



Forgeworks Beliefs Credo

These are our Equipment Budget Philosophies for the 15bbl or smaller scale brew pub style brewery. This information can help you re-appropriate start up expenditures, and give you a good idea of what equipment can be purchased at a future date (year one or two) once cash flow has begun to offset debt service, payroll, raw material and supplies costs.

Savings examples based on a 7bbl Brewhouse

Immediate dollars not spent on needed items, to re-appropriate in other areas of your Brew Pub on other needed items: \$10465, or in the case of a boiler \$2000 additional.

(make your own keg washer, buy your chiller direct, buy your heat exchanger direct, hot liquor tank with only one electric element)

Delayed Equipment Investments: \$14,535

(VFD on pump, flowmeter, grain mill, grain conveyance, grist hydrator, select/strategic hardpiping)

Savings on items likely not needed at this scale: \$27,935 on the conservative end

(MashTun Rake & Plow, Process Piping, minimal Controls)

Pricing Differences Electric, In-Direct Fire or Steam?

How you choose to fire your kettle is directly related to both upfront costs, and an annual operation cost per brew.

Electric Kettles

Electric Fire has some popularity in smaller systems, such as 3.5 & 5bb. But, here is what you should know about electric. Unless your area has very inexpensive electric rates, your cost per brew is likely to be the highest of the three heating options. You will need three phase power, and if your building doesn't already have it, it will be a large up-front expense. Any upgrades to the electric system will stay with the building when or if you ever move your operation. Electric Kettles don't require exhaust venting, thus there is upfront savings there, as well as one less penetration in your ceiling or outer wall. If you already have three phase power, then your upfront costs may be less than the other two heating options.

Typically *Indirect Fire* Systems have less up front costs, and less operational costs in terms of cost per brew. If Natural Gas is readily available in your area this may be the best way to go. The burners we provide can be converted to Propane, and a kit for this conversation is provided. However, if you go the propane route, unless propane is very reasonable in your area, this could make the In-direct fire option more expensive per brew than electric.

Steam fired brewhouses have the most expensive up front costs, and the cost per brew may not be as favorable compared to In-direct fire, but likely better than electric. Steam fire is the only reasonable option for brewhouses 20bbl and larger, but is not common with brewhouses 10bbl and smaller. Steam fired brewhouses around the 7-10bbl scale are commonly used when that brewery anticipates around the clock brewing, or at least 6 brews per week. Steam fired systems do not require exhaust venting.

Brewhouse Parts (Valves, Clamps, Hoses, Fittings) *(not spending dollars on marked-up items)*

As a convenience to our customers, we offer a Brewers Soft Hose kit of a 100' for the brewhouse,, cut and fitted in lengths of your choice. We also can provide a package of Valves, Clamps for the brewhouse, which includes the minimal parts you will need to get brewing, and a few extras. You can shave some dollars by sourcing each needed part yourself. We are happy to provide you both with a list of suppliers, and a list of parts you will need.

Kettle Venting *(not spending dollars on marked-up items)*

Whether your kettle is Electric, In-Direct Fire or Steam, it will require steam venting (the use of a Condenser in lieu of venting to the outside of your building, are not recommended, and should avoided, unless in your case you are unable to vent to the outside). In-Direct Fire always requires exhaust venting, electric or steam fired kettles do not.

Steam venting parts are reasonably priced as they are single wall sections. We strongly recommend that all sections used are Stainless Steel. Galvanized steel does not hold up to prolonged exposure to cleaning caustics and acids, thus compromising its non-corrosive characteristics and will soon begin to rust. This rust will get into your kettle, and your wort. Although Stainless is recommended, you can incorporate galvanized sections as long as the first two sections from the kettle are stainless. When it comes to venting the steam, it is best if it is a straight vertical shot to the outside of the building. If turns are required, nothing more than 45° turns are optimal. A 90° turn is not recommending. Extreme turns expose your wort to condensation dropping straight down the venting, instead of flowing on the walls down into the condensation ring (and routed away from the kettle).

Straight shots are less expensive (turns add significant cost), so when you are considering the exact location of the kettle, choose a workable location that also has the opportunity for the straightest shot possible.

One expense shocker is the price on double walled Class-A exhaust venting parts, which are required by code to vent your Kettle exhaust (in the case of in-direct fire). Get shocked early on, getting your head around the budget needed to properly vent the exhaust on your kettle. Although turns in the exhaust venting are ok compared to the steam venting, each turn will add significant cost. If reasonable, buy as many of the parts as you can to avoid markups from your professional HVAC installer. You can save some significant money buy these parts direct, but may need help understanding from your HVAC source all the exact parts you will need for your particular roof line or if any slight turns are needed.

Shop quotes on the venting and hookup of the burner (in the case of in-direct fire). Its good to ask other breweries in the area who they used. See if the HVAC company will negotiate on the markup of the parts, or give you an exact list of parts for a small fee, so that you can order them directly.

You will want to start brewing as soon as possible after taking delivery of your brewhouse and cellaring vessels. We recommend you work on the venting component early, as sometimes the parts may have a turnaround time associated, or your HVAC company may be backed up. Any unnecessary delays in brewing prolong revenues coming in, so delays are at a cost.

We provide a very detailed document on venting as well as on in-direct fire burner installation.

Chillers *(not spending dollars on marked-up items)*

-Based on the HP and other features, we have seen these priced from US Makers anywhere from \$15,000 to

\$21,500. Manufacturers of Chiller equipment have the expertise you need to calculate which of their models will best accommodate that balance between the needs of your initial equipment, and what you will be adding to the loads with your first few steps of expansion, adding fermenters. They have a team of engineers to help guide you, and they are the ones that you will call on for service, including installation questions from your chosen HVAC professionals. At Forgeworks, we believe it would be a disservice to offer you a Chiller at a marked-up price, and just drop shipping the equipment to you from the manufacturer that you can buy directly from.

Buyer beware on China Made Turnkey Brewhouses that include chillers. A big component of this "packaging" is including inferior made components, such as chillers, boilers, heat exchangers, pumps and flow meters. The only service/warranty option in this scenario is working with a company that didn't make the equipment, and may not stock parts or have the expertise to get your brewery back up and brewing.

We recommend you buy your Chiller Direct from either G&D, Advantage Engineering, or Pro Chiller. Buying directly will preclude you from spending at the very least \$1500 more than you should.

Boilers (*not spending dollars on marked-up items*)

Same scenario as with the Chiller, but 5x the impact. Steam fired equipment is an efficient way to heat in terms of energy transfer and finite controlling, but does however come with some steeper start up costs as well as ongoing maintenance cost combined with staff training/expertise. Most building codes require a dedicated explosion proof room to house a boiler, and there is specialized piping involved from the boiler room to the brewhouse. Boilers require regular maintenance schedules from your trained staff or a hired company, specialized chemicals, and annual inspections. With this type of equipment, we at Forgeworks strongly feel that we would be doing you a disservice to be in the middle of an information exchange between you and the Boiler manufacturer to determine the right equipment, while also and facilitating this purchase at a higher cost to you, when you can receive the best service possible via buying direct. Buying directly means there is at least \$2000 not spent unnecessarily.

On the resource page of our website, under Articles, we have a list of Industry Resources. These are companies that we recommend you look into, for various ancillary products from Cold Rooms to Chemicals, from Forums to Osha Topics. When it comes to boilers, we recommend : Columbia, Hurst, Rite, and Allied Boilers.

Hot Liquor Tank

This is a broader topic that you might think, and really does take some careful evaluation of how you will produce all the hot water for the brew operations. In fact, once you decide what size brewhouse you are going with, this is the next logical topic to tackle...your plan for Hot Liquor.

Hot Water on Demand systems are certainly an option, but if this is your only source of producing hot water, and you are planning to go directly into the Mash Tun without a holding tank of some sort, this poses a few things to work through. First, if your water requires treatment, pH adjustments, etc, you will have to perform this in the Mash Tun. The second issue to consider is that you forfeit the ability to re-capture hot water from the Heat Exchanger. Without a holding tank, this hot water from the heat exchanger, besides maybe a sink full or a few buckets, will all go down the drain. Re-capturing hot water from the heat exchanger becomes a big deal when you begin to perform back to back brews.

If you do incorporate Hot Water on Demand at whatever level, we recommend the Rinnai brand. Many breweries supplement a Hot Liquor Tank with an On-Demand (Tankless) system.

<https://www.rinnai.com.au/hot-water/>

At Forgeworks, for the 10bbl and smaller scale, we believe that a Hot Liquor Tank should be a minimalist piece of equipment, not a duplication of a Kettle. An In-Direct fire or Steam fired HLT is pretty much a kettle, and adds cost. An In-Direct Fire HLT would require exhaust venting and a penetration in the wall or ceiling to vent to the outside. In this case, on a 7bbl, it is \$4250 more to make it direct fire capable, and another \$1706 on top of that for Steam. There are some advantages to having your HLT act like a Kettle, such as when you size up your HLT to 2-4x your brewhouse capacity.

We recommend a single size or 2x size HLT, that is insulated, and ported for 1-2 Electric Immersion Elements.

So the concept is that you already have a kettle, so probably 90% of our customers heat their Hot Liquor in the kettle the evening before brew day, the controller maintains the temp (this also helps evaporate off chlorine) through the night. On brew day you transfer to the HLT. Because the HLT is insulated, and because there is a lot of heat mass when you transfer, you will only lose a degree, two at the most....so you allow for that loss when you heat in the kettle. The only reason the HLT has (1) electric immersion element port is for a contingency plan. Let's say you go to brew and the school calls and your kid is sick. Delay in brewing. Or after you do the transfer, you figure out you are low on hops and have to go to the brewery down the street and borrow some...and while you do that, you drink a few beers with that brewer before returning to your brew floor. You then anticipate your HLT has dropped a degree or two during this delay.....and you kick in 1 or 2 of the electric immersion elements to raise the temp back up. In most cases, you would never need to use the electric immersion elements for heating your HLT.

Our kettles are built with 40% freeboard.....so more extra space in the kettle over many, if not all other Kettle suppliers. In the case of doing a back to back brew with a single size HLT, you can heat enough water in the kettle to cover brew 1 and the strike water for brew 2. Then you recover your hot water from the Heat X on brew 1, into the HLT and use that water for sparge on brew 2. Sometimes a 2x size HLT is good idea, especially if you forecast doing back to back brewing frequently.....but the process is the same.

The case for a direct fire or steam HLT would be applicable primarily for a large scale brewhouses, say 15bbl & up, where you plan to double and triple brew all the time. In this case, heating all your water in the HLT makes more sense, saves time not having to transfer Hot Liquor from the kettle..thus pays for the extra cost in having basically two kettles. Most of these brewhouses of this scale incorporate an HLT is 2-4 times the size of the brewhouse.

Cold Liquor Tank

If your ground water is well over 80°, you are a candidate for a Cold Liquor Tank. We see most of our requests for Cold Liquor Tanks by breweries in the Southern states, such Texas, Florida, Tennessee, Georgia. If your tap water is 80° or less, a beefy two-stage Heat Exchanger by Thermaline will get the job handled. To tool around with this topic, visit the Thermaline Heat Exchanger website's Beer Calculator page. You can plug in scenarios for a single or double stage heat exchanger, it kicks out the result and all the stats, plus a price. They build these in these United States, and they get them built in 3-4 days. Check out the link below.

<https://brew.thermaline.com/>

If you have a large enough Cold Room, you can buy any ol' re-purposed single wall tank and use it as your cold liquor. This is where you can really save money. We can build you a single wall tank, but when it comes to jacketed, glycol cooled Cold Liquor Tanks, we would steer you to the imported version. A Cold Liquor tank does not need to be US MADE durable, nor sanitary. That said, spending as little as possible on a CLT makes a lot of sense.

Cold Room

On the subject of Cold Rooms, build the biggest one you can possibly make room for.

Brewhouse Features

Platform (*\$4615 that you can spend later*)

Ladders are used, make-shift platforms are used, but a fitted stainless Platform is the ultimate way to go. Permanent platforms provide a comfortable position to work your grain bed, and provide a safe exit in the case of boil over. They can also be fitted later for any type of controls you may want to incorporate. This is definitely an item that if you are short on budget, and you have to shave large amounts somewhere, you can easily add the permanent platform later. We save all the drawings, so we can easily fit up a platform to your brewhouse years down the road. The only additional investment is the shipping separate from the brewhouse.

Step ladders can be a little crude and not as safe as this other \$665 option from U-Line.

<https://www.uline.com/Product/Detail/H-1867/Ladders/Work-Platform-3-Steps-36-x-36>

Grist Case (Mounted or Suspended), not spending \$5000-\$6000

-Short of the Grist Hopper actually being a Silo outside storing your bulk purchased two-row grain, we don't believe these a priority item. Couple of points on this include the fact that if your hopper is suspended from the ceiling or mounted to your Mash Tun, they are "at considerable height" and require cleaning. Even if the hopper is sealed from above, steam gets in from below. Cleaning these can be daunting, and perhaps overlooked. Do they save time? Not these types, you still open each 55lb bag and load the mill's hopper, and convey the grist up into the hopper in the sky. This takes time, as does the mash-in the next day. Without a grist case, the milling/conveying time over laps with the mash-in time thus nets less time. The only advantage we feel this offers is eliminating the back and forth from loading the mill to working your grain bed, in the case of brewing solo.

A floor mounted Grist Case presents both the investment in the case, and an investment in a second augering/conveying system. This does not save time, but adds more time to the scenario above. You open each bag of grain, load your mill hopper and convey the grist to a floor level grist case. On brew day, a second auger conveys the grist to the mash tun, which additional time. The only advantage we feel this offers is just like in the scenario above, eliminating the back and forth from loading the mill to working your grain bed, in the case of brewing solo.

Not having a grist case saves time and money spent on equipment that would likely not show an impressive return on investment. Your staff will have less exposure to safety issues with working at height while cleaning the grist case at frequent intervals.

Flow Meters (\$1130)

-A flow meter is a nice thing to have, and you can add it later should you deem it necessary. When you do buy one, it's very important to buy the best one you can work out with your budget. Good thing to ask around, as there seems to be products out there that are shy on accuracy. If this device is not as accurate as it should be, it will throw the measurements you are depending on completely off.

These units are the best that we found in the market based on our customer's recommendations. However, the minimum flow range (5 GPM) is typically too high for small brew pub applications because of the smaller diameter (1" I.D.) hoses that are commonly used. In other words, smaller brewpubs would need to use a (1.5" I.D.) hose with flow ranges in the 10gpm range to make these units function properly and give you accurate measurements.

I would ask a sales representative with these companies what the minimum flow and maximum flow rates are for their meter. Here are three units that have been recommended.

<http://www.gpimeters.com/G2S10T09GMA-Prodview.html>

<https://www.gwkent.com/econo-turbine-flow-meter.html>

https://www.anderson-negele.com/wp-content/themes/andersonnegele/assets/izmag/pdf/IZMAG_05067_en_na.pdf

VFD on Centrifugal Pump

-We've seen a pump mounted on a skateboard, and a dolly, but you should pop for a cart. However, a VFD is not essential, and it is something you can add later. This reduces your upfront costs by at least \$625. You can vorlauf, sparge, transfer, and knockout without a flow meter or VFD on your pump. Combined, that's \$1755 you can spend later.

Rake and Plow

This is a \$13,135 feature upgrade on a 7bbl, and \$13,980 on a 10bbl. On a 15bbl, this equipment is finally worth having at \$16,540. A Rake and Plow does improve your efficiencies, but that direct benefit is relative only at the 15bbl level, as you can effectively work your grain bed by way of a brewers paddle and do what a rake and plow would do for you.

A Rake and Plow can begin to make sense on a 10bbl or smaller system when you are brewing back to back brews multiple times a week. This equipment will make the brew task less physical, and reduce time on grain out. However, at this scale, it will not necessarily improve your efficiencies.

At the 15bbl scale and larger, a Rake and Plow becomes essential, both from a physical perspective, but also efficiencies and time.

Installation and Commissioning (*ranging from \$2500-\$3000 plus travel and per diem*)

When you purchase a soft hose connection brewhouse, you won't need the help of any manufacturer to set the tanks, and your local HVAC professional whom you likely already have on sight for your build out, will be helping you with Kettle venting, and installation of your direct fire burner. Help from your equipment provider to place the tanks, install the parts, and commission the system comes into play when you incorporate Process Piping, and it will cost you money.

Process Piping (aka hardpiping)

-This is another adder, \$12,500 for the 7bbl 2-Vessel Brewhouse, and \$12,800 for the 10bbl. This comes with a Diverter Panel, sometimes called a swing panel, and all the valving. At Forgeworks, we feel that this additional feature is not needed unless you are in a 6-8 brew per week scenario, and/or at the 20bbl or larger scale. There is a bit of a trade off on the benefits of Process Piping, which include more automated capability, less overall time per brew, and that is that there are many more moving parts in the system, more things to break or require troubleshooting, and more chemicals to clean. This type of manifolding also presents a much higher training curve to get acquainted with the system, and is increasingly difficult to have multiple staff members completely trained up. Mistakes in manipulating the valves can result in wort or caustic being routed to the wrong place. Ask around, this happens. Soft Hose connections are made much more deliberately, your brewer knowing exactly what is being connection and where material is being routed.

We do offer this upgrade, and understand the need and benefit associated. In the case of our building a Process Piped brewhouse for you, having a member or two of our staff on site to set up the brewhouse will save some installation time and effort. We offer this service separately.

Many of our customers, who have a Soft Hose Connection system, eventually added some hard piped connections, once everything on the brew floor had been dialed in. One might include a hard connection from

the HLT to the Mash Tun, with a dedicated pump. Another may be a hard pipe from the Cellaring area to the cold room (through the cold room wall). Simple hard pipe connections such as these can save some time and reduce the routing of soft hoses to other areas of the operation that are distant to the Brewhouse or Cellaring line. Hot Liquor tanks do not need to be in direct proximity of the Brewhouse, and if they are located a ways away, a hard pipe connection would be a good way to go. Local Stainless Steel welders can be sourced for these simple hard connections as you need them. Each one of these types of connections may cost you \$1000 or less from a local sanitary stainless steel welder.

Controls

These range from \$2300-\$5400, and normally go hand in hand with a Process Piped system. They can come into play with soft hose connection systems, at some level....but generally are not necessarily. With a soft hose connection system, which is a Forgeworks staple, a simple Johnson A421 Controller Kit at \$243, will be all you need to fire and control the Kettle. The same controller could be added to the Hot Liquor tank and each of your jacketed cellaring vessels. Controls are often referred to as a more involved single panel of multiple control functions, such as Rake and Plow, Pumps, Kettle temperature, vorlauf, transfers, knockouts, and cleaning. They can range from simple analog type operation to touch screen manipulation.

Controls can also be added later, even in the case of Process Piping. Controls can also be sourced by a multitude of suppliers, perhaps even a person in your local area.

Tank Light

-Nice to have, but at the 15bbl and smaller scale, its definitely not needed. These are pricey, and the price doesn't included what your electrician will charge you to bring it power.
Installation

GRAIN HANDLING

Barley Cracker (aka Grain Mill) (\$4050 expenditure delay)

Cracking your own grain gives you consistent control of your crush, thus the highest possible efficiencies related to the crush, consistent results from your recipes, and its less physical on brew day. However, you can initially, and for however long brew successfully, working bag by bag into the Mash Tun.

Grist Conveyance (*minimum of a \$1500 expenditure delay*)

A Barley Cracker comes in the production line first, then the Grist Conveyance system. A "Disk and Chain", or "Disk & Cable" type conveyance system is expensive, and is not typically relevant to breweries at the 15bbl or less scale. These type conveyance systems are key when you have a conveyance run in excess of 75 feet, especially with multiple horizontal turns. These systems are easier on your grist during the conveyance, thus minimizing influence on your crush such as increasing the percentage of smaller particles and powder. Flex Augers are a common type of conveyance system for conveyance runs of 75ft or less with no horizontal turns. These are reasonably priced at approximately \$1500, and Forgeworks can provide you with a sample parts list. We recommend using the product from Farmer Boy Ag, Model 350.

<https://www.farmerboyag.com/flex-augers-parts>

This grist conveyance product marries up perfectly with the Forgeworks Barley Cracker 1200, and you buy it direct and save at least \$150.

Grist Hydrator (*\$650 expenditure delay*)

-These go hand-in-hand with having an auger. You can make a case for having this be the third item you bring on in the grain handling department. Mill first, Conveyance second, and Grist Hydrator third. With a mill and an auger, you can still get by for a while without a Grist Hydrator. When you buy our Mash

Tun, we equip it with a 4" Tri-Clamp ferrule that will fit many popular grist hydrators on the market, including our very own Forgeworks version.

Keg Washer (*build your own for around \$200, and don't pay \$4515-11,900 at start up*)

This equipment is essential for the brewery, and there are many to choose from on the market. Forgeworks doesn't offer this in our fabrication line up, and we also feel like offering this resale would only be yet another opportunity for us to be a disservice to your future trouble shooting and your pocket book. We have researched pricing on these and have found they range from \$4515-\$11,900.

You can also make your own with ordinary parts available from brewery fittings suppliers. This can get you by until you are brewing 3-5 times a week or more.

Here are some video demos of this brewery made Keg Washer:

<https://www.youtube.com/watch?v=Bl6pxAV32t4&t=2s>

<https://www.youtube.com/watch?v=K6Mx0HHSr1E>

Keg Washer Parts List

Manifold <http://www.gwkent.com/manifold-1.html>

Elbow (2) <http://www.gwkent.com/elbow-tc.html>

Butterfly <http://www.gwkent.com/tri-clamp-butterfly-valves-plastic-handle.html>

Sankey Tap <http://www.gwkent.com/beer-keg-coupler-american-sankey.html>

Beer Nut ball valve (2) <http://www.gwkent.com/beer-line-ball-valve-stainless-steel.html>

Pressure Gauge <http://www.gwkent.com/digital-sanitary-pressure-gauges-1.html>

TC to make CO2 Adapter to Ball Valve <http://www.gwkent.com/female-adaptor.html>

Ball valve for CO2 <http://www.gwkent.com/ball-valves-nptf.html>

TC Hose Barb <http://www.gwkent.com/hose-barb.html>

You will also need braided hose from hardware store to attach sankey valve to TC Hose Barb – use 5/16 hose. On the exhaust part of the sankey valve use 3/4 inch braided hose.

For the pump, use your sanitary centrifugal brewhouse pump, 1HP.

This bit on a brewery made Keg Washer was provided to us from Tom Hennessy, a well known brewery consultant that has had his hand in over 90 Brewery Start Ups, and whom has owned and sold at least (4) Brew Pubs. He is a well known author and speaker at GABF and the Craft Brewers Conferences. He is partly responsible for the beginnings of Bennett Forgeworks developing our line of Forgeworks brewery equipment.

Here is a link to books authored by Tom Hennessy"

<http://www.breweryoperationsmanual.com/>

Tom Hennessy also offers a three day "Brewery Immersion Course" on small commercial brew pub type operations, including brewing and the front of the house particulars. The cost is \$2500 for two people, and is well worth the investment. This knowledge will save you thousands of dollars on start up costs, and thousands more in the long run. He offers a number of locations to conduct this course, as he matches the location closest to what your intended business model is. Three of the 5 locations have a Forgeworks 7bbl Brewhouse, and all three of these locations are within 30 miles of our fabrication facility in Ridgway, CO, one being next door and another three blocks away.

<https://www.coloradoboy.com/immersion>

Cold Room *(check into the CoolBot product, and possibility of a DIY built cold room)*

We have heard many times that building the largest cold room possible for your space is something you will never regret. This can certainly be challenging with both budget and space. One thing you can do to make your cold room a bit more affordable, no matter what size you are able to swing, is by cooling it with a standard window air conditioner, with the use of the CoolBot (\$349). Made in the USA. See the link below.

<https://www.storeitcold.com/product/coolbot-walk-in-cooler-controller/>

Spend less or Re-appropriate?

We trust this document helped significantly in either your spending less on your start up, and/or finding areas to re-appropriate dollars for other important components of the brewery and front of the house. If you have shopped a few US fabricators on their Brewhouses, you have found that we are reasonably priced. We are in the business of building Sexy, Burley, and Beautifully Basic Brewhouses (and a workhorse of a Barley Cracker too). With our competitiveness in the brewery equipment marketplace, combined with our helping spent less in many areas of your start up, we think you will be motivated to place us on your short list, and certainly hope we have begun to earn your trust. For all the ancillary items we offer to support the brewhouses we fabricate (parts, pumps, heat exchanger, etc.), we keep the margins as low as possible to make the convenience of ordering as many components from one supplier reasonably priced.