577500	196693.20	57.70
10/26/1900	H	Minneapolis	3	0	0	0	1	5.9	293500	197095.65	64.77
10/26/1900	H	Minneapolis	3	0	0	0	1	5.9	557500	197095.65	64.77
10/26/1900	H	Minneapolis	3	1	250	5000	1	5.9	305500	197176.34	110.72
10/26/1900	H	Minneapolis	3	1	250	5000	1	5.9	569500	197176.34	110.72
10/26/1900	H	Minneapolis	3	1	706	5000	1	5.9	305500	197167.12	108.07
10/26/1900	H	Minneapolis	3	1	706	5000	1	5.9	569500	197167.12	108.07
10/26/1900	H	Minneapolis	3	1	250	15000	1	5.9	305500	197177.37	111.03
10/26/1900	H	Minneapolis	3	1	250	15000	1	5.9	569500	197177.37	111.03
10/26/1900	H	Minneapolis	3	1	706	15000	1	5.9	305500	197178.86	111.47
10/26/1900	H	Minneapolis	3	1	706	15000	1	5.9	569500	197178.86	111.47
300	H	Minneapolis	3	0	0	0	1	7.5	301500	197083.09	80.12
300	H	Minneapolis	3	0	0	0	1	7.5	565500	197083.09	80.12
300	H	Minneapolis	3	1	250	5000	1	7.5	313500	197180.94	133.71
300	H	Minneapolis	3	1	250	5000	1	7.5	577500	197180.94	133.71
300	H	Minneapolis	3	1	706	5000	1	7.5	313500	197186.17	135.63
300	H	Minneapolis	3	1	706	5000	1	7.5	577500	197186.17	135.63
300	H	Minneapolis	3	1	250	15000	1	7.5	313500	197173.42	131.05
300	H	Minneapolis	3	1	250	15000	1	7.5	577500	197173.42	131.05
300	H	Minneapolis	3	1	706	15000	1	7.5	313500	197158.51	126.07
300	H	Minneapolis	3	1	706	15000	1	7.5	577500	197158.51	126.07
300	L	0	3	1	250	5000	0	0	232000	191323.72	71.46
300	L	0	3	1	250	5000	0	0	452000	191323.72	71.46
300	L	0	3	1	706	5000	0	0	232000	191354.53	87.51
300	L	0	3	1	706	5000	0	0	452000	191354.53	87.51
300	L	0	3	1	250	15000	0	0	232000	190534.40	12.54
300	L	0	3	1	250	15000	0	0	452000	190534.40	12.54
300	L	0	3	1	706	15000	0	0	232000	191354.85	87.72
300	L	0	3	1	706	15000	0	0	452000	191354.85	87.72

300	L	San Diego	3	0	0	0	1	5.9	249500	190541.99	31.06
300	L	San Diego	3	0	0	0	1	5.9	469500	190541.99	31.06
300	L	San Diego	3	1	250	5000	1	5.9	261500	189387.86	19.73
300	L	San Diego	3	1	250	5000	1	5.9	481500	189387.86	19.73
300	L	San Diego	3	1	706	5000	1	5.9	261500	189388.24	19.73
300	L	San Diego	3	1	706	5000	1	5.9	481500	189388.24	19.73
300	L	San Diego	3	1	250	15000	1	5.9	261500	189347.56	19.36
300	L	San Diego	3	1	250	15000	1	5.9	481500	189347.56	19.36
300	L	San Diego	3	1	706	15000	1	5.9	261500	189444.28	20.27
300	L	San Diego	3	1	706	15000	1	5.9	481500	189444.28	20.27
300	L	San Diego	3	1	250	5000	1	7.5	269500	189378.06	23.42
300	L	San Diego	3	1	250	5000	1	7.5	489500	189378.06	23.42
300	L	San Diego	3	1	706	5000	1	7.5	269500	189367.13	23.30
300	L	San Diego	3	1	706	5000	1	7.5	489500	189367.13	23.30
300	L	San Diego	3	1	250	15000	1	7.5	269500	189447.15	24.21
300	L	San Diego	3	1	250	15000	1	7.5	489500	189447.15	24.21
300	L	San Diego	3	1	706	15000	1	7.5	269500	190119.89	36.08
300	L	San Diego	3	1	706	15000	1	7.5	489500	190119.89	36.08
300	L	South Carolina	3	1	250	5000	1	5.9	261500	189713.28	23.34
300	L	South Carolina	3	1	250	5000	1	5.9	481500	189713.28	23.34
300	L	South Carolina	3	1	706	5000	1	5.9	261500	189696.30	23.12
300	L	South Carolina	3	1	706	5000	1	5.9	481500	189696.30	23.12
300	L	South Carolina	3	1	250	15000	1	5.9	261500	189694.58	23.09
300	L	South Carolina	3	1	250	15000	1	5.9	481500	189694.58	23.09
300	L	South Carolina	3	1	706	15000	1	5.9	261500	189673.12	22.82
300	L	South Carolina	3	1	706	15000	1	5.9	481500	189673.12	22.82
300	L	South Carolina	3	1	250	5000	1	7.5	269500	189712.80	27.83
300	L	South Carolina	3	1	250	5000	1	7.5	489500	189712.80	27.83
300	L	South Carolina	3	1	706	5000	1	7.5	269500	191223.18	184.37
300	L	South Carolina	3	1	706	5000	1	7.5	489500	191223.18	184.37
300	L	South Carolina	3	1	250	15000	1	7.5	269500	190473.25	48.61
300	L	South Carolina	3	1	250	15000	1	7.5	489500	190473.25	48.61
300	L	South Carolina	3	1	706	15000	1	7.5	269500	189700.31	27.63

300	L	South Carolina	3	1	706	15000	1	7.5	489500	189700.31	27.63		
300	L	New York	3	0	0	0	1	5.9	249500	190927.21	52.26		
300	L	New York	3	0	0	0	1	5.9	469500	190927.21	52.26		
300	L	New York	3	1	250	5000	1	5.9	261500	190795.45	59.61		
300	L	New York	3	1	250	5000	1	5.9	481500	190795.45	59.61		
300	L	New York	3	1	706	5000	1	5.9	261500	189227.12	18.33		
300	L	New York	3	1	706	5000	1	5.9	481500	189227.12	18.33		
300	L	New York	3	1	250	15000	1	5.9	261500	190765.24	57.13		
300	L	New York	3	1	250	15000	1	5.9	481500	190765.24	57.13		
300	L	New York	3	1	706	15000	1	5.9	261500	189220.12	18.27		
300	L	New York	3	1	706	15000	1	5.9	481500	189220.12	18.27		
300	L	New York	3	1	250	5000	1	7.5	269500	189231.02	21.90		
300	L	New York	3	1	250	5000	1	7.5	489500	189231.02	21.90		
300	L	New York	3	1	706	5000	1	7.5	269500	190004.45	33.28		
300	L	New York	3	1	706	5000	1	7.5	489500	190004.45	33.28		
300	L	New York	3	1	250	15000	1	7.5	269500	189209.33	21.69		
300	L	New York	3	1	250	15000	1	7.5	489500	189209.33	21.69		
300	L	New York	3	1	706	15000	1	7.5	269500	190724.47	64.52		
300	L	New York	3	1	706	15000	1	7.5	489500	190724.47	64.52		
300	L	Minneapolis	3	0	0	0	1	5.9	249500	111520.80	0.37		
300	L	Minneapolis	3	0	0	0	1	5.9	469500	111520.80	0.37		
300	L	Minneapolis	3	1	250	5000	1	5.9	261500	190404.38	38.17		
300	L	Minneapolis	3	1	250	5000	1	5.9	481500	190404.38	38.17		
300	L	Minneapolis	3	1	706	5000	1	5.9	261500	190384.95	37.50		
300	L	Minneapolis	3	1	706	5000	1	5.9	481500	190384.95	37.50		
300	L	Minneapolis	3	1	250	15000	1	5.9	261500	189706.82	23.25		
300	L	Minneapolis	3	1	250	15000	1	5.9	481500	189706.82	23.25		
300	L	Minneapolis	3	1	706	15000	1	5.9	261500	189623.05	22.21		
300	L	Minneapolis	3	1	706	15000	1	5.9	481500	189623.05	22.21		
300	L	Minneapolis	3	1	250	5000	1	7.5	269500	189643.34	26.78		
300	L	Minneapolis	3	1	250	5000	1	7.5	489500	189643.34	26.78		
300	L	Minneapolis	3	1	706	5000	1	7.5	269500	189618.57	26.43		
300	L	Minneapolis	3	1	706	5000	1	7.5	489500	189618.57	26.43		

300	L	Minneapolis	3	1	250	15000	1	7.5	269500	189659.62	27.02	
300	L	Minneapolis	3	1	250	15000	1	7.5	489500	189659.62	27.02	
300	L	Minneapolis	3	1	706	15000	1	7.5	269500	189680.79	27.33	
300	L	Minneapolis	3	1	706	15000	1	7.5	489500	189680.79	27.33	
100	H	0	15	1	250	5000	0	0	144000	410084.01	8.42	
100	H	0	15	1	250	5000	0	0	276000	410084.01	8.42	
100	H	0	15	1	706	5000	0	0	144000	409972.45	7.81	
100	H	0	15	1	706	5000	0	0	276000	409972.45	7.81	
100	H	0	15	1	250	15000	0	0	144000	409994.12	7.92	
100	H	0	15	1	250	15000	0	0	276000	409994.12	7.92	
100	H	0	15	1	706	15000	0	0	144000	410259.79	9.60	
100	H	0	15	1	706	15000	0	0	276000	410259.79	9.60	
100	H	San Diego	15	0	0	0	1	5.9	161500	402267.54	3.19	
100	H	San Diego	15	0	0	0	1	5.9	293500	402267.54	3.19	
100	H	San Diego	15	1	250	5000	1	5.9	173500	397429.48	2.95	
100	H	San Diego	15	1	250	5000	1	5.9	305500	397429.48	2.95	
100	H	San Diego	15	1	706	5000	1	5.9	173500	397472.63	2.96	
100	H	San Diego	15	1	706	5000	1	5.9	305500	397472.63	2.96	
100	H	San Diego	15	1	250	15000	1	5.9	173500	397341.10	2.93	
100	H	San Diego	15	1	250	15000	1	5.9	305500	397341.10	2.93	
100	H	San Diego	15	1	706	15000	1	5.9	173500	397429.48	2.95	
100	H	San Diego	15	1	706	15000	1	5.9	305500	397429.48	2.95	
100	H	San Diego	15	0	0	0	1	7.5	169500	402125.79	4.00	
100	H	San Diego	15	0	0	0	1	7.5	301500	402125.79	4.00	
100	H	San Diego	15	1	250	5000	1	7.5	181500	397384.19	3.50	
100	H	San Diego	15	1	250	5000	1	7.5	313500	397384.19	3.50	
100	H	San Diego	15	1	706	5000	1	7.5	181500	397492.84	3.53	
100	H	San Diego	15	1	706	5000	1	7.5	313500	397492.84	3.53	
100	H	San Diego	15	1	250	15000	1	7.5	181500	397502.88	3.53	
100	H	San Diego	15	1	250	15000	1	7.5	313500	397502.88	3.53	
100	H	San Diego	15	1	706	15000	1	7.5	181500	397559.00	3.55	
100	H	San Diego	15	1	706	15000	1	7.5	313500	397559.00	3.55	
100	H	South Carolina	15	0	0	0	1	5.9	161500	395133.24	1.80	

100	H	South Carolina	15	0	0	0	1	5.9	293500	395133.24	1.80
100	H	South Carolina	15	1	250	5000	1	5.9	173500	391777.52	2.10
100	H	South Carolina	15	1	250	5000	1	5.9	305500	391777.52	2.10
100	H	South Carolina	15	1	706	5000	1	5.9	173500	391629.94	2.09
100	H	South Carolina	15	1	706	5000	1	5.9	305500	391629.94	2.09
100	H	South Carolina	15	1	250	15000	1	5.9	173500	391744.70	2.10
100	H	South Carolina	15	1	250	15000	1	5.9	305500	391744.70	2.10
100	H	South Carolina	15	1	706	15000	1	5.9	173500	391653.98	2.09
100	H	South Carolina	15	1	706	15000	1	5.9	305500	391653.98	2.09
100	H	South Carolina	15	0	0	0	1	7.5	169500	396721.24	2.54
100	H	South Carolina	15	0	0	0	1	7.5	301500	396721.24	2.54
100	H	South Carolina	15	1	250	5000	1	7.5	181500	391602.00	2.49
100	H	South Carolina	15	1	250	5000	1	7.5	313500	391602.00	2.49
100	H	South Carolina	15	1	706	5000	1	7.5	181500	391662.22	2.49
100	H	South Carolina	15	1	706	5000	1	7.5	313500	391662.22	2.49
100	H	South Carolina	15	1	250	15000	1	7.5	181500	391518.68	2.48
100	H	South Carolina	15	1	250	15000	1	7.5	313500	391518.68	2.48
100	H	South Carolina	15	1	706	15000	1	7.5	181500	391500.42	2.47
100	H	South Carolina	15	1	706	15000	1	7.5	313500	391500.42	2.47
100	H	New York	15	0	0	0	1	5.9	161500	399384.00	2.43
100	H	New York	15	0	0	0	1	5.9	293500	399384.00	2.43
100	H	New York	15	1	250	5000	1	5.9	173500	395454.36	2.58
100	H	New York	15	1	250	5000	1	5.9	305500	395454.36	2.58
100	H	New York	15	1	706	5000	1	5.9	173500	395370.26	2.57
100	H	New York	15	1	706	5000	1	5.9	305500	395370.26	2.57
100	H	New York	15	1	250	15000	1	5.9	173500	395400.36	2.58
100	H	New York	15	1	250	15000	1	5.9	305500	395400.36	2.58
100	H	New York	15	1	706	15000	1	5.9	173500	395408.79	2.58
100	H	New York	15	1	706	15000	1	5.9	305500	395408.79	2.58
100	H	New York	15	0	0	0	1	7.5	169500	399460.57	3.11
100	H	New York	15	0	0	0	1	7.5	301500	399460.57	3.11
100	H	New York	15	1	250	5000	1	7.5	181500	395272.58	3.05
100	H	New York	15	1	250	5000	1	7.5	313500	395272.58	3.05

100	H	New York	15	1	706	5000	1	7.5	181500	395562.92	3.10
100	H	New York	15	1	706	5000	1	7.5	313500	395562.92	3.10
100	H	New York	15	1	250	15000	1	7.5	181500	395417.59	3.08
100	H	New York	15	1	250	15000	1	7.5	313500	395417.59	3.08
100	H	New York	15	1	706	15000	1	7.5	181500	395314.77	3.06
100	H	New York	15	1	706	15000	1	7.5	313500	395314.77	3.06
100	H	Minneapolis	15	0	0	0	1	5.9	161500	406691.45	6.12
100	H	Minneapolis	15	0	0	0	1	5.9	293500	406691.45	6.12
100	H	Minneapolis	15	1	250	5000	1	5.9	173500	399592.58	3.48
100	H	Minneapolis	15	1	250	5000	1	5.9	305500	399592.58	3.48
100	H	Minneapolis	15	1	706	5000	1	5.9	173500	401291.48	4.06
100	H	Minneapolis	15	1	706	5000	1	5.9	305500	401291.48	4.06
100	H	Minneapolis	15	1	250	15000	1	5.9	173500	399681.79	3.51
100	H	Minneapolis	15	1	250	15000	1	5.9	305500	399681.79	3.51
100	H	Minneapolis	15	1	706	15000	1	5.9	173500	399594.41	3.48
100	H	Minneapolis	15	1	706	15000	1	5.9	305500	399594.41	3.48
100	H	Minneapolis	15	0	0	0	1	7.5	169500	406700.36	7.80
100	H	Minneapolis	15	0	0	0	1	7.5	301500	406700.36	7.80
100	H	Minneapolis	15	1	250	5000	1	7.5	181500	399822.50	4.24
100	H	Minneapolis	15	1	250	5000	1	7.5	313500	399822.50	4.24
100	H	Minneapolis	15	1	706	5000	1	7.5	181500	399482.26	4.12
100	H	Minneapolis	15	1	706	5000	1	7.5	313500	399482.26	4.12
100	H	Minneapolis	15	1	250	15000	1	7.5	181500	399731.57	4.20
100	H	Minneapolis	15	1	250	15000	1	7.5	313500	399731.57	4.20
100	H	Minneapolis	15	1	706	15000	1	7.5	181500	399592.73	4.15
100	H	Minneapolis	15	1	706	15000	1	7.5	313500	399592.73	4.15
100	L	0	15	1	250	5000	0	0	100000	373842.47	0.36
100	L	0	15	1	250	5000	0	0	188000	373842.47	0.36
100	L	0	15	1	706	5000	0	0	100000	375338.21	0.38
100	L	0	15	1	706	5000	0	0	188000	375338.21	0.38
100	L	0	15	1	250	15000	0	0	100000	373798.11	0.36
100	L	0	15	1	250	15000	0	0	188000	373798.11	0.36
100	L	0	15	1	706	15000	0	0	100000	375395.77	0.38

100	L	0	15	1	706	15000	0	0	188000	375395.77	0.38
100	L	San Diego	15	1	250	5000	1	5.9	129500	372736.98	1.21
100	L	San Diego	15	1	250	5000	1	5.9	217500	372736.98	1.21
100	L	San Diego	15	1	706	5000	1	5.9	129500	372662.94	1.20
100	L	San Diego	15	1	706	5000	1	5.9	217500	372662.94	1.20
100	L	San Diego	15	1	250	15000	1	5.9	129500	375581.45	1.32
100	L	San Diego	15	1	250	15000	1	5.9	217500	375581.45	1.32
100	L	San Diego	15	1	706	15000	1	5.9	129500	374132.48	1.26
100	L	San Diego	15	1	706	15000	1	5.9	217500	374132.48	1.26
100	L	San Diego	15	0	0	0	1	7.5	125500	400302.68	5.51
100	L	San Diego	15	0	0	0	1	7.5	213500	400302.68	5.51
100	L	San Diego	15	1	250	5000	1	7.5	137500	372726.63	1.44
100	L	San Diego	15	1	250	5000	1	7.5	225500	372726.63	1.44
100	L	San Diego	15	1	706	5000	1	7.5	137500	369719.36	1.32
100	L	San Diego	15	1	706	5000	1	7.5	225500	369719.36	1.32
100	L	San Diego	15	1	250	15000	1	7.5	137500	371162.53	1.38
100	L	San Diego	15	1	250	15000	1	7.5	225500	371162.53	1.38
100	L	San Diego	15	1	706	15000	1	7.5	137500	371142.07	1.38
100	L	San Diego	15	1	706	15000	1	7.5	225500	371142.07	1.38
100	L	South Carolina	15	0	0	0	1	5.9	117500	398985.12	3.63
100	L	South Carolina	15	0	0	0	1	5.9	205500	398985.12	3.63
100	L	South Carolina	15	1	250	5000	1	5.9	129500	366049.33	1.01
100	L	South Carolina	15	1	250	5000	1	5.9	217500	366049.33	1.01
100	L	South Carolina	15	1	706	5000	1	5.9	129500	370472.92	1.13
100	L	South Carolina	15	1	706	5000	1	5.9	217500	370472.92	1.13
100	L	South Carolina	15	1	250	15000	1	5.9	129500	367471.58	1.05
100	L	South Carolina	15	1	250	15000	1	5.9	217500	367471.58	1.05
100	L	South Carolina	15	1	706	15000	1	5.9	129500	370423.31	1.13
100	L	South Carolina	15	1	706	15000	1	5.9	217500	370423.31	1.13
100	L	South Carolina	15	1	250	5000	1	7.5	137500	367469.23	1.25
100	L	South Carolina	15	1	250	5000	1	7.5	225500	367469.23	1.25
100	L	South Carolina	15	1	706	5000	1	7.5	137500	367457.21	1.25
100	L	South Carolina	15	1	706	5000	1	7.5	225500	367457.21	1.25

100	L	South Carolina	15	1	250	15000	1	7.5	137500	370534.30	1.35	
100	L	South Carolina	15	1	250	15000	1	7.5	225500	370534.30	1.35	
100	L	South Carolina	15	1	706	15000	1	7.5	137500	373380.48	1.47	
100	L	South Carolina	15	1	706	15000	1	7.5	225500	373380.48	1.47	
100	L	New York	15	0	0	0	1	5.9	117500	403851.48	9.04	
100	L	New York	15	0	0	0	1	5.9	205500	403851.48	9.04	
100	L	New York	15	1	250	5000	1	5.9	129500	370770.16	1.14	
100	L	New York	15	1	250	5000	1	5.9	217500	370770.16	1.14	
100	L	New York	15	1	706	5000	1	5.9	129500	367721.65	1.05	
100	L	New York	15	1	706	5000	1	5.9	217500	367721.65	1.05	
100	L	New York	15	1	250	15000	1	5.9	129500	367654.24	1.05	
100	L	New York	15	1	250	15000	1	5.9	217500	367654.24	1.05	
100	L	New York	15	1	706	15000	1	5.9	129500	370709.19	1.14	
100	L	New York	15	1	706	15000	1	5.9	217500	370709.19	1.14	
100	L	New York	15	0	0	0	1	7.5	125500	403837.16	11.44	
100	L	New York	15	0	0	0	1	7.5	213500	403837.16	11.44	
100	L	New York	15	1	250	5000	1	7.5	137500	370617.26	1.36	
100	L	New York	15	1	250	5000	1	7.5	225500	370617.26	1.36	
100	L	New York	15	1	706	5000	1	7.5	137500	369214.72	1.31	
100	L	New York	15	1	706	5000	1	7.5	225500	369214.72	1.31	
100	L	New York	15	1	250	15000	1	7.5	137500	372156.59	1.42	
100	L	New York	15	1	250	15000	1	7.5	225500	372156.59	1.42	
100	L	New York	15	1	706	15000	1	7.5	137500	367736.84	1.26	
100	L	New York	15	1	706	15000	1	7.5	225500	367736.84	1.26	
100	L	Minneapolis	15	0	0	0	1	5.9	117500	397215.79	2.98	
100	L	Minneapolis	15	0	0	0	1	5.9	205500	397215.79	2.98	
100	L	Minneapolis	15	1	250	5000	1	5.9	129500	370150.17	1.12	
100	L	Minneapolis	15	1	250	5000	1	5.9	217500	370150.17	1.12	
100	L	Minneapolis	15	1	706	5000	1	5.9	129500	370051.42	1.12	
100	L	Minneapolis	15	1	706	5000	1	5.9	217500	370051.42	1.12	
100	L	Minneapolis	15	1	250	15000	1	5.9	129500	373054.09	1.22	
100	L	Minneapolis	15	1	250	15000	1	5.9	217500	373054.09	1.22	
100	L	Minneapolis	15	1	706	15000	1	5.9	129500	374592.41	1.28	

100	L	Minneapolis	15	1	706	15000	1	5.9	217500	374592.41	1.28
100	L	Minneapolis	15	1	250	5000	1	7.5	137500	373096.89	1.46
100	L	Minneapolis	15	1	250	5000	1	7.5	225500	373096.89	1.46
100	L	Minneapolis	15	1	706	5000	1	7.5	137500	371626.99	1.39
100	L	Minneapolis	15	1	706	5000	1	7.5	225500	371626.99	1.39
100	L	Minneapolis	15	1	250	15000	1	7.5	137500	376044.62	1.59
100	L	Minneapolis	15	1	250	15000	1	7.5	225500	376044.62	1.59
100	L	Minneapolis	15	1	706	15000	1	7.5	137500	373008.03	1.45
100	L	Minneapolis	15	1	706	15000	1	7.5	225500	373008.03	1.45
300	H	San Diego	15	0	0	0	1	5.9	293500	984261.22	8.48
300	H	San Diego	15	0	0	0	1	5.9	557500	984261.22	8.48
300	H	San Diego	15	1	250	5000	1	5.9	305500	984748.41	13.88
300	H	San Diego	15	1	250	5000	1	5.9	569500	984748.41	13.88
300	H	San Diego	15	1	706	5000	1	5.9	305500	984764.21	13.95
300	H	San Diego	15	1	706	5000	1	5.9	569500	984764.21	13.95
300	H	San Diego	15	1	250	15000	1	5.9	305500	984723.64	13.76
300	H	San Diego	15	1	250	15000	1	5.9	569500	984723.64	13.76
300	H	San Diego	15	1	706	15000	1	5.9	305500	984777.98	14.02
300	H	San Diego	15	1	706	15000	1	5.9	569500	984777.98	14.02
300	H	San Diego	15	0	0	0	1	7.5	301500	984243.02	10.73
300	H	San Diego	15	0	0	0	1	7.5	565500	984243.02	10.73
300	H	San Diego	15	1	250	5000	1	7.5	313500	984782.23	16.74
300	H	San Diego	15	1	250	5000	1	7.5	577500	984782.23	16.74
300	H	San Diego	15	1	706	5000	1	7.5	313500	984769.39	16.67
300	H	San Diego	15	1	706	5000	1	7.5	577500	984769.39	16.67
300	H	San Diego	15	1	250	15000	1	7.5	313500	984732.06	16.46
300	H	San Diego	15	1	250	15000	1	7.5	577500	984732.06	16.46
300	H	San Diego	15	1	706	15000	1	7.5	313500	984734.34	16.48
300	H	San Diego	15	1	706	15000	1	7.5	577500	984734.34	16.48
300	H	South Carolina	15	0	0	0	1	5.9	293500	984322.54	8.64
300	H	South Carolina	15	0	0	0	1	5.9	557500	984322.54	8.64
300	H	South Carolina	15	1	250	5000	1	5.9	305500	985118.37	15.84
300	H	South Carolina	15	1	250	5000	1	5.9	569500	985118.37	15.84

300	H	South Carolina	15	1	706	5000	1	5.9	305500	985248.90	16.67
300	H	South Carolina	15	1	706	5000	1	5.9	569500	985248.90	16.67
300	H	South Carolina	15	1	250	15000	1	5.9	305500	985139.25	15.96
300	H	South Carolina	15	1	250	15000	1	5.9	569500	985139.25	15.96
300	H	South Carolina	15	1	706	15000	1	5.9	305500	985275.05	16.84
300	H	South Carolina	15	1	706	15000	1	5.9	569500	985275.05	16.84
300	H	South Carolina	15	0	0	0	1	7.5	301500	984349.79	11.06
300	H	South Carolina	15	0	0	0	1	7.5	565500	984349.79	11.06
300	H	South Carolina	15	1	250	5000	1	7.5	313500	985171.11	19.28
300	H	South Carolina	15	1	250	5000	1	7.5	577500	985171.11	19.28
300	H	South Carolina	15	1	706	5000	1	7.5	313500	985258.87	19.96
300	H	South Carolina	15	1	706	5000	1	7.5	577500	985258.87	19.96
300	H	South Carolina	15	1	250	15000	1	7.5	313500	985188.39	19.41
300	H	South Carolina	15	1	250	15000	1	7.5	577500	985188.39	19.41
300	H	South Carolina	15	1	706	15000	1	7.5	313500	985157.49	19.18
300	H	South Carolina	15	1	706	15000	1	7.5	577500	985157.49	19.18
300	H	New York	15	0	0	0	1	5.9	293500	982436.65	5.56
300	H	New York	15	0	0	0	1	5.9	557500	982436.65	5.56
300	H	New York	15	1	250	5000	1	5.9	305500	983090.56	8.93
300	H	New York	15	1	250	5000	1	5.9	569500	983090.56	8.93
300	H	New York	15	1	706	5000	1	5.9	305500	983031.61	8.82
300	H	New York	15	1	706	5000	1	5.9	569500	983031.61	8.82
300	H	New York	15	1	250	15000	1	5.9	305500	983102.53	8.95
300	H	New York	15	1	250	15000	1	5.9	569500	983102.53	8.95
300	H	New York	15	1	706	15000	1	5.9	305500	983035.84	8.82
300	H	New York	15	1	706	15000	1	5.9	569500	983035.84	8.82
300	H	New York	15	0	0	0	1	7.5	301500	982451.50	7.09
300	H	New York	15	0	0	0	1	7.5	565500	982451.50	7.09
300	H	New York	15	1	250	5000	1	7.5	313500	982999.09	10.44
300	H	New York	15	1	250	5000	1	7.5	577500	982999.09	10.44
300	H	New York	15	1	706	5000	1	7.5	313500	982979.13	10.40
300	H	New York	15	1	706	5000	1	7.5	577500	982979.13	10.40
300	H	New York	15	1	250	15000	1	7.5	313500	982990.65	10.42

300	H	New York	15	1	250	15000	1	7.5	577500	982990.65	10.42
300	H	New York	15	1	706	15000	1	7.5	313500	983097.18	10.66
300	H	New York	15	1	706	15000	1	7.5	577500	983097.18	10.66
300	H	Minneapolis	15	0	0	0	1	5.9	293500	985291.61	12.05
300	H	Minneapolis	15	0	0	0	1	5.9	557500	985291.61	12.05
300	H	Minneapolis	15	1	250	5000	1	5.9	305500	985727.54	20.63
300	H	Minneapolis	15	1	250	5000	1	5.9	569500	985727.54	20.63
300	H	Minneapolis	15	1	706	5000	1	5.9	305500	985684.27	20.20
300	H	Minneapolis	15	1	706	5000	1	5.9	569500	985684.27	20.20
300	H	Minneapolis	15	1	250	15000	1	5.9	305500	985803.48	21.44
300	H	Minneapolis	15	1	250	15000	1	5.9	569500	985803.48	21.44
300	H	Minneapolis	15	1	706	15000	1	5.9	305500	985721.66	20.57
300	H	Minneapolis	15	1	706	15000	1	5.9	569500	985721.66	20.57
300	H	Minneapolis	15	0	0	0	1	7.5	301500	985289.31	15.31
300	H	Minneapolis	15	0	0	0	1	7.5	565500	985289.31	15.31
300	H	Minneapolis	15	1	250	5000	1	7.5	313500	985692.45	24.19
300	H	Minneapolis	15	1	250	5000	1	7.5	577500	985692.45	24.19
300	H	Minneapolis	15	1	706	5000	1	7.5	313500	985717.96	24.49
300	H	Minneapolis	15	1	706	5000	1	7.5	577500	985717.96	24.49
300	H	Minneapolis	15	1	250	15000	1	7.5	313500	985749.26	24.88
300	H	Minneapolis	15	1	250	15000	1	7.5	577500	985749.26	24.88
300	H	Minneapolis	15	1	706	15000	1	7.5	313500	985627.26	23.44
300	H	Minneapolis	15	1	706	15000	1	7.5	577500	985627.26	23.44
300	L	0	15	1	250	5000	0	0	232000	969797.16	0.48
300	L	0	15	1	250	5000	0	0	452000	969797.16	0.48
300	L	0	15	1	706	5000	0	0	232000	957827.75	0.32
300	L	0	15	1	706	5000	0	0	452000	957827.75	0.32
300	L	0	15	1	250	15000	0	0	232000	954048.50	0.29
300	L	0	15	1	250	15000	0	0	452000	954048.50	0.29
300	L	0	15	1	706	15000	0	0	232000	958114.11	0.33
300	L	0	15	1	706	15000	0	0	452000	958114.11	0.33
300	L	San Diego	15	0	0	0	1	5.9	249500	963704.15	0.95
300	L	San Diego	15	0	0	0	1	5.9	469500	963704.15	0.95

300	L	San Diego	15	1	250	5000	1	5.9	261500	950691.56	0.94
300	L	San Diego	15	1	250	5000	1	5.9	481500	950691.56	0.94
300	L	San Diego	15	1	706	5000	1	5.9	261500	946744.13	0.86
300	L	San Diego	15	1	706	5000	1	5.9	481500	946744.13	0.86
300	L	San Diego	15	1	250	15000	1	5.9	261500	947020.82	0.87
300	L	San Diego	15	1	250	15000	1	5.9	481500	947020.82	0.87
300	L	San Diego	15	1	706	15000	1	5.9	261500	950510.49	0.94
300	L	San Diego	15	1	706	15000	1	5.9	481500	950510.49	0.94
300	L	San Diego	15	0	0	0	1	7.5	257500	971133.87	1.58
300	L	San Diego	15	0	0	0	1	7.5	477500	971133.87	1.58
300	L	San Diego	15	1	250	5000	1	7.5	269500	946690.87	1.03
300	L	San Diego	15	1	250	5000	1	7.5	489500	946690.87	1.03
300	L	San Diego	15	1	706	5000	1	7.5	269500	946755.33	1.03
300	L	San Diego	15	1	706	5000	1	7.5	489500	946755.33	1.03
300	L	San Diego	15	1	250	15000	1	7.5	269500	946556.96	1.03
300	L	San Diego	15	1	250	15000	1	7.5	489500	946556.96	1.03
300	L	San Diego	15	1	706	15000	1	7.5	269500	954429.30	1.23
300	L	San Diego	15	1	706	15000	1	7.5	489500	954429.30	1.23
300	L	South Carolina	15	0	0	0	1	5.9	249500	963731.86	0.95
300	L	South Carolina	15	0	0	0	1	5.9	469500	963731.86	0.95
300	L	South Carolina	15	1	250	5000	1	5.9	261500	948228.51	0.89
300	L	South Carolina	15	1	250	5000	1	5.9	481500	948228.51	0.89
300	L	South Carolina	15	1	706	5000	1	5.9	261500	948108.56	0.89
300	L	South Carolina	15	1	706	5000	1	5.9	481500	948108.56	0.89
300	L	South Carolina	15	1	250	15000	1	5.9	261500	952171.79	0.97
300	L	South Carolina	15	1	250	15000	1	5.9	481500	952171.79	0.97
300	L	South Carolina	15	1	706	15000	1	5.9	261500	948326.29	0.89
300	L	South Carolina	15	1	706	15000	1	5.9	481500	948326.29	0.89
300	L	South Carolina	15	0	0	0	1	7.5	257500	960000.29	1.08
300	L	South Carolina	15	0	0	0	1	7.5	477500	960000.29	1.08
300	L	South Carolina	15	1	250	5000	1	7.5	269500	948206.27	1.06
300	L	South Carolina	15	1	250	5000	1	7.5	489500	948206.27	1.06
300	L	South Carolina	15	1	706	5000	1	7.5	269500	952029.53	1.16

300	L	South Carolina	15	1	706	5000	1	7.5	489500	952029.53	1.16
300	L	South Carolina	15	1	250	15000	1	7.5	269500	951958.20	1.15
300	L	South Carolina	15	1	250	15000	1	7.5	489500	951958.20	1.15
300	L	South Carolina	15	1	706	15000	1	7.5	269500	955833.13	1.27
300	L	South Carolina	15	1	706	15000	1	7.5	489500	955833.13	1.27
300	L	New York	15	0	0	0	1	5.9	249500	957977.75	0.80
300	L	New York	15	0	0	0	1	5.9	469500	957977.75	0.80
300	L	New York	15	1	250	5000	1	5.9	261500	945690.79	0.84
300	L	New York	15	1	250	5000	1	5.9	481500	945690.79	0.84
300	L	New York	15	1	706	5000	1	5.9	261500	949555.76	0.92
300	L	New York	15	1	706	5000	1	5.9	481500	949555.76	0.92
300	L	New York	15	1	250	15000	1	5.9	261500	945815.68	0.85
300	L	New York	15	1	250	15000	1	5.9	481500	945815.68	0.85
300	L	New York	15	1	706	15000	1	5.9	261500	945615.93	0.84
300	L	New York	15	1	706	15000	1	5.9	481500	945615.93	0.84
300	L	New York	15	0	0	0	1	7.5	257500	965474.68	1.28
300	L	New York	15	0	0	0	1	7.5	477500	965474.68	1.28
300	L	New York	15	1	250	5000	1	7.5	269500	945776.75	1.01
300	L	New York	15	1	250	5000	1	7.5	489500	945776.75	1.01
300	L	New York	15	1	706	5000	1	7.5	269500	949484.64	1.09
300	L	New York	15	1	706	5000	1	7.5	489500	949484.64	1.09
300	L	New York	15	1	250	15000	1	7.5	269500	945804.34	1.01
300	L	New York	15	1	250	15000	1	7.5	489500	945804.34	1.01
300	L	New York	15	1	706	15000	1	7.5	269500	953392.83	1.19
300	L	New York	15	1	706	15000	1	7.5	489500	953392.83	1.19
300	L	Minneapolis	15	0	0	0	1	5.9	249500	975897.42	1.56
300	L	Minneapolis	15	0	0	0	1	5.9	469500	975897.42	1.56
300	L	Minneapolis	15	1	250	5000	1	5.9	261500	948144.13	0.89
300	L	Minneapolis	15	1	250	5000	1	5.9	481500	948144.13	0.89
300	L	Minneapolis	15	1	706	5000	1	5.9	261500	951844.22	0.97
300	L	Minneapolis	15	1	706	5000	1	5.9	481500	951844.22	0.97
300	L	Minneapolis	15	1	250	15000	1	5.9	261500	948313.41	0.89
300	L	Minneapolis	15	1	250	15000	1	5.9	481500	948313.41	0.89

300	L	Minneapolis	15	1	706	15000	1	5.9	261500	948125.00	0.89
300	L	Minneapolis	15	1	706	15000	1	5.9	481500	948125.00	0.89
300	L	Minneapolis	15	0	0	0	1	7.5	257500	979740.04	2.49
300	L	Minneapolis	15	0	0	0	1	7.5	477500	979740.04	2.49
300	L	Minneapolis	15	1	250	5000	1	7.5	269500	948032.49	1.06
300	L	Minneapolis	15	1	250	5000	1	7.5	489500	948032.49	1.06
300	L	Minneapolis	15	1	706	5000	1	7.5	269500	948067.42	1.06
300	L	Minneapolis	15	1	706	5000	1	7.5	489500	948067.42	1.06
300	L	Minneapolis	15	1	250	15000	1	7.5	269500	948158.86	1.06
300	L	Minneapolis	15	1	250	15000	1	7.5	489500	948158.86	1.06
300	L	Minneapolis	15	1	706	15000	1	7.5	269500	948007.69	1.06
300	L	Minneapolis	15	1	706	15000	1	7.5	489500	948007.69	1.06
100	H	0	50	1	250	5000	0	0	144000	1334212.31	0.29
100	H	0	50	1	250	5000	0	0	276000	1334212.31	0.29
100	H	0	50	1	706	5000	0	0	144000	1334097.38	0.29
100	H	0	50	1	706	5000	0	0	276000	1334097.38	0.29
100	H	0	50	1	250	15000	0	0	144000	1333704.48	0.28
100	H	0	50	1	250	15000	0	0	276000	1333704.48	0.28
100	H	0	50	1	706	15000	0	0	144000	1334364.66	0.29
100	H	0	50	1	706	15000	0	0	276000	1334364.66	0.29
100	H	San Diego	50	0	0	0	1	5.9	161500	1338519.47	0.79
100	H	San Diego	50	0	0	0	1	5.9	293500	1338519.47	0.79
100	H	San Diego	50	1	250	5000	1	5.9	173500	1323653.32	0.80
100	H	San Diego	50	1	250	5000	1	5.9	305500	1323653.32	0.80
100	H	San Diego	50	1	706	5000	1	5.9	173500	1323298.10	0.79
100	H	San Diego	50	1	706	5000	1	5.9	305500	1323298.10	0.79
100	H	San Diego	50	1	250	15000	1	5.9	173500	1324300.43	0.81
100	H	San Diego	50	1	250	15000	1	5.9	305500	1324300.43	0.81
100	H	San Diego	50	1	706	15000	1	5.9	173500	1323713.19	0.80
100	H	San Diego	50	1	706	15000	1	5.9	305500	1323713.19	0.80
100	H	San Diego	50	0	0	0	1	7.5	169500	1344411.27	1.19
100	H	San Diego	50	0	0	0	1	7.5	301500	1344411.27	1.19
100	H	San Diego	50	1	250	5000	1	7.5	181500	1323813.95	0.95

100	H	San Diego	50	1	250	5000	1	7.5	313500	1323813.95	0.95
100	H	San Diego	50	1	706	5000	1	7.5	181500	1324073.48	0.96
100	H	San Diego	50	1	706	5000	1	7.5	313500	1324073.48	0.96
100	H	San Diego	50	1	250	15000	1	7.5	181500	1323401.43	0.94
100	H	San Diego	50	1	250	15000	1	7.5	313500	1323401.43	0.94
100	H	San Diego	50	1	706	15000	1	7.5	181500	1324248.77	0.96
100	H	San Diego	50	1	706	15000	1	7.5	313500	1324248.77	0.96
100	H	South Carolina	50	0	0	0	1	5.9	161500	1315895.44	0.49
100	H	South Carolina	50	0	0	0	1	5.9	293500	1315895.44	0.49
100	H	South Carolina	50	1	250	5000	1	5.9	173500	1303985.37	0.58
100	H	South Carolina	50	1	250	5000	1	5.9	305500	1303985.37	0.58
100	H	South Carolina	50	1	706	5000	1	5.9	173500	1303780.60	0.58
100	H	South Carolina	50	1	706	5000	1	5.9	305500	1303780.60	0.58
100	H	South Carolina	50	1	250	15000	1	5.9	173500	1304101.64	0.58
100	H	South Carolina	50	1	250	15000	1	5.9	305500	1304101.64	0.58
100	H	South Carolina	50	1	706	15000	1	5.9	173500	1308507.66	0.62
100	H	South Carolina	50	1	706	15000	1	5.9	305500	1308507.66	0.62
100	H	South Carolina	50	0	0	0	1	7.5	169500	1315972.47	0.63
100	H	South Carolina	50	0	0	0	1	7.5	301500	1315972.47	0.63
100	H	South Carolina	50	1	250	5000	1	7.5	181500	1303716.64	0.69
100	H	South Carolina	50	1	250	5000	1	7.5	313500	1303716.64	0.69
100	H	South Carolina	50	1	706	5000	1	7.5	181500	1304072.23	0.69
100	H	South Carolina	50	1	706	5000	1	7.5	313500	1304072.23	0.69
100	H	South Carolina	50	1	250	15000	1	7.5	181500	1303554.65	0.68
100	H	South Carolina	50	1	250	15000	1	7.5	313500	1303554.65	0.68
100	H	South Carolina	50	1	706	15000	1	7.5	181500	1304252.01	0.69
100	H	South Carolina	50	1	706	15000	1	7.5	313500	1304252.01	0.69
100	H	New York	50	0	0	0	1	5.9	161500	1329623.84	0.64
100	H	New York	50	0	0	0	1	5.9	293500	1329623.84	0.64
100	H	New York	50	1	250	5000	1	5.9	173500	1316426.06	0.70
100	H	New York	50	1	250	5000	1	5.9	305500	1316426.06	0.70
100	H	New York	50	1	706	5000	1	5.9	173500	1316272.06	0.70
100	H	New York	50	1	706	5000	1	5.9	305500	1316272.06	0.70

100	H	New York	50	1	250	15000	1	5.9	173500	1316089.43	0.69
100	H	New York	50	1	250	15000	1	5.9	305500	1316089.43	0.69
100	H	New York	50	1	706	15000	1	5.9	173500	1316807.00	0.70
100	H	New York	50	1	706	15000	1	5.9	305500	1316807.00	0.70
100	H	New York	50	0	0	0	1	7.5	169500	1329820.30	0.81
100	H	New York	50	0	0	0	1	7.5	301500	1329820.30	0.81
100	H	New York	50	1	250	5000	1	7.5	181500	1316537.05	0.83
100	H	New York	50	1	250	5000	1	7.5	313500	1316537.05	0.83
100	H	New York	50	1	706	5000	1	7.5	181500	1316596.74	0.84
100	H	New York	50	1	706	5000	1	7.5	313500	1316596.74	0.84
100	H	New York	50	1	250	15000	1	7.5	181500	1316506.01	0.83
100	H	New York	50	1	250	15000	1	7.5	313500	1316506.01	0.83
100	H	New York	50	1	706	15000	1	7.5	181500	1316117.56	0.83
100	H	New York	50	1	706	15000	1	7.5	313500	1316117.56	0.83
100	H	Minneapolis	50	0	0	0	1	5.9	161500	1354132.92	1.36
100	H	Minneapolis	50	0	0	0	1	5.9	293500	1354132.92	1.36
100	H	Minneapolis	50	1	250	5000	1	5.9	173500	1330277.40	0.91
100	H	Minneapolis	50	1	250	5000	1	5.9	305500	1330277.40	0.91
100	H	Minneapolis	50	1	706	5000	1	5.9	173500	1331076.38	0.93
100	H	Minneapolis	50	1	706	5000	1	5.9	305500	1331076.38	0.93
100	H	Minneapolis	50	1	250	15000	1	5.9	173500	1330026.28	0.91
100	H	Minneapolis	50	1	250	15000	1	5.9	305500	1330026.28	0.91
100	H	Minneapolis	50	1	706	15000	1	5.9	173500	1330931.54	0.92
100	H	Minneapolis	50	1	706	15000	1	5.9	305500	1330931.54	0.92
100	H	Minneapolis	50	0	0	0	1	7.5	169500	1354131.10	1.73
100	H	Minneapolis	50	0	0	0	1	7.5	301500	1354131.10	1.73
100	H	Minneapolis	50	1	250	5000	1	7.5	181500	1330151.00	1.08
100	H	Minneapolis	50	1	250	5000	1	7.5	313500	1330151.00	1.08
100	H	Minneapolis	50	1	706	5000	1	7.5	181500	1330485.30	1.09
100	H	Minneapolis	50	1	706	5000	1	7.5	313500	1330485.30	1.09
100	H	Minneapolis	50	1	250	15000	1	7.5	181500	1331434.31	1.11
100	H	Minneapolis	50	1	250	15000	1	7.5	313500	1331434.31	1.11
100	H	Minneapolis	50	1	706	15000	1	7.5	181500	1331015.21	1.10

100	H	Minneapolis	50	1	706	15000	1	7.5	313500	1331015.21	1.10
100	L	0	50	1	250	5000	0	0	100000	1262076.44	0.10
100	L	0	50	1	250	5000	0	0	188000	1262076.44	0.10
100	L	0	50	1	706	5000	0	0	100000	1257070.49	0.10
100	L	0	50	1	706	5000	0	0	188000	1257070.49	0.10
100	L	0	50	1	250	15000	0	0	100000	1247115.26	0.09
100	L	0	50	1	250	15000	0	0	188000	1247115.26	0.09
100	L	0	50	1	706	15000	0	0	100000	1247190.09	0.09
100	L	0	50	1	706	15000	0	0	188000	1247190.09	0.09
100	L	San Diego	50	0	0	0	1	5.9	117500	1332864.25	0.63
100	L	San Diego	50	0	0	0	1	5.9	205500	1332864.25	0.63
100	L	San Diego	50	1	250	5000	1	5.9	129500	1241198.22	0.30
100	L	San Diego	50	1	250	5000	1	5.9	217500	1241198.22	0.30
100	L	San Diego	50	1	706	5000	1	5.9	129500	1236398.33	0.29
100	L	San Diego	50	1	706	5000	1	5.9	217500	1236398.33	0.29
100	L	San Diego	50	1	250	15000	1	5.9	129500	1236049.33	0.29
100	L	San Diego	50	1	250	15000	1	5.9	217500	1236049.33	0.29
100	L	San Diego	50	1	706	15000	1	5.9	129500	1236307.33	0.29
100	L	San Diego	50	1	706	15000	1	5.9	217500	1236307.33	0.29
100	L	San Diego	50	0	0	0	1	7.5	125500	1342350.45	1.01
100	L	San Diego	50	0	0	0	1	7.5	213500	1342350.45	1.01
100	L	San Diego	50	1	250	5000	1	7.5	137500	1241188.30	0.36
100	L	San Diego	50	1	250	5000	1	7.5	225500	1241188.30	0.36
100	L	San Diego	50	1	706	5000	1	7.5	137500	1236256.59	0.35
100	L	San Diego	50	1	706	5000	1	7.5	225500	1236256.59	0.35
100	L	San Diego	50	1	250	15000	1	7.5	137500	1240895.72	0.36
100	L	San Diego	50	1	250	15000	1	7.5	225500	1240895.72	0.36
100	L	San Diego	50	1	706	15000	1	7.5	137500	1240894.32	0.36
100	L	San Diego	50	1	706	15000	1	7.5	225500	1240894.32	0.36
100	L	South Carolina	50	1	250	5000	1	5.9	129500	1229073.26	0.28
100	L	South Carolina	50	1	250	5000	1	5.9	217500	1229073.26	0.28
100	L	South Carolina	50	1	706	5000	1	5.9	129500	1228618.16	0.27
100	L	South Carolina	50	1	706	5000	1	5.9	217500	1228618.16	0.27

100	L	South Carolina	50	1	250	15000	1	5.9	129500	1223577.76	0.27
100	L	South Carolina	50	1	250	15000	1	5.9	217500	1223577.76	0.27
100	L	South Carolina	50	1	706	15000	1	5.9	129500	1224173.63	0.27
100	L	South Carolina	50	1	706	15000	1	5.9	217500	1224173.63	0.27
100	L	South Carolina	50	0	0	0	1	7.5	125500	1366337.58	2.84
100	L	South Carolina	50	0	0	0	1	7.5	213500	1366337.58	2.84
100	L	South Carolina	50	1	250	5000	1	7.5	137500	1228784.98	0.33
100	L	South Carolina	50	1	250	5000	1	7.5	225500	1228784.98	0.33
100	L	South Carolina	50	1	706	5000	1	7.5	137500	1223677.90	0.32
100	L	South Carolina	50	1	706	5000	1	7.5	225500	1223677.90	0.32
100	L	South Carolina	50	1	250	15000	1	7.5	137500	1238282.37	0.35
100	L	South Carolina	50	1	250	15000	1	7.5	225500	1238282.37	0.35
100	L	South Carolina	50	1	706	15000	1	7.5	137500	1223736.98	0.32
100	L	South Carolina	50	1	706	15000	1	7.5	225500	1223736.98	0.32
100	L	New York	50	0	0	0	1	5.9	117500	1349303.24	0.98
100	L	New York	50	0	0	0	1	5.9	205500	1349303.24	0.98
100	L	New York	50	1	250	5000	1	5.9	129500	1224205.36	0.27
100	L	New York	50	1	250	5000	1	5.9	217500	1224205.36	0.27
100	L	New York	50	1	706	5000	1	5.9	129500	1224153.84	0.27
100	L	New York	50	1	706	5000	1	5.9	217500	1224153.84	0.27
100	L	New York	50	1	250	15000	1	5.9	129500	1234224.68	0.29
100	L	New York	50	1	250	15000	1	5.9	217500	1234224.68	0.29
100	L	New York	50	1	706	15000	1	5.9	129500	1228936.40	0.28
100	L	New York	50	1	706	15000	1	5.9	217500	1228936.40	0.28
100	L	New York	50	0	0	0	1	7.5	125500	1377365.84	17.27
100	L	New York	50	0	0	0	1	7.5	213500	1377365.84	17.27
100	L	New York	50	1	250	5000	1	7.5	137500	1229276.21	0.33
100	L	New York	50	1	250	5000	1	7.5	225500	1229276.21	0.33
100	L	New York	50	1	706	5000	1	7.5	137500	1224332.52	0.32
100	L	New York	50	1	706	5000	1	7.5	225500	1224332.52	0.32
100	L	New York	50	1	250	15000	1	7.5	137500	1238846.46	0.35
100	L	New York	50	1	250	15000	1	7.5	225500	1238846.46	0.35
100	L	New York	50	1	706	15000	1	7.5	137500	1224373.31	0.32

100	L	New York	50	1	706	15000	1	7.5	225500	1224373.31	0.32
100	L	Minneapolis	50	0	0	0	1	5.9	117500	1341560.68	0.78
100	L	Minneapolis	50	0	0	0	1	5.9	205500	1341560.68	0.78
100	L	Minneapolis	50	1	250	5000	1	5.9	129500	1232293.55	0.28
100	L	Minneapolis	50	1	250	5000	1	5.9	217500	1232293.55	0.28
100	L	Minneapolis	50	1	706	5000	1	5.9	129500	1251682.60	0.32
100	L	Minneapolis	50	1	706	5000	1	5.9	217500	1251682.60	0.32
100	L	Minneapolis	50	1	250	15000	1	5.9	129500	1232111.44	0.28
100	L	Minneapolis	50	1	250	15000	1	5.9	217500	1232111.44	0.28
100	L	Minneapolis	50	1	706	15000	1	5.9	129500	1237390.47	0.29
100	L	Minneapolis	50	1	706	15000	1	5.9	217500	1237390.47	0.29
100	L	Minneapolis	50	0	0	0	1	7.5	125500	1374540.38	7.50
100	L	Minneapolis	50	0	0	0	1	7.5	213500	1374540.38	7.50
100	L	Minneapolis	50	1	250	5000	1	7.5	137500	1237185.12	0.35
100	L	Minneapolis	50	1	250	5000	1	7.5	225500	1237185.12	0.35
100	L	Minneapolis	50	1	706	5000	1	7.5	137500	1237105.85	0.35
100	L	Minneapolis	50	1	706	5000	1	7.5	225500	1237105.85	0.35
100	L	Minneapolis	50	1	250	15000	1	7.5	137500	1237263.06	0.35
100	L	Minneapolis	50	1	250	15000	1	7.5	225500	1237263.06	0.35
100	L	Minneapolis	50	1	706	15000	1	7.5	137500	1242214.70	0.36
100	L	Minneapolis	50	1	706	15000	1	7.5	225500	1242214.70	0.36
300	H	0	50	1	250	5000	0	0	276000	3290081.78	0.97
300	H	0	50	1	250	5000	0	0	540000	3290081.78	0.97
300	H	0	50	1	706	5000	0	0	276000	3290159.29	0.98
300	H	0	50	1	706	5000	0	0	540000	3290159.29	0.98
300	H	0	50	1	250	15000	0	0	276000	3290204.73	0.98
300	H	0	50	1	250	15000	0	0	540000	3290204.73	0.98
300	H	0	50	1	706	15000	0	0	276000	3290036.35	0.97
300	H	0	50	1	706	15000	0	0	540000	3290036.35	0.97
300	H	San Diego	50	0	0	0	1	5.9	293500	3277298.22	1.17
300	H	San Diego	50	0	0	0	1	5.9	557500	3277298.22	1.17
300	H	San Diego	50	1	250	5000	1	5.9	305500	3279126.61	1.78
300	H	San Diego	50	1	250	5000	1	5.9	569500	3279126.61	1.78

300	H	San Diego	50	1	706	5000	1	5.9	305500	3279387.65	1.80
300	H	San Diego	50	1	706	5000	1	5.9	569500	3279387.65	1.80
300	H	San Diego	50	1	250	15000	1	5.9	305500	3279525.18	1.81
300	H	San Diego	50	1	250	15000	1	5.9	569500	3279525.18	1.81
300	H	San Diego	50	1	706	15000	1	5.9	305500	3279209.73	1.79
300	H	San Diego	50	1	706	15000	1	5.9	569500	3279209.73	1.79
300	H	San Diego	50	0	0	0	1	7.5	301500	3277515.74	1.50
300	H	San Diego	50	0	0	0	1	7.5	565500	3277515.74	1.50
300	H	San Diego	50	1	250	5000	1	7.5	313500	3279208.56	2.13
300	H	San Diego	50	1	250	5000	1	7.5	577500	3279208.56	2.13
300	H	San Diego	50	1	706	5000	1	7.5	313500	3278885.16	2.10
300	H	San Diego	50	1	706	5000	1	7.5	577500	3278885.16	2.10
300	H	San Diego	50	1	250	15000	1	7.5	313500	3279266.01	2.14
300	H	San Diego	50	1	250	15000	1	7.5	577500	3279266.01	2.14
300	H	San Diego	50	1	706	15000	1	7.5	313500	3279544.90	2.16
300	H	San Diego	50	1	706	15000	1	7.5	577500	3279544.90	2.16
300	H	South Carolina	50	0	0	0	1	5.9	293500	3277922.46	1.20
300	H	South Carolina	50	0	0	0	1	5.9	557500	3277922.46	1.20
300	H	South Carolina	50	1	250	5000	1	5.9	305500	3280147.36	1.86
300	H	South Carolina	50	1	250	5000	1	5.9	569500	3280147.36	1.86
300	H	South Carolina	50	1	706	5000	1	5.9	305500	3280581.03	1.90
300	H	South Carolina	50	1	706	5000	1	5.9	569500	3280581.03	1.90
300	H	South Carolina	50	1	250	15000	1	5.9	305500	3280514.67	1.89
300	H	South Carolina	50	1	250	15000	1	5.9	569500	3280514.67	1.89
300	H	South Carolina	50	1	706	15000	1	5.9	305500	3280476.34	1.89
300	H	South Carolina	50	1	706	15000	1	5.9	569500	3280476.34	1.89
300	H	South Carolina	50	0	0	0	1	7.5	301500	3277684.71	1.51
300	H	South Carolina	50	0	0	0	1	7.5	565500	3277684.71	1.51
300	H	South Carolina	50	1	250	5000	1	7.5	313500	3280595.51	2.27
300	H	South Carolina	50	1	250	5000	1	7.5	577500	3280595.51	2.27
300	H	South Carolina	50	1	706	5000	1	7.5	313500	3280696.71	2.28
300	H	South Carolina	50	1	706	5000	1	7.5	577500	3280696.71	2.28
300	H	South Carolina	50	1	250	15000	1	7.5	313500	3280850.09	2.29

300	H	South Carolina	50	1	250	15000	1	7.5	577500	3280850.09	2.29
300	H	South Carolina	50	1	706	15000	1	7.5	313500	3280665.18	2.27
300	H	South Carolina	50	1	706	15000	1	7.5	577500	3280665.18	2.27
300	H	New York	50	0	0	0	1	5.9	293500	3271243.31	0.95
300	H	New York	50	0	0	0	1	5.9	557500	3271243.31	0.95
300	H	New York	50	1	250	5000	1	5.9	305500	3273611.99	1.44
300	H	New York	50	1	250	5000	1	5.9	569500	3273611.99	1.44
300	H	New York	50	1	706	5000	1	5.9	305500	3273549.10	1.44
300	H	New York	50	1	706	5000	1	5.9	569500	3273549.10	1.44
300	H	New York	50	1	250	15000	1	5.9	305500	3273160.75	1.42
300	H	New York	50	1	250	15000	1	5.9	569500	3273160.75	1.42
300	H	New York	50	1	706	15000	1	5.9	305500	3273563.38	1.44
300	H	New York	50	1	706	15000	1	5.9	569500	3273563.38	1.44
300	H	New York	50	0	0	0	1	7.5	301500	3271306.85	1.20
300	H	New York	50	0	0	0	1	7.5	565500	3271306.85	1.20
300	H	New York	50	1	250	5000	1	7.5	313500	3273365.66	1.70
300	H	New York	50	1	250	5000	1	7.5	577500	3273365.66	1.70
300	H	New York	50	1	706	5000	1	7.5	313500	3273122.29	1.69
300	H	New York	50	1	706	5000	1	7.5	577500	3273122.29	1.69
300	H	New York	50	1	250	15000	1	7.5	313500	3273370.20	1.70
300	H	New York	50	1	250	15000	1	7.5	577500	3273370.20	1.70
300	H	New York	50	1	706	15000	1	7.5	313500	3273759.29	1.73
300	H	New York	50	1	706	15000	1	7.5	577500	3273759.29	1.73
300	H	Minneapolis	50	0	0	0	1	5.9	293500	3280998.75	1.38
300	H	Minneapolis	50	0	0	0	1	5.9	557500	3280998.75	1.38
300	H	Minneapolis	50	1	250	5000	1	5.9	305500	3282437.77	2.07
300	H	Minneapolis	50	1	250	5000	1	5.9	569500	3282437.77	2.07
300	H	Minneapolis	50	1	706	5000	1	5.9	305500	3282458.95	2.08
300	H	Minneapolis	50	1	706	5000	1	5.9	569500	3282458.95	2.08
300	H	Minneapolis	50	1	250	15000	1	5.9	305500	3282237.92	2.05
300	H	Minneapolis	50	1	250	15000	1	5.9	569500	3282237.92	2.05
300	H	Minneapolis	50	1	706	15000	1	5.9	305500	3282562.63	2.09
300	H	Minneapolis	50	1	706	15000	1	5.9	569500	3282562.63	2.09

300	H	Minneapolis	50	0	0	0	1	7.5	301500	3281007.70	1.75
300	H	Minneapolis	50	0	0	0	1	7.5	565500	3281007.70	1.75
300	H	Minneapolis	50	1	250	5000	1	7.5	313500	3282084.77	2.43
300	H	Minneapolis	50	1	250	5000	1	7.5	577500	3282084.77	2.43
300	H	Minneapolis	50	1	706	5000	1	7.5	313500	3282157.89	2.44
300	H	Minneapolis	50	1	706	5000	1	7.5	577500	3282157.89	2.44
300	H	Minneapolis	50	1	250	15000	1	7.5	313500	3282195.05	2.45
300	H	Minneapolis	50	1	250	15000	1	7.5	577500	3282195.05	2.45
300	H	Minneapolis	50	1	706	15000	1	7.5	313500	3282232.40	2.45
300	H	Minneapolis	50	1	706	15000	1	7.5	577500	3282232.40	2.45
300	L	0	50	1	250	5000	0	0	232000	3189605.35	0.33
300	L	0	50	1	250	5000	0	0	452000	3189605.35	0.33
300	L	0	50	1	706	5000	0	0	232000	3164563.88	0.20
300	L	0	50	1	706	5000	0	0	452000	3164563.88	0.20
300	L	0	50	1	250	15000	0	0	232000	3177379.43	0.25
300	L	0	50	1	250	15000	0	0	452000	3177379.43	0.25
300	L	0	50	1	706	15000	0	0	232000	3177368.69	0.25
300	L	0	50	1	706	15000	0	0	452000	3177368.69	0.25
300	L	San Diego	50	1	250	5000	1	5.9	261500	3152310.12	0.57
300	L	San Diego	50	1	250	5000	1	5.9	481500	3152310.12	0.57
300	L	San Diego	50	1	706	5000	1	5.9	261500	3152702.27	0.57
300	L	San Diego	50	1	706	5000	1	5.9	481500	3152702.27	0.57
300	L	San Diego	50	1	250	15000	1	5.9	261500	3152183.72	0.57
300	L	San Diego	50	1	250	15000	1	5.9	481500	3152183.72	0.57
300	L	San Diego	50	1	706	15000	1	5.9	261500	3151845.41	0.56
300	L	San Diego	50	1	706	15000	1	5.9	481500	3151845.41	0.56
300	L	San Diego	50	0	0	0	1	7.5	257500	3221223.19	8.54
300	L	San Diego	50	0	0	0	1	7.5	477500	3221223.19	8.54
300	L	San Diego	50	1	250	5000	1	7.5	269500	3152344.59	0.68
300	L	San Diego	50	1	250	5000	1	7.5	489500	3152344.59	0.68
300	L	San Diego	50	1	706	5000	1	7.5	269500	3152244.11	0.67
300	L	San Diego	50	1	706	5000	1	7.5	489500	3152244.11	0.67
300	L	San Diego	50	1	250	15000	1	7.5	269500	3152658.75	0.68

300	L	San Diego	50	1	250	15000	1	7.5	489500	3152658.75	0.68
300	L	San Diego	50	1	706	15000	1	7.5	269500	3152087.21	0.67
300	L	San Diego	50	1	706	15000	1	7.5	489500	3152087.21	0.67
300	L	South Carolina	50	0	0	0	1	5.9	249500	3196803.43	1.02
300	L	South Carolina	50	0	0	0	1	5.9	469500	3196803.43	1.02
300	L	South Carolina	50	1	250	5000	1	5.9	261500	3170104.26	0.75
300	L	South Carolina	50	1	250	5000	1	5.9	481500	3170104.26	0.75
300	L	South Carolina	50	1	706	5000	1	5.9	261500	3157322.21	0.61
300	L	South Carolina	50	1	706	5000	1	5.9	481500	3157322.21	0.61
300	L	South Carolina	50	1	250	15000	1	5.9	261500	3170429.04	0.75
300	L	South Carolina	50	1	250	15000	1	5.9	481500	3170429.04	0.75
300	L	South Carolina	50	1	706	15000	1	5.9	261500	3157689.61	0.61
300	L	South Carolina	50	1	706	15000	1	5.9	481500	3157689.61	0.61
300	L	South Carolina	50	0	0	0	1	7.5	257500	3221218.19	8.53
300	L	South Carolina	50	0	0	0	1	7.5	477500	3221218.19	8.53
300	L	South Carolina	50	1	250	5000	1	7.5	269500	3157265.57	0.72
300	L	South Carolina	50	1	250	5000	1	7.5	489500	3157265.57	0.72
300	L	South Carolina	50	1	706	5000	1	7.5	269500	3157787.19	0.73
300	L	South Carolina	50	1	706	5000	1	7.5	489500	3157787.19	0.73
300	L	South Carolina	50	1	250	15000	1	7.5	269500	3182821.57	1.16
300	L	South Carolina	50	1	250	15000	1	7.5	489500	3182821.57	1.16
300	L	South Carolina	50	1	706	15000	1	7.5	269500	3157928.08	0.73
300	L	South Carolina	50	1	706	15000	1	7.5	489500	3157928.08	0.73
300	L	New York	50	0	0	0	1	5.9	249500	3214903.01	2.75
300	L	New York	50	0	0	0	1	5.9	469500	3214903.01	2.75
300	L	New York	50	1	250	5000	1	5.9	261500	3149036.16	0.54
300	L	New York	50	1	250	5000	1	5.9	481500	3149036.16	0.54
300	L	New York	50	1	706	5000	1	5.9	261500	3149103.76	0.54
300	L	New York	50	1	706	5000	1	5.9	481500	3149103.76	0.54
300	L	New York	50	1	250	15000	1	5.9	261500	3149300.97	0.54
300	L	New York	50	1	250	15000	1	5.9	481500	3149300.97	0.54
300	L	New York	50	1	706	15000	1	5.9	261500	3161766.55	0.65
300	L	New York	50	1	706	15000	1	5.9	481500	3161766.55	0.65

300	L	New York	50	0	0	0	1	7.5	257500	3214660.67	3.42
300	L	New York	50	0	0	0	1	7.5	477500	3214660.67	3.42
300	L	New York	50	1	250	5000	1	7.5	269500	3149611.67	0.65
300	L	New York	50	1	250	5000	1	7.5	489500	3149611.67	0.65
300	L	New York	50	1	706	5000	1	7.5	269500	3161538.43	0.77
300	L	New York	50	1	706	5000	1	7.5	489500	3161538.43	0.77
300	L	New York	50	1	250	15000	1	7.5	269500	3149102.81	0.65
300	L	New York	50	1	250	15000	1	7.5	489500	3149102.81	0.65
300	L	New York	50	1	706	15000	1	7.5	269500	3173865.72	0.96
300	L	New York	50	1	706	15000	1	7.5	489500	3173865.72	0.96
300	L	Minneapolis	50	0	0	0	1	5.9	249500	3200372.88	1.17
300	L	Minneapolis	50	0	0	0	1	5.9	469500	3200372.88	1.17
300	L	Minneapolis	50	1	250	5000	1	5.9	261500	3182517.97	0.96

Appendix C

TCO with Social Cost of Carbon

Table C.1: Cost of Capital Data

Max Power	**Reliability**	**Location**	**Fuel Price**	**Battery**	**Battery Cost**	**Battery Cycle Life**	**Solar**	**Solar Price**	**Lifetime**	**Cost of Capital**	**Capital**	**Annual Opex**	**TCO**
kW			$/gal		$/kWh			$/Wp	years	%/annual	$	$	$
100	H	0	3	0	0	0	0	0	1	0	132000	92177.76	224177.76
100	H	0	3	0	0	0	0	0	1	1	132000	92177.76	223265.11
100	H	0	3	0	0	0	0	0	1	5	132000	92177.76	219788.35
100	H	0	3	0	0	0	0	0	5	0	132000	92177.76	592888.82
100	H	0	3	0	0	0	0	0	5	1	132000	92177.76	579378.44
100	H	0	3	0	0	0	0	0	5	5	132000	92177.76	531081.48
100	H	0	3	0	0	0	0	0	10	0	264000	92177.76	1185777.64
100	H	0	3	0	0	0	0	0	10	1	264000	92177.76	1137043.67
100	H	0	3	0	0	0	0	0	10	5	264000	91190.14	968146.13
100	H	0	3	1	250	5000	0	0	1	0	144000	90233.78	234233.78
100	H	0	3	1	250	5000	0	0	1	1	144000	90233.78	233340.37
100	H	0	3	1	250	5000	0	0	1	5	144000	90233.78	229936.93
100	H	0	3	1	250	5000	0	0	5	0	144000	90233.78	595168.89
100	H	0	3	1	250	5000	0	0	5	1	144000	90233.78	581943.44
100	H	0	3	1	250	5000	0	0	5	5	144000	90233.78	534665.04
100	H	0	3	1	250	5000	0	0	10	0	276000	90233.78	1178337.78
100	H	0	3	1	250	5000	0	0	10	1	276000	90233.78	1130631.59
100	H	0	3	1	250	5000	0	0	10	5	276000	90233.78	972761.31
100	H	0	3	1	706	5000	0	0	1	0	144000	90239.47	234239.47
100	H	0	3	1	706	5000	0	0	1	1	144000	90239.47	233346.01
100	H	0	3	1	706	5000	0	0	1	5	144000	90239.47	229942.35
100	H	0	3	1	706	5000	0	0	5	0	144000	90239.47	595197.35
100	H	0	3	1	706	5000	0	0	5	1	144000	90239.47	581971.06
100	H	0	3	1	706	5000	0	0	5	5	144000	90239.47	534689.68
100	H	0	3	1	706	5000	0	0	10	0	276000	90239.47	1178394.69
100	H	0	3	1	706	5000	0	0	10	1	276000	90239.47	1130685.50
100	H	0	3	1	706	5000	0	0	10	5	276000	90239.47	972805.26
100	H	0	3	1	250	15000	0	0	1	0	144000	90184.33	234184.33
100	H	0	3	1	250	15000	0	0	1	1	144000	90184.33	233291.42
100	H	0	3	1	250	15000	0	0	1	5	144000	90184.33	229889.84
100	H	0	3	1	250	15000	0	0	5	0	144000	90184.33	594921.66
100	H	0	3	1	250	15000	0	0	5	1	144000	90184.33	581703.45
100	H	0	3	1	250	15000	0	0	5	5	144000	90184.33	534450.96
100	H	0	3	1	250	15000	0	0	10	0	276000	90184.33	1177843.32
100	H	0	3	1	250	15000	0	0	10	1	276000	90184.33	1130163.27
100	H	0	3	1	250	15000	0	0	10	5	276000	90184.33	972379.51
100	H	0	3	1	706	15000	0	0	1	0	144000	90215.28	234215.28
100	H	0	3	1	706	15000	0	0	1	1	144000	90215.28	233322.06
100	H	0	3	1	706	15000	0	0	1	5	144000	90215.28	229919.31

100	H	0	3	1	706	15000	0	0	5	0	144000	90215.28	595076.40
100	H	0	3	1	706	15000	0	0	5	1	144000	90215.28	581853.66
100	H	0	3	1	706	15000	0	0	5	5	144000	90215.28	534584.95
100	H	0	3	1	706	15000	0	0	10	0	276000	90215.28	1178152.80
100	H	0	3	1	706	15000	0	0	10	1	276000	90215.28	1130456.39
100	H	0	3	1	706	15000	0	0	10	5	276000	90215.28	972618.48
100	H	San Diego	3	0	0	0	1	5.9	1	0	161500	89168.54	250668.54
100	H	San Diego	3	0	0	0	1	5.9	1	1	161500	89168.54	249785.69
100	H	San Diego	3	0	0	0	1	5.9	1	5	161500	89168.54	246422.42
100	H	San Diego	3	0	0	0	1	5.9	5	0	161500	89168.54	607342.71
100	H	San Diego	3	0	0	0	1	5.9	5	1	161500	89168.54	594273.39
100	H	San Diego	3	0	0	0	1	5.9	5	5	161500	89168.54	547553.12
100	H	San Diego	3	0	0	0	1	5.9	10	0	293500	89168.54	1185185.42
100	H	San Diego	3	0	0	0	1	5.9	10	1	293500	89168.54	1138042.42
100	H	San Diego	3	0	0	0	1	5.9	10	5	293500	89168.54	982035.85
100	H	San Diego	3	1	250	5000	1	5.9	1	0	173500	88068.29	261568.29
100	H	San Diego	3	1	250	5000	1	5.9	1	1	173500	88068.29	260696.32
100	H	San Diego	3	1	250	5000	1	5.9	1	5	173500	88068.29	257374.56
100	H	San Diego	3	1	250	5000	1	5.9	5	0	173500	88068.29	613841.43
100	H	San Diego	3	1	250	5000	1	5.9	5	1	173500	88068.29	600933.37
100	H	San Diego	3	1	250	5000	1	5.9	5	5	173500	88068.29	554789.59
100	H	San Diego	3	1	250	5000	1	5.9	10	0	305500	88068.29	1186182.86
100	H	San Diego	3	1	250	5000	1	5.9	10	1	305500	88068.29	1139621.55
100	H	San Diego	3	1	250	5000	1	5.9	10	5	305500	88068.29	985539.96
100	H	San Diego	3	1	706	5000	1	5.9	1	0	173500	88045.36	261545.36
100	H	San Diego	3	1	706	5000	1	5.9	1	1	173500	88045.36	260673.62
100	H	San Diego	3	1	706	5000	1	5.9	1	5	173500	88045.36	257352.72
100	H	San Diego	3	1	706	5000	1	5.9	5	0	173500	88045.36	613726.79
100	H	San Diego	3	1	706	5000	1	5.9	5	1	173500	88045.36	600822.09
100	H	San Diego	3	1	706	5000	1	5.9	5	5	173500	88045.36	554690.32
100	H	San Diego	3	1	706	5000	1	5.9	10	0	305500	88045.36	1185953.58
100	H	San Diego	3	1	706	5000	1	5.9	10	1	305500	88045.36	1139404.39
100	H	San Diego	3	1	706	5000	1	5.9	10	5	305500	88045.36	985362.91
100	H	San Diego	3	1	250	15000	1	5.9	1	0	173500	88072.64	261572.64
100	H	San Diego	3	1	250	15000	1	5.9	1	1	173500	88072.64	260700.64
100	H	San Diego	3	1	250	15000	1	5.9	1	5	173500	88072.64	257378.71
100	H	San Diego	3	1	250	15000	1	5.9	5	0	173500	88072.64	613863.22
100	H	San Diego	3	1	250	15000	1	5.9	5	1	173500	88072.64	600954.52
100	H	San Diego	3	1	250	15000	1	5.9	5	5	173500	88072.64	554808.46
100	H	San Diego	3	1	250	15000	1	5.9	10	0	305500	88072.64	1186226.44
100	H	San Diego	3	1	250	15000	1	5.9	10	1	305500	88072.64	1139662.83
100	H	San Diego	3	1	250	15000	1	5.9	10	5	305500	88072.64	985573.61

100	H	San Diego	3	1	706	15000	1	5.9	1	0	173500	88115.43	261615.43
100	H	San Diego	3	1	706	15000	1	5.9	1	1	173500	88115.43	260743.00
100	H	San Diego	3	1	706	15000	1	5.9	1	5	173500	88115.43	257419.46
100	H	San Diego	3	1	706	15000	1	5.9	5	0	173500	88115.43	614077.16
100	H	San Diego	3	1	706	15000	1	5.9	5	1	173500	88115.43	601162.19
100	H	San Diego	3	1	706	15000	1	5.9	5	5	173500	88115.43	554993.71
100	H	San Diego	3	1	706	15000	1	5.9	10	0	305500	88115.43	1186654.33
100	H	San Diego	3	1	706	15000	1	5.9	10	1	305500	88115.43	1140068.10
100	H	San Diego	3	1	706	15000	1	5.9	10	5	305500	88115.43	985904.01
100	H	San Diego	3	0	0	0	1	7.5	1	0	169500	89171.07	258671.07
100	H	San Diego	3	0	0	0	1	7.5	1	1	169500	89171.07	257788.19
100	H	San Diego	3	0	0	0	1	7.5	1	5	169500	89171.07	254424.83
100	H	San Diego	3	0	0	0	1	7.5	5	0	169500	89171.07	615355.34
100	H	San Diego	3	0	0	0	1	7.5	5	1	169500	89171.07	602285.65
100	H	San Diego	3	0	0	0	1	7.5	5	5	169500	89171.07	555564.06
100	H	San Diego	3	0	0	0	1	7.5	10	0	301500	89171.07	1193210.68
100	H	San Diego	3	0	0	0	1	7.5	10	1	301500	89171.07	1146066.34
100	H	San Diego	3	0	0	0	1	7.5	10	5	301500	89171.07	990055.35
100	H	San Diego	3	1	250	5000	1	7.5	1	0	181500	88117.61	269617.61
100	H	San Diego	3	1	250	5000	1	7.5	1	1	181500	88117.61	268745.16
100	H	San Diego	3	1	250	5000	1	7.5	1	5	181500	88117.61	265421.53
100	H	San Diego	3	1	250	5000	1	7.5	5	0	181500	88117.61	622088.03
100	H	San Diego	3	1	250	5000	1	7.5	5	1	181500	88117.61	609172.75
100	H	San Diego	3	1	250	5000	1	7.5	5	5	181500	88117.61	563003.12
100	H	San Diego	3	1	250	5000	1	7.5	10	0	313500	88117.61	1194676.07
100	H	San Diego	3	1	250	5000	1	7.5	10	1	313500	88117.61	1148088.69
100	H	San Diego	3	1	250	5000	1	7.5	10	5	313500	88117.61	993920.80
100	H	San Diego	3	1	706	5000	1	7.5	1	0	181500	88054.64	269554.64
100	H	San Diego	3	1	706	5000	1	7.5	1	1	181500	88054.64	268682.81
100	H	San Diego	3	1	706	5000	1	7.5	1	5	181500	88054.64	265361.56
100	H	San Diego	3	1	706	5000	1	7.5	5	0	181500	88054.64	621773.19
100	H	San Diego	3	1	706	5000	1	7.5	5	1	181500	88054.64	608867.14
100	H	San Diego	3	1	706	5000	1	7.5	5	5	181500	88054.64	562730.51
100	H	San Diego	3	1	706	5000	1	7.5	10	0	313500	88054.64	1194046.39
100	H	San Diego	3	1	706	5000	1	7.5	10	1	313500	88054.64	1147492.30
100	H	San Diego	3	1	706	5000	1	7.5	10	5	313500	88054.64	993434.58
100	H	San Diego	3	1	250	15000	1	7.5	1	0	181500	88095.59	269595.59
100	H	San Diego	3	1	250	15000	1	7.5	1	1	181500	88095.59	268723.36
100	H	San Diego	3	1	250	15000	1	7.5	1	5	181500	88095.59	265400.57
100	H	San Diego	3	1	250	15000	1	7.5	5	0	181500	88095.59	621977.97
100	H	San Diego	3	1	250	15000	1	7.5	5	1	181500	88095.59	609065.91
100	H	San Diego	3	1	250	15000	1	7.5	5	5	181500	88095.59	562907.82

100	H	San Diego	3	1	250	15000	1	7.5	10	0	313500	88095.59	1194455.94
100	H	San Diego	3	1	250	15000	1	7.5	10	1	313500	88095.59	1147880.20
100	H	San Diego	3	1	250	15000	1	7.5	10	5	313500	88095.59	993750.82
100	H	San Diego	3	1	706	15000	1	7.5	1	0	181500	88072.89	269572.89
100	H	San Diego	3	1	706	15000	1	7.5	1	1	181500	88072.89	268700.89
100	H	San Diego	3	1	706	15000	1	7.5	1	5	181500	88072.89	265378.95
100	H	San Diego	3	1	706	15000	1	7.5	5	0	181500	88072.89	621864.47
100	H	San Diego	3	1	706	15000	1	7.5	5	1	181500	88072.89	608955.74
100	H	San Diego	3	1	706	15000	1	7.5	5	5	181500	88072.89	562809.54
100	H	San Diego	3	1	706	15000	1	7.5	10	0	313500	88072.89	1194228.94
100	H	San Diego	3	1	706	15000	1	7.5	10	1	313500	88072.89	1147665.20
100	H	San Diego	3	1	706	15000	1	7.5	10	5	313500	88072.89	993575.54
100	H	South Carolina	3	0	0	0	1	5.9	1	0	161500	87604.44	249104.44
100	H	South Carolina	3	0	0	0	1	5.9	1	1	161500	87604.44	248237.07
100	H	South Carolina	3	0	0	0	1	5.9	1	5	161500	87604.44	244932.80
100	H	South Carolina	3	0	0	0	1	5.9	5	0	161500	87604.44	599522.19
100	H	South Carolina	3	0	0	0	1	5.9	5	1	161500	87604.44	586682.11
100	H	South Carolina	3	0	0	0	1	5.9	5	5	161500	87604.44	540781.37
100	H	South Carolina	3	0	0	0	1	5.9	10	0	293500	87604.44	1169544.38
100	H	South Carolina	3	0	0	0	1	5.9	10	1	293500	87604.44	1123228.31
100	H	South Carolina	3	0	0	0	1	5.9	10	5	293500	87604.44	969958.25
100	H	South Carolina	3	1	250	5000	1	5.9	1	0	173500	86817.48	260317.48
100	H	South Carolina	3	1	250	5000	1	5.9	1	1	173500	86817.48	259457.90
100	H	South Carolina	3	1	250	5000	1	5.9	1	5	173500	86817.48	256183.32
100	H	South Carolina	3	1	250	5000	1	5.9	5	0	173500	86817.48	607587.41
100	H	South Carolina	3	1	250	5000	1	5.9	5	1	173500	86817.48	594862.68
100	H	South Carolina	3	1	250	5000	1	5.9	5	5	173500	86817.48	549374.26
100	H	South Carolina	3	1	250	5000	1	5.9	10	0	305500	86817.48	1173674.81
100	H	South Carolina	3	1	250	5000	1	5.9	10	1	305500	86817.48	1127774.80
100	H	South Carolina	3	1	250	5000	1	5.9	10	5	305500	86817.48	975881.58
100	H	South Carolina	3	1	706	5000	1	5.9	1	0	173500	86816.61	260316.61
100	H	South Carolina	3	1	706	5000	1	5.9	1	1	173500	86816.61	259457.04
100	H	South Carolina	3	1	706	5000	1	5.9	1	5	173500	86816.61	256182.48
100	H	South Carolina	3	1	706	5000	1	5.9	5	0	173500	86816.61	607583.03
100	H	South Carolina	3	1	706	5000	1	5.9	5	1	173500	86816.61	594858.43
100	H	South Carolina	3	1	706	5000	1	5.9	5	5	173500	86816.61	549370.47
100	H	South Carolina	3	1	706	5000	1	5.9	10	0	305500	86816.61	1173666.06
100	H	South Carolina	3	1	706	5000	1	5.9	10	1	305500	86816.61	1127766.51
100	H	South Carolina	3	1	706	5000	1	5.9	10	5	305500	86816.61	975874.82
100	H	South Carolina	3	1	250	15000	1	5.9	1	0	173500	86840.51	260340.51
100	H	South Carolina	3	1	250	15000	1	5.9	1	1	173500	86840.51	259480.70
100	H	South Carolina	3	1	250	15000	1	5.9	1	5	173500	86840.51	256205.25

100	H	South Carolina	3	1	250	15000	1	5.9	5	0	173500	86840.51	607702.56
100	H	South Carolina	3	1	250	15000	1	5.9	5	1	173500	86840.51	594974.45
100	H	South Carolina	3	1	250	15000	1	5.9	5	5	173500	86840.51	549473.97
100	H	South Carolina	3	1	250	15000	1	5.9	10	0	305500	86840.51	1173905.11
100	H	South Carolina	3	1	250	15000	1	5.9	10	1	305500	86840.51	1127992.93
100	H	South Carolina	3	1	250	15000	1	5.9	10	5	305500	86840.51	976059.41
100	H	South Carolina	3	1	706	15000	1	5.9	1	0	173500	86813.21	260313.21
100	H	South Carolina	3	1	706	15000	1	5.9	1	1	173500	86813.21	259453.68
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100	H	South Carolina	3	1	706	15000	1	5.9	5	0	173500	86813.21	607566.07
100	H	South Carolina	3	1	706	15000	1	5.9	5	1	173500	86813.21	594841.96
100	H	South Carolina	3	1	706	15000	1	5.9	5	5	173500	86813.21	549355.78
100	H	South Carolina	3	1	706	15000	1	5.9	10	0	305500	86813.21	1173632.14
100	H	South Carolina	3	1	706	15000	1	5.9	10	1	305500	86813.21	1127734.38
100	H	South Carolina	3	1	706	15000	1	5.9	10	5	305500	86813.21	975848.62
100	H	South Carolina	3	0	0	0	1	7.5	1	0	169500	87560.71	257060.71
100	H	South Carolina	3	0	0	0	1	7.5	1	1	169500	87560.71	256193.78
100	H	South Carolina	3	0	0	0	1	7.5	1	5	169500	87560.71	252891.16
100	H	South Carolina	3	0	0	0	1	7.5	5	0	169500	87560.71	607303.57
100	H	South Carolina	3	0	0	0	1	7.5	5	1	169500	87560.71	594469.90
100	H	South Carolina	3	0	0	0	1	7.5	5	5	169500	87560.71	548592.07
100	H	South Carolina	3	0	0	0	1	7.5	10	0	301500	87560.71	1177107.13
100	H	South Carolina	3	0	0	0	1	7.5	10	1	301500	87560.71	1130814.18
100	H	South Carolina	3	0	0	0	1	7.5	10	5	301500	87560.71	977620.62
100	H	South Carolina	3	1	250	5000	1	7.5	1	0	181500	86832.19	268332.19
100	H	South Carolina	3	1	250	5000	1	7.5	1	1	181500	86832.19	267472.47
100	H	South Carolina	3	1	250	5000	1	7.5	1	5	181500	86832.19	264197.32
100	H	South Carolina	3	1	250	5000	1	7.5	5	0	181500	86832.19	615660.95
100	H	South Carolina	3	1	250	5000	1	7.5	5	1	181500	86832.19	602934.07
100	H	South Carolina	3	1	250	5000	1	7.5	5	5	181500	86832.19	557437.94
100	H	South Carolina	3	1	250	5000	1	7.5	10	0	313500	86832.19	1181821.91
100	H	South Carolina	3	1	250	5000	1	7.5	10	1	313500	86832.19	1135914.12
100	H	South Carolina	3	1	250	5000	1	7.5	10	5	313500	86832.19	983995.16
100	H	South Carolina	3	1	706	5000	1	7.5	1	0	181500	86842.50	268342.50
100	H	South Carolina	3	1	706	5000	1	7.5	1	1	181500	86842.50	267482.68
100	H	South Carolina	3	1	706	5000	1	7.5	1	5	181500	86842.50	264207.14
100	H	South Carolina	3	1	706	5000	1	7.5	5	0	181500	86842.50	615712.51
100	H	South Carolina	3	1	706	5000	1	7.5	5	1	181500	86842.50	602984.11
100	H	South Carolina	3	1	706	5000	1	7.5	5	5	181500	86842.50	557482.59
100	H	South Carolina	3	1	706	5000	1	7.5	10	0	313500	86842.50	1181925.02
100	H	South Carolina	3	1	706	5000	1	7.5	10	1	313500	86842.50	1136011.78
100	H	South Carolina	3	1	706	5000	1	7.5	10	5	313500	86842.50	984074.78

100	H	South Carolina	3	1	250	15000	1	7.5	1	0	181500	86820.51	268320.51
100	H	South Carolina	3	1	250	15000	1	7.5	1	1	181500	86820.51	267460.90
100	H	South Carolina	3	1	250	15000	1	7.5	1	5	181500	86820.51	264186.20
100	H	South Carolina	3	1	250	15000	1	7.5	5	0	181500	86820.51	615602.54
100	H	South Carolina	3	1	250	15000	1	7.5	5	1	181500	86820.51	602877.37
100	H	South Carolina	3	1	250	15000	1	7.5	5	5	181500	86820.51	557387.37
100	H	South Carolina	3	1	250	15000	1	7.5	10	0	313500	86820.51	1181705.09
100	H	South Carolina	3	1	250	15000	1	7.5	10	1	313500	86820.51	1135803.48
100	H	South Carolina	3	1	250	15000	1	7.5	10	5	313500	86820.51	983904.95
100	H	South Carolina	3	1	706	15000	1	7.5	1	0	181500	86832.40	268332.40
100	H	South Carolina	3	1	706	15000	1	7.5	1	1	181500	86832.40	267472.67
100	H	South Carolina	3	1	706	15000	1	7.5	1	5	181500	86832.40	264197.52
100	H	South Carolina	3	1	706	15000	1	7.5	5	0	181500	86832.40	615661.99
100	H	South Carolina	3	1	706	15000	1	7.5	5	1	181500	86832.40	602935.08
100	H	South Carolina	3	1	706	15000	1	7.5	5	5	181500	86832.40	557438.84
100	H	South Carolina	3	1	706	15000	1	7.5	10	0	313500	86832.40	1181823.99
100	H	South Carolina	3	1	706	15000	1	7.5	10	1	313500	86832.40	1135916.09
100	H	South Carolina	3	1	706	15000	1	7.5	10	5	313500	86832.40	983996.77
100	H	New York	3	0	0	0	1	5.9	1	0	161500	88572.78	250072.78
100	H	New York	3	0	0	0	1	5.9	1	1	161500	88572.78	249195.82
100	H	New York	3	0	0	0	1	5.9	1	5	161500	88572.78	245855.03
100	H	New York	3	0	0	0	1	5.9	5	0	161500	88572.78	604363.89
100	H	New York	3	0	0	0	1	5.9	5	1	161500	88572.78	591381.88
100	H	New York	3	0	0	0	1	5.9	5	5	161500	88572.78	544973.77
100	H	New York	3	0	0	0	1	5.9	10	0	293500	88572.78	1179227.77
100	H	New York	3	0	0	0	1	5.9	10	1	293500	88572.78	1132399.75
100	H	New York	3	0	0	0	1	5.9	10	5	293500	88572.78	977435.51
100	H	New York	3	1	250	5000	1	5.9	1	0	173500	87692.20	261192.20
100	H	New York	3	1	250	5000	1	5.9	1	1	173500	87692.20	260323.96
100	H	New York	3	1	250	5000	1	5.9	1	5	173500	87692.20	257016.38
100	H	New York	3	1	250	5000	1	5.9	5	0	173500	87692.20	611961.00
100	H	New York	3	1	250	5000	1	5.9	5	1	173500	87692.20	599108.06
100	H	New York	3	1	250	5000	1	5.9	5	5	173500	87692.20	553161.33
100	H	New York	3	1	250	5000	1	5.9	10	0	305500	87692.20	1182421.99
100	H	New York	3	1	250	5000	1	5.9	10	1	305500	87692.20	1136059.52
100	H	New York	3	1	250	5000	1	5.9	10	5	305500	87692.20	982635.92
100	H	New York	3	1	706	5000	1	5.9	1	0	173500	87720.90	261220.90
100	H	New York	3	1	706	5000	1	5.9	1	1	173500	87720.90	260352.38
100	H	New York	3	1	706	5000	1	5.9	1	5	173500	87720.90	257043.72
100	H	New York	3	1	706	5000	1	5.9	5	0	173500	87720.90	612104.52
100	H	New York	3	1	706	5000	1	5.9	5	1	173500	87720.90	599247.37
100	H	New York	3	1	706	5000	1	5.9	5	5	173500	87720.90	553285.60

100	H	New York	3	1	706	5000	1	5.9	10	0	305500	87720.90	1182709.03
100	H	New York	3	1	706	5000	1	5.9	10	1	305500	87720.90	1136331.39
100	H	New York	3	1	706	5000	1	5.9	10	5	305500	87720.90	982857.56
100	H	New York	3	1	250	15000	1	5.9	1	0	173500	87661.12	261161.12
100	H	New York	3	1	250	15000	1	5.9	1	1	173500	87661.12	260293.19
100	H	New York	3	1	250	15000	1	5.9	1	5	173500	87661.12	256986.78
100	H	New York	3	1	250	15000	1	5.9	5	0	173500	87661.12	611805.62
100	H	New York	3	1	250	15000	1	5.9	5	1	173500	87661.12	598957.24
100	H	New York	3	1	250	15000	1	5.9	5	5	173500	87661.12	553026.79
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100	H	New York	3	1	250	15000	1	5.9	10	1	305500	87661.12	1135765.20
100	H	New York	3	1	250	15000	1	5.9	10	5	305500	87661.12	982395.96
100	H	New York	3	1	706	15000	1	5.9	1	0	173500	87692.00	261192.00
100	H	New York	3	1	706	15000	1	5.9	1	1	173500	87692.00	260323.76
100	H	New York	3	1	706	15000	1	5.9	1	5	173500	87692.00	257016.19
100	H	New York	3	1	706	15000	1	5.9	5	0	173500	87692.00	611959.99
100	H	New York	3	1	706	15000	1	5.9	5	1	173500	87692.00	599107.08
100	H	New York	3	1	706	15000	1	5.9	5	5	173500	87692.00	553160.46
100	H	New York	3	1	706	15000	1	5.9	10	0	305500	87692.00	1182419.97
100	H	New York	3	1	706	15000	1	5.9	10	1	305500	87692.00	1136057.61
100	H	New York	3	1	706	15000	1	5.9	10	5	305500	87692.00	982634.36
100	H	New York	3	0	0	0	1	7.5	1	0	169500	88570.21	258070.21
100	H	New York	3	0	0	0	1	7.5	1	1	169500	88570.21	257193.28
100	H	New York	3	0	0	0	1	7.5	1	5	169500	88570.21	253852.58
100	H	New York	3	0	0	0	1	7.5	5	0	169500	88570.21	612351.06
100	H	New York	3	0	0	0	1	7.5	5	1	169500	88570.21	599369.43
100	H	New York	3	0	0	0	1	7.5	5	5	169500	88570.21	552962.66
100	H	New York	3	0	0	0	1	7.5	10	0	301500	88570.21	1187202.11
100	H	New York	3	0	0	0	1	7.5	10	1	301500	88570.21	1140375.44
100	H	New York	3	0	0	0	1	7.5	10	5	301500	88570.21	985415.69
100	H	New York	3	1	250	5000	1	7.5	1	0	181500	87674.54	269174.54
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100	H	New York	3	1	250	5000	1	7.5	1	5	181500	87674.54	264999.56
100	H	New York	3	1	250	5000	1	7.5	5	0	181500	87674.54	619872.68
100	H	New York	3	1	250	5000	1	7.5	5	1	181500	87674.54	607022.33
100	H	New York	3	1	250	5000	1	7.5	5	5	181500	87674.54	561084.86
100	H	New York	3	1	250	5000	1	7.5	10	0	313500	87674.54	1190245.35
100	H	New York	3	1	250	5000	1	7.5	10	1	313500	87674.54	1143892.22
100	H	New York	3	1	250	5000	1	7.5	10	5	313500	87674.54	990499.52
100	H	New York	3	1	706	5000	1	7.5	1	0	181500	87702.16	269202.16
100	H	New York	3	1	706	5000	1	7.5	1	1	181500	87702.16	268333.82
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100	H	New York	3	1	706	5000	1	7.5	5	0	181500	87702.16	620010.81
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100	H	New York	3	1	706	5000	1	7.5	10	0	313500	87702.16	1190521.62
100	H	New York	3	1	706	5000	1	7.5	10	1	313500	87702.16	1144153.89
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100	H	New York	3	1	250	15000	1	7.5	1	0	181500	87707.05	269207.05
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100	H	New York	3	1	250	15000	1	7.5	5	1	181500	87707.05	607180.13
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100	H	New York	3	1	250	15000	1	7.5	10	0	313500	87707.05	1190570.50
100	H	New York	3	1	250	15000	1	7.5	10	1	313500	87707.05	1144200.18
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100	H	New York	3	1	706	15000	1	7.5	1	0	181500	87695.57	269195.57
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100	H	New York	3	1	706	15000	1	7.5	5	1	181500	87695.57	607124.43
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100	H	New York	3	1	706	15000	1	7.5	10	0	313500	87695.57	1190455.71
100	H	New York	3	1	706	15000	1	7.5	10	1	313500	87695.57	1144091.46
100	H	New York	3	1	706	15000	1	7.5	10	5	313500	87695.57	990661.96
100	H	Minneapolis	3	0	0	0	1	5.9	1	0	161500	90181.58	251681.58
100	H	Minneapolis	3	0	0	0	1	5.9	1	1	161500	90181.58	250788.69
100	H	Minneapolis	3	0	0	0	1	5.9	1	5	161500	90181.58	247387.22
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100	H	Minneapolis	3	0	0	0	1	5.9	10	0	293500	90181.58	1195315.82
100	H	Minneapolis	3	0	0	0	1	5.9	10	1	293500	90181.58	1147637.23
100	H	Minneapolis	3	0	0	0	1	5.9	10	5	293500	90181.58	989858.27
100	H	Minneapolis	3	1	250	5000	1	5.9	1	0	173500	88622.94	262122.94
100	H	Minneapolis	3	1	250	5000	1	5.9	1	1	173500	88622.94	261245.48
100	H	Minneapolis	3	1	250	5000	1	5.9	1	5	173500	88622.94	257902.80
100	H	Minneapolis	3	1	250	5000	1	5.9	5	0	173500	88622.94	616614.68
100	H	Minneapolis	3	1	250	5000	1	5.9	5	1	173500	88622.94	603625.32
100	H	Minneapolis	3	1	250	5000	1	5.9	5	5	173500	88622.94	557190.93
100	H	Minneapolis	3	1	250	5000	1	5.9	10	0	305500	88622.94	1191729.35
100	H	Minneapolis	3	1	250	5000	1	5.9	10	1	305500	88622.94	1144874.81
100	H	Minneapolis	3	1	250	5000	1	5.9	10	5	305500	88622.94	989822.82

100	H	Minneapolis	3	1	706	5000	1	5.9	1	0	173500	88646.28	262146.28
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100	H	Minneapolis	3	1	706	5000	1	5.9	1	5	173500	88646.28	257925.03
100	H	Minneapolis	3	1	706	5000	1	5.9	5	0	173500	88646.28	616731.38
100	H	Minneapolis	3	1	706	5000	1	5.9	5	1	173500	88646.28	603738.61
100	H	Minneapolis	3	1	706	5000	1	5.9	5	5	173500	88646.28	557291.99
100	H	Minneapolis	3	1	706	5000	1	5.9	10	0	305500	88646.28	1191962.77
100	H	Minneapolis	3	1	706	5000	1	5.9	10	1	305500	88646.28	1145095.88
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100	H	Minneapolis	3	1	250	15000	1	5.9	1	0	173500	88669.65	262169.65
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100	H	Minneapolis	3	1	250	15000	1	5.9	1	5	173500	88669.65	257947.28
100	H	Minneapolis	3	1	250	15000	1	5.9	5	0	173500	88669.65	616848.23
100	H	Minneapolis	3	1	250	15000	1	5.9	5	1	173500	88669.65	603852.03
100	H	Minneapolis	3	1	250	15000	1	5.9	5	5	173500	88669.65	557393.16
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100	H	Minneapolis	3	1	250	15000	1	5.9	10	5	305500	88669.65	990183.50
100	H	Minneapolis	3	1	706	15000	1	5.9	1	0	173500	88639.14	262139.14
100	H	Minneapolis	3	1	706	15000	1	5.9	1	1	173500	88639.14	261261.52
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100	H	Minneapolis	3	1	706	15000	1	5.9	5	5	173500	88639.14	557261.08
100	H	Minneapolis	3	1	706	15000	1	5.9	10	0	305500	88639.14	1191891.37
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100	H	Minneapolis	3	1	706	15000	1	5.9	10	5	305500	88639.14	989947.92
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100	H	Minneapolis	3	0	0	0	1	7.5	5	0	169500	90171.43	620357.15
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100	H	Minneapolis	3	0	0	0	1	7.5	10	0	301500	90171.43	1203214.30
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100	H	Minneapolis	3	1	250	5000	1	7.5	1	0	181500	88653.27	270153.27
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100	H	Minneapolis	3	1	250	5000	1	7.5	5	1	181500	88653.27	611772.56
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100	H	Minneapolis	3	1	250	5000	1	7.5	10	0	313500	88653.27	1200032.71
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100	H	Minneapolis	3	1	706	5000	1	7.5	10	1	313500	88642.92	1153064.07
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100	H	Minneapolis	3	1	250	15000	1	7.5	1	0	181500	88645.22	270145.22
100	H	Minneapolis	3	1	250	15000	1	7.5	1	1	181500	88645.22	269267.55
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100	H	Minneapolis	3	1	250	15000	1	7.5	10	5	313500	88645.22	997994.91
100	H	Minneapolis	3	1	706	15000	1	7.5	1	0	181500	88654.10	270154.10
100	H	Minneapolis	3	1	706	15000	1	7.5	1	1	181500	88654.10	269276.33
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100	H	Minneapolis	3	1	706	15000	1	7.5	5	0	181500	88654.10	624770.48
100	H	Minneapolis	3	1	706	15000	1	7.5	5	1	181500	88654.10	611776.55
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100	L	0	3	0	0	0	0	0	1	0	88000	92469.78	180469.78
100	L	0	3	0	0	0	0	0	1	1	88000	92469.78	179554.23
100	L	0	3	0	0	0	0	0	1	5	88000	92469.78	176066.45
100	L	0	3	0	0	0	0	0	5	0	88000	92469.78	550348.88
100	L	0	3	0	0	0	0	0	5	1	88000	92469.78	536795.70
100	L	0	3	0	0	0	0	0	5	5	88000	92469.78	488345.74
100	L	0	3	0	0	0	0	0	10	0	176000	92469.78	1100697.76
100	L	0	3	0	0	0	0	0	10	1	176000	92469.78	1051809.41
100	L	0	3	0	0	0	0	0	10	5	176000	92469.78	890027.10
100	L	0	3	1	250	5000	0	0	1	0	100000	83305.50	183305.50
100	L	0	3	1	250	5000	0	0	1	1	100000	83305.50	182480.69
100	L	0	3	1	250	5000	0	0	1	5	100000	83305.50	179338.57

100	L	0	3	1	250	5000	0	0	5	0	100000	83305.50	516527.48
100	L	0	3	1	250	5000	0	0	5	1	100000	83305.50	504317.50
100	L	0	3	1	250	5000	0	0	5	5	100000	83305.50	460669.20
100	L	0	3	1	250	5000	0	0	10	0	188000	83305.50	1021054.97
100	L	0	3	1	250	5000	0	0	10	1	188000	83305.50	977011.73
100	L	0	3	1	250	5000	0	0	10	5	188000	83305.50	831262.96
100	L	0	3	1	706	5000	0	0	1	0	100000	84619.15	184619.15
100	L	0	3	1	706	5000	0	0	1	1	100000	84619.15	183781.34
100	L	0	3	1	706	5000	0	0	1	5	100000	84619.15	180589.67
100	L	0	3	1	706	5000	0	0	5	0	100000	84619.15	523095.77
100	L	0	3	1	706	5000	0	0	5	1	100000	84619.15	510693.24
100	L	0	3	1	706	5000	0	0	5	5	100000	84619.15	466356.65
100	L	0	3	1	706	5000	0	0	10	0	188000	84619.15	1034191.53
100	L	0	3	1	706	5000	0	0	10	1	188000	84619.15	989453.77
100	L	0	3	1	706	5000	0	0	10	5	188000	84619.15	841406.67
100	L	0	3	1	250	15000	0	0	1	0	100000	84320.10	184320.10
100	L	0	3	1	250	15000	0	0	1	1	100000	84320.10	183485.25
100	L	0	3	1	250	15000	0	0	1	5	100000	84320.10	180304.86
100	L	0	3	1	250	15000	0	0	5	0	100000	84320.10	521600.51
100	L	0	3	1	250	15000	0	0	5	1	100000	84320.10	509241.82
100	L	0	3	1	250	15000	0	0	5	5	100000	84320.10	465061.92
100	L	0	3	1	250	15000	0	0	10	0	188000	84320.10	1031201.03
100	L	0	3	1	250	15000	0	0	10	1	188000	84320.10	986621.37
100	L	0	3	1	250	15000	0	0	10	5	188000	84320.10	839097.48
100	L	0	3	1	706	15000	0	0	1	0	100000	83619.46	183619.46
100	L	0	3	1	706	15000	0	0	1	1	100000	83619.46	182791.54
100	L	0	3	1	706	15000	0	0	1	5	100000	83619.46	179637.58
100	L	0	3	1	706	15000	0	0	5	0	100000	83619.46	518097.29
100	L	0	3	1	706	15000	0	0	5	1	100000	83619.46	505841.29
100	L	0	3	1	706	15000	0	0	5	5	100000	83619.46	462028.49
100	L	0	3	1	706	15000	0	0	10	0	188000	83619.46	1024194.58
100	L	0	3	1	706	15000	0	0	10	1	188000	83619.46	979985.35
100	L	0	3	1	706	15000	0	0	10	5	188000	83619.46	833687.29
100	L	San Diego	3	0	0	0	1	5.9	1	0	117500	89708.63	207208.63
100	L	San Diego	3	0	0	0	1	5.9	1	1	117500	89708.63	206320.43
100	L	San Diego	3	0	0	0	1	5.9	1	5	117500	89708.63	202936.79
100	L	San Diego	3	0	0	0	1	5.9	5	0	117500	89708.63	566043.16
100	L	San Diego	3	0	0	0	1	5.9	5	1	117500	89708.63	552894.68
100	L	San Diego	3	0	0	0	1	5.9	5	5	117500	89708.63	505891.43
100	L	San Diego	3	0	0	0	1	5.9	10	0	205500	89708.63	1102586.32
100	L	San Diego	3	0	0	0	1	5.9	10	1	205500	89708.63	1055157.77
100	L	San Diego	3	0	0	0	1	5.9	10	5	205500	89708.63	898206.28

100	L	San Diego	3	1	250	5000	1	5.9	1	0	129500	82605.07	212105.07
100	L	San Diego	3	1	250	5000	1	5.9	1	1	129500	82605.07	211287.19
100	L	San Diego	3	1	250	5000	1	5.9	1	5	129500	82605.07	208171.49
100	L	San Diego	3	1	250	5000	1	5.9	5	0	129500	82605.07	542525.33
100	L	San Diego	3	1	250	5000	1	5.9	5	1	129500	82605.07	530418.01
100	L	San Diego	3	1	250	5000	1	5.9	5	5	129500	82605.07	487136.71
100	L	San Diego	3	1	250	5000	1	5.9	10	0	217500	82605.07	1043550.67
100	L	San Diego	3	1	250	5000	1	5.9	10	1	217500	82605.07	999877.74
100	L	San Diego	3	1	250	5000	1	5.9	10	5	217500	82605.07	855354.43
100	L	San Diego	3	1	706	5000	1	5.9	1	0	129500	82285.70	211785.70
100	L	San Diego	3	1	706	5000	1	5.9	1	1	129500	82285.70	210970.99
100	L	San Diego	3	1	706	5000	1	5.9	1	5	129500	82285.70	207867.33
100	L	San Diego	3	1	706	5000	1	5.9	5	0	129500	82285.70	540928.50
100	L	San Diego	3	1	706	5000	1	5.9	5	1	129500	82285.70	528867.98
100	L	San Diego	3	1	706	5000	1	5.9	5	5	129500	82285.70	485754.01
100	L	San Diego	3	1	706	5000	1	5.9	10	0	217500	82285.70	1040356.99
100	L	San Diego	3	1	706	5000	1	5.9	10	1	217500	82285.70	996852.91
100	L	San Diego	3	1	706	5000	1	5.9	10	5	217500	82285.70	852888.36
100	L	San Diego	3	1	250	15000	1	5.9	1	0	129500	81958.71	211458.71
100	L	San Diego	3	1	250	15000	1	5.9	1	1	129500	81958.71	210647.24
100	L	San Diego	3	1	250	15000	1	5.9	1	5	129500	81958.71	207555.91
100	L	San Diego	3	1	250	15000	1	5.9	5	0	129500	81958.71	539293.55
100	L	San Diego	3	1	250	15000	1	5.9	5	1	129500	81958.71	527280.96
100	L	San Diego	3	1	250	15000	1	5.9	5	5	129500	81958.71	484338.32
100	L	San Diego	3	1	250	15000	1	5.9	10	0	217500	81958.71	1037087.10
100	L	San Diego	3	1	250	15000	1	5.9	10	1	217500	81958.71	993755.90
100	L	San Diego	3	1	250	15000	1	5.9	10	5	217500	81958.71	850363.43
100	L	San Diego	3	1	706	15000	1	5.9	1	0	129500	82284.58	211784.58
100	L	San Diego	3	1	706	15000	1	5.9	1	1	129500	82284.58	210969.88
100	L	San Diego	3	1	706	15000	1	5.9	1	5	129500	82284.58	207866.26
100	L	San Diego	3	1	706	15000	1	5.9	5	0	129500	82284.58	540922.88
100	L	San Diego	3	1	706	15000	1	5.9	5	1	129500	82284.58	528862.53
100	L	San Diego	3	1	706	15000	1	5.9	5	5	129500	82284.58	485749.15
100	L	San Diego	3	1	706	15000	1	5.9	10	0	217500	82284.58	1040345.75
100	L	San Diego	3	1	706	15000	1	5.9	10	1	217500	82284.58	996842.27
100	L	San Diego	3	1	706	15000	1	5.9	10	5	217500	82284.58	852879.68
100	L	San Diego	3	0	0	0	1	7.5	1	0	125500	91264.80	216764.80
100	L	San Diego	3	0	0	0	1	7.5	1	1	125500	91264.80	215861.19
100	L	San Diego	3	0	0	0	1	7.5	1	5	125500	91264.80	212418.86
100	L	San Diego	3	0	0	0	1	7.5	5	0	125500	91264.80	581824.01
100	L	San Diego	3	0	0	0	1	7.5	5	1	125500	91264.80	568447.44
100	L	San Diego	3	0	0	0	1	7.5	5	5	125500	91264.80	520628.83

100	L	San Diego	3	0	0	0	1	7.5	10	0	213500	91264.80	1126148.03
100	L	San Diego	3	0	0	0	1	7.5	10	1	213500	91264.80	1077896.74
100	L	San Diego	3	0	0	0	1	7.5	10	5	213500	91264.80	918222.62
100	L	San Diego	3	1	250	5000	1	7.5	1	0	137500	82614.79	220114.79
100	L	San Diego	3	1	250	5000	1	7.5	1	1	137500	82614.79	219296.83
100	L	San Diego	3	1	250	5000	1	7.5	1	5	137500	82614.79	216180.76
100	L	San Diego	3	1	250	5000	1	7.5	5	0	137500	82614.79	550573.97
100	L	San Diego	3	1	250	5000	1	7.5	5	1	137500	82614.79	538465.23
100	L	San Diego	3	1	250	5000	1	7.5	5	5	137500	82614.79	495178.83
100	L	San Diego	3	1	250	5000	1	7.5	10	0	225500	82614.79	1051647.95
100	L	San Diego	3	1	250	5000	1	7.5	10	1	225500	82614.79	1007969.88
100	L	San Diego	3	1	250	5000	1	7.5	10	5	225500	82614.79	863429.55
100	L	San Diego	3	1	706	5000	1	7.5	1	0	137500	82277.52	219777.52
100	L	San Diego	3	1	706	5000	1	7.5	1	1	137500	82277.52	218962.89
100	L	San Diego	3	1	706	5000	1	7.5	1	5	137500	82277.52	215859.54
100	L	San Diego	3	1	706	5000	1	7.5	5	0	137500	82277.52	548887.60
100	L	San Diego	3	1	706	5000	1	7.5	5	1	137500	82277.52	536828.29
100	L	San Diego	3	1	706	5000	1	7.5	5	5	137500	82277.52	493718.60
100	L	San Diego	3	1	706	5000	1	7.5	10	0	225500	82277.52	1048275.20
100	L	San Diego	3	1	706	5000	1	7.5	10	1	225500	82277.52	1004775.45
100	L	San Diego	3	1	706	5000	1	7.5	10	5	225500	82277.52	860825.20
100	L	San Diego	3	1	250	15000	1	7.5	1	0	137500	82609.12	220109.12
100	L	San Diego	3	1	250	15000	1	7.5	1	1	137500	82609.12	219291.21
100	L	San Diego	3	1	250	15000	1	7.5	1	5	137500	82609.12	216175.35
100	L	San Diego	3	1	250	15000	1	7.5	5	0	137500	82609.12	550545.59
100	L	San Diego	3	1	250	15000	1	7.5	5	1	137500	82609.12	538437.67
100	L	San Diego	3	1	250	15000	1	7.5	5	5	137500	82609.12	495154.25
100	L	San Diego	3	1	250	15000	1	7.5	10	0	225500	82609.12	1051591.17
100	L	San Diego	3	1	250	15000	1	7.5	10	1	225500	82609.12	1007916.11
100	L	San Diego	3	1	250	15000	1	7.5	10	5	225500	82609.12	863385.71
100	L	San Diego	3	1	706	15000	1	7.5	1	0	137500	82258.38	219758.38
100	L	San Diego	3	1	706	15000	1	7.5	1	1	137500	82258.38	218943.94
100	L	San Diego	3	1	706	15000	1	7.5	1	5	137500	82258.38	215841.31
100	L	San Diego	3	1	706	15000	1	7.5	5	0	137500	82258.38	548791.88
100	L	San Diego	3	1	706	15000	1	7.5	5	1	137500	82258.38	536735.38
100	L	San Diego	3	1	706	15000	1	7.5	5	5	137500	82258.38	493635.72
100	L	San Diego	3	1	706	15000	1	7.5	10	0	225500	82258.38	1048083.77
100	L	San Diego	3	1	706	15000	1	7.5	10	1	225500	82258.38	1004594.14
100	L	San Diego	3	1	706	15000	1	7.5	10	5	225500	82258.38	860677.38
100	L	South Carolina	3	0	0	0	1	5.9	1	0	117500	90661.18	208161.18
100	L	South Carolina	3	0	0	0	1	5.9	1	1	117500	90661.18	207263.54
100	L	South Carolina	3	0	0	0	1	5.9	1	5	117500	90661.18	203843.98

100	L	South Carolina	3	0	0	0	1	5.9	5	0	117500	90661.18	570805.88
100	L	South Carolina	3	0	0	0	1	5.9	5	1	117500	90661.18	557517.78
100	L	South Carolina	3	0	0	0	1	5.9	5	5	117500	90661.18	510015.44
100	L	South Carolina	3	0	0	0	1	5.9	10	0	205500	90661.18	1112111.75
100	L	South Carolina	3	0	0	0	1	5.9	10	1	205500	90661.18	1064179.60
100	L	South Carolina	3	0	0	0	1	5.9	10	5	205500	90661.18	905561.56
100	L	South Carolina	3	1	250	5000	1	5.9	1	0	129500	81808.32	211308.32
100	L	South Carolina	3	1	250	5000	1	5.9	1	1	129500	81808.32	210498.34
100	L	South Carolina	3	1	250	5000	1	5.9	1	5	129500	81808.32	207412.69
100	L	South Carolina	3	1	250	5000	1	5.9	5	0	129500	81808.32	538541.62
100	L	South Carolina	3	1	250	5000	1	5.9	5	1	129500	81808.32	526551.08
100	L	South Carolina	3	1	250	5000	1	5.9	5	5	129500	81808.32	483687.23
100	L	South Carolina	3	1	250	5000	1	5.9	10	0	217500	81808.32	1035583.24
100	L	South Carolina	3	1	250	5000	1	5.9	10	1	217500	81808.32	992331.55
100	L	South Carolina	3	1	250	5000	1	5.9	10	5	217500	81808.32	849202.20
100	L	South Carolina	3	1	706	5000	1	5.9	1	0	129500	82488.04	211988.04
100	L	South Carolina	3	1	706	5000	1	5.9	1	1	129500	82488.04	211171.33
100	L	South Carolina	3	1	706	5000	1	5.9	1	5	129500	82488.04	208060.04
100	L	South Carolina	3	1	706	5000	1	5.9	5	0	129500	82488.04	541940.20
100	L	South Carolina	3	1	706	5000	1	5.9	5	1	129500	82488.04	529850.03
100	L	South Carolina	3	1	706	5000	1	5.9	5	5	129500	82488.04	486630.04
100	L	South Carolina	3	1	706	5000	1	5.9	10	0	217500	82488.04	1042380.40
100	L	South Carolina	3	1	706	5000	1	5.9	10	1	217500	82488.04	998769.35
100	L	South Carolina	3	1	706	5000	1	5.9	10	5	217500	82488.04	854450.78
100	L	South Carolina	3	1	250	15000	1	5.9	1	0	129500	81496.09	210996.09
100	L	South Carolina	3	1	250	15000	1	5.9	1	1	129500	81496.09	210189.20
100	L	South Carolina	3	1	250	15000	1	5.9	1	5	129500	81496.09	207115.32
100	L	South Carolina	3	1	250	15000	1	5.9	5	0	129500	81496.09	536980.45
100	L	South Carolina	3	1	250	15000	1	5.9	5	1	129500	81496.09	525035.67
100	L	South Carolina	3	1	250	15000	1	5.9	5	5	129500	81496.09	482335.42
100	L	South Carolina	3	1	250	15000	1	5.9	10	0	217500	81496.09	1032460.90
100	L	South Carolina	3	1	250	15000	1	5.9	10	1	217500	81496.09	989374.29
100	L	South Carolina	3	1	250	15000	1	5.9	10	5	217500	81496.09	846791.20
100	L	South Carolina	3	1	706	15000	1	5.9	1	0	129500	81799.04	211299.04
100	L	South Carolina	3	1	706	15000	1	5.9	1	1	129500	81799.04	210489.15
100	L	South Carolina	3	1	706	15000	1	5.9	1	5	129500	81799.04	207403.85
100	L	South Carolina	3	1	706	15000	1	5.9	5	0	129500	81799.04	538495.19
100	L	South Carolina	3	1	706	15000	1	5.9	5	1	129500	81799.04	526506.01
100	L	South Carolina	3	1	706	15000	1	5.9	5	5	129500	81799.04	483647.03
100	L	South Carolina	3	1	706	15000	1	5.9	10	0	217500	81799.04	1035490.39
100	L	South Carolina	3	1	706	15000	1	5.9	10	1	217500	81799.04	992243.61
100	L	South Carolina	3	1	706	15000	1	5.9	10	5	217500	81799.04	849130.49

100	L	South Carolina	3	0	0	0	1	7.5	1	0	125500	88157.12	213657.12
100	L	South Carolina	3	0	0	0	1	7.5	1	1	125500	88157.12	212784.28
100	L	South Carolina	3	0	0	0	1	7.5	1	5	125500	88157.12	209459.16
100	L	South Carolina	3	0	0	0	1	7.5	5	0	125500	88157.12	566285.59
100	L	South Carolina	3	0	0	0	1	7.5	5	1	125500	88157.12	553364.51
100	L	South Carolina	3	0	0	0	1	7.5	5	5	125500	88157.12	507174.18
100	L	South Carolina	3	0	0	0	1	7.5	10	0	213500	88157.12	1095071.18
100	L	South Carolina	3	0	0	0	1	7.5	10	1	213500	88157.12	1048462.91
100	L	South Carolina	3	0	0	0	1	7.5	10	5	213500	88157.12	894225.90
100	L	South Carolina	3	1	250	5000	1	7.5	1	0	137500	81474.62	218974.62
100	L	South Carolina	3	1	250	5000	1	7.5	1	1	137500	81474.62	218167.94
100	L	South Carolina	3	1	250	5000	1	7.5	1	5	137500	81474.62	215094.88
100	L	South Carolina	3	1	250	5000	1	7.5	5	0	137500	81474.62	544873.09
100	L	South Carolina	3	1	250	5000	1	7.5	5	1	137500	81474.62	532931.46
100	L	South Carolina	3	1	250	5000	1	7.5	5	5	137500	81474.62	490242.46
100	L	South Carolina	3	1	250	5000	1	7.5	10	0	225500	81474.62	1040246.19
100	L	South Carolina	3	1	250	5000	1	7.5	10	1	225500	81474.62	997170.93
100	L	South Carolina	3	1	250	5000	1	7.5	10	5	225500	81474.62	854625.41
100	L	South Carolina	3	1	706	5000	1	7.5	1	0	137500	81485.68	218985.68
100	L	South Carolina	3	1	706	5000	1	7.5	1	1	137500	81485.68	218178.89
100	L	South Carolina	3	1	706	5000	1	7.5	1	5	137500	81485.68	215105.41
100	L	South Carolina	3	1	706	5000	1	7.5	5	0	137500	81485.68	544928.41
100	L	South Carolina	3	1	706	5000	1	7.5	5	1	137500	81485.68	532985.15
100	L	South Carolina	3	1	706	5000	1	7.5	5	5	137500	81485.68	490290.36
100	L	South Carolina	3	1	706	5000	1	7.5	10	0	225500	81485.68	1040356.82
100	L	South Carolina	3	1	706	5000	1	7.5	10	1	225500	81485.68	997275.71
100	L	South Carolina	3	1	706	5000	1	7.5	10	5	225500	81485.68	854710.84
100	L	South Carolina	3	1	250	15000	1	7.5	1	0	137500	81810.06	219310.06
100	L	South Carolina	3	1	250	15000	1	7.5	1	1	137500	81810.06	218500.06
100	L	South Carolina	3	1	250	15000	1	7.5	1	5	137500	81810.06	215414.35
100	L	South Carolina	3	1	250	15000	1	7.5	5	0	137500	81810.06	546550.31
100	L	South Carolina	3	1	250	15000	1	7.5	5	1	137500	81810.06	534559.51
100	L	South Carolina	3	1	250	15000	1	7.5	5	5	137500	81810.06	491694.76
100	L	South Carolina	3	1	250	15000	1	7.5	10	0	225500	81810.06	1043600.62
100	L	South Carolina	3	1	250	15000	1	7.5	10	1	225500	81810.06	1000348.01
100	L	South Carolina	3	1	250	15000	1	7.5	10	5	225500	81810.06	857215.62
100	L	South Carolina	3	1	706	15000	1	7.5	1	0	137500	82453.47	219953.47
100	L	South Carolina	3	1	706	15000	1	7.5	1	1	137500	82453.47	219137.10
100	L	South Carolina	3	1	706	15000	1	7.5	1	5	137500	82453.47	216027.12
100	L	South Carolina	3	1	706	15000	1	7.5	5	0	137500	82453.47	549767.36
100	L	South Carolina	3	1	706	15000	1	7.5	5	1	137500	82453.47	537682.25
100	L	South Carolina	3	1	706	15000	1	7.5	5	5	137500	82453.47	494480.38

100	L	South Carolina	3	1	706	15000	1	7.5	10	0	225500	82453.47	1050034.72
100	L	South Carolina	3	1	706	15000	1	7.5	10	1	225500	82453.47	1006441.94
100	L	South Carolina	3	1	706	15000	1	7.5	10	5	225500	82453.47	862183.85
100	L	New York	3	0	0	0	1	5.9	1	0	117500	91143.63	208643.63
100	L	New York	3	0	0	0	1	5.9	1	1	117500	91143.63	207741.22
100	L	New York	3	0	0	0	1	5.9	1	5	117500	91143.63	204303.45
100	L	New York	3	0	0	0	1	5.9	5	0	117500	91143.63	573218.14
100	L	New York	3	0	0	0	1	5.9	5	1	117500	91143.63	559859.33
100	L	New York	3	0	0	0	1	5.9	5	5	117500	91143.63	512104.21
100	L	New York	3	0	0	0	1	5.9	10	0	205500	91143.63	1116936.28
100	L	New York	3	0	0	0	1	5.9	10	1	205500	91143.63	1068749.05
100	L	New York	3	0	0	0	1	5.9	10	5	205500	91143.63	909286.93
100	L	New York	3	1	250	5000	1	5.9	1	0	129500	82629.18	212129.18
100	L	New York	3	1	250	5000	1	5.9	1	1	129500	82629.18	211311.07
100	L	New York	3	1	250	5000	1	5.9	1	5	129500	82629.18	208194.45
100	L	New York	3	1	250	5000	1	5.9	5	0	129500	82629.18	542645.88
100	L	New York	3	1	250	5000	1	5.9	5	1	129500	82629.18	530535.02
100	L	New York	3	1	250	5000	1	5.9	5	5	129500	82629.18	487241.09
100	L	New York	3	1	250	5000	1	5.9	10	0	217500	82629.18	1043791.76
100	L	New York	3	1	250	5000	1	5.9	10	1	217500	82629.18	1000106.09
100	L	New York	3	1	250	5000	1	5.9	10	5	217500	82629.18	855540.60
100	L	New York	3	1	706	5000	1	5.9	1	0	129500	81687.61	211187.61
100	L	New York	3	1	706	5000	1	5.9	1	1	129500	81687.61	210378.83
100	L	New York	3	1	706	5000	1	5.9	1	5	129500	81687.61	207297.73
100	L	New York	3	1	706	5000	1	5.9	5	0	129500	81687.61	537938.07
100	L	New York	3	1	706	5000	1	5.9	5	1	129500	81687.61	525965.22
100	L	New York	3	1	706	5000	1	5.9	5	5	129500	81687.61	483164.62
100	L	New York	3	1	706	5000	1	5.9	10	0	217500	81687.61	1034376.14
100	L	New York	3	1	706	5000	1	5.9	10	1	217500	81687.61	991188.27
100	L	New York	3	1	706	5000	1	5.9	10	5	217500	81687.61	848270.10
100	L	New York	3	1	250	15000	1	5.9	1	0	129500	82990.37	212490.37
100	L	New York	3	1	250	15000	1	5.9	1	1	129500	82990.37	211668.68
100	L	New York	3	1	250	15000	1	5.9	1	5	129500	82990.37	208538.45
100	L	New York	3	1	250	15000	1	5.9	5	0	129500	82990.37	544451.84
100	L	New York	3	1	250	15000	1	5.9	5	1	129500	82990.37	532288.05
100	L	New York	3	1	250	15000	1	5.9	5	5	129500	82990.37	488804.87
100	L	New York	3	1	250	15000	1	5.9	10	0	217500	82990.37	1047403.69
100	L	New York	3	1	250	15000	1	5.9	10	1	217500	82990.37	1003527.06
100	L	New York	3	1	250	15000	1	5.9	10	5	217500	82990.37	858329.63
100	L	New York	3	1	706	15000	1	5.9	1	0	129500	82320.50	211820.50
100	L	New York	3	1	706	15000	1	5.9	1	1	129500	82320.50	211005.45
100	L	New York	3	1	706	15000	1	5.9	1	5	129500	82320.50	207900.48

100	L	New York	3	1	706	15000	1	5.9	5	0	129500	82320.50	541102.50
100	L	New York	3	1	706	15000	1	5.9	5	1	129500	82320.50	529036.89
100	L	New York	3	1	706	15000	1	5.9	5	5	129500	82320.50	485904.69
100	L	New York	3	1	706	15000	1	5.9	10	0	217500	82320.50	1040705.01
100	L	New York	3	1	706	15000	1	5.9	10	1	217500	82320.50	997182.53
100	L	New York	3	1	706	15000	1	5.9	10	5	217500	82320.50	853157.09
100	L	New York	3	0	0	0	1	7.5	1	0	125500	87706.18	213206.18
100	L	New York	3	0	0	0	1	7.5	1	1	125500	87706.18	212337.81
100	L	New York	3	0	0	0	1	7.5	1	5	125500	87706.18	209029.70
100	L	New York	3	0	0	0	1	7.5	5	0	125500	87706.18	564030.92
100	L	New York	3	0	0	0	1	7.5	5	1	125500	87706.18	551175.93
100	L	New York	3	0	0	0	1	7.5	5	5	125500	87706.18	505221.88
100	L	New York	3	0	0	0	1	7.5	10	0	213500	87706.18	1090561.84
100	L	New York	3	0	0	0	1	7.5	10	1	213500	87706.18	1044191.97
100	L	New York	3	0	0	0	1	7.5	10	5	213500	87706.18	890743.90
100	L	New York	3	1	250	5000	1	7.5	1	0	137500	82329.43	219829.43
100	L	New York	3	1	250	5000	1	7.5	1	1	137500	82329.43	219014.28
100	L	New York	3	1	250	5000	1	7.5	1	5	137500	82329.43	215908.98
100	L	New York	3	1	250	5000	1	7.5	5	0	137500	82329.43	549147.13
100	L	New York	3	1	250	5000	1	7.5	5	1	137500	82329.43	537080.20
100	L	New York	3	1	250	5000	1	7.5	5	5	137500	82329.43	493943.32
100	L	New York	3	1	250	5000	1	7.5	10	0	225500	82329.43	1048794.25
100	L	New York	3	1	250	5000	1	7.5	10	1	225500	82329.43	1005267.06
100	L	New York	3	1	250	5000	1	7.5	10	5	225500	82329.43	861226.00
100	L	New York	3	1	706	5000	1	7.5	1	0	137500	82011.94	219511.94
100	L	New York	3	1	706	5000	1	7.5	1	1	137500	82011.94	218699.94
100	L	New York	3	1	706	5000	1	7.5	1	5	137500	82011.94	215606.61
100	L	New York	3	1	706	5000	1	7.5	5	0	137500	82011.94	547559.70
100	L	New York	3	1	706	5000	1	7.5	5	1	137500	82011.94	535539.31
100	L	New York	3	1	706	5000	1	7.5	5	5	137500	82011.94	492568.78
100	L	New York	3	1	706	5000	1	7.5	10	0	225500	82011.94	1045619.40
100	L	New York	3	1	706	5000	1	7.5	10	1	225500	82011.94	1002260.06
100	L	New York	3	1	706	5000	1	7.5	10	5	225500	82011.94	858774.46
100	L	New York	3	1	250	15000	1	7.5	1	0	137500	82338.71	219838.71
100	L	New York	3	1	250	15000	1	7.5	1	1	137500	82338.71	219023.48
100	L	New York	3	1	250	15000	1	7.5	1	5	137500	82338.71	215917.82
100	L	New York	3	1	250	15000	1	7.5	5	0	137500	82338.71	549193.55
100	L	New York	3	1	250	15000	1	7.5	5	1	137500	82338.71	537125.27
100	L	New York	3	1	250	15000	1	7.5	5	5	137500	82338.71	493983.53
100	L	New York	3	1	250	15000	1	7.5	10	0	225500	82338.71	1048887.11
100	L	New York	3	1	250	15000	1	7.5	10	1	225500	82338.71	1005355.00
100	L	New York	3	1	250	15000	1	7.5	10	5	225500	82338.71	861297.70

100	L	New York	3	1	706	15000	1	7.5	1	0	137500	82654.93	220154.93
100	L	New York	3	1	706	15000	1	7.5	1	1	137500	82654.93	219336.56
100	L	New York	3	1	706	15000	1	7.5	1	5	137500	82654.93	216218.98
100	L	New York	3	1	706	15000	1	7.5	5	0	137500	82654.93	550774.64
100	L	New York	3	1	706	15000	1	7.5	5	1	137500	82654.93	538660.01
100	L	New York	3	1	706	15000	1	7.5	5	5	137500	82654.93	495352.59
100	L	New York	3	1	706	15000	1	7.5	10	0	225500	82654.93	1052049.29
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100	L	Minneapolis	3	0	0	0	1	5.9	1	0	117500	92782.64	210282.64
100	L	Minneapolis	3	0	0	0	1	5.9	1	1	117500	92782.64	209364.00
100	L	Minneapolis	3	0	0	0	1	5.9	1	5	117500	92782.64	205864.42
100	L	Minneapolis	3	0	0	0	1	5.9	5	0	117500	92782.64	581413.18
100	L	Minneapolis	3	0	0	0	1	5.9	5	1	117500	92782.64	567814.15
100	L	Minneapolis	3	0	0	0	1	5.9	5	5	117500	92782.64	519200.26
100	L	Minneapolis	3	0	0	0	1	5.9	10	0	205500	92782.64	1133326.37
100	L	Minneapolis	3	0	0	0	1	5.9	10	1	205500	92782.64	1084272.61
100	L	Minneapolis	3	0	0	0	1	5.9	10	5	205500	92782.64	921942.93
100	L	Minneapolis	3	1	250	5000	1	5.9	1	0	129500	83022.90	212522.90
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100	L	Minneapolis	3	1	250	5000	1	5.9	1	5	129500	83022.90	208569.43
100	L	Minneapolis	3	1	250	5000	1	5.9	5	0	129500	83022.90	544614.49
100	L	Minneapolis	3	1	250	5000	1	5.9	5	1	129500	83022.90	532445.92
100	L	Minneapolis	3	1	250	5000	1	5.9	5	5	129500	83022.90	488945.70
100	L	Minneapolis	3	1	250	5000	1	5.9	10	0	217500	83022.90	1047728.97
100	L	Minneapolis	3	1	250	5000	1	5.9	10	1	217500	83022.90	1003835.14
100	L	Minneapolis	3	1	250	5000	1	5.9	10	5	217500	83022.90	858580.81
100	L	Minneapolis	3	1	706	5000	1	5.9	1	0	129500	82378.53	211878.53
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100	L	Minneapolis	3	1	706	5000	1	5.9	1	5	129500	82378.53	207955.74
100	L	Minneapolis	3	1	706	5000	1	5.9	5	0	129500	82378.53	541392.63
100	L	Minneapolis	3	1	706	5000	1	5.9	5	1	129500	82378.53	529318.51
100	L	Minneapolis	3	1	706	5000	1	5.9	5	5	129500	82378.53	486155.90
100	L	Minneapolis	3	1	706	5000	1	5.9	10	0	217500	82378.53	1041285.25
100	L	Minneapolis	3	1	706	5000	1	5.9	10	1	217500	82378.53	997732.10
100	L	Minneapolis	3	1	706	5000	1	5.9	10	5	217500	82378.53	853605.13
100	L	Minneapolis	3	1	250	15000	1	5.9	1	0	129500	82407.21	211907.21
100	L	Minneapolis	3	1	250	15000	1	5.9	1	1	129500	82407.21	211091.30
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100	L	Minneapolis	3	1	250	15000	1	5.9	5	0	129500	82407.21	541536.07
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100	L	Minneapolis	3	1	250	15000	1	5.9	10	0	217500	82407.21	1041572.15
100	L	Minneapolis	3	1	250	15000	1	5.9	10	1	217500	82407.21	998003.83
100	L	Minneapolis	3	1	250	15000	1	5.9	10	5	217500	82407.21	853826.67
100	L	Minneapolis	3	1	706	15000	1	5.9	1	0	129500	82731.71	212231.71
100	L	Minneapolis	3	1	706	15000	1	5.9	1	1	129500	82731.71	211412.59
100	L	Minneapolis	3	1	706	15000	1	5.9	1	5	129500	82731.71	208292.11
100	L	Minneapolis	3	1	706	15000	1	5.9	5	0	129500	82731.71	543158.55
100	L	Minneapolis	3	1	706	15000	1	5.9	5	1	129500	82731.71	531032.67
100	L	Minneapolis	3	1	706	15000	1	5.9	5	5	129500	82731.71	487685.01
100	L	Minneapolis	3	1	706	15000	1	5.9	10	0	217500	82731.71	1044817.11
100	L	Minneapolis	3	1	706	15000	1	5.9	10	1	217500	82731.71	1001077.23
100	L	Minneapolis	3	1	706	15000	1	5.9	10	5	217500	82731.71	856332.34
100	L	Minneapolis	3	0	0	0	1	7.5	1	0	125500	90895.52	216395.52
100	L	Minneapolis	3	0	0	0	1	7.5	1	1	125500	90895.52	215495.56
100	L	Minneapolis	3	0	0	0	1	7.5	1	5	125500	90895.52	212067.16
100	L	Minneapolis	3	0	0	0	1	7.5	5	0	125500	90895.52	579977.59
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100	L	Minneapolis	3	0	0	0	1	7.5	5	5	125500	90895.52	519030.02
100	L	Minneapolis	3	0	0	0	1	7.5	10	0	213500	90895.52	1122455.18
100	L	Minneapolis	3	0	0	0	1	7.5	10	1	213500	90895.52	1074399.13
100	L	Minneapolis	3	0	0	0	1	7.5	10	5	213500	90895.52	915371.09
100	L	Minneapolis	3	1	250	5000	1	7.5	1	0	137500	84033.87	221533.87
100	L	Minneapolis	3	1	250	5000	1	7.5	1	1	137500	84033.87	220701.86
100	L	Minneapolis	3	1	250	5000	1	7.5	1	5	137500	84033.87	217532.26
100	L	Minneapolis	3	1	250	5000	1	7.5	5	0	137500	84033.87	557669.37
100	L	Minneapolis	3	1	250	5000	1	7.5	5	1	137500	84033.87	545352.63
100	L	Minneapolis	3	1	250	5000	1	7.5	5	5	137500	84033.87	501322.70
100	L	Minneapolis	3	1	250	5000	1	7.5	10	0	225500	84033.87	1065838.74
100	L	Minneapolis	3	1	250	5000	1	7.5	10	1	225500	84033.87	1021410.42
100	L	Minneapolis	3	1	250	5000	1	7.5	10	5	225500	84033.87	874387.30
100	L	Minneapolis	3	1	706	5000	1	7.5	1	0	137500	82397.28	219897.28
100	L	Minneapolis	3	1	706	5000	1	7.5	1	1	137500	82397.28	219081.46
100	L	Minneapolis	3	1	706	5000	1	7.5	1	5	137500	82397.28	215973.60
100	L	Minneapolis	3	1	706	5000	1	7.5	5	0	137500	82397.28	549486.39
100	L	Minneapolis	3	1	706	5000	1	7.5	5	1	137500	82397.28	537409.53
100	L	Minneapolis	3	1	706	5000	1	7.5	5	5	137500	82397.28	494237.10
100	L	Minneapolis	3	1	706	5000	1	7.5	10	0	225500	82397.28	1049472.79
100	L	Minneapolis	3	1	706	5000	1	7.5	10	1	225500	82397.28	1005909.72
100	L	Minneapolis	3	1	706	5000	1	7.5	10	5	225500	82397.28	861749.94
100	L	Minneapolis	3	1	250	15000	1	7.5	1	0	137500	82393.99	219893.99
100	L	Minneapolis	3	1	250	15000	1	7.5	1	1	137500	82393.99	219078.21
100	L	Minneapolis	3	1	250	15000	1	7.5	1	5	137500	82393.99	215970.47

100	L	Minneapolis	3	1	250	15000	1	7.5	5	0	137500	82393.99	549469.95
100	L	Minneapolis	3	1	250	15000	1	7.5	5	1	137500	82393.99	537393.56
100	L	Minneapolis	3	1	250	15000	1	7.5	5	5	137500	82393.99	494222.85
100	L	Minneapolis	3	1	250	15000	1	7.5	10	0	225500	82393.99	1049439.89
100	L	Minneapolis	3	1	250	15000	1	7.5	10	1	225500	82393.99	1005878.56
100	L	Minneapolis	3	1	250	15000	1	7.5	10	5	225500	82393.99	861724.54
100	L	Minneapolis	3	1	706	15000	1	7.5	1	0	137500	83374.77	220874.77
100	L	Minneapolis	3	1	706	15000	1	7.5	1	1	137500	83374.77	220049.28
100	L	Minneapolis	3	1	706	15000	1	7.5	1	5	137500	83374.77	216904.55
100	L	Minneapolis	3	1	706	15000	1	7.5	5	0	137500	83374.77	554373.86
100	L	Minneapolis	3	1	706	15000	1	7.5	5	1	137500	83374.77	542153.73
100	L	Minneapolis	3	1	706	15000	1	7.5	5	5	137500	83374.77	498469.13
100	L	Minneapolis	3	1	706	15000	1	7.5	10	0	225500	83374.77	1059247.73
100	L	Minneapolis	3	1	706	15000	1	7.5	10	1	225500	83374.77	1015167.86
100	L	Minneapolis	3	1	706	15000	1	7.5	10	5	225500	83374.77	869297.90
300	H	0	3	0	0	0	0	0	1	0	264000	221257.28	485257.28
300	H	0	3	0	0	0	0	0	1	1	264000	221257.28	483066.61
300	H	0	3	0	0	0	0	0	1	5	264000	221257.28	474721.22
300	H	0	3	0	0	0	0	0	5	0	264000	221257.28	1370286.39
300	H	0	3	0	0	0	0	0	5	1	264000	221257.28	1337856.99
300	H	0	3	0	0	0	0	0	5	5	264000	221257.28	1221928.22
300	H	0	3	0	0	0	0	0	10	0	528000	221257.28	2740572.78
300	H	0	3	0	0	0	0	0	10	1	528000	221257.28	2623595.06
300	H	0	3	0	0	0	0	0	10	5	528000	218886.66	2218184.80
300	H	0	3	1	250	5000	0	0	1	0	276000	218945.71	494945.71
300	H	0	3	1	250	5000	0	0	1	1	276000	218945.71	492777.94
300	H	0	3	1	250	5000	0	0	1	5	276000	218945.71	484519.73
300	H	0	3	1	250	5000	0	0	5	0	276000	218945.71	1370728.57
300	H	0	3	1	250	5000	0	0	5	1	276000	218945.71	1338637.97
300	H	0	3	1	250	5000	0	0	5	5	276000	218945.71	1223920.36
300	H	0	3	1	250	5000	0	0	10	0	540000	218945.71	2729457.15
300	H	0	3	1	250	5000	0	0	10	1	540000	218945.71	2613701.54
300	H	0	3	1	250	5000	0	0	10	5	540000	218945.71	2230640.77
300	H	0	3	1	706	5000	0	0	1	0	276000	218950.70	494950.70
300	H	0	3	1	706	5000	0	0	1	1	276000	218950.70	492782.87
300	H	0	3	1	706	5000	0	0	1	5	276000	218950.70	484524.47
300	H	0	3	1	706	5000	0	0	5	0	276000	218950.70	1370753.48
300	H	0	3	1	706	5000	0	0	5	1	276000	218950.70	1338662.14
300	H	0	3	1	706	5000	0	0	5	5	276000	218950.70	1223941.93
300	H	0	3	1	706	5000	0	0	10	0	540000	218950.70	2729506.95
300	H	0	3	1	706	5000	0	0	10	1	540000	218950.70	2613748.71
300	H	0	3	1	706	5000	0	0	10	5	540000	218950.70	2230679.23

300	H	0	3	1	250	15000	0	0	1	0	276000	218958.70	494958.70
300	H	0	3	1	250	15000	0	0	1	1	276000	218958.70	492790.79
300	H	0	3	1	250	15000	0	0	1	5	276000	218958.70	484532.09
300	H	0	3	1	250	15000	0	0	5	0	276000	218958.70	1370793.49
300	H	0	3	1	250	15000	0	0	5	1	276000	218958.70	1338700.99
300	H	0	3	1	250	15000	0	0	5	5	276000	218958.70	1223976.58
300	H	0	3	1	250	15000	0	0	10	0	540000	218958.70	2729586.99
300	H	0	3	1	250	15000	0	0	10	1	540000	218958.70	2613824.52
300	H	0	3	1	250	15000	0	0	10	5	540000	218958.70	2230741.03
300	H	0	3	1	706	15000	0	0	1	0	276000	218975.06	494975.06
300	H	0	3	1	706	15000	0	0	1	1	276000	218975.06	492806.99
300	H	0	3	1	706	15000	0	0	1	5	276000	218975.06	484547.68
300	H	0	3	1	706	15000	0	0	5	0	276000	218975.06	1370875.31
300	H	0	3	1	706	15000	0	0	5	1	276000	218975.06	1338780.41
300	H	0	3	1	706	15000	0	0	5	5	276000	218975.06	1224047.42
300	H	0	3	1	706	15000	0	0	10	0	540000	218975.06	2729750.62
300	H	0	3	1	706	15000	0	0	10	1	540000	218975.06	2613979.50
300	H	0	3	1	706	15000	0	0	10	5	540000	218975.06	2230867.39
300	H	San Diego	3	0	0	0	1	5.9	1	0	293500	218159.49	511659.49
300	H	San Diego	3	0	0	0	1	5.9	1	1	293500	218159.49	509499.50
300	H	San Diego	3	0	0	0	1	5.9	1	5	293500	218159.49	501270.94
300	H	San Diego	3	0	0	0	1	5.9	5	0	293500	218159.49	1384297.45
300	H	San Diego	3	0	0	0	1	5.9	5	1	293500	218159.49	1352322.09
300	H	San Diego	3	0	0	0	1	5.9	5	5	293500	218159.49	1238016.42
300	H	San Diego	3	0	0	0	1	5.9	10	0	557500	218159.49	2739094.90
300	H	San Diego	3	0	0	0	1	5.9	10	1	557500	218159.49	2623754.97
300	H	San Diego	3	0	0	0	1	5.9	10	5	557500	218159.49	2242069.76
300	H	San Diego	3	1	250	5000	1	5.9	1	0	305500	218259.92	523759.92
300	H	San Diego	3	1	250	5000	1	5.9	1	1	305500	218259.92	521598.93
300	H	San Diego	3	1	250	5000	1	5.9	1	5	305500	218259.92	513366.59
300	H	San Diego	3	1	250	5000	1	5.9	5	0	305500	218259.92	1396799.58
300	H	San Diego	3	1	250	5000	1	5.9	5	1	305500	218259.92	1364809.50
300	H	San Diego	3	1	250	5000	1	5.9	5	5	305500	218259.92	1250451.22
300	H	San Diego	3	1	250	5000	1	5.9	10	0	569500	218259.92	2752099.17
300	H	San Diego	3	1	250	5000	1	5.9	10	1	569500	218259.92	2636706.14
300	H	San Diego	3	1	250	5000	1	5.9	10	5	569500	218259.92	2254845.22
300	H	San Diego	3	1	706	5000	1	5.9	1	0	305500	218286.32	523786.32
300	H	San Diego	3	1	706	5000	1	5.9	1	1	305500	218286.32	521625.07
300	H	San Diego	3	1	706	5000	1	5.9	1	5	305500	218286.32	513391.74
300	H	San Diego	3	1	706	5000	1	5.9	5	0	305500	218286.32	1396931.61
300	H	San Diego	3	1	706	5000	1	5.9	5	1	305500	218286.32	1364937.66
300	H	San Diego	3	1	706	5000	1	5.9	5	5	305500	218286.32	1250565.54

300	H	San Diego	3	1	706	5000	1	5.9	10	0	569500	218286.32	2752363.22
300	H	San Diego	3	1	706	5000	1	5.9	10	1	569500	218286.32	2636956.23
300	H	San Diego	3	1	706	5000	1	5.9	10	5	569500	218286.32	2255049.12
300	H	San Diego	3	1	250	15000	1	5.9	1	0	305500	218307.14	523807.14
300	H	San Diego	3	1	250	15000	1	5.9	1	1	305500	218307.14	521645.68
300	H	San Diego	3	1	250	15000	1	5.9	1	5	305500	218307.14	513411.56
300	H	San Diego	3	1	250	15000	1	5.9	5	0	305500	218307.14	1397035.68
300	H	San Diego	3	1	250	15000	1	5.9	5	1	305500	218307.14	1365038.67
300	H	San Diego	3	1	250	15000	1	5.9	5	5	305500	218307.14	1250655.65
300	H	San Diego	3	1	250	15000	1	5.9	10	0	569500	218307.14	2752571.35
300	H	San Diego	3	1	250	15000	1	5.9	10	1	569500	218307.14	2637153.36
300	H	San Diego	3	1	250	15000	1	5.9	10	5	569500	218307.14	2255209.83
300	H	San Diego	3	1	706	15000	1	5.9	1	0	305500	218280.63	523780.63
300	H	San Diego	3	1	706	15000	1	5.9	1	1	305500	218280.63	521619.43
300	H	San Diego	3	1	706	15000	1	5.9	1	5	305500	218280.63	513386.31
300	H	San Diego	3	1	706	15000	1	5.9	5	0	305500	218280.63	1396903.13
300	H	San Diego	3	1	706	15000	1	5.9	5	1	305500	218280.63	1364910.01
300	H	San Diego	3	1	706	15000	1	5.9	5	5	305500	218280.63	1250540.88
300	H	San Diego	3	1	706	15000	1	5.9	10	0	569500	218280.63	2752306.27
300	H	San Diego	3	1	706	15000	1	5.9	10	1	569500	218280.63	2636902.29
300	H	San Diego	3	1	706	15000	1	5.9	10	5	569500	218280.63	2255005.14
300	H	San Diego	3	0	0	0	1	7.5	1	0	301500	218159.56	519659.56
300	H	San Diego	3	0	0	0	1	7.5	1	1	301500	218159.56	517499.56
300	H	San Diego	3	0	0	0	1	7.5	1	5	301500	218159.56	509271.01
300	H	San Diego	3	0	0	0	1	7.5	5	0	301500	218159.56	1392297.78
300	H	San Diego	3	0	0	0	1	7.5	5	1	301500	218159.56	1360322.40
300	H	San Diego	3	0	0	0	1	7.5	5	5	301500	218159.56	1246016.71
300	H	San Diego	3	0	0	0	1	7.5	10	0	565500	218159.56	2747095.56
300	H	San Diego	3	0	0	0	1	7.5	10	1	565500	218159.56	2631755.59
300	H	San Diego	3	0	0	0	1	7.5	10	5	565500	218159.56	2250070.26
300	H	San Diego	3	1	250	5000	1	7.5	1	0	313500	218259.00	531759.00
300	H	San Diego	3	1	250	5000	1	7.5	1	1	313500	218259.00	529598.02
300	H	San Diego	3	1	250	5000	1	7.5	1	5	313500	218259.00	521365.72
300	H	San Diego	3	1	250	5000	1	7.5	5	0	313500	218259.00	1404795.02
300	H	San Diego	3	1	250	5000	1	7.5	5	1	313500	218259.00	1372805.07
300	H	San Diego	3	1	250	5000	1	7.5	5	5	313500	218259.00	1258447.27
300	H	San Diego	3	1	250	5000	1	7.5	10	0	577500	218259.00	2760090.05
300	H	San Diego	3	1	250	5000	1	7.5	10	1	577500	218259.00	2644697.50
300	H	San Diego	3	1	250	5000	1	7.5	10	5	577500	218259.00	2262838.18
300	H	San Diego	3	1	706	5000	1	7.5	1	0	313500	218278.03	531778.03
300	H	San Diego	3	1	706	5000	1	7.5	1	1	313500	218278.03	529616.86
300	H	San Diego	3	1	706	5000	1	7.5	1	5	313500	218278.03	521383.84

300	H	San Diego	3	1	706	5000	1	7.5	5	0	313500	218278.03	1404890.15
300	H	San Diego	3	1	706	5000	1	7.5	5	1	313500	218278.03	1372897.41
300	H	San Diego	3	1	706	5000	1	7.5	5	5	313500	218278.03	1258529.64
300	H	San Diego	3	1	706	5000	1	7.5	10	0	577500	218278.03	2760280.30
300	H	San Diego	3	1	706	5000	1	7.5	10	1	577500	218278.03	2644877.69
300	H	San Diego	3	1	706	5000	1	7.5	10	5	577500	218278.03	2262985.09
300	H	San Diego	3	1	250	15000	1	7.5	1	0	313500	218282.66	531782.66
300	H	San Diego	3	1	250	15000	1	7.5	1	1	313500	218282.66	529621.44
300	H	San Diego	3	1	250	15000	1	7.5	1	5	313500	218282.66	521388.25
300	H	San Diego	3	1	250	15000	1	7.5	5	0	313500	218282.66	1404913.29
300	H	San Diego	3	1	250	15000	1	7.5	5	1	313500	218282.66	1372919.87
300	H	San Diego	3	1	250	15000	1	7.5	5	5	313500	218282.66	1258549.68
300	H	San Diego	3	1	250	15000	1	7.5	10	0	577500	218282.66	2760326.58
300	H	San Diego	3	1	250	15000	1	7.5	10	1	577500	218282.66	2644921.53
300	H	San Diego	3	1	250	15000	1	7.5	10	5	577500	218282.66	2263020.82
300	H	San Diego	3	1	706	15000	1	7.5	1	0	313500	218259.19	531759.19
300	H	San Diego	3	1	706	15000	1	7.5	1	1	313500	218259.19	529598.20
300	H	San Diego	3	1	706	15000	1	7.5	1	5	313500	218259.19	521365.89
300	H	San Diego	3	1	706	15000	1	7.5	5	0	313500	218259.19	1404795.93
300	H	San Diego	3	1	706	15000	1	7.5	5	1	313500	218259.19	1372805.95
300	H	San Diego	3	1	706	15000	1	7.5	5	5	313500	218259.19	1258448.05
300	H	San Diego	3	1	706	15000	1	7.5	10	0	577500	218259.19	2760091.85
300	H	San Diego	3	1	706	15000	1	7.5	10	1	577500	218259.19	2644699.21
300	H	San Diego	3	1	706	15000	1	7.5	10	5	577500	218259.19	2262839.57
300	H	South Carolina	3	0	0	0	1	5.9	1	0	293500	219051.80	512551.80
300	H	South Carolina	3	0	0	0	1	5.9	1	1	293500	219051.80	510382.97
300	H	South Carolina	3	0	0	0	1	5.9	1	5	293500	219051.80	502120.76
300	H	South Carolina	3	0	0	0	1	5.9	5	0	293500	219051.80	1388759.00
300	H	South Carolina	3	0	0	0	1	5.9	5	1	293500	219051.80	1356652.85
300	H	South Carolina	3	0	0	0	1	5.9	5	5	293500	219051.80	1241879.65
300	H	South Carolina	3	0	0	0	1	5.9	10	0	557500	219051.80	2748017.99
300	H	South Carolina	3	0	0	0	1	5.9	10	1	557500	219051.80	2632206.30
300	H	South Carolina	3	0	0	0	1	5.9	10	5	557500	219051.80	2248959.93
300	H	South Carolina	3	1	250	5000	1	5.9	1	0	305500	218375.80	523875.80
300	H	South Carolina	3	1	250	5000	1	5.9	1	1	305500	218375.80	521713.67
300	H	South Carolina	3	1	250	5000	1	5.9	1	5	305500	218375.80	513476.96
300	H	South Carolina	3	1	250	5000	1	5.9	5	0	305500	218375.80	1397379.02
300	H	South Carolina	3	1	250	5000	1	5.9	5	1	305500	218375.80	1365371.95
300	H	South Carolina	3	1	250	5000	1	5.9	5	5	305500	218375.80	1250952.95
300	H	South Carolina	3	1	250	5000	1	5.9	10	0	569500	218375.80	2753258.04
300	H	South Carolina	3	1	250	5000	1	5.9	10	1	569500	218375.80	2637803.74
300	H	South Carolina	3	1	250	5000	1	5.9	10	5	569500	218375.80	2255740.08

300	H	South Carolina	3	1	706	5000	1	5.9	1	0	305500	218377.60	523877.60
300	H	South Carolina	3	1	706	5000	1	5.9	1	1	305500	218377.60	521715.45
300	H	South Carolina	3	1	706	5000	1	5.9	1	5	305500	218377.60	513478.67
300	H	South Carolina	3	1	706	5000	1	5.9	5	0	305500	218377.60	1397388.00
300	H	South Carolina	3	1	706	5000	1	5.9	5	1	305500	218377.60	1365380.66
300	H	South Carolina	3	1	706	5000	1	5.9	5	5	305500	218377.60	1250960.72
300	H	South Carolina	3	1	706	5000	1	5.9	10	0	569500	218377.60	2753276.00
300	H	South Carolina	3	1	706	5000	1	5.9	10	1	569500	218377.60	2637820.75
300	H	South Carolina	3	1	706	5000	1	5.9	10	5	569500	218377.60	2255753.94
300	H	South Carolina	3	1	250	15000	1	5.9	1	0	305500	218337.61	523837.61
300	H	South Carolina	3	1	250	15000	1	5.9	1	1	305500	218337.61	521675.85
300	H	South Carolina	3	1	250	15000	1	5.9	1	5	305500	218337.61	513440.58
300	H	South Carolina	3	1	250	15000	1	5.9	5	0	305500	218337.61	1397188.06
300	H	South Carolina	3	1	250	15000	1	5.9	5	1	305500	218337.61	1365186.58
300	H	South Carolina	3	1	250	15000	1	5.9	5	5	305500	218337.61	1250787.59
300	H	South Carolina	3	1	250	15000	1	5.9	10	0	569500	218337.61	2752876.11
300	H	South Carolina	3	1	250	15000	1	5.9	10	1	569500	218337.61	2637442.00
300	H	South Carolina	3	1	250	15000	1	5.9	10	5	569500	218337.61	2255445.16
300	H	South Carolina	3	1	706	15000	1	5.9	1	0	305500	218366.01	523866.01
300	H	South Carolina	3	1	706	15000	1	5.9	1	1	305500	218366.01	521703.97
300	H	South Carolina	3	1	706	15000	1	5.9	1	5	305500	218366.01	513467.63
300	H	South Carolina	3	1	706	15000	1	5.9	5	0	305500	218366.01	1397330.04
300	H	South Carolina	3	1	706	15000	1	5.9	5	1	305500	218366.01	1365324.41
300	H	South Carolina	3	1	706	15000	1	5.9	5	5	305500	218366.01	1250910.54
300	H	South Carolina	3	1	706	15000	1	5.9	10	0	569500	218366.01	2753160.08
300	H	South Carolina	3	1	706	15000	1	5.9	10	1	569500	218366.01	2637710.96
300	H	South Carolina	3	1	706	15000	1	5.9	10	5	569500	218366.01	2255664.43
300	H	South Carolina	3	0	0	0	1	7.5	1	0	301500	218175.03	519675.03
300	H	South Carolina	3	0	0	0	1	7.5	1	1	301500	218175.03	517514.88
300	H	South Carolina	3	0	0	0	1	7.5	1	5	301500	218175.03	509285.74
300	H	South Carolina	3	0	0	0	1	7.5	5	0	301500	218175.03	1392375.13
300	H	South Carolina	3	0	0	0	1	7.5	5	1	301500	218175.03	1360397.49
300	H	South Carolina	3	0	0	0	1	7.5	5	5	301500	218175.03	1246083.68
300	H	South Carolina	3	0	0	0	1	7.5	10	0	565500	218175.03	2747250.26
300	H	South Carolina	3	0	0	0	1	7.5	10	1	565500	218175.03	2631902.11
300	H	South Carolina	3	0	0	0	1	7.5	10	5	565500	218175.03	2250189.72

Appendix D

Control Results

Table D.1: PE Control Cost Data

Case	**capital**	**opex**	**annual opex**	**year**	**discount**	**TCO**
low fuel	144000	820.70	-66476.78	1	0	210476.78
low fuel	144000	820.70	-66476.78	1	1	209818.60
low fuel	144000	820.70	-66476.78	1	5	207311.22
low fuel	144000	820.70	-66476.78	5	0	476383.91
low fuel	144000	820.70	-66476.78	5	1	466640.49
low fuel	144000	820.70	-66476.78	5	5	431809.67
low fuel	276000	820.70	-66476.78	10	0	940767.81
low fuel	276000	820.70	-66476.78	10	1	905621.84
low fuel	276000	820.70	-66476.78	10	5	789316.08
mid fuel	144000	4103.51	-332383.91	1	0	476383.91
mid fuel	144000	4103.51	-332383.91	1	1	473092.98
mid fuel	144000	4103.51	-332383.91	1	5	460556.10
mid fuel	144000	4103.51	-332383.91	5	0	1805919.53
mid fuel	144000	4103.51	-332383.91	5	1	1757202.43
mid fuel	144000	4103.51	-332383.91	5	5	1583048.36
mid fuel	276000	4103.51	-332383.91	10	0	3599839.05
mid fuel	276000	4103.51	-332383.91	10	1	3424109.19

mid fuel	276000	4103.51	-332383.91	10	5	2842580.41
high fuel	144000	13664.67	-1106838.40	1	0	1250838.40
high fuel	144000	13664.67	-1106838.40	1	1	1239879.61
high fuel	144000	13664.67	-1106838.40	1	5	1198131.81
high fuel	144000	13664.67	-1106838.40	5	0	5678192.02
high fuel	144000	13664.67	-1106838.40	5	1	5515964.09
high fuel	144000	13664.67	-1106838.40	5	5	4936031.05
high fuel	276000	13664.67	-1106838.40	10	0	11344384.04
high fuel	276000	13664.67	-1106838.40	10	1	10759203.59
high fuel	276000	13664.67	-1106838.40	10	5	8822712.76
perfect PE	173500	718.13	-58168.41	1	0	231668.41
perfect PE	173500	718.13	-58168.41	1	1	231092.48
perfect PE	173500	718.13	-58168.41	1	5	228898.48
perfect PE	173500	718.13	-58168.41	5	0	464342.03
perfect PE	173500	718.13	-58168.41	5	1	455816.36
perfect PE	173500	718.13	-58168.41	5	5	425338.75
perfect PE	305500	718.13	-58168.41	10	0	887184.05
perfect PE	305500	718.13	-58168.41	10	1	856430.68
perfect PE	305500	718.13	-58168.41	10	5	754661.01
solar following	173500	719.09	-58245.97	1	0	231745.97
solar following	173500	719.09	-58245.97	1	1	231169.28
solar following	173500	719.09	-58245.97	1	5	228972.35
solar following	173500	719.09	-58245.97	5	0	464729.85
solar following	173500	719.09	-58245.97	5	1	456192.81
solar following	173500	719.09	-58245.97	5	5	425674.57
solar following	305500	719.09	-58245.97	10	0	887959.71
solar following	305500	719.09	-58245.97	10	1	857165.33
solar following	305500	719.09	-58245.97	10	5	755259.95
pe following	173500	803.35	-65071.01	1	0	238571.01
pe following	173500	803.35	-65071.01	1	1	237926.75

pe following	173500	803.35	-65071.01	1	5	235472.39
pe following	173500	803.35	-65071.01	5	0	498855.07
pe following	173500	803.35	-65071.01	5	1	489317.70
pe following	173500	803.35	-65071.01	5	5	455223.44
pe following	305500	803.35	-65071.01	10	0	956210.15
pe following	305500	803.35	-65071.01	10	1	921807.40
pe following	305500	803.35	-65071.01	10	5	807961.13
perfect PE	173500	3577.31	-289761.92	1	0	463261.92
perfect PE	173500	3577.31	-289761.92	1	1	460392.99
perfect PE	173500	3577.31	-289761.92	1	5	449463.73
perfect PE	173500	3577.31	-289761.92	5	0	1622309.58
perfect PE	173500	3577.31	-289761.92	5	1	1579839.53
perfect PE	173500	3577.31	-289761.92	5	5	1428017.45
perfect PE	305500	3577.31	-289761.92	10	0	3203119.16
perfect PE	305500	3577.31	-289761.92	10	1	3049923.34
perfect PE	305500	3577.31	-289761.92	10	5	2542964.70
solar following	173500	3585.07	-290390.67	1	0	463890.67
solar following	173500	3585.07	-290390.67	1	1	461015.51
solar following	173500	3585.07	-290390.67	1	5	450062.54
solar following	173500	3585.07	-290390.67	5	0	1625453.35
solar following	173500	3585.07	-290390.67	5	1	1582891.15
solar following	173500	3585.07	-290390.67	5	5	1430739.63
solar following	305500	3585.07	-290390.67	10	0	3209406.70
solar following	305500	3585.07	-290390.67	10	1	3055878.47
solar following	305500	3585.07	-290390.67	10	5	2547819.78
pe following	173500	4013.30	-325077.59	1	0	498577.59
pe following	173500	4013.30	-325077.59	1	1	495359.00
pe following	173500	4013.30	-325077.59	1	5	483097.71
pe following	173500	4013.30	-325077.59	5	0	1798887.96
pe following	173500	4013.30	-325077.59	5	1	1751241.74

pe following	173500	4013.30	-325077.59	5	5	1580915.85
pe following	305500	4013.30	-325077.59	10	0	3556275.92
pe following	305500	4013.30	-325077.59	10	1	3384408.87
pe following	305500	4013.30	-325077.59	10	5	2815662.99
perfect PE	173500	11897.03	-963659.53	1	0	1137159.53
perfect PE	173500	11897.03	-963659.53	1	1	1127618.34
perfect PE	173500	11897.03	-963659.53	1	5	1091270.98
perfect PE	173500	11897.03	-963659.53	5	0	4991797.63
perfect PE	173500	11897.03	-963659.53	5	1	4850555.25
perfect PE	173500	11897.03	-963659.53	5	5	4345641.44
perfect PE	305500	11897.03	-963659.53	10	0	9942095.26
perfect PE	305500	11897.03	-963659.53	10	1	9432612.84
perfect PE	305500	11897.03	-963659.53	10	5	7746623.43
solar following	173500	11911.14	-964802.21	1	0	1138302.21
solar following	173500	11911.14	-964802.21	1	1	1128749.71
solar following	173500	11911.14	-964802.21	1	5	1092359.25
solar following	173500	11911.14	-964802.21	5	0	4997511.04
solar following	173500	11911.14	-964802.21	5	1	4856101.17
solar following	173500	11911.14	-964802.21	5	5	4350588.65
solar following	305500	11911.14	-964802.21	10	0	9953522.08
solar following	305500	11911.14	-964802.21	10	1	9443435.52
solar following	305500	11911.14	-964802.21	10	5	7755446.91
pe following	173500	13315.90	-1078587.97	1	0	1252087.97
pe following	173500	13315.90	-1078587.97	1	1	1241408.88
pe following	173500	13315.90	-1078587.97	1	5	1200726.64
pe following	173500	13315.90	-1078587.97	5	0	5566439.86
pe following	173500	13315.90	-1078587.97	5	1	5408352.56
pe following	173500	13315.90	-1078587.97	5	5	4843221.47
pe following	305500	13315.90	-1078587.97	10	0	11091379.73
pe following	305500	13315.90	-1078587.97	10	1	10521135.15

pe following	305500	13315.90	-1078587.97	10	5	8634070.42