TOWARDS A SOLAR POWERED DREAM IN HIGH PARK

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Abstract

For the 2015 edition of Canadian Stage Company's annual Dream in High Park, I was invited to join the production team as Lighting Designer for the two plays in repertory that summer, *The Comedy of Errors* and *The Tragedie of Julius Caesar*, as my thesis project. As part of the thesis, I was asked to approach the project through the lens of environmental sustainability of the lighting design and posed the question "Could the Dream become solar powered?". What started with two plays and that query has led to a long process of examining my own priorities as a lighting designer trying to balance sustainability and artistry. Rather than a purely design driven thesis, this paper details my approach to sustainability from those 2015 Dream productions through to the present day.

Dedication

To my family – especially my wife Giselle and my mother Judy for their love, support, patience and for giving me that extra push when I needed it.

Acknowledgements

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I am grateful to Alan Ross, former Production Manager at Canadian Stage Company, for offering me this opportunity to work in High Park and to former Technical Director Billy Wolf for supporting me wholeheartedly in my pursuit of reducing power consumption.

To all the staff at Canadian Stage Company and the production team in the Park – thank you for being incredibly welcoming and generous with your time.

It was a privilege and a pleasure to work alongside some of the most talented designers in the country – thank you to Teresa Przybylski, Sean Mulcahy, Michelle Tracey and Lyon Smith.

Thank you to Cole Vincent for volunteering his time as my Assistant Lighting Designer on this project. His diligence with tracking levels and note-taking made my life so much easier.

Finally, thank you to the Kyle Morton at AC Lighting for your generous loan of gear for the summer and to Greg Wilkie at Solotech Toronto for going above and beyond to put together a rental package which helped fulfill many of the sustainability goals while fitting it into our relatively miniscule budget.

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Introduction

One of Toronto's most beloved traditions every summer involves upwards of about a thousand people congregating in a magical clearing in High Park surrounded by massive red oak trees, to see some of the country's most well-respected actors interpret William Shakespeare's plays. Produced by the Canadian Stage Company, the *Dream in High Park* has continuously evolved over the years – from runs of a single Bard play to a rep season of two plays to a mini festival of theatre, music and dance, and now back to a single run of a Bard play again (with occasional special events thrown in for good measure).

In 2010 Canadian Stage and York University formed a partnership around York's Directing MFA program where students in the program would direct the High Park shows for their final thesis project. When I was subsequently approached about designing the lighting for the 2015 season as my own thesis project, I agreed while acknowledging that this wouldn't be a simple, straightforward lighting design. At the time I was there, the MFA Design program at York was subtitled "Sustainable Theatre Design" so I was challenged to look at the lighting design through an environmentally conscious lens.

I should mention that at this point the Dream in High Park was briefly renamed to Shakespeare in High Park for several years, including the time of these two productions, but in recent years has reverted back to its original name so that's what I'm using here.

One of the things which had often struck me about the lighting of plays I had seen in High Park is the sheer number of fixtures required to illuminate the stage under a daylight sky. When the shows open in late June/early July, the days are quite long, the sky is bright and, for

roughly the first hour, stage lighting seems almost redundant. On even the cloudiest, darkest days you can easily see everyone onstage.

As retired York University Professor Peter McKinnon pointed out in one of his History of Visual Sources lectures ("Vis" for short), we live in a very bright time. Candlelight has given way to gaslight, gaslight to the electric tungsten light and now incandescent tungsten light bulbs are slowly being phased out to be replaced by short arc, laser and especially LED (light emitting diode) sources. While these technologies have been around for ages, more recent developments in the past decade or so have led to more widespread use and generally, brighter and brighter lighting fixtures - not just in the theatre but in homes, factories and even on the streets.

For my central thesis question "Could the Dream become solar powered?" I wanted to consider a number of options. We knew the chance of actually having solar panels brought into the park would be unlikely so the question became largely about reducing electricity consumption as much as possible without sacrificing the artistry and integrity of the lighting design.

As LED stage lighting was becoming more and more prevalent, it was acknowledged from the get-go that LED fixtures would be the preferred light source - assuming they fit within our budgetary limits and fulfilled our artistic needs. But, I was also very interested in the concept of reducing the overall brightness of the lighting and possibly even having very minimal, if any, stage lighting for that first half hour or so of each performance while daylight

still persisted. That turned out to not align with at least one stakeholder involved in the production but we'll discuss that further in a later chapter.

The two shows performing in rep that season, *The Tragedie of Julius Caesar* (which, from here on out I'll refer to as *Julius Caesar*) and *The Comedy of Errors*, are perhaps as far apart thematically and tonally as any two of Shakespeare's plays can be. The approach of the two directors, Matjash Mrozewski and Estelle Shook, respectively, was also quite distinct which meant coming up with a flexible repertory lighting rig which would serve both shows with a minimum of changeover time.

The set for both shows was designed by Teresa Przybylski, also a retired York University professor, and centred around a relatively sparse, bare deck which did away with the usual balcony tier often associated with the High Park stage and instead framed the performing area with a leafy backdrop which could be very present or blend in with the venue's surrounding forest depending on the lighting. Przybylski also designed distinctive set pieces which anchored the visual identity of each play.

As staged, there was a significant time gap between the periods of the two shows. One of Shakespeare's earliest plays, *Comedy of Errors* is originally set in ancient Greece but Mrozewski transposed it to fin de siècle Venice of the late 19th Century. Sean Mulcahy's costume designs play up differences both subtle and bold in the styles of the characters from Venice and their unannounced visitors from the Americas with a colour palette ranging from intense reds and golds to more neutral browns and beiges.

On the other hand, Shook opened *Julius Caesar* quite firmly in its original time and place (Rome, 44BC) until the action takes a radical shift after Caesar's assassination and we find ourselves in the modern-day Occupy Movement which was still in its waning days when this production was staged. Designer Michelle Tracy costumed everyone but Caesar in white togas with red accents which the cast doffed after the murder to reveal contemporary khaki, denim, and dark hoodies.

Just as I acknowledged that the practical portion of this thesis project would not be a straightforward design, I'll also mention that this document will not be a typical look into the design process. Rather, it will touch upon the design considerations of the two plays while focussing on the central question of whether it would be possible to power the Dream in High Park exclusively with solar energy.

Chapter 1 – Getting Started

Lighting Design Philosophy – *Comedy of Errors*

Mrozewski's directive was to largely paint the stage with broad strokes of light, keeping the stage relatively bright so we didn't miss any of the humorous shenanigans while using colour to take us through a full cycle of evening to night to morning and back to early evening. Przybylski designed a series of four black and white printed panels which, although they were a bit on the reflective side, took the coloured light quite beautifully once the sun went down.

Although not as imperative as time of day, lighting would also help to denote place – from the seemingly endless Venetian canals to an intimate café or salon. The biggest challenge with this piece was to create that sense of moving time – especially when it got later into the night – while also keeping the stage brightly lit.

The lighting colour palette was dominated by pinks, blues and cool whites – colours, it turned out, that the LED fixtures we ended up using were able to radiate quite effectively.

Lighting Design Philosophy – *Julius Caesar*

Whereas the lighting approach to *Comedy* was focussed on denoting time and place, the emphasis in *Caesar* was predominantly about evoking mood and atmosphere while also moving seamlessly between quiet isolated moments of tenderness and loud, epic crowd scenes. Unlike *Comedy of Errors*, which confined the performers to the stage proper, Caesar engulfed the entire amphitheatre in the action. Shadow play was also discussed right from day one so

footlights and other portable lighting sources were considered. The colour palette was mostly blue and cold white with hits of red.

Site Considerations

As already mentioned, the Dream amphitheatre sits in an isolated wooded area of High Park. In 1983, Toronto Free Theatre produced the first show here, *A Midsummer Night's Dream*, on the eastern slope of Hawk Hill. For the first decade or so it was literally just that, a hill, until the City of Toronto terraced the slope for seating in 1997 and a permanent stage was added in 2005. With considerable investment by both CanStage and the City of Toronto, the site has evolved to its present configuration with a fair amount of infrastructure in place to facilitate an easier load in and set up each year. This includes separate power disconnects for stage lighting and site operations as well as cement podiums for vertical truss towers which serve as the FOH lighting positions. There is also a permanent control booth installed at the back of the audience.

Even with the amount of infrastructure that exists, a lighting install at the site has many inherent challenges. There is no power, data or circuit cabling run so any cabling, especially at front of house, must be trenched/buried and except for the control booth, there is no shelter from the elements. As anyone who has spent a summer in Toronto can attest, rain is a constant threat – even on the most beautiful sunny days. Proper power grounding is an absolute must and for electronic devices (such as LED lighting fixtures) which are not weather rated to at least IP 65, some form of rain-cover or enclosure is a necessity.

All that being said, sitting out under the stars while building cues and making notes through tech rehearsals can be quite lovely, at least until the mosquitos arrive. Luckily, CanStage has found a bug repellent which seems to work (at least most of the time) and they keep a good stock of it onsite. One other perk, which I frequently took advantage of, was the gas barbeque backstage.

Lighting Gear Considerations

Rather than strip gear out of Canadian Stage's other venues, especially the Berkeley Street Theatre, to supply the Dream, Canadian Stage has mostly relied on a rental package each year for lighting and audio. According to former Production Manager Alan Ross, there are a number of reasons for this including scheduling conflicts with current shows and the suitability of gear they own for the often harsh outdoor conditions.

Since the early days of performances in the park, the PAR 64 has reigned as the workhorse fixture of choice for most of the lighting designers who have lit productions there. They're lightweight, bright and most importantly, they'll work in even the most horrendous of weather conditions. In Chapter 2 we'll take a closer look at the lighting gear used for several of the early Dream in High Park productions.

In the current market, there are literally dozens of outdoor-rated static and automated LED fixtures available. Many of the major brands will put out IP 65 variants of their most popular models or have an entire range of fixtures just for outdoor use with some even going an extra step to IP 66 rating for the permanent outdoor installation and for the cruise ship market.

Unfortunately, in 2015 the options for outdoor rated theatrical LED fixtures was much more limited. Given the repertory setup of the season and the disparity between the two productions, my plan was to have a small number of automated moving head spots in the rig but, at the time, there was really only one suitable IP 65 rated automated fixture available on the market. Danish manufacturer SGM had released the G Spot in 2013 to much fanfare and claimed it was the World's first IP 65 moving head – even going so far as to have one running in the middle of a fountain during the Prolight and Sound Trade Fair in Frankfurt that year.

Although the fixture caught on with rental houses quite quickly, sadly, no one in the Toronto area had added any to their rental inventory yet. After much back and forth and negotiation via email with SGM's Business Development Manager in Denmark, it became clear that, with no local supplier, the G Spot was not going to fit into our budget, so it was time to come up with an alternative plan if I was still going to have any moving lights in the park.

Fortunately we fared much better with static LED's. Local Toronto manufacturer AC Lighting had recently released the Chroma-Q Color Force Compact – the first IP 65 rated fixture in their enormously popular Color Force line. It featured RGBA mixing and a relatively high Color Rendering Index (CRI) of 92. They also had one of the first rechargeable, wireless LED fixtures on the market, the Color Charge. AC Lighting's Technical Sales Manager at the time, Kyle Morton, is a York University Theatre graduate and facilitated the loan of 40 Color Force Compacts and 15 Color Charges for the entire summer run of the shows and these became the backbone of the lighting rig.

Now that we had a substantial portion of our lighting system donated for the summer, I returned to my hunt for affordable moving heads and other fixtures to round out the lighting plot. Montreal based Solotech had recently set up shop in Toronto with their acquisition of Midnite Hour Productions, one of my long-time suppliers and occasionally, employer. My Account Manager at the time, Greg Wilkie, and I bounced options around for a couple weeks before settling on German Light Products (GLP) Impression Spot Ones for the moving spots I was determined to have in the rig. The Spot Ones were actually one of the earliest LED profiles on the market and feature RGB color mixing and a zoom range of 10 to 32 degrees. I was also able to squeeze three JB A7 moving wash fixtures from JB Lighting into the budget. These were also RGB and very lightweight (17 lbs/8 kg) which was important as I wanted to hang one from a wall structure upstage centre which would not be able to handle a heavier fixture like the Spot One (48 lbs/22kg).

Since I was not entirely confident that the LED fixtures that I had at my disposal would give me enough front light (a fear that turned out to be completely justified), I also added half a dozen each of Source Four ellipsoidals and PARs to the Solotech rental package for FOH, along with a handful of additional Source Fours as specials and aisle lights for the action in the audience. Canadian Stage also graciously supplied me with 12 PAR 16 Birdies which we used as footlights.

Once the gear was confirmed we still had a couple challenges in regards to weather rating. While much of the rig was fine to deal with the elements, the moving lights were not nor were the power supplies for the Color Force Compacts – even if the fixtures were IP 65. For the moving lights, Canadian Stage's Technical Director Billy Wolf had their shop fabricate simple

wooden covers which sat above the fixture and shielded the most fragile electronics from rain. These worked well and from the reports I received, we only had issues with two or three fixtures throughout the entire summer. For added protection, the crew would bag the most exposed fixtures each night if precipitation was in the forecast.

We put the Color Force power supplies in large Rubbermaid containers with carefully cut-out holes for cables. Similar to a scroller PSU, the Color Force Compact power supply sends both power and data down an XLR 4 cable and up to 5 units can be daisy chained per line. While we had no trouble keeping fixtures or power supplies dry we learned a valuable lesson about cable connections – the crew had done their best to tape every XLR4 connection, but we found that moisture would still get in and eventually cause shorting issues. We discovered that we were better off leaving most of these connections un-taped – this way at least any water or moisture which did get in would eventually evaporate. In the years since, I've found small, inexpensive plastic covers which snap around the cable connections and do a much better job of keeping moisture out than tape ever would.

Chapter 2 – A Sustainable Approach

Why is Sustainability Important?

We could quote any number of scientists about the reality of climate change or we could just take a look at the world around us and realize that it is definitely getting hotter out there. The numbers don't lie, and they tell a chilling, or rather, warming tale – according to the US National Oceanic and Atmospheric Administration, the Earth's temperature has risen by an average of 0.06° Celsius per decade since 1850, or about 1° Celsius in total while the rate of warming since 1982 is more than three times as fast. The ten warmest years in the historical record have all occurred in the past decade (2015-2024) with 2024 being the warmest year since global records began in 1850. And this is not just a regional phenomenon – 2024 was the warmest year on record for both the Northern and Southern Hemispheres individually as well as for land and ocean areas individually.

Of course, there are many who claim that this is a natural cycle and not human-produced but the overwhelming opinion of climate experts would argue other wise. According to a 2023 report from the Intergovernmental Panel on Climate Change, the United Nations body for assessing the science related to climate change, there is no debate about the cause of this warming trend:

> *Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020.*

Once we accept that emissions of greenhouse gases are the primary culprit then we must look at what the sources of those gases are. Many people guess transportation, especially cars, and they would be correct for the United States and several other countries but, globally electricity and heat production are the largest contributors to emissions. In Canada, we've been fortunate to see a steady decline of greenhouse gas emissions from the electricity sector since 2003 – largely due to the shutting down of many coal burning plants. From 1990 to 2023, this sector had reduced those emissions by 48%.

Canada is one of the world's leading producers of hydroelectricity which accounts for about 60% of all electricity generated in the country. Fossil fuels come in second at about 19% (split mostly between coal and natural gas), while nuclear power is close behind in third at 16%. Renewable sources (outside of hydro) account for only 5.2% with much of that capacity coming from wind energy. While hydroelectric generation might seem like a panacea, it does come with its own set of problems including ecological influences on wildlife and fish not to mention the displacement of human habitats – quite often those belonging to First Nations. The recently completed Site C Dam in British Columbia is but one example of the long-term consequences of a massive hydroelectric project.

Location is also a challenge with hydro – you can only build these dams and generating stations in suitable locations and that may be nowhere near where you need the power. There's also no guarantee that the water will flow forever – one dry season could be disastrous for a community which relies solely on hydroelectricity and thanks to climate change and global warming, huge swings in conditions from flood to drought have become the norm in many parts of Canada and the world. It seems like only yesterday that the Lower Mainland of British

Columbia was experiencing the now infamous “heat dome” of the Summer of 2021 with temperatures approaching 50° Celsius only to followed that Fall by the equally infamous “atmospheric river” which caused unprecedented flooding.

The existing hydroelectric dams may not be going anywhere soon but, if the proliferation of other more ecologically friendly and renewable sources of electricity like solar and wind could speed up, perhaps we wouldn’t need to keep spending billions of dollars building these massive dams which force both humans and animals to relocate.

So, while renewable sources of power like solar and wind are a key component of reducing greenhouse gases and slowing climate change, reducing our electricity usage also plays a key role and, in the short term, should be a more easily obtainable goal.

When we come back to the central thesis question about powering the Dream using solar power, in a perfect world this wouldn’t even be a question because the governments and utilities would convert the entire grid to renewable sources and that would be that. For the purposes of this exercise, however, we’re realistically assuming that this won’t be happening anytime in the near future and investigating the feasibility of a more localized solution.

Why Do We Need Stage Lighting When the Sun is Still Out?

As I stated in the Introduction, my initial approach to cut down on electricity usage was to use as little lighting as possible, or none at all, at the start of each production – at least in the early days of summer when the sky was still quite bright. As the plays progressed into the evening dusk, daylight would imperceptibly give way to artificial light.

At Shakespeare's Globe in London, the famous reconstruction of the Globe Theatre where Shakespeare debuted many of his works, daytime presentations have traditionally used no artificial light, relying on the open-air design to allow daylight in just as the original Globe would have in Shakespeare's day. However, the original Globe only staged afternoon shows while the modern theatre-goer usually prefers to attend in the evening. For performances after the sun has gone down, Shakespeare's Globe has floodlights installed which mimic daylight throughout the entire venue – part of the mandate of the organization being that programming should be structured around "shared light" (i.e. the stage should be no brighter than the audience).

Given that Shakespeare's plays had traditionally been staged under these conditions, it seemed like a way of not only being friendly to the environment but also being true to the history of these works. As we got into staging and lighting levels, I realized I was fighting a losing battle on this front. The directors, both of which had tentatively bought into this notion of starting under natural light, were swayed to change their mind by their mentor, Peter Hinton, who had directed several shows in High Park himself (including *The Comedy of Errors* in 1990). Hinton believes strongly that audiences will lose focus if the stage is not brightly

illuminated right from the start. So, somewhat begrudgingly, I did what just about every lighting designer at the park did before me, I threw as much light at the stage as I possibly could. Looking back, I'm not sure if this was the right move or not but, it certainly saved me some work later in the summer when Canadian Stage traditionally brings in the lighting designer to adjust the lighting levels for the shorter days and earlier sunsets which herald the approaching Fall.

Somewhat ironically, almost the exact opposite situation occurred at Shakespeare's Globe not long after my experience in High Park. In 2016, newly appointed Artistic Director Emma Rice staged a production of *A Midsummer Night's Dream* which featured a full theatrical lighting system for the first time in that venue's history. Although the show was a hit and attracted a whole new audience to Shakespeare's Globe, it was announced that Rice's contract was being terminated less than two years into her mandate. In his statement regarding her termination, Globe CEO Neil Constable wrote:

> *The Globe was reconstructed as a radical experiment to explore the conditions within which Shakespeare and his contemporaries worked, and we believe this should continue to be the central tenet of our work. Whilst the realisation of Emma's vision has been a vital part of our continuing experimentation as a theatre, we have now concluded that a predominant use of contemporary sound and lighting technology will not enable us to optimise further experimentation in our unique theatre spaces and the playing conditions which they offer.*

So, in other words, while I was pushed to use artificial light where I felt it wasn't necessary, it appears Rice lost her job for adding artificial light when her employer felt it went against the principles of the organization. Of course, as with most decisions at this level there's

probably much more to the story than we'll ever know but who knows, maybe it was just about the lighting.

Can We Have Sustainable Lighting without Throwing Out Our Old Fixtures?

As a lighting designer it can be hard to justify what we do as environmentally friendly, no matter how hard we work to reduce our power consumption. Even the smallest of theatres putting on a show will naturally use more electricity than the average home, corner store or coffee shop. It can become a crisis of conscience as a designer trying to balance sustainability with artistry.

In the book Sustainable Theatre, renowned (and recently retired) British Lighting Designer Paule Constable talks about taking responsibility and reconsidering standard practices:

> *Every light in the rig needs a clear use and purpose. When deciding on equipment I consider what energy a luminaire uses and if the brightness is needed. Does that unit have to be tungsten? I consider whether I can achieve the same effect with a lower powered yet bright discharge unit. I consider the best practices regarding the length of time the rig is on and attempt to only power up the rig as and when it is necessary. I discuss with my production electrician how accepted practices might change to cut down on wastage: can we use rubber straps made of old bike tyres? Velcro straps to attach cables to bars? Cable tray? What is possible?*

I find a certain amount of comfort in Constable's words even while she challenges us as designers to essentially rethink our practice. As long as the decisions we make are well informed and deliberate then we should have no trouble defending them if they serve the production.

The new tools which technology has made available to us – ultra-bright moving lights, colour changing LED's – these are all amazing tools to have in our toolbox but that doesn't mean we need to throw out the old tools. Live theatre itself is a testament to this – or we would have stopped doing it with the invention of the television. The TV may be a more efficient way of delivering art and entertainment but it's no substitute for being in the same room with a bunch of people experiencing live actors, dancers or singers expressing the full range of human emotion.

Carpenters always talk about choosing the right tool for a job and as a Lighting Designer, it's up to us to do the same and go through the same thought process which Constable details above. If a power-hungry lighting fixture is the right tool then that's what you choose but only after considering the alternative.

There is a push within the industry to extend the life of older fixtures by offering retrofit options. ETC's Source 4WRD is probably the most visible and commercially available manifestation of this – an easy and relatively inexpensive way for a venue to convert their existing inventory of Source Fours to LED. There are also smaller companies and even individuals who have designed and built LED retrofit kits for everything from 1960's era Strand Patt 123's to arc-source moving lights from the mid 1990's. This was actually happening as early as 2005 when lighting designer Leroy Bennett had Upstaging, an American rental and production company, convert a couple hundred arc-source Martin MAC 300's to LED for Paul McCartney's US Tour. This was done mostly for the esthetic purposes over sustainability concerns but one unintended benefit was that those fixtures now used about a third of the electricity than they used to.

Despite these efforts, I regularly see posts on social media of theatres and rental companies “proudly” showing bins of older lighting fixtures bound for the scrap yard - usually with a proclamation about how exited they are to be “going green” by buying all new LED fixtures. Now, don’t get me wrong, just as there is with household appliances, cars, etc. there is a natural life cycle for lighting fixtures and when they reach the end of that life, hopefully the metal can be recycled or the entire product upcycled into something else – for instance, as much as I love using PAR cans as fixtures, it’s also kind of fun when people turn them into planters. It is, however, frustrating when the fixtures they’re throwing out look like they might still have a few years of life in them. Hopefully the venue has held onto a few of each type for designers like me who just want another tool in the tool box but, for the perfectly good fixtures they’re throwing out, it would be nice if they reached out to a local school or community theatre before binning them. In Vancouver, we have a stagehand who is very well-known around town for his efforts to rehome gear which is bound for the junk yard and I’m sure the dozens of teachers and amateur producers he’s helped will be forever grateful.

To summarize, as artists, Lighting Designers should have access to all the tools, both new and old, as long as they have fully considered the ramifications of their choices. In some cases, older fixtures may have outlived their day-to-day usefulness but may be the only solution to a design challenge, or, there may be environmentally friendly options to extend their life (ie. an LED retrofit).

Chapter 3 – Looking Back and Moving Forward

Is Tungsten Theatre Lighting Dead?

In a word, no, despite many predicting its imminent demise and some even praying it comes soon, there are just too many incandescent tungsten fixtures out there lighting stages all around the world. For instance, in just over 30 years ETC has sold more than four million Source Fours and, even if a conservative estimate says that a quarter of them have been either scrapped or converted to LED, that leaves more than three million still in use.

Then there's everybody's old favourite, the PAR 64. While the lamps get harder and harder to find as many manufacturers have stopped making them, those with stock hoard and guard them as if they were Gollum holding the ring. While the larger touring rock shows have mostly opted for more efficient and flexible fixtures, there are exceptions. The most prominent of these over the past decade was Kanye West's 2015 Glastonbury performance and 2016 Saint Pablo world tour. For Glastonbury, Kanye performed under a massive rectangular array of nearly 800 PARs – all in open white. The subsequent world tour design was a variation on this but with West "surfing" over the audience on part of the rig. While these lighting rigs were far from environmentally friendly in terms of power consumption you could also argue that they kept a lot of metal out of the scrap yard - at least until the end of the tour.

Many lighting designers for contemporary dance still swear by the PAR 64 for backlight as it has a power, warmth and beam shape that no one has quite managed to replicate with an LED fixture yet. While it doesn't quite have the intensity of a 1000 watt PAR 64, some designers prefer the Source Four PAR which uses the same lamps as the Source Four ranging from 375 to

750 watts. Depending on the lamp used, these can reduce the amount of electricity use by more than half while retaining a similar beam shape and lighting quality of the original PAR 64.

While these are fixtures that have been around for decades, there are also younger manufacturers like Portman Lights which have proudly made innovative tungsten fixtures one of their signatures along with newer LED fixtures which do a fantastic job of replicating the warm glow of incandescent lamps.

The one thing which may hasten the death of the tungsten lighting fixture in theatres is government regulation. In the European Union, legislation in 2009 banned retailers from selling tungsten lighting for domestic use but, at the time, left an exemption open for theatres. There have been repeated threats that this exemption may be overturned at any time while other countries have also considered enacting their own bans. In the UK, The Association for Lighting Production and Design has largely spearheaded the campaign to allow theatres to keep using tungsten lamps under the #savestagelighting. At the moment there does not appear to be an imminent threat but that could change at any time as governments and committees change hands.

Evolution of the Dream Lighting from 1991 to 2024

So, just how prevalent was the PAR 64 in High Park throughout the years? Thanks to several lighting designers who volunteered to share their plots and equipment lists we're able to get a broad overview of the fixtures used and the potential electricity usage from some of the early shows in High Park in the 1990's right up until 2024.

Kevin Fraser, one of Canada's most venerated lighting designers, lit half a dozen different shows in the park between 1991 and 1999. He pointed out that there was a strong emphasis on the PAR 64 since that was the only fixture they had found in previous years that could stand up to outdoor conditions all summer. He remarked "IP ratings certainly existed but nobody at Canadian Stage, or I, had heard of them."

Fraser couldn't find an exact list from his first Dream show, *As You Like It* (1991) but recalled it being very simple and almost identical to the following year with approximately 100 PAR 64's and 3 Century lekos. In 1992, they ran two Shakespeare plays, *Henry VI* and *Edward IV*, consecutively in the park, both designed by Fraser with almost identical lighting plots due to the quick turnaround between them. That rig included 104 PAR 64's, 3 Century lekos, 21 floodlights and a small assortment of specialty fixtures including flat packs and star strobes.

For the next four years, Canadian Stage would do something they haven't done since – remount a High Park show the year after its initial run – *Twelfth Night* in 1993 and 1994 and *A Midsummer's Night Dream* in 1995 and 1996. For *Twelfth Night*, the rig was largely the same for both years with between 96 and 100 PAR 64's, a pair of Century lekos and some floodlights. For *Midsummer Night's Dream*, the number of PARs was reduced to 95. This is also the first High Park show to have a Source Four – one single 10 degree. The only other fixtures were a handful of floodlights along with 10 star strobes.

In another break from tradition, in 1999 the park would not host one of the Bard's works. Instead Canadian Stage presented the Canadian musical *Rock and Roll* by John Grey.

Fraser's rig for this show was slightly larger than previous years with 109 PAR 64's (including a dozen ACL's), plus another 18 smaller PAR 46's, 5 Source Fours and 10 star strobes.

Arun Srinivasan, Freelance LD and a graduate of York's Theatre program, lit *The Tempest* in 2009 and *Romeo and Juliet* in 2010. His lighting equipment list for both years were very similar as was the potential electricity consumption. A total of 83 PAR 64's was used both years with the rest of the rigs rounded out mostly by Source Fours (15 for *The Tempest* and 19 for *Romeo and Juliet*) with a handful of specialty fixtures including inkie fresnels and Atomic strobes.

Another York Theatre graduate, Logan Raju Cracknell has lit several recent shows in the park including last year's *Hamlet* (2024) and currently is about to open *Romeo and Juliet*. For *Hamlet*, Cracknell's rig included 37 Source Four PARs, 64 Source Fours along with a sizeable LED rig of 40 Chauvet Colorado 3 Solos and 14 Elation SixBars.

Based on the gear lists provided by each of these designers, a quick calculation shows the total potential electrical load for each production. Now, bear in mind, these figures are based on every fixture running at full output but, as previously mentioned that is often the case at the beginning of each show as the designers try to overcome daylight to make the stage brighter than the surroundings:

- *As You Like It* (1991) – 102.2 Kilowatts
- *Henry VI* & *Edward IV* (1992) – 111.2 Kilowatts
- *Twelfth Night* (1993-1994) – 100.2 Kilowatts
- *A Midsummer Night's Dream* (1995-1996) – 97.5 Kilowatts

- *Rock and Roll* (1999) – 117.2 Kilowatts
- *The Tempest* (2009) – 96.6 Kilowatts
- *Romeo and Juliet* (2010) – 97.5 Kilowatts
- *Hamlet* (2024) – 85.3 Kilowatts

As this data shows, even small steps like swapping 1000 watt PAR 64's down to 575 watt Source Four PARs can reduce power consumption considerably and doing so in conjunction with substituting even a moderate number of LED fixtures is a big move in the right direction. So, keeping those figures in mind let's look at our results with a largely LED rig:

- *The Comedy of Errors* and *Julius Caesar* (2015) – 24.1 Kilowatts.

That's a potential reduction in power load of between 72% compared to *Hamlet* (2024) and 80% compared to *Rock and Roll* (1999). Because the power feed for the Dream site is shared between production and operations we were not able to get a totally accurate reading on the actual power consumption of the lighting rig but I was informed that the overall site saw a power reduction of approximately 60% to 70% compared to recent years. This represents significant savings and, as you'll see in the upcoming section entitled **What Worked and What Didn't In 2015**, the advancements made since 2015 that have created better LED fixtures plus the abundance of newer IP 65 and IP 66 rated fixtures on the market would enable us to drop this power consumption even more.

Colour Rendering and LEDs

While tungsten light sources are still preferred by many designers and still in wide use in performance spaces the world over there's no denying that LED fixtures have been embraced by many as the future or, in many cases, the present, of theatrical lighting. Even a huge fan of tungsten warmth like myself has to admit that, in most cases now, I'd prefer the flexibility of a rig of colour-mixing LED's over one of single-purpose conventional fixtures. In the decade or so that I've been working with LED fixtures in earnest, the way they render colour has improved substantially but, in my honest opinion, I have yet to see one which makes skin tones look as good as an incandescent source.

While the colour rendering of LED's has improved steadily over the past decade, new methods of evaluating and recording colour rendition have been introduced to allow lighting designers to make better informed decisions when choosing fixtures. I mentioned CRI or Colour Rendering Index earlier when talking about the Color Force Compact fixtures and it is still widely referred to even as newer metrics like TM-30 are gaining in popularity.

CRI is expressed as a single number (Ra) and uses white light (usually tungsten or daylight) as its reference with a "perfect" score of 100. The source being tested is rated compared to a source of the same colour temperature based on the average of how well it renders 8 different colour samples. The higher the CRI number, the closer a fixture supposedly is to rendering those 8 colours identically to the reference source. Most LED fixtures which are

considered useable for theatre (especially for front face light) have a CRI of at least 85 and preferably more than 90 but, as we look deeper, we'll see that CRI values can be misleading.

TM-30 on the other hand, expands the colour sample count to 99 and is expressed as two numbers - the colour fidelity (Rf) and the colour gamut (Rg) – as well as a chart called the Colour Vector Graphic. The colour fidelity value is essentially the same as CRI's "Ra" value but the broader sample count and the addition of the colour gamut value is where TM-30 becomes a much more valuable metric and also demonstrates where CRI is severely lacking when it comes to judging the quality of light from an LED fixture.

The 8 sample colours referenced by CRI are all pastels and one of the most important colours for skin tone, Strong Red, is not considered unless you move into Extended CRI which looks at an additional 7 colour samples for a total of 15. Most manufacturers quoting CRI, unfortunately, avoid using Extended CRI and it's not difficult to manipulate their product's output to make those 8 pastels look really good while ignoring the rest.

With 99 sample colours, it's much harder to "fool" TM-30 since one low score on a sample can pull the Rf value down substantially. Meanwhile, the gamut value (Rg) evaluates how saturated the light is within a range of 60 to 140 with 100 being perfect saturation compared to the reference source. Values less than 100 are undersaturated while those higher than 100 are oversaturated. By looking at the Color Vector Graphic you can identify exactly which colours are over and under saturated – a black circle represents the reference source and an overlaid red circle shows where the tested source deviates from the reference.

Whereas the white light generated by a glowing filament (tungsten) or the sun (daylight) is considered full spectrum because it contains all the visible colours, LED's emit different colours of a very narrow spectrum. The LED chips used in lighting fixtures (theatrical or otherwise) create light by passing electrical current through a semiconductor "sandwich" and the colour or spectrum is determined by the semiconductor material. Up until 1992, there was no real blue LED and it was this development which made it possible for LED's to move beyond their use just as indicator lights for control panels, etc. To create a "white" LED with a broader spectrum the most common method is to partially treat a blue LED with a phosphour coating which emits a yellow-ish light when excited by the LED. The yellow light then mixes with the original blue light to create white. Cool white LED's naturally appear brighter than warm white LED's of the same power because more of the original blue light is being allowed to shine through plus, human eyes generally perceive cooler tones as brighter than warm ones.

All of the theatrical LED fixtures currently on the market typically use one of two methods to create white light – they either have the aforementioned "white" LED chip (phosphour treated blue) or, they additively mix the colours from various different LED chips. The first theatrical LED fixtures to hit the market in the early 2000's were wash fixtures which mixed red, green and blue LED's to create a very crude white light – in Canada these are often referred to as "Smarties" lights since the face of them resembles our favourite childhood candy. The white light from these fixtures usually have a pink or lavender tint. Subsequent developments would add white or amber chips and also start to introduce tri or quad LED's which were essentially multiple chips mounted to a single substrate so as to appear as a single colour changing source. With most of these early fixtures, you'd be hard pressed to hit a CRI of

80 with low to mid 70's being more common – assuming the manufacturer even mentioned a CRI value at all.

In 2010 we saw a handful of manufacturers including Robert Juliat and Prism Projection release profile or "leko" fixtures at the large trade shows and a year later, after years of folks asking when ETC would have an LED Source Four on the market, they finally jumped on board with the announcement of the Lustr+, the LED version of their extremely popular fixture. As the fixture developers discovered, the more different colours of LED you can mix, the broader the colour gamut you can create and the closer you can get to a decent white light by filling in holes in the spectrum. While most predecessors to the Source Four Lustr+ were still using either single white chips or up to five colour LED chips, the first generation of the Lustr+ used seven colours to achieve a relatively high CRI (up to 92).

While the release of the Lustr+ set a new benchmark for LED ellipsoidals, it didn't take long for ETC to announce the Lustr 2 in 2014. The new model swapped the white LED chip of its predecessor for a lime one which improved both the brightness and the colour rendition. It didn't take long to catch on and soon most of the manufacturers were adding either lime or mint chips to their colour mixing LED fixtures.

Lustr+ or Lustr 2 fixtures would have been a welcome addition to the lighting rig for the Dream not just for the excellent colour rendition but also because the lensing of an ellipsoidal fixture allows more control. Unfortunately, budgetary concerns and the lack of an outdoor rating had precluded their inclusion at the time.

Fortunately, the colour rendering of the fixtures we did end up with was fine for their intended purposes. As the workhorse fixture, the Color Force Compacts were able to wash the performance area and provide colour variety while also working well with the variety of skin tones present onstage. After a thorough search, I could not find any CRI ratings for either the Impression Spot Ones or JB A7's. The GLP website says that the Spot One has a "High CRI" – whatever that means. Since I was largely relying on these fixtures as specials and backlights, I was not as concerned with their colour rendition.

What Worked and What Didn't in 2015

In the earlier section on the evolution of the lighting in the park we determined that this experiment was certainly successful from a power saving standpoint but what about artistically? Were the fixtures we were able to procure the right choice for the job? Should I have added more conventional tungsten fixtures to the plot? If the budget was higher would that have made a difference? If I were to re-design the lighting today using newer fixtures, what would I choose?

While I was relatively satisfied with the final look of both plays, there were certainly times where I would have liked a bit more punch and a bit more control out of the Color Force Compacts. It was incredibly versatile having that many luminaires with color changing ability and for times when we went to more saturated looks, especially in blue tones, they worked well but, for times when I just needed bright white light, warm or cool, they didn't quite cut it. Part of this issue was that there were very limited beam options – the standard at 14° or by

adding an optional frosted optic filter you could get to 21°. Either way, it's a very soft edged beam and, due to the nature of "Smarties" type fixtures, you can't really shape them with barn doors like you can with a Fresnel of PAR. The throw from the furthest FOH trusses to the stage was about 45 feet and from that distance you really need something with a bit more defined beam if you want to have any chance of isolating an area on the stage but the Compacts were so soft you just couldn't get that kind of control.

If I could have added more conventional tungsten fixtures I definitely would have but the budget just wouldn't allow that without giving up something else – like the moving lights I fought so hard to get. I think another half dozen each of the Source Fours and Sour Four PARs from FOH would have been just enough to bump up the face levels where I would have liked them to be – especially for *Comedy of Errors* since it was a fairly bright piece to begin with. The other option would have been to go with arc source moving lights which might have proven more versatile with more brightness and better colour rendition – at the time there were a few I considered but they were all pretty power hungry and quite heavy except for Italian manufacturer Clay Paky's Sharpy Washes – a fantastic fixture that only used a 330 watt short-arc lamp. Unfortunately, Solotech would have had to bring them in from out of town which proved prohibitively expensive.

If I were to light these plays again with gear available now, and assuming I had either the budget or a generous rental company, it would be fairly easy to move to an all LED rig while cutting down the power consumption even more and, more importantly, achieving my artistic vision for the show. Without cutting or adding any fixtures, just swapping one for one, here are the substitutes I'd consider from currently available gear:

- ETC Source Fours (750 watt) -> ETC ColorSource Spot VXT's (238.5 watt)
- ETC Source Four PARs (750 watt) -> Chauvet Rêve P-3 IP PAR (274 watt)
- Chroma Q Color Force Compact (60 watt) -> Elation Fuze PAR Z175 (175 watt)
- Chroma Q Color Charge (100 watt) -> Chauvet Well Panel X (120 watt)
- JB A7 Moving Wash (300 watt) -> Chauvet Rogue Outcast 2X Wash (291 watt)
- Impression Spot One (600 watt) -> Ayrton Stradale (630 watt)
- MR16 PAR Birdie (75 watt) -> Gantom 7 (8 watt)

Total Wattage of new Fixtures = 19.8 Kw

The astute reader would have noticed that some of the LED fixtures I chose to replace the ones we used in 2015 are using more electricity. This has been one of the paradoxes of the rapid proliferation of LED lighting – in our constant quest for more brightness some of the newer LED's are approaching the same power consumption levels of the tungsten and arc-source fixtures they were designed to replace. In the case of arc-sources there can still be huge savings in the overall energy consumption because the LED does not need to stay "lamped on" constantly but it is somewhat ironic that regulatory bodies keep heralding the LED as the magic bullet to save electricity when some fixtures are using just as much.

The other paradox is that, given the traditionally low power consumption of LED's, we are lighting things up, especially buildings and other structures, which we never used to do. Cities all over the world are starting to look more and more like the Las Vegas Strip (or, for a more local reference – Honest Ed's) and, while architects and architectural lighting designers

tout the “environmental advantages of LED lighting” – the truth is they’re still using more electricity than if they just didn’t light the building at all.

Having determined that it’s possible to cut the electricity consumption by upwards of 75% to 80%, at least for stage lighting, in the next chapter we’ll look at the feasibility of powering it with solar energy.

Chapter 4 – Going Solar

Solar Energy – A Brief Primer

The principles which led to the development of the modern solar panel were first discovered in 1839 by French physicist Edmond Becquerel. He was experimenting with an electrolytic cell made of two metal electrodes placed in an electricity-conducting solution when he noticed that electricity-generation increased when exposed to light. Over the next century there would be several more promising discoveries made but it was the development of the silicon photovoltaic (PV) cell in 1954 by American scientists Daryl Chapin, Calvin Fuller and Gerald Pearson which truly revolutionized the solar energy industry and PV cells are still the most widely used form of solar energy generation in the world.

While LED's rely on semiconductors made from various materials to convert electricity into light, PV cells do the opposite – using silicon-based semiconductors to generate electricity from light. The early cells were not incredibly efficient and their earliest uses were for powering the electronics in satellites since the sun's rays were that much more powerful beyond Earth's atmosphere.

Today it is estimated that there is around 19,000 square kilometers of PV solar panels generating electricity all around the world. While individual home and factory owners have made sizeable investments in solar panels for their own use it is the proliferation of massive solar farms around the world which hold the true promise of a future which relies less on fossil fuels and more on the sun to provide our electricity needs.

Besides photovoltaic panels, there are other ways of using the sun to generate electricity. The most common is Concentrated Solar Power (CSP) which uses a massive array of mirrors to focus sunlight to a single point where it heats a working liquid to drive a turbine attached to a generator. CSP plants need direct sunlight so they generally work best in areas which receive little cloud cover (i.e. a desert) and require huge tracts of land to be viable so we will not consider them for this project.

Types of Photovoltaic Solar Energy Systems

There are essentially two ways of setting up a PV solar energy system – either as a grid-direct system or a battery system. In a grid-direct system, any excess power not being used at the source (for instance, a home with solar panels on the roof) is fed back into the main power grid and, if there is little or no sun, power from the grid can still be accessed. In a battery system, the excess power is used to charge batteries for later use – usually at night or on a dark, cloudy day when there is little to no sunlight to generate electricity. These systems tend to be used more in remote locations that are off-grid or in places that are prone to regular blackouts.

A grid-direct system's most obvious advantage is that you don't require massive batteries and you're also not at risk of losing power if you go through a long period of dark days. Of course, you can also use a hybrid combination of these two systems for ultimate flexibility, especially in the case of an unexpected blackout.

For the purposes of this exercise we shall be looking at a completely self-sufficient battery system which could, in theory, remove the Dream site from the grid completely or become part of a hybrid system.

Components of a Solar Power System

We've already talked about the most basic component, the PV cell. These cells are grouped together in modules which can then be wired and mounted together to form what we would commonly call a solar panel. You could build one massive panel to suit your needs but, more commonly, you would see a bunch of panels arranged and wired together into a solar array.

The power generated by solar panels is direct current or DC but the electricity grid and most electronics, including the LED lighting fixtures most commonly used to light shows, are alternating current or AC. To charging batteries, however, DC is fine. An inverter is used to convert the DC to AC – in a grid system the inverter is connected between the solar panels and the grid and in a battery system, it's used between the battery and whatever is being powered.

For the battery system we're contemplating, we would also require a charge controller which would connect between the solar panels and the battery to regulate the flow of electricity to ensure that we don't over-charge the battery.

Of course, if we're investigating a battery system we need a battery and the most common ones used with solar systems are lead-acid or lithium-ion (Li-ion). Lead-acid batteries

are still fairly common in permanent installations due to their lower upfront cost but in recent years, Li-ion have become the preferred battery type due to the fact that you can pack more energy into a smaller battery – they also charge faster and have a longer lifespan than lead-acid batteries.

The last components we would need is the hardware to mount the panels and the wiring to get the electricity where we need it.

Designing a Solar Power System for High Park

Since the Dream in High Park shows are only performed in the evenings, this means we wouldn't actually be using the power we generate from the sun during the day except to charge our battery. It also means we require a fairly substantial battery capacity since we can't generate solar power during the show. To determine our needs, we're going to work backwards – looking at the size of battery we need and then figuring out what size of solar panel array we would need to charge it based on the available sunlight at the site – with a contingency for overcast days or other unforeseen circumstances.

To calculate the capacity of the battery we need to take the total wattage of the lighting system, in this case we'll use our 2015 figure of 24.1 Kw and multiply it by the number of hours we'll be using it each day. Lately, Canadian Stage has been mounting longer versions of some of the Shakespeare plays and including an intermission but, for our productions, both plays were trimmed down to about 90 minutes straight through. Rounding this up to 2 hours knowing that we won't be running at full capacity all the time but also allowing time for the audience to exit

following the show. That gives us a total of 48.2 Kilowatt Hours (Kwh) that we would require for each performance day. For rehearsal and tech days, we'll triple the time to 6 hours which puts us at 144.6 Kwh and rounding this up to 150 Kwh puts us in the same ballpark in terms of battery capacity as many of the EV's on the road. Thanks largely to the film industry there are now several companies out there supplying batteries in this range to replace the noisy, polluting diesel generators which they used to use for shooting on location.

One of those companies is Greenwave Power Inc. Based in Vancouver with offices in Toronto and Los Angeles, they've been at the forefront of supplying "clean" power (i.e. no diesel generators) to events and film shoots for several years. Based on our power needs and desire to use solar energy for charging, Managing Director Chris Martz recommended their smaller Apollo series of batteries which come "solar-ready" with a built-in inverter and charge controller. Each of these batteries is rated for a capacity of 5 Kwh so we would be looking at 10 of these batteries running in parallel to supply performance days and 30 of them to keep us powered up during tech. If we want to ensure that we always have battery power in reserve, we could double or triple the number of batteries and alternate between sets of them.

Solar cells are most efficient when the sun is hitting them relatively straight on rather than at a steep angle. This why you occasionally see solar panels mounted on tracking arms which follow the sun or more commonly, on angled brackets on the roofs of buildings rather than just lying flat on the roof. At the Dream site in High Park, the tree canopy provides a fair amount of shade which makes finding any position for solar panels challenging, even if they were on tracking arms. Given the natural beauty of the site, it also seems wrong to spoil it by having solar panels everywhere – even if part of their purpose is to help save the environment.

One solution is to use portable solar panels which could be laid out on the stage and potentially even the audience terraces. These could be set up each night after a show to catch the sunlight the next day and then packed up when the crews arrive to start their preshow preparations in the early evening – by which point the sun starts to get too low to generate electricity as much as it did during the afternoon.

According to readily available information on the Natural Resources Canada website, Toronto averages just under 4 hours a day of peak solar hours when the sun is high enough in the sky to provide more direct solar radiation. Through my observations of how the sunlight traversed the sky over the park each day, there is an area of roughly 180 square metres that receive enough sun during those peak hours which could be covered by solar panels.

There are several manufacturers of small, portable solar panels including models which fold up or even roll up. I did a comparison of several brands and the average maximum power output is approximately 200 watts from 1 square meter of solar panel under optimal conditions. The Apollo batteries can use up to 4.4 kilowatts of power for charging and, if they are receiving that full amount, a single battery only takes about two hours to charge. If they are only receiving half that amount, say, 2.2 Kw watts, they would take twice as long – about four hours.

If we manage to capture a full four hours of peak solar energy with 180 square metres of solar panels, we're looking at a potential charging capacity of 36 kW. Divide that by 2.2 kW and, in theory, we can charge 16 batteries even if we're only running at half capacity.

Another option for the solar panels, and one which is quite popular in tropical locales which receive a lot of sunlight, is to build shades over a parking lot and cover these in solar panels. One advantage of this solution is that the panels could be permanent, and the electricity generated could be used for other purposes in the Dream's off-season. There is a fairly large parking lot just outside of the Dream site at the Grenadier Café which has space for nearly 150 cars and by my estimate, could easily be covered by 1200 square metres of solar panels mounted on shade structures. This parking lot is a couple hundred metres away from and across a major road from the performance site so this would be a major endeavour but there is definite potential to generate a fair amount of power – nearly 240 kilowatts during peak solar hours. In theory, this would be enough to charge over 100 Apollo batteries every 4 hours.

Chapter 5 - Conclusion

While the rig we used in 2015 achieved our goals in term of power reduction, I do know there was some frustration from the directors regarding the intensity of light at times where they just wanted a bit more. If I had written this immediately after that experience, my answer to the thesis question probably would have been a resounding “no” but, considering how far LED fixtures have come since 2015, I’m much more willing today to choose an all LED lighting rig than I was at that time.

If the last ten years are any indication, we’ll be seeing continued advancement in LED sources in the not-too-distant future. Other alternative sources, like laser and laser/phosphour, are also finding their way into stage lighting but, so far, their use has been mostly limited to effects and beam fixtures – especially in the United States where laser use is strictly regulated.

The math has shown us that there is certainly potential for solar power usage in the park, but it would require significant investments from Canadian Stage, the city of Toronto and the technicians/staff on site – especially in the case of the portable option which would need to be setup and struck each day. Given the unpredictable nature of Toronto’s summer weather, a stand-alone battery system may not be the best approach. A hybrid system which is still connected to the grid would be more practical – especially during tech and rehearsals when the hours of usage, and hence the required kilowatt hours, are quite a bit higher than regular performance days.

Whether Canadian Stage ever decides to pursue solar power or not hopefully, in the years to come prices for newer, IP65 rated LED fixtures will become affordable enough that,

even if they do remain connected to the grid, they can reduce the power consumption and get closer to our 2015 numbers than where they have been running for the past few years. While one company making a change like this may not turn the tide of climate change, it sets an example for other companies and individuals to consider their actions and, hopefully, adjust their attitudes and behaviours to put humanity on a path to an environmentally sustainable future.

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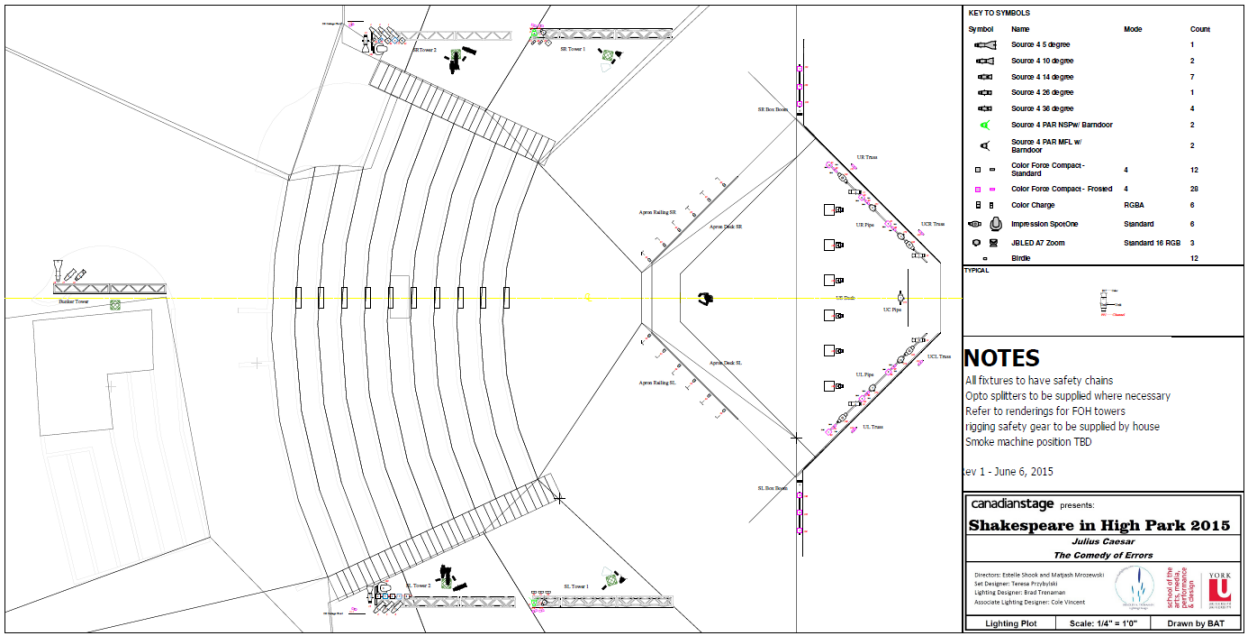
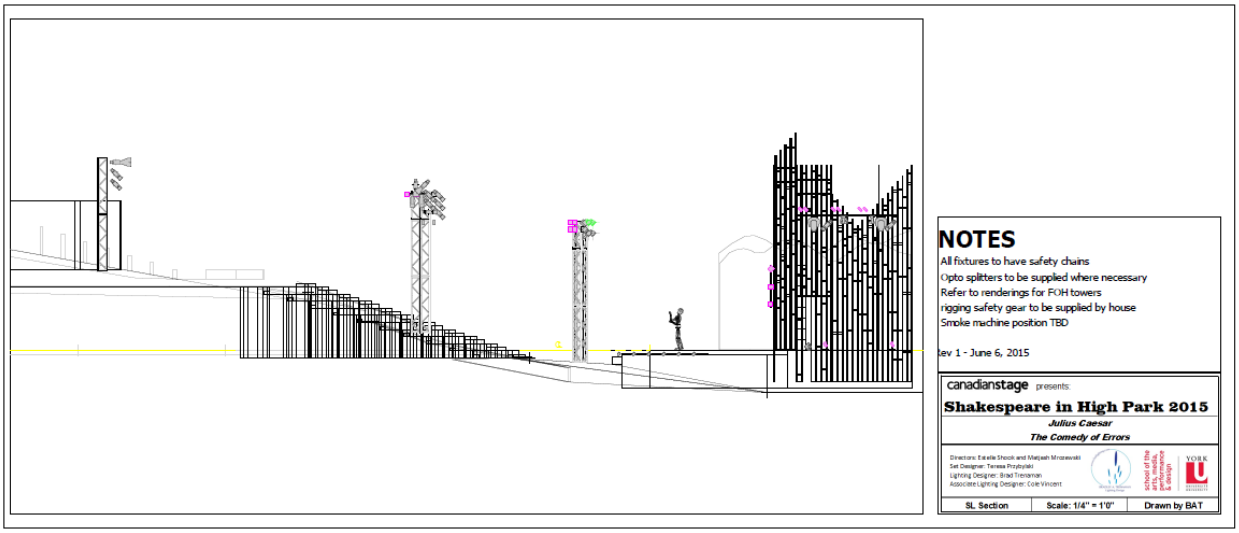
Appendix 1 – Lighting Plots and Paperwork

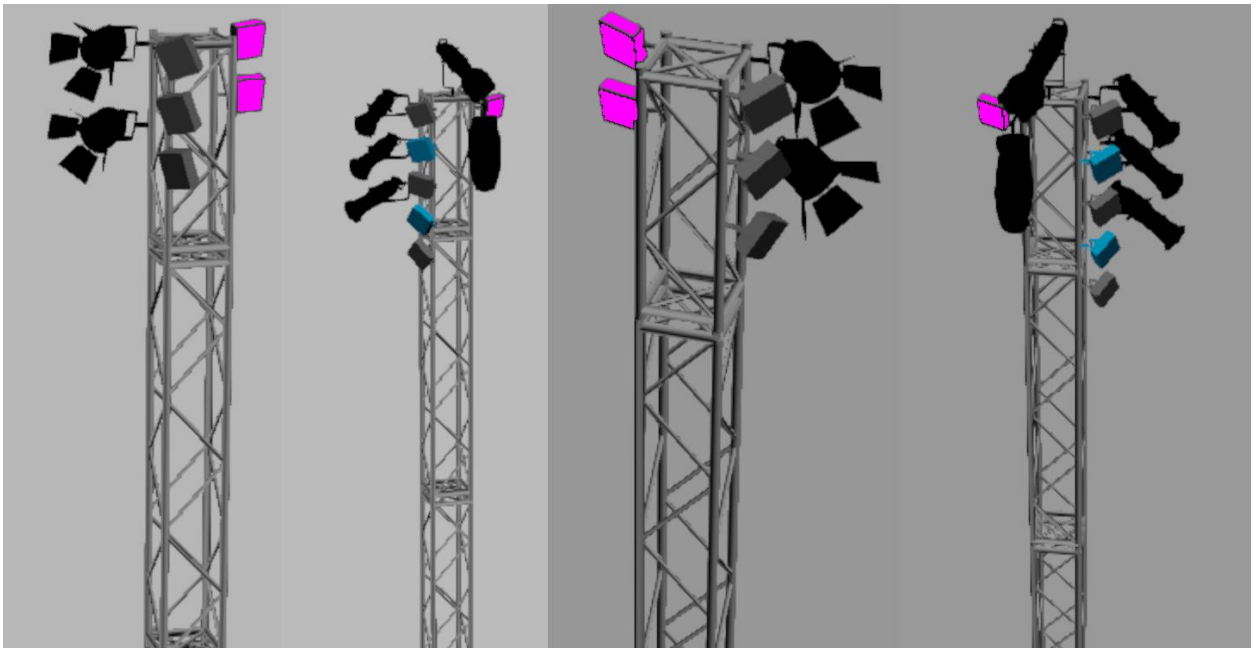
Lighting Plot



Stage Left Section



FOH Truss Tower Detail



SL Truss Tower 1 SL Truss Tower 2 SR Truss Tower 1 SR Truss Tower 2

Channel Schedule

3D Lighting

07/08/25

Venue: High Park Amphitheatre
Show: Shakespeare in High Park 201

Designer: Brad Trenaman
Associate: Cole Vincent

Channel	Patch	Purpose	Type	Lens	Position	Unit	Color	Gobo
1	A.10	DR Fill /	Source 4 750	14 Degree	SR Tower 2	11	L202 + R119	
2	A.9	DC Fill /	Source 4 750	14 Degree	SR Tower 2	10	L202 + R119	
3	A.8	DL Fill /	Source 4 750	14 Degree	SR Tower 2	9	L202 + R119	
4	A.2	DR Fill \	Source 4 750	14 Degree	SL Tower 2	9	L202 + R119	
5	A.3	DC Fill \	Source 4 750	14 Degree	SL Tower 2	10	L202 + R119	
6	A.4	DL Fill \	Source 4 750	14 Degree	SL Tower 2	11	L202 + R119	
7	A.12	UR Fill /	Source 4 Par	MFL	SR Tower 1	7	L202 & BD	
8	A.11	UL Fill /	Source 4 Par	NSP	SR Tower 1	6	L202 & BD	
9	A.5	UR Fill \	Source 4 Par	NSP	SL Tower 1	6	L202 & BD	
10	A.6	UL Fill \	Source 4 Par	MFL	SL Tower 1	7	L202 & BD	
11	A.22	Door 1 SR	Source 4 750	36 Degree	UR Pipe	8	R3202	
12	A.21	Door 2 CSR	Source 4 750	36 Degree	UR Pipe	1	R3202	
13	A.19	Door 3 CSL	Source 4 750	36 Degree	UL Pipe	12	R3202	
14	A.20	Door 4 SL	Source 4 750	36 Degree	UL Pipe	4	R3202	
15	A.1	Audience Platform <	Source 4 750	10 Degree	SL Tower 2	1	L202 + R132	
15	A.7	Audience Platform >	Source 4 750	10 Degree	SR Tower 2	1	L202 + R132	
16	A.15	Ctr Aisle Top	Source 4 750	26 Degree	Bunker Tower	3	L202 + R132	
17	A.14	Ctr Aisle Ctr	Source 4 750	14 Degree	Bunker Tower	2	L202 + R132	
18	A.13	DC Special	Source 4 750	5 Degree	Bunker Tower	1	L202 + R132	
22	A.18	Footlights SR	Birdie		Apron Railing SR	6	R3409 + R101	
23	A.17	Footlights Ctr	Birdie		Apron Railing SL	5	R3409 + R101	
23	A.17	Footlights Ctr	Birdie		Apron Railing SR	2	R3409 + R101	
24	A.16	Footlights SL	Birdie		Apron Railing SL	1	R3409 + R101	

Spot Schedule

3D Lighting

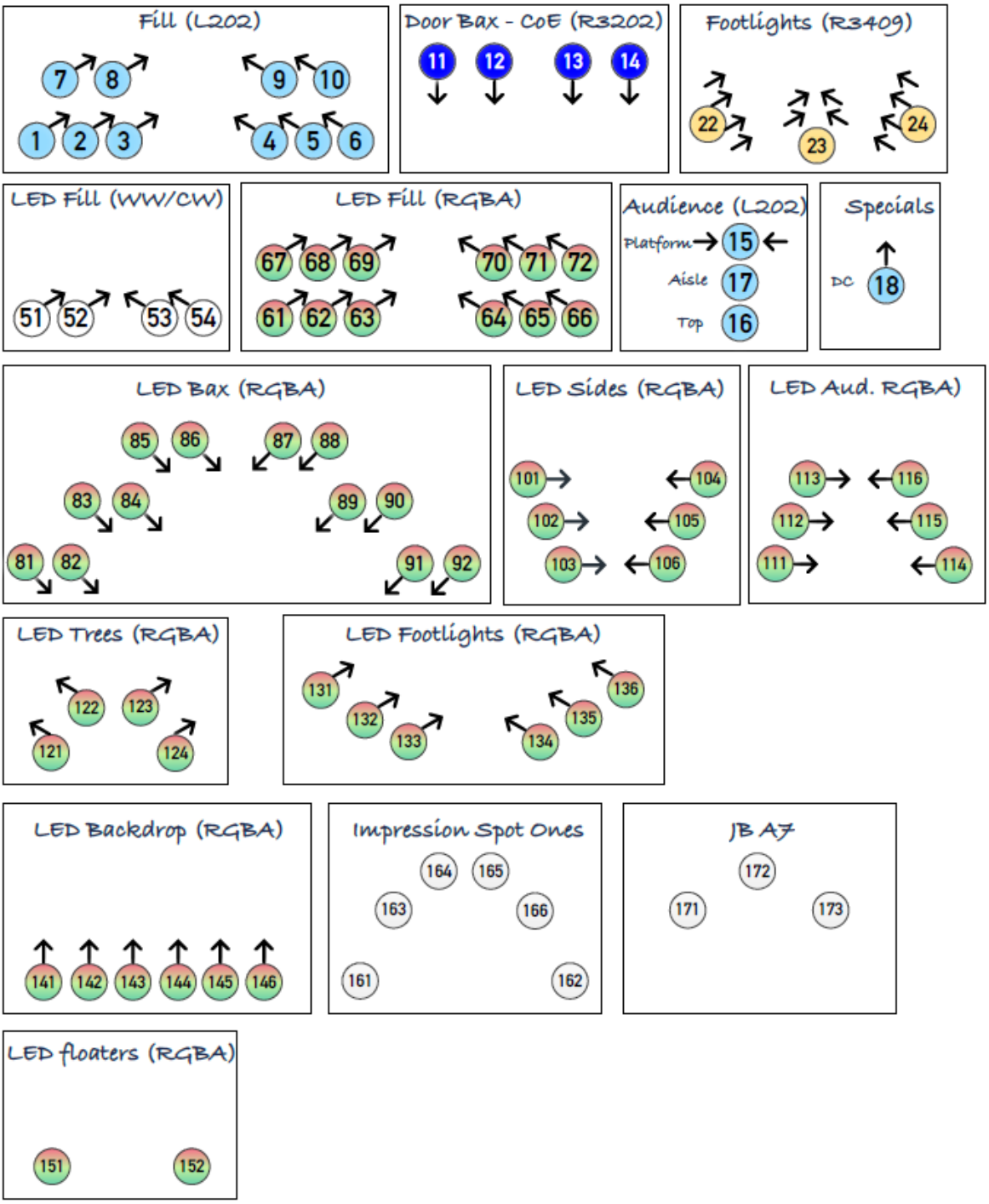
07/08/25

Venue: High Park Amphitheatre
Show: Shakespeare in High Park 2015

Designer: Brad Trenaman
Associate: Cole Vincent

Spot	Patch	Purpose	Type	Lens	Position	Unit
61	B.73	CF Fill DR /	Color Force Compact	Standard	SR Tower 2	8
62	B.69	CF Fill DC /	Color Force Compact	Standard	SR Tower 2	6
63	B.65	CF Fill DL /	Color Force Compact	Standard	SR Tower 2	4
64	B.5	CF Fill DR \	Color Force Compact	Standard	SL Tower 2	4
65	B.9	CF Fill DC \	Color Force Compact	Standard	SL Tower 2	6
66	B.13	CF Fill DL \	Color Force Compact	Standard	SL Tower 2	8
67	B.97	CF Fill UR /	Color Force Compact	Standard	SR Tower 1	5
68	B.93	CF Fill UC /	Color Force Compact	Standard	SR Tower 1	4
69	B.89	CF Fill UL /	Color Force Compact	Standard	SR Tower 1	3
70	B.37	CF Fill UR \	Color Force Compact	Standard	SL Tower 1	5
71	B.33	CF Fill UC \	Color Force Compact	Standard	SL Tower 1	4
72	B.29	CF Fill UL \	Color Force Compact	Standard	SL Tower 1	3
81	B.157	CF Bax SR 1	Color Force Compact	Frosted	UR Pipe	11
82	B.153	CF Bax SR 2	Color Force Compact	Frosted	UR Pipe	10
83	B.149	CF Bax SR 3	Color Force Compact	Frosted	UR Pipe	7
84	B.145	CF Bax SR 4	Color Force Compact	Frosted	UR Pipe	6
85	B.141	CF Bax SR 5	Color Force Compact	Frosted	UR Pipe	4
86	B.165	CF Bax SR 6	Color Force Compact	Frosted	UR Pipe	3
87	B.161	CF Bax SL 1	Color Force Compact	Frosted	UL Pipe	9
88	B.137	CF Bax SL 2	Color Force Compact	Frosted	UL Pipe	8
89	B.133	CF Bax SL 3	Color Force Compact	Frosted	UL Pipe	6
90	B.129	CF Bax SL 4	Color Force Compact	Frosted	UL Pipe	5
91	B.125	CF Bax SL 5	Color Force Compact	Frosted	UL Pipe	2
92	B.121	CF Bax SL 6	Color Force Compact	Frosted	UL Pipe	1
101	B.101	CF SR Top	Color Force Compact	Frosted	SR Box Boom	1
102	B.105	CF SR Mid	Color Force Compact	Frosted	SR Box Boom	2
103	B.109	CF SR Bottom	Color Force Compact	Frosted	SR Box Boom	3
104	B.41	CF SL Top	Color Force Compact	Frosted	SL Box Boom	1
105	B.45	CF SL Mid	Color Force Compact	Frosted	SL Box Boom	2
106	B.49	CF SL Bottom	Color Force Compact	Frosted	SL Box Boom	3
111	B.61	CF Aud SR Bottom	Color Force Compact	Frosted	SR Tower 2	2
112	B.85	CF Aud SR Mid	Color Force Compact	Frosted	SR Tower 1	2
113	B.81	CF Aud SR Top	Color Force Compact	Frosted	SR Tower 1	1
114	B.1	CF Aud SL Bottom	Color Force Compact	Frosted	SL Tower 2	2

Shakespeare in High Park 2015 - Magic Sheet



Appendix 2 – Cue Sheets

Lighting Cue Sheet	Page 1 of 3
Production Title: Comedy of Errors	**2015-06-24**
Designer: Brad Trenaman	**ALD: Cole Vincent, Head Electrician: Monica Sass**

Cue #	Count	Act / Scene	Page #	Taken On	Description
1	10S	Preshow	0.5	Preset - 1/2 hour	House Lights up
2	5s	Top of show	0.5	Places	BLACKOUT
3	2s	Overture	0.5	Music start	UC Bax
AF 3.5	4s	Overture	0.5	Complete stage for overture	Full stage lit
4	Snap	Overture	0.5	Doors 1-4 open	Bax thru doors
AF 4.5	1s	Overture	0.5	Doors close	Bax out
5	Snap	Overture	0.5	Doors 1-4 open	Bax thru doors
AF 5.5	1s	Overture	0.5	Doors close	Bax out
6	Snap	Overture	0.5	All clap	boost
7	3s	Overture	0.5	Gondola splits	Very cool wash
AF 7.5	3s	Overture	0.5	AF	
8	2s	Overture - AIS2	0.5 to 1	Rug set	Full stage int (mostly DC)
9		AIS2	2	Egeon "A heavier task"	Pull in to rug CC
10	12s	AIS2	3	Egeon "Heavens did grant"	Cooler and darker
11	7s	AIS2	3	Egeon "O let me say no more"	Restore up
12	7+12s	AIS2	4	Egeon - "My youngest boy"	Pull in to rug CC
13	5s	AIS2	5	Egeon "Warrant they live"	
14	3+5s	AIS2	5 to 6	Egeon "His lifeless end" - exeunt	Trans to exterior
15	5+7s	AIS2	7	Balth "your own content" - exeunt	boost DC for AoS
16	4s	AIS2	7	AoS "Lose myself"	Restore and brighter
17	3+5s	AIS2	9	DoE "take my heels" - exeunt	Danger - darker & cooler
18	7s	AIS2	9 to 10	AoS "money is not safe" - exit	Trans to interior. D3 bax
AF 18.5	5s	AIS2	10	AF (Sofa set)	Add light at sofa
19	25+30s	AIS2	14	Adri "His company must"	Sunset
20	3s	AIIS2	14 to 15	Luci "serve mad jealousy" - exeunt	Quick to AoS ext on apron SR
21	5+8s	AIIS2	15	AoS arrive SL café table	SL up ext.
22	7s	AIIS2	16	DoS "jest is earnest"	Full stage up
23	5+7s	AIIS2	16	AoS "hides his beams"	Boost DC for fight
24	7+9s	AIIS2	16	AoS "in your sconce"	Restore up & brighten
AF 25	9+12s	AIIS2	18?	AF (back to café table)	Pull back to SL café
26	6s	AIIS2	20	DoS "bald followers"	Full stage bright
27	3+5s	AIIS2	22	Adri "on thy confusion"	boost DC for AoS aside
28	5+7s	AIIS2	22	AoS "the **offered** fallacy"	Restore
29	3+5s	AIIS2	22	Luci "spread for dinner"	boost ML for DoS aside
30	5+7s	AIIS2	23	DoS "black and blue"	Restore
31	4+7s	AIIS2	24	Luci "dine too late" - exeunt	Trans to ext for gondola
32	5s	AIIIS1	25	D5 in place	Ext DS w/ gondola arrive at door
33	5s	AIIIS1	26	Balth "a merry feast"?	Add int warth US of door

Lighting Cue Sheet	Page 2 of 3

Production Title: Comedy of Errors	2015-06-24

Designer: Brad Trenaman	ALD: Cole Vincent, Head Electrician: Monica Sass

Cue #	Count	Act / Scene	Page #	Taken On	Description
33	5s	AIIIS1	26	Balth "a merry feast"	Add Int LX US of door
34	3s	AIIIS1	26	Vis - D5 spin CW	Ext SR, Int SL
35	2s	AIIIS1	27	DoS "for an ass" - Luce on D4	D4 bax
36	3s	AIIIS1	29	Adri "from the door" - Exit w/ Luce	D4 bax out
37	4s	AIIIS1	30	AoE "an iron crow" - D5 spin CCW	Copy Q33
38	3s	AIIIS1	31	AoE "cost me some expense"	Trans to ext on SR apron
39	5+7s	AIIIS2	32	Top of scene - chaise set	Int. night
40	7+12s	AIIIS2	32	Luci "flattery conquers strife"	Pull to AoS DC
41	4+6s	AIIIS2	33	AoS "if she sink"	Restore up
42	7+9s	AIIIS2	34	Luci "that's my sister"	Pull to chaise
43	4+6s	AIIIS2	34	Luci "get her good will" - exit	Restore up
44	7+12s	AIIIS2	37	DoS "look so low"	Pull in to DC
45	2+4s	AIIIS2	38	AoS "**but** lest myself"	Quick trans to ext on apron
46	5+7s	AIIIS2	38	Angelo enter "Master Antipholus"	Full stage ext.
47	3+5s	AIIIS2	39	AoS "straight away" - exit	Quick trans to DoE on apron SL
48	4+6s	AIVS1	40	Ange & Offi on - Top of scene	Full stg ext - fantasy realm
49	5+8s	AIVS1	44	AoE "to prison till it come"	Pull to DoS DC
50	3+4s	AIVS1	44	DoS "masters' minds fulfill" - exit	Scene chg
51	4+6s	AIVS2	45	Top of scene - desk set SR	Int. candlelit
52	2s	AIVS2	48	Adr "and my injury"	Trans.
53	3+5s	AIVS3	49	Top of scene - AoS enter UL	Ext. moonlit
54	1+3s	AIVS3	50	AoS "**Some** blessed power"	DC heavenly light
55	2+4s	AIVS3	50	Courtesan enter UC	UC bex, colour chg - bordello-ish
56	5+8s	AIVS3	52	DoS "that you know" - exeunt	Pull CC for Court.
57	3+5s	AIVS4	53	Top of scene - AoE & Off. Enter	Full stage moonlit ext.
58	5+8s	AIVS4	54	AoE "so, is an ass"	Pull to DoE DC
59	4+6s	AIVS4	54	DoE "door to door"	Restore and boost
60	4+6s	AIVS4	55	AoE "feel your ear"	Pinch Q - supernatural
61	15+20s	AIVS4	57	DOE "**In** verity you did"	Slow restore (copy Q61)
62	7+10s	AIVS4 to AVS1	61	AoS "our stuff aboard"	Scene change???
63	2s	AVS1	63	DoS "we are spoiled"	Add D1, D4 & gates UC bax
64	25s	AVS1	69	Solinus "fear nothing"	First hint of sunrise
65	25s	AVS1	72	Soli "stark mad"	Sunrise continue
66	7+10s	AVS1	73	Egeon "**Not** know my voice"	Pull CC/DC for Egeon
67	5+7s	AVS1	73	Egeon "my son Antipholus"	Restore, touch more sunrise
68	20s	AVS1	74	Solin. "make thee dote"	Sunrise continue
69	15s	AVS1	75	Abbess "the same Emilia"	Sunrise continue
70	12s	AVS1	77	AoE "my good cheer"	Final build of sunrise

Lighting Cue Sheet	Page 3 of 3

Production Title: Comedy of Errors	2015-06-24

Designer: Brad Trenaman	ALD: Cole Vincent, Head Electrician: Monica Sass

Cue #	Count	Act / Scene	Page #	Taken On	Description
71	3s	AVS1	79	DoE "one before another" - exit UC	Pull to UC bax
72	3s	AVS1	79	DoE & DoS X UC	BLACKOUT
73	1s	Curtain Calls	79	CALLS	Full stage warm and bright
74	5s	Post Shpow	79	Bows complete	Houselights, etc.

Lighting Cue Sheet	Page 1 of 4

Production Title: Julius Caesar	2015-06-24

Designer: Brad Trenaman	ALD: Cole Vincent, Head Electrician: Monica Sass

Cue #	Count	Act / Scene	Page #	Taken On	Description
1	20s	Preshow	1	Preset - 1/2 hour	Houselights up, stage & picnic area lit
2	15s	Preshow	1	"Picnicners" arrive	Slight boost on picnic area
3	10s	Preshow	1	Poet on audience platform	Boost at plat.
4	15s	Preshow	1	Poet done - exits	Lose plat.
5	3s	Preshow	1	Show start - Mur. "You blockes"	Boost picnic area and DS of stage
6	4+7s	Preshow	2	Mur. & Fla. To DC of stage	Boost area DC of stage
7	4s	Preshow	2	Mur. "Feast of Lupercall" - samba	Boost & colour chg in aud.
8	5+7s	Preshow	2	Flav "Fearfulnesse" - Ant. To plat.	Boost platform
9	5s	Preshow - A1S1	2	Procession at top of hill	Light for procession
10	8s	AIS1	3	Caes. off cart, X down aisle to plat.	Lose top of hill, boost plat.
11	7s	AIS1	4	Caes. "leave him: Passe" - exit US	Lose plat. & CTR aisle
12	4s	AIS1	4	Scn. w/ Cass. & Brut.	Light HR & HL aisles
AF 12.5	10s	AIS1	4	AF	Add path to DC of stage
12.7	8s	AIS1	5	Cass. X to DC of stage???	Lose HR aisle???
13	10s	AIS1	5(??)	Both DC of stage	
AF 13.5		AIS1	??	???	
14	9+15s	AIS1	7	Cass. & Brut. Onstage	
15	10s	AIS1	9	Caes. & traine enter	Boost stage
16	25s	AIS1	14	Cass. "**Caesar** doth bear me hard"	Pull to DC on Cass.
16.5	3s	AIS1	14	Cass. "Shall be glanced at"	Storm start - faint lightning, cooler
16.7	Snap	AIS1	14	Cass. "Shake him"	Lightning
17	7s	AIS1	14	Poet start on plat.	Boost platform - storm cont.
18	Snap	AIS1	14	Poet "Reckoning"	Lightning
19	Snap	AIS1	14	Poet "forgiving"	Lightning
20	Snap	A1S3	15	Caska "thing unfirme"	Lightning
21	Snap	A1S3	15	Caska "or else the world"	Lightning
22	Snap	A1S3	15	Caska "hundred ghastly women"	Lightning
23	Snap	A1S3	15	Caska "These are naturall"	Lightning
24	Snap	A1S3	15	Poet "things themselves"	Lightning
25	7s	A1S3	15	Poet "Skie is not to walk in" - sits	Lose plat.
26	Snap	A1S3	16	Cask. "Farewell"	Lightning
27	Snap	A1S3	16	Caska "Eare is good"	Lightning
28	Snap	A1S3	16	Cass. "honest men"	Lightning
29	Snap	A1S3	16	Cass. "walk'd about the streets"	Lightning
30	Snap	A1S3	16	Cass. "to the Thunder-stone"	Lightning
31	Snap	A1S3	16	Caska. "dreadfull Heraulds"	Lightning
32	Snap	A1S3	17	Cass. "selfe in wonder"	Lightning
33	Snap	A1S3	17	Cass. "some monstrous State"	Lightning

Lighting Cue Sheet	Page 2 of 4

Production Title: Julius Caesar	2015-06-24

Designer: Brad Trenaman	ALD: Cole Vincent, Head Electrician: Monica Sass

Cue #	Count	Act / Scene	Page #	Taken On	Description
34	Snap	AIS3	17	Cass. "stange eruptions are" ???	Lightning
35	Snap	AIS3	17	Cass. "let it be who it is" ???	Lightning
36	Snap	AIS3	17	Cass. "weake most strong"	Lightning
37	Snap	AIS3	17	Cass. "Tyrants doe defeat"	Lightning
38	Snap	AIS3	18	Caska. "Who goes farthest"	Lightning
40		AIS3	18	Cass. "Pompeyes Porch", Cinna on	Boost aisle (lightning???)
42	Snap	AIS3	19	Cinn. "fearfull Night is this"	Lightning
45	7s	AIS3	19	Cass. "Pompeyes Theatre", Cin exit	Pull down?
49		AIS3	20	Cass. "Yields him ours" - Poet on	Boost plat. For Poet
50	5+9s	AIIS1	21	Top of scene, Brut. On UR	SR Apron lit for Brut., storm cont.
54	Snap	AIIS1	21	Brut. "kill him in the shell"	Lightning
AF 54.5	3s	AIIS1	21	AF	Pull to DC for Brut.
58		AIIS1	21	Brut. "full petition", Poet on plat.	Boost SL apron & plat.
59		AIIS1	22	2nd knock??	Boost DC
60		AIIS1	22	Brut. "and affabilitie" - consp. On	Boost full stage for conspirators
61	5+8s	AIIS1	23	Conspirators DC	Pull to DC
62	9s	AIIS1	26	Brut. "to you every one", Port. On	Boost for Port. On UR
63	10s	AIIS1	28	Port. " contagion of the night"	Start losing US
64	7s	AIIS1	29	Both DC, Brut. kneels	Pull DC
65	5s	AIIS1 to AIIS2	29	Brut. "Noble Wife", Poet on	Boost plat. For Poet
66	5s	AIIS2	30	Top of scene, Caes. On UL	SL apron lit for Caes., storm cont.
67	5+8s	AIIS2	30	Calp. On UL	Full stg lit
69	3+7s	AIIS2	34	Both exeunt, Poet on	Plat. for poet
70	5s	AIIIS1	35	Top of scene - Caes. et al ctr aisle	Light up ctr aisle & plat.
71	5s	AIIIS1	37	Caes. "and that I am he"	Boost plat. for Caes. stabbing
72	5+8s	AIIIS1	38	All stab Caes. DC of stage	Plat. & aisle down bit
73	7+12s	AIIIS1	38	Caes. "Then fall Ceasar" - dies	Add DC special "altar"
75	7+10s	AIIIS1	38	Brut. "Freedome and Liberty"	Pull DC for consp. wash hands
76	3s	AIIIS1	39	Cass. "boldest, and **best** hearts"	Full stg up for Ant. entrance
79	5+8s	AIIIS1	42	Ant. "O pardon me"	Pull to DC
80	5+7s	AIIIS1 - AIIIS2	42	Ant. "Dogges of Warre"	Boost DC & audience up
81	8+12s	AIIIS2	43	Brut. "to need my death"	Full stage boost as Brut X US
82	15s	AIIIS2	44	Ant. "Friends, Romans"	Boost DC
83	3s	AIIIS2	44	Ant. "in Caesar's Funerall"	Add ctr aisle for Ant. Into audience
83.5	3s	AIIIS2	44	Ant. "I rather choose"	Boost HL aisle bottom for will reveal
83.6	3s	AIIIS2	45	Ant. "tis his will"	Lose HL aisel bottom as Ant moves

Lighting Cue Sheet	Page 3 of 4

Production Title: Julius Caesar	2015-06-24

Designer: Brad Trenaman	ALD: Cole Vincent, Head Electrician: Monica Sass

Cue #	Count	Act / Scene	Page #	Taken On	Description
84	5+9s	AIIIS2	47	Ant. "When comes such another"	Audience warm, candlelit
84.5	3+5s	AIIIS2	47	Pleb 3 "Come away, away"	Boost aisle
AF 84.6	1s	AIIIS2	47	AF	MARK
85	4s	AIIIS3	48	Top of scene, Cinn on CC	Pull to DC/CC
AF 85.5	5+7s	AIIIS3	48	AF	MARK
86	5+9s	AIIIS3	50	Pleb 4 "name's Cinna" - all to stage	Lose aisle
87	5s	AIIIS3	50	Plebs drag Cinna UC	UC top special
AF 87.5	D1s, 2s	AIIIS3	50	AF	MARK
88	5s	AIIIS3	50	1st pillar topples	Cool sil. Look full stage
91	7s	AIVS1	51	Top of scene - Ant & Oct ctr aisle	Centre aisle lit
92	5+9s	AIVS1	51	Oct. "Asconius Pedianus"	Add area DS of stage as they reach
93	5+9s	AIVS1	51	Oct. "Marcus Atilius" - on stage	DC stage area up as they reach
94	7s	AIVS1	51	Oct. "Millions of Mischeefes"	Lose DC w/ exit - stage dim
AF 100	1s	AIVS1 - AIVS2	51	AF	MARK
101	5+8s	AIVS2	52	Top of scene - tent in place	DC tent (footlights)
102	5s	AIVS2	52	Mess. "the greater part"	Add HR aisle for Cass et al
102.5	10s	AIVS2	52-53	"???" - Cass. Onstage	Pull down top/middle of aisle
102.7	10s	AIVS2	58	Brut. "this Taper here"	Pull down aisle
103	3s	AIVS2	60	Cass. "Good night my Lord" - exit	Aisle dim after Cass et al exit
105	7s	AIVS2	60	Brut. "let me see, let me see"	Ctr aisle up for Caes.
106	7s	AIVS2	61	Brut. "at Philippi then"	Lose plat. As Caes. Exit
107	7s	AIVS2	61	Vis. - Caes. Clear of ctr aisle	Lose aisle
108	3s	AIVS2	61	Both "it shall be done my Lord"	Stage dim for strike tent
AF 109	2s	AIVS2 - AVS1	61	AF	Loses HR aisle
AF 110	Snap	AVS1	62	AF	MARK
AF 110.5	2+7s	AVS1	62	AF - Top of scene	Light for Ant & Oct UC
111	3s	AVS1	62	Ant. "Tis not so"	Top of HL aisle lit
AF 112	5s	AVS1	62	AF	Rest of aisle lit
113	5s	AVS1	63	Ant. "Oh, you flatterers"	Lose top of HR aisle
AF 115	7s	AVS1	63	AF	MARK
AF 115.5	5+7s	AVS1	63	AF	Add HR grass
116	3s	AVS1	64	Brut. "Leade on"	Ctr aisle up for Caes.
116.5	3s	AVS1	64	Brut. "But it sufficeth"	Light for Brut. DS of stage
117	4+5s	AVS1	64	Caes. Cross Brut. DC	Lose aisle
118	3s	AVS2	64	Brut. "Let them all come down"	Lose grass DC & HR aisle
AF 118.5	10s	AVS2	64	AF	HR tree dim
AF 118.7	3s	AVS2 - AVS3	64	AF	MARK
AF 119	5s	AVS3	65	Top of scene- Titi & Pind on HL	DSC grass area lit

Lighting Cue Sheet | **Page 4 of 4**

Production Title: Julius Caesar | **2015-06-24**

Designer: Brad Trenaman | **ALD: Cole Vincent, Head Electrician: Monica Sass**

Cue #	Count	Act / Scene	Page #	Taken On	Description
121	4s	AVS3	65	Cass. "This Hill is farre enough"	Add ctr aisle & bit of stage DC
122	4+5s	AVS3	66	Titi "Even with a thought"	Add stage & DC grass, aisle down bit
123	7+15s	AVS3	66	Cass. "Sword that kiil'd thee"	Pull to Cass. body DCR
124	8s	AVS3	66	Titi. & Mess. on from HR grass	Add HR grass
125	3+7s	AVS3 - AVS4	68	Brut. "proper Entrailes"	Boost for riot police, cop LX trees
126	3s	AVS4	68	Brut. "and I am Brutus"	House LX up cool
127	2s	AVS4	68	Brut. "Know me for Brutus" - music	Full stage up cold and bright
AF 128	D13,Snap	AVS4	68	AF (music beat drop)	Searchlights
AF 128.5	5s	AVS4 - AVS5	68	AF - Brut et al to aisle/plat.	Add aisle/plat.
129	3+5s	AVS5	69	Brut. "**Come** poore remaines"	Pull to aisle/ dim on stage
AF 131	D5, 30s	AVS5	71	AF	Slow XF to warm/candlelit aud.
132	3+6s	AVS5	71	Caes. & Brut. reach stage	Add stage, aud/aisle dim
AF 133	3s	AVS5	71	AF	DC special for Brut. body
134	4+6s	AVS5	71	Ant. & Oct. on UR	Full stage very bright
135	7s	AVS5	71	Oct. "This happy day."	Aisle up for Ant.
135.5	Snap	AVS5	71	Ant. Reach platform	Disco chase
136	Snap	AVS5	71	Oct. flips switch	BLACKOUT
137	1s	Calls	71	Cast ready	Full stage up bright
138	5s	Postshow	71	Bows complete	Houselights, etc.

Appendix 3 – Fixture Specifications

Powerful Workhorse Fixture

The Chroma-Q® Color Force Compact™ is a powerful creative lighting tool that works in perfect harmony with the popular Color Force™ range. The Compact is a cost-effective workhorse, ideal for a wide range of applications. Utilising core LED technology from the Color Force range, the fixture provides 1700 lumens in a cost-effective, slim, compact profile, while maintaining colour compatibility with the rest of the range.

Compact Yet Powerful

Despite measuring only 235mm / 9.25" in length, the Color Force Compact produces a powerful 1700 lumens output - making it ideal for lighting areas with a very small footprint.

Multi-Purpose Workhorse Fixture

With its rugged external design and IP65 rated* casing, the Color Force Compact has been designed as a multi-purpose workhorse fixture suitable for numerous entertainment lighting applications - including uplighting, pipe-end shin-busting, backlighting, truss toner and other wash applications.

Fast & Efficient Set-Up

Up to five fixtures can be daisy-chained from each 15-way Compact PSU output, eliminating the need to home-run a cable from each fixture back to the PSU. In addition, up to four fixtures per output can be daisy-chained on a Chroma-Q Color Block PSU (PSU-05B, PSU530).

Cost-Effective Investment

The Color Force Compact enables an even wider range of users and budgets to utilise the power of the Color Force as a creative lighting tool.

Power Across The Spectrum

The Color Force Compact uses its huge RGBA colour mixing palette to deliver a full range of high brightness colours across the spectrum. Deep cold blues, red hot lava looks and super soft pastels are all available from a single fixture.

Colour

The Chroma-Q RGBA engine has been developed to deliver an incredible CRI of 92, for true colour balance across the spectrum.

Optics & Dimming

The Color Force Compact fixture's custom optical design provides a smooth, uniform output with outstanding colour blend across the spectrum.

Separate discreet RGBA LEDs are used for increased efficiencies and the custom Chroma-Q optical design delivers surprisingly clean shadows for most common real world applications.

Theatrical grade dimming, a high CRI of 92 for extremely accurate colour rendition and a clean white ensures the light output feels just right.

Full Range of Accessories

For real versatility and compatibility with existing lighting inventories, the Color Force Compact is compatible with City Theatrical top hat, half top hat, egg crate louver and barn door accessories.

The fixture is supplied with a holder for these four optional accessories, as well as interchangeable clear and frosted glass light lenses.

An optional W-DMX wireless accessory for the 15-way PSU is also available.

Full Range Of Creative Tools

Complementing other models in the range, the Color Force line-up now provides a full choice of creative tools for almost any entertainment application.

Control

Compatibility with industry standard control consoles is assured. HSI, FxHSI, RGB (**Magic Amber), RGBA, RGBI (Magic Amber), Look Select, Master and Slave Standalone control modes.

Key Features

- Compact yet powerful - 1700 lumens from a very small footprint
- IP65 rated*
- Multi-purpose workhorse fixture - suitable for a wide range of applications
- Deep cold blues, red hot lava and super-soft pastels - all from a single fixture
- High CRI of 92 - true colour balance across the spectrum
- Custom optics - ensure a smooth even beam
- Theatrical grade dimming - suitable for a wide range – of applications
- Accepts City Theatrical accessories - use with your existing accessories inventory

Technical Specification

Color Force Compact Technical Specification

Product Code	CHCFCRGBA
Dimensions	212mm x 196mm x 152mm / 8.4" x 7.7" x 6"
Weight	4kgs / 8.5 lbs
Shipping Dimensions	267mm x 254mm x 241mm / 10.5" x 10" x 9.5"
Shipping Weight	5.4kg / 12lbs
Power Input Rating	48V DC
Power Consumption	60W
Typical Power & Current	Measurements done with all LEDs at max. intensity. Measurements made at nominal voltage. Allow for deviation of +/- 10%.
Power Connector In/Out	XLR 4-pin

Data Connector In/Out	XLR 4-pin
Max Cable Run	~60m / 200ft (PSU to last unit)
Power Supply	External - PSU15
Cooling System	Convection
Construction	Cast machined aluminium
Colour	Black
Built-In Hardware	Yoke assembly
IP Rating	*IP65
Approvals	CISPR22 :2006/EN55022 :2006 & CISPR 24:1997/ EN55024 :1998, ICES-003 :2004 & FCC Part 15 Subpart B: 2007

Control & Photometric

LEDs	28 (7 x RGBA) LEDs, total 28 LEDS
Control Modes	52 channels FxHSI, 45 channels HSI, 45 channels RGB, 15 channels FxHSI, 9 channels HSI, 9 channels RGB, 9 channels FxHSI, 3 channels HSI, 3 channels RGB, 60 channels RGBA, 61 channels sRGBI, 12 channels RGBA, 13 channels sRGBI, 4 channels RGBA, 5 channels sRGBI, Look Select Master Standalone Slave Standalone
Dimming Curve	Theatrical
Variable Effects Engine	Yes

Effects Parameters	Grouping, colour speed, colour fan, colour range, colour step, intensity effects, intensity fan
Hot Lumen Output	1700 (Red: 350, Green: 960, Blue: 90, Amber: 700)
Optics	Specialised close focus lens
Beam Angle	14° (approx.)
With Optional Frosted Optic	21° (approx.)
Beam Distribution	Asymmetrical direct illumination
CCT	Adjustable 1,000 - 10,000K
Colour Gamut	Performance enhanced
CRI	92
Lamp Life	L70 at 50,000 hours

Color Force Compact 15-Way Power Supply (to suit up to 15 Fixtures)

Product Code	CHCFCPSU15
Dims.	412mm x 133mm x 268mm / 16.9" x 5.2" x 10.5"
Weight	9.5kg /21lbs
Power	100-120V~, 10A ; 200-240V~, 5A ; 50-60Hz

Control Protocol	ANSI E1.11 USITT DMX 512-A
IP Rating	IP20
Approvals	CSA C22. No. 166-M1983: R2008 CAN/CSAC22.2 No. 60950-1-07 UL 60950-1:2007, EN 60950-1/A1:2010

Accessories

CHCFCTH	***Top Hat For Compact - Black
CHCFCHTH	***Half Top Hat For Compact - Black
CHCFCECL	***Egg Crate Louver For Compact - Black
CHCFCBD	***Barn Door For Compact - Black

CHCFCCL	Clear Glass For Compact (Comes With Fixture)
CHCFCFL	Frosted Glass For Compact (Comes With Fixture)
CHCFCAH	Color Force Accessory Holder (Comes With Fixture)
CHCFCDMXDP	W-DMX Wireless Option For PSU-15

* As per IEC60529 ingress protection rating code. **Magic Amber is the term used for the unit's ability to bring in amber when mixing colours that require it. ***City Theatrical accessories.

For the latest news and information on the Chroma-Q range, visit www.chroma-q.com

Battery Powered LED Fixture

The new Chroma-Q™ Color Charge™ LED fixture is a 600 lumen, battery powered, wireless DMX fixture which is ideal for any indoor temporary lighting application where wiring is a challenge or where install speed is critical, transforming a venue in minutes.

Nickel-Metal Hydride Battery

The Color Charge fixture's environmentally friendly design includes a recyclable long life battery cell and an interchangeable LED head for upgrading in the future. The highly efficient nickel-metal hydride (NiMH) power cell delivers up to 30 hours usage from a single charge and provides up to 1,000 charges; approximately double the life of lead-acid batteries. The fixture also features a built-in mains charger that enables it to continue to be used while charging, and a gas gauge showing the percentage and hours of usage remaining.

Wireless

The Color Charge features Wireless Solutions wireless DMX control and syncing between units, allowing connection of up to 512 fixtures on a single network. With a wireless range of 150m in a crowded room and 250m with a clear line of site, the Color Charge is ideal for large indoor spaces. Also, the unit's wireless aerial folds away discreetly for convenient transportation.

Master/Slave

The plug and play fixture also features synchronised effects between units, slave modes allowing simple opposite a/b colour effects and a built-in stand-alone playback mode.

High Quality Light

Part of the new generation of Chroma-Q LED lighting models, the Color Charge utilises unique colour mixing and control management technologies providing a high quality light output.

The Chroma-Q RGBA engine has been developed to deliver an incredible CRI of 92, for true colour balance across the spectrum and accurate tungsten white light emulation. The fixture utilises unique ColorSure™ technology for enhanced colour consistency across fixtures.

The Color Charge is extremely bright for a battery powered fixture, producing 600 lumens output. The unit also features smooth, theatrical grade dimming, making it suitable for a wide range of temporary entertainment and architectural lighting applications.

Practical

Featuring a quick focus click mechanism providing stepped beam angles, the remote head can be quickly and easily positioned. For discreet usage, the unit features a black body and optional half hat snoot to hide the lens source from view.

The Color Charge can be floor mounted or hung from truss via M12 nutsert and safely secured in place via a built-in Kensington lock slot. For maximum practicality, the Color Charge can also be mains powered and controlled via wired DMX.

Shown with optional half hat snoot

Key Features

- Battery powered LED fixture - no need for mains power
- Long battery life - NiMH battery lasts up to 30 hours
- Long product life - up to 1,000 battery recharges
- Wireless control and syncing between units - no cables
- 600 lumen output - extremely bright for a battery powered fixture
- RGBA - improved colour rendition and a wider colour range
- High CRI of 92
- Theatrical grade dimming
- Future proof - interchangeable head
- Green design

Technical Specification

Color Charge Technical Specification

Product Code	CHCCRGBA
Dimensions	140mm x 230mm x 280mm / 5.5" x 9" x 11"
Weight	7.5kg / 16lbs
Power (for charging only)	100-240V AC, 50-60Hz, 100W, IEC
Control Protocol	ANSI E1.1 DMX-512A, wireless W-DMX / XLR 5-pin in / through
Cooling System	Convection

Construction	Black anodised aluminium extrusion
Built-In Hardware	1/2" female thread computer lock
IP Rating	IP20
Approvals	CISPR 22:2006/EN55022:2006, CISPR 24:1997/EN55024:1998, ICES-003:2004, FCC Part 15 Subpart B:2007

Control & Photometric

LED	1 x RGBA cell, total 12 LEDs
Control Modes	5 channels St RGBI (*Magic Amber) 5 channels Fx HSI 3 channels RGB 4 channels RGBA 1 channel DMX Look Select Demo Stand-alone Master
Dimming Curve	Theatrical
Variable Effects Engine	Yes

Lumen Output	600 hot lumens (prelim.)
Optics	Specialised close focus lens
Beam Angle	22°
Beam Distribution	Symmetrical direct illumination
CCT	Adjustable 1,000 - 10,000K
CRI	92
Colour Gamut	Performance enhanced
Lamp Life	L70 at 50,000 hours

Accessories

CHCCHHS	Chroma-Q Half Hat Snoot for Color Charge

CHCCCI	Chroma-Q Power Cradle to take 3 Color Charge units

*Magic Amber is the term used for the unit's ability to bring in amber when mixing colours that require it.


Stepped Beam Angles


Optional Half Hat Snoot


Optional Power Cradle


Built-in Mains Charger


Built-in M12 Nutsert

For the latest news and information on the Chroma-Q range, visit www.chroma-q.com


impression Wash
THE IMPRESSION SPOT ONE & IMPRESSION WASH ONE BOTH FEATURES...
Key benefits for owners
5 Year Warranty
400W RGB LED inside
Spot & Wash ...the dynamic duo!
impression series
www.glp.de


impression series
impression Spot
Impression Spot One & Impression Wash One – the Dynamic Duo
The Impression experience - now Spot on!

JBLED A7

OPTICS AND LIGHT SOURCE
- Zoom optics 12°-36° (1/10 peak), 8°-28° (1/2 peak, FWHM)
- Highly efficient lens system
- 108 Luxeon high power LEDs

EFFECTS
- 450° Pan / 330° Tilt movement
- Additive colour mixing 8bit or 16bit
- Separate CTC channel
- Optimised colour mixing performance through LEDs packed in higher density
- High resolution electronic dimmer 0-100%
- True colour dimming
- Electronic strobe with pulse and random effects

MOVEMENT
- High-resolution three-phase stepper motors
- Precise and fast movements
- extremely quiet, suitable for noise-sensitive applications

CONTROL
- DMX-512
- Embedded DMX-In module for JB-lighting Wireless DMX
- Illuminated graphics display, electronically revolvable
- Stand-alone mode

POWER CONSUMPTION
- Max. 350VA, 90-240V, 50-60 Hz

CONSTRUCTION
- Compact housing
- 3pin and 5pin XLR connectors
- Silent, temperature-controlled additional fans
- Omega brackets for quick and easy mounting in any orientation
- Dimensions: 320 x 370 x 200 mm
- Weight: 8.8 kg

ACCESSORIES
Wireless TRX
Honeycomb aperture
Filter frame
Diffusion plate
Omega bracket for single clamp attachment
2-compartment flightcase
4-compartment flightcase
6-compartment flightcase

The JBLED A7 is optionally available in customized colours.

Appendix 4 – Solar Panels and Batteries

RENOGY

400W Compact Mono Portable Solar Suitcase

RSP400LSC-G1

Key Features

Provides you with more power generation in a lighter weight, smaller size, more portable solution.

Empowering the future with advanced mono-perc solar cell technology. With ETFE film and reinforced materials, it provides a durable, long-term,stable and secure source of energy. Light and durable, the compact suitcase 400 W module.

- Constructed with ETFE and reinforced materials
- Easy to set up and put away
- Lighter mass and smaller size
- Up to IP68 waterproof rating
- More durable construction

Potential Uses

Renogy compact Suitcase® portable modules can be used to charge portable energy storage devices. provide power during camping, fishing and other activities.

Also can be used to charge RV life batteries while parked or as a supplement to an existing PV system.

10 Years — Power Output Warranty

5 Years — Material and Workmanship Warranty

Renogy | www.renogy.com | support@renogy.com | 909-287-7111
5050 S. Archibald Ave, Ontario, CA 91762

400W Compact Mono Portable Solar Suitcase

RSP400LSC-G1

Electrical Data

Maximum Power at STC*	400 W
OptimumOperatingVoltage(V_{mp})	40.0 V
OptimumOperatingCurrent(I_{mp})	10.0 A
OpenCircuitVoltage(V_{oc})	47.2 V
ShortCircuitVoltage(I_{sc})	11.0 A
Module Efficiency	16.5 %
Maximum System Voltage	600 VDC UL
Maximum Series Fuse Rating	15 A

Mechanical Data

Solar Cell Type	MONO PERC
Number of Cells	288 (4x18x4)
Size(unfolded)	2838x855x20 mm(111.7x33.7x0.79 in)
Size(folded)	708x855x80mm(27.8x33.7x3.2 in)
Weight	13.7kg (30.2 lbs)
Front Film	ETFE
Connectors	Solar Connectors
Frame	Aluminum(black)

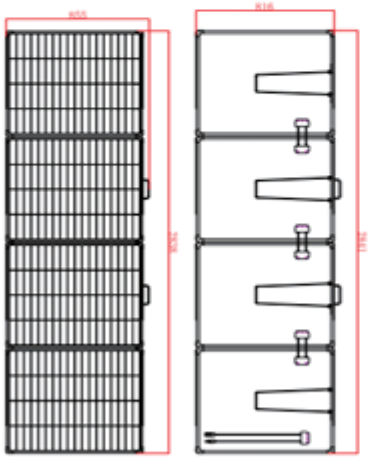
Thermal Characteristics

OperatingTemp.Range	-40°C-85°C(-40°F-185°F)
Nominal Operating Cell Temerature (NOCT)	48±2°C
Temperature Coefficient of Pmax	-0.38%/°C
Temperature Coefficient of Voc	-0.28%/°C
Temperature Coefficient of Isc	0.05%/°C

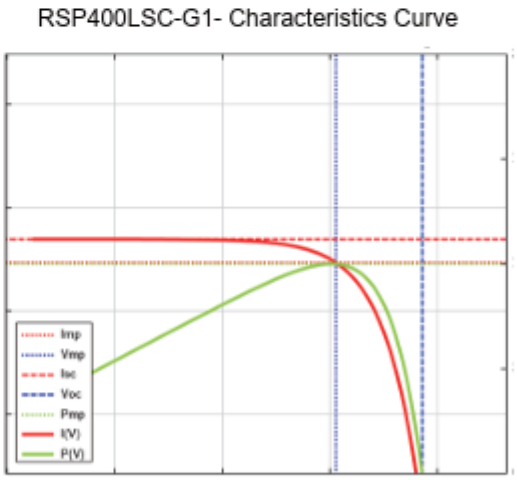
MC4 Connectors

Rated Current	30A
Maximum Voltage	1000V DC
Maximum AWG Size Range	12 AWG
Temperature Range	- 40°C - 80°C(-40°F-176°F)
IP Rating	IP 67

Module Diagram



IV-Curve



*All specifications and data described in this data sheet are tested under Standard Test Conditions (STC - Irradiance: 1000W/m², Temperature: 25°C, Air Mass: 1.5) and may deviate marginally from actual values. Renogy and any of its affiliates has reserved the right to make any modifications to the information on this data sheet without notice. It is our goal to supply our customers with the most recent information regarding our products. These data sheets can be found in the downloads section of our website, www.renogy.com

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A NEW STANDARD

Apollo 5K

The Premium LiFePO4 Solar Generator

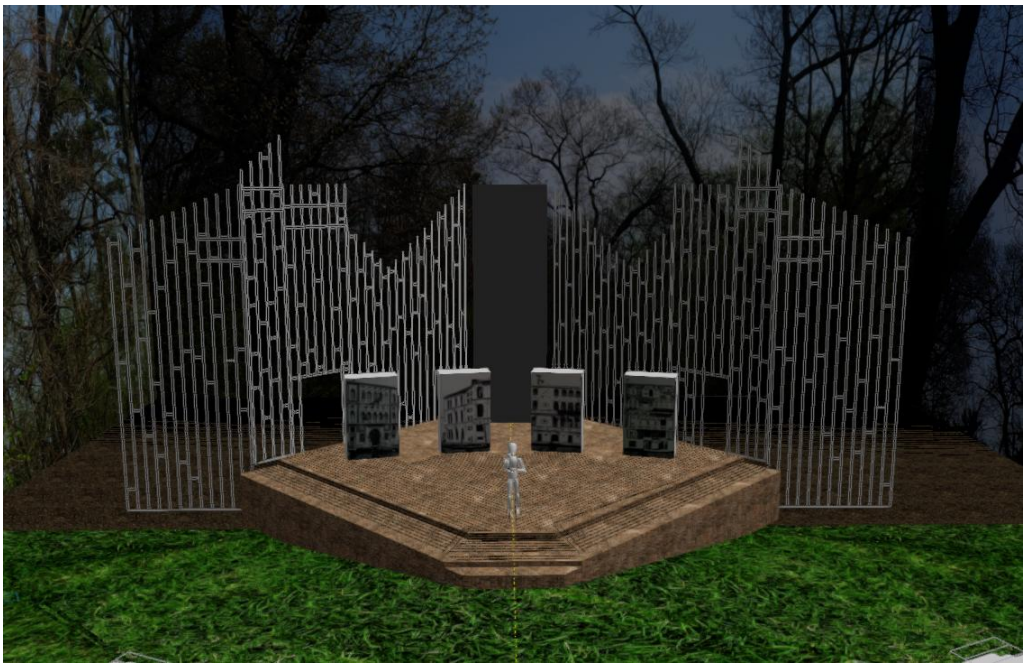
Rated AC power		120 VAC / 3,000 W Continuous (6,000 W Surge)
Battery Bank	Rated voltage	51.2 VDC
	Battery capacity	5,376 Wh
	Battery type	Lithium Ion / LiFePO4
BMS Settings	High voltage protection	60.0 VDC
	Low voltage protection	40.0 VDC
	Low voltage recovery	44.8 VDC
	Floating charge voltage	58.4 VDC
	Maximum current	105 A
AC Input	AC input voltage	65 VAC - 140 VAC
	Frequency	60 Hz or 50 Hz (Auto-detection)
Charge	AC charger	Max. 3,000 W (120 V * 25 A) Max. 600 W (120 V * 5 A) @ Max. load (3,000 W)
	Solar charger	Max 4,400 watts charging MPPT input Voc range 60 VDC - 500 VDC MPPT input Isc 18 A
	Car charger	Max. 12 VDC x 10 A or 24 VDC x 10 A
AC Output	Voltage range	120 VAC ±5% (Inverter mode)
	Frequency	60 Hz or 50 Hz ±1%(Inverter mode)
	Output wave	Pure Sine Wave
	Transfer time	< 20ms (Typical load)
	Efficiency	> 94%
DC Output	USB ports	USB-QC3.0 x 2 USB-C 18 W x 1 USB-C 100 W x 1
	12 V outlets	12 VDC 30 A x 1 12 VDC 10 A x 1 12 VDC 2 A x 2
	Wireless charger	15 W
Working Temperatures	Operating Ambient Temp	+32 to +104 F (0 to +40 C)
	Optimal Operating Ambient Temp	+50 to +95 F (+10 to +35 C)
	Storage Ambient Temp	+14 to +115 F (-10 to +45 C)
Size / Weight	Product Size	L 23.2 in x W 14.6 in x H 18.6 in (18.9 incl. feet) (L 589mm x W 371mm x H 472mm [480mm incl. feet])
	Product Weight	132 lbs (60 kg)
Max Input	AC Input (UPS + Charge)	3,600 W
	Solar Input (Inversion + Charge)	5,000 W
	AC + Solar (UPS + Charge)	7,400 W

Features

- Dual-CPU Intelligent Control Technology manages energy input/output
- High-frequency pure sine wave output is clean and reliable for any load
- Wide input voltage range and consistent voltage output
- Three programmable working modes prioritize different energy needs:
  - UPS mode: Utility Power first, a.k.a. “Pass-through AC Power”
  - AC Fast Charge (AC F.C.) mode: 120V AC power Fast Charge, 600W-3,000W (5A - 25A) programmable
  - Battery First mode: The solar charges the battery and grid. AC Power is only used if battery is almost empty.
- Energy Saving mode: Inverter standby consumption of only 15W.
- 94% Inverter Efficiency.
- Intelligent MPPT solar controller features over-charge & over-discharge protection, current limiting charging, and multiple other safety protections
- Battery over-voltage and low-voltage protection, overload protection, short circuit protection, over-temperature and under-temperature protection.
- A 4.3” wireless touchscreen shows real-time running statuses at-a-glance
- Remote monitoring & control via touchscreen and phone app
- Compact and modular unit design for portability
- Smart Fan Control keeps the unit cool, safe, and reliable
- Multiple output power supply (120VAC/3000W, 12VDC/600W, 5VDC/120W)
- Unattended mode: If battery runs out, inverter auto-starts when solar power is available.
- 6,000+ Battery Life Cycles (20+ Years of Regular Use)
- Split-phase and 3-phase power with multiple Apollo units
- Link 12x Units in Parallel (36 kW) and add 10 Expansion Batteries for 118,272 kWh storage.
- Removable wheeled chassis (Standard and Off-Road versions)
- “Unattended Mode”- when battery runs out, inverter is automatically re-started when solar power is available.

Appendix 5 – Renderings

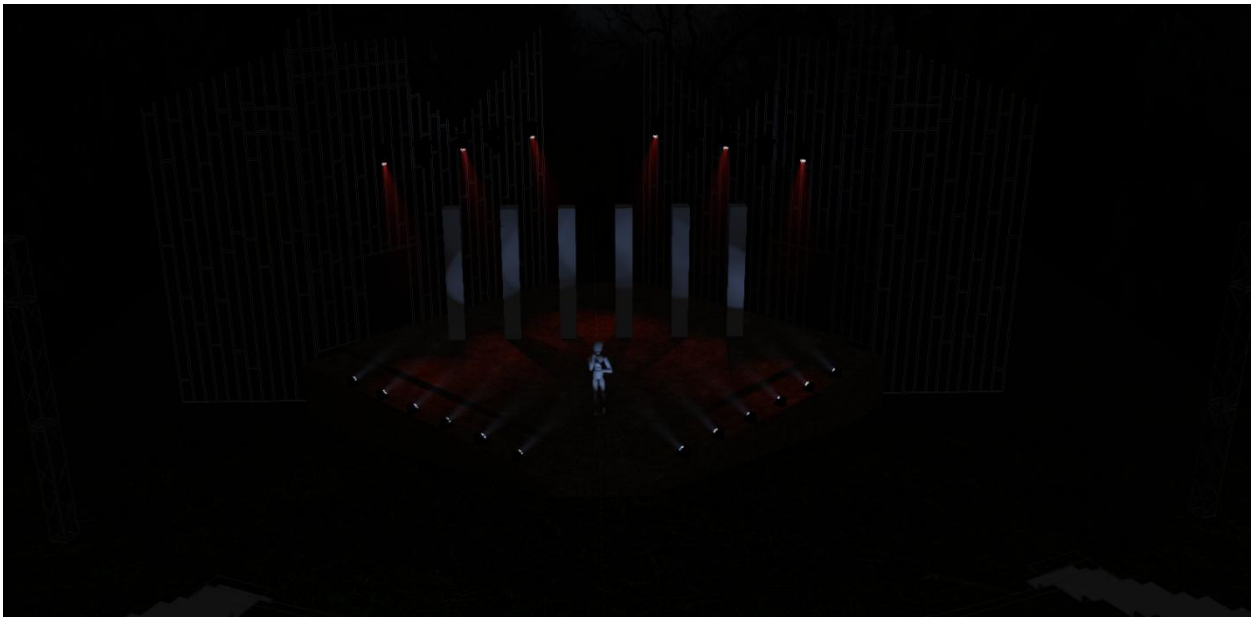
The Comedy of Errors set "daylight"



Julius Caesar set "daylight"

The Comedy of Errors – late evening look

Julius Caesar – pre-riot look with footlights



Appendix 6 - Production Photos

Comedy of Errors

All photos by Paul Lampert

Comedy of Errors

All photos by Paul Lampert

The Tragedie of Julius Caesar

All photos by Paul Lampert

The Tragedie of Julius Caesar

All photos by Paul Lampert