REACHING SUSTAINABILITY GOALS: INSULATION FOR INDUSTRIAL FACILITIES

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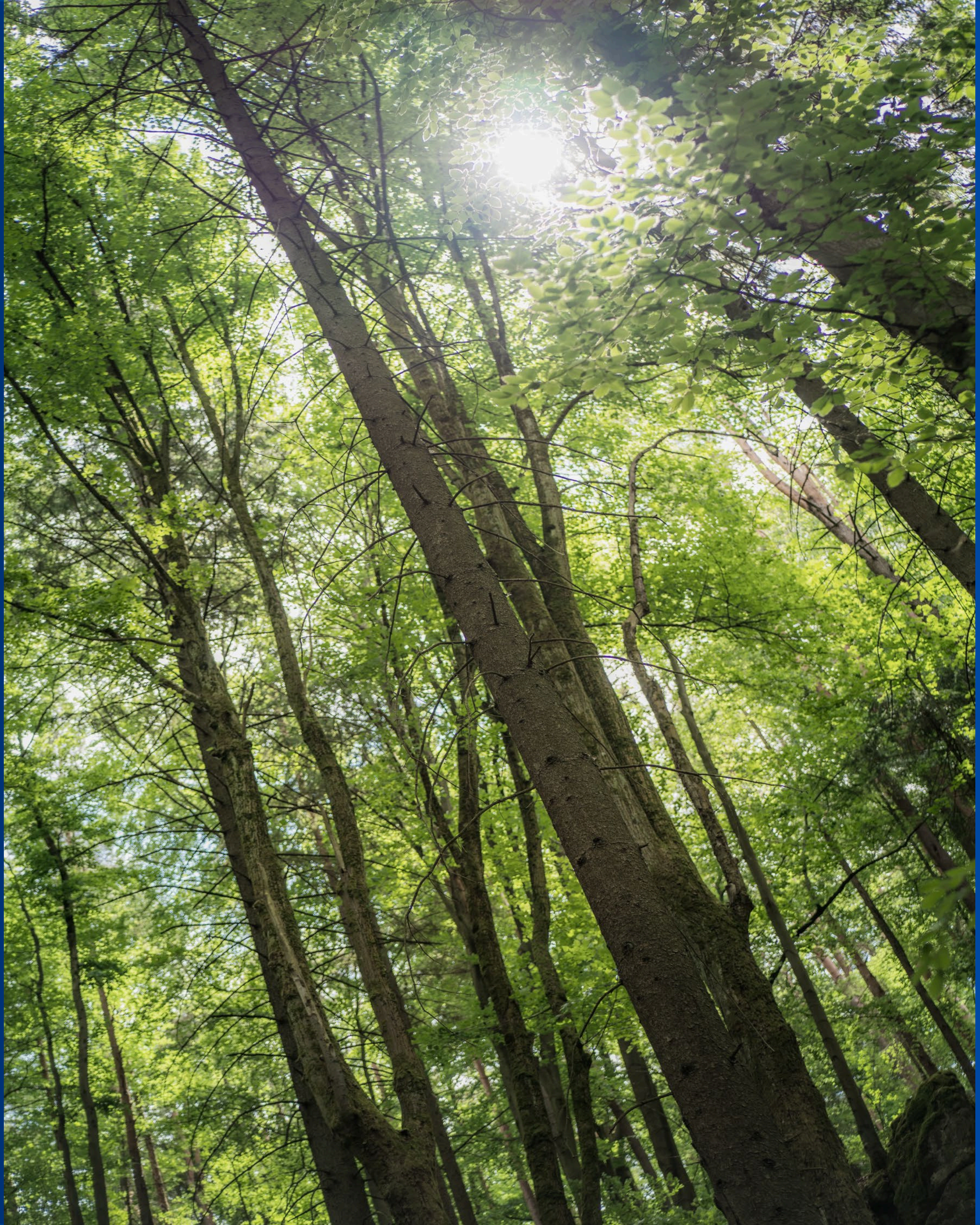


AGENDA

- The Goal / Path / Challenge
- Corporate / Government Sustainability Commitments
- High Tech Solutions—High Cost
- Real World Benefits of Mechanical Insulation
- Conclusion

The Goal

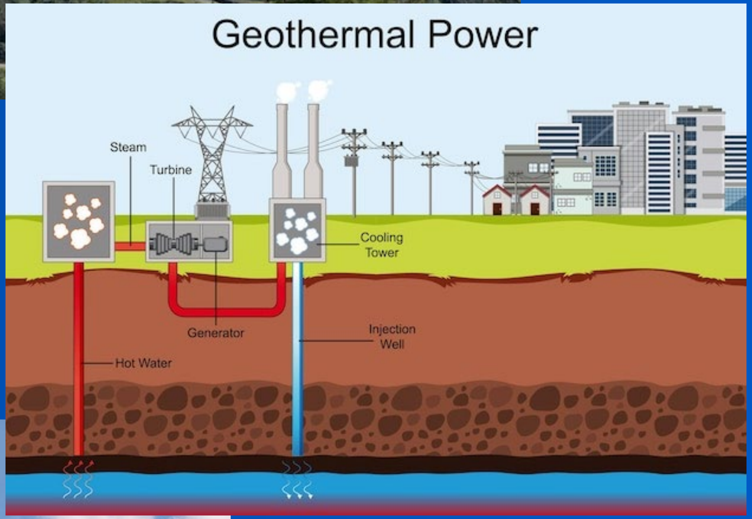
Due to public and government pressure, most companies have set goals for reducing energy consumption and greenhouse gas (GHG) emissions.

- Short-term (2030, 2035) targets for reducing energy use and/or carbon emissions
- Long-term targets (2040, 2050) to achieve net-zero operations

The Path

Typical programs to achieve reductions in energy consumption and the associated GHG emissions most often involve transitioning to “green” energy technologies.

- Solar and wind, possibly with battery back-up
- Geothermal
- Hydrogen / ammonia
- Carbon capture, utilization, and sequestration (CCUS)
- Hydroelectric



The Challenge

- Lengthy design, approval, and construction cycles
- Significant capital investment $$$$
- Technologies still being developed
- Some don’t provide 24/7/365 solutions

UN 2030 Agenda for Sustainable Development

On October 21, 2015, the United Nations (UN) adopted the 2030 Agenda for Sustainable Development

“All countries and all stakeholders, acting in collaborative partnership, will implement this plan... We are determined to take the bold and transformative steps which are urgently needed to shift the world on to a sustainable and resilient path... “

Planet: We are determined to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations.

UN 2030 Agenda for Sustainable Development

The agenda set 17 Sustainable Development Goals and 169 targets to be met by the member nations.

Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all.

Goal 13: Take urgent action to combat climate change and its impacts.*

Goal 7. Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All

7.1 By 2030, ensure universal access to affordable, reliable and modern energy services

7.2 By 2030, increase substantially the share of renewable energy in the global energy mix

7.3 By 2030, double the global rate of improvement in energy efficiency

7.a By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology

7.b By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States and landlocked developing countries, in accordance with their respective programmes of support

High-Tech Solutions—High Cost

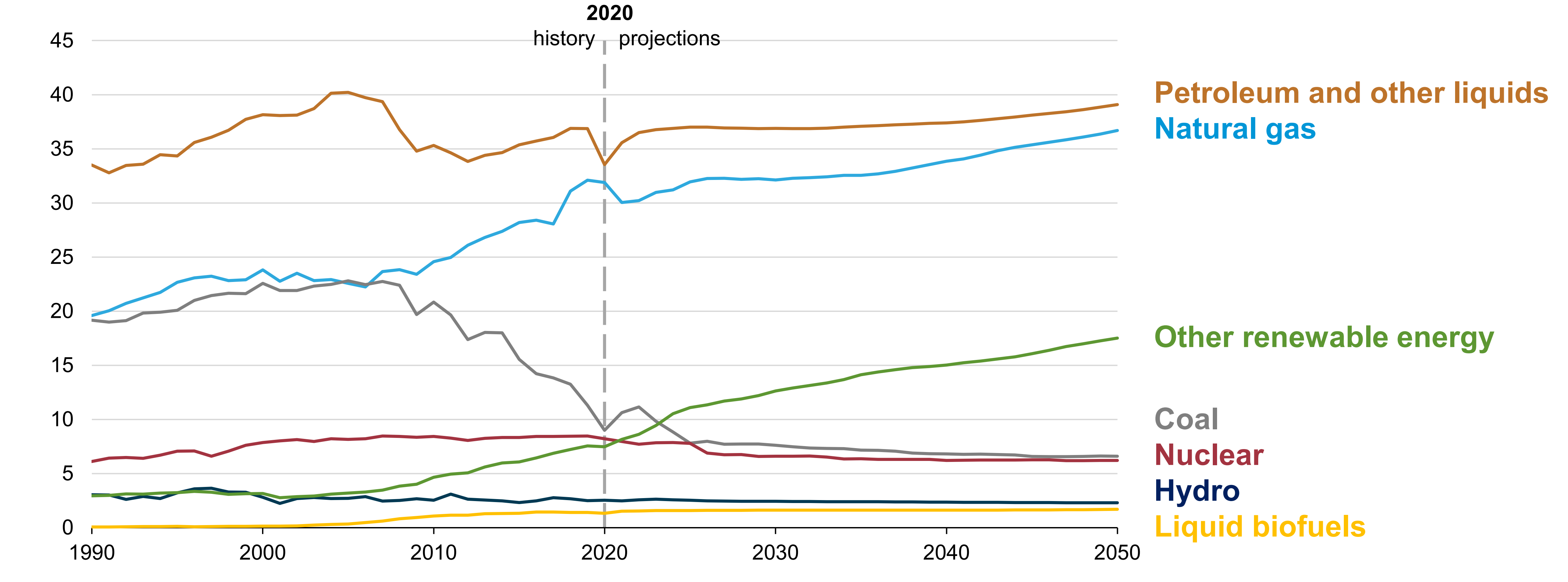
Industrial Information Resources (IIR), a leading market research and analytics firm, is currently tracking 82 projects in North America scheduled to kick off in 2023 that are related to carbon capture and sequestration, at a total investment value of $44.2B.* Average investment—$539 million.

IIR is also tracking 104 hydrogen power projects (to produce or consume H2) scheduled to begin construction in 2023, with a total investment value of $36.3B (some may overlap with CCS projects).* Average investment—$349 million.

A leading global manufacturer of hydrogen and nitrogen products, CF Industries, recently announced a $198.5 million plan to build a CO_2 dehydration and compression unit at its ammonia production plant in Donaldsonville. (1)

* As of 1-16-23
(1) Hydrocarbon Processing, 10/13/22

Energy Sources – Where Are We Going?



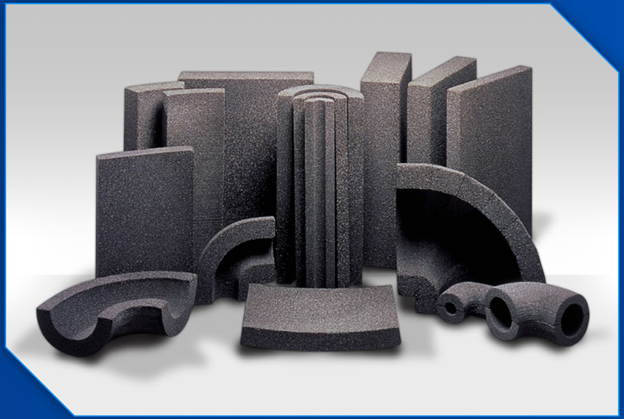
Source: U.S. Energy Information Administration, Annual Energy Outlook 2021(AEO2021), www.eia.gov/aeo

How Will You Get There?

Any plans to reduce a facility's or company's carbon footprint and achieve sustainability targets, must address how this will be accomplished:

1. Buying carbon offsets
2. Moving emissions from one operation to another or one location to another
3. Actually reducing the carbon emissions from the process area or facility

Real World Benefits of Mechanical Insulation




Real World Benefits of Mechanical Insulation

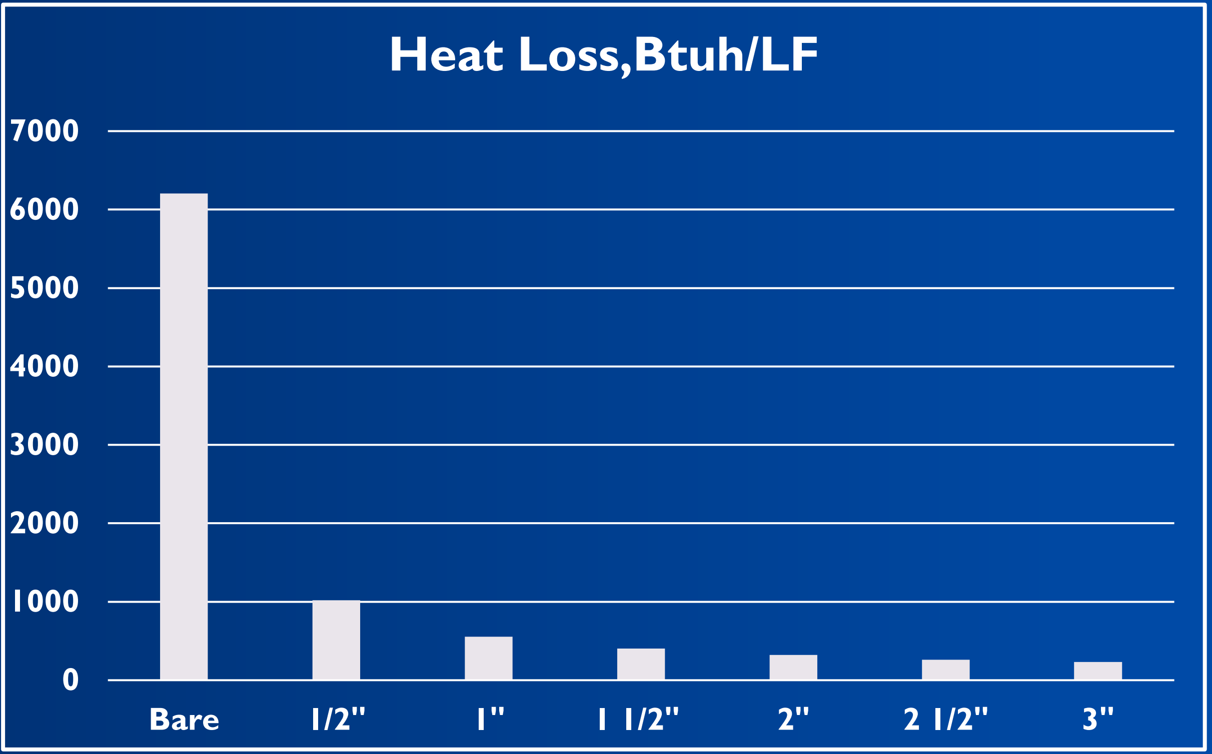
Real World Benefits of Mechanical Insulation

Oil Refinery Example

- Medium-sized oil refinery—125,000 barrel per day capacity
- 1.87 million linear feet of piping
- 8” nominal pipe size (NPS)
- 600°F operating temperature
- 60°F ambient temperature
- 5 mph wind
- 1 ½” mineral fiber pipe insulation (ASTM C547, Type I)

Source: Hart, Gordon H., “How Many Barrels of Oil Can Mechanical Insulation Save?”, *Insulation Outlook*, May 2005

Real World Benefits of Mechanical Insulation



Assumptions:

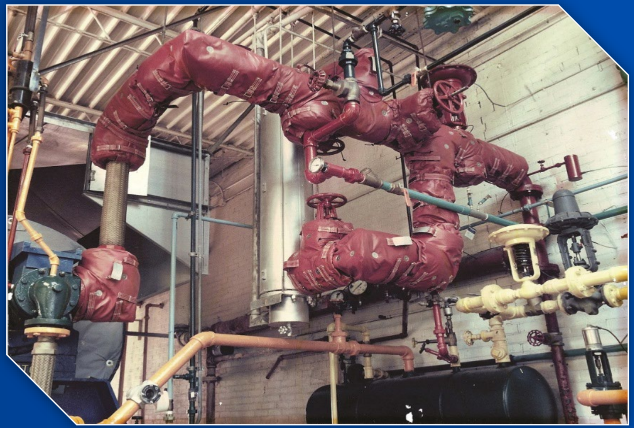
- 1% of the insulation is missing
- Reinsulate with 1½” of insulation
- 75% conversion efficiency (combustion)
- In operation 50 weeks per year
- Price of oil at $42/barrel ($1/gallon)

Annual Savings = $8.8 million/year

Source: Hart, Gordon H., “How Many Barrels of Oil Can Mechanical Insulation Save?”, *Insulation Outlook*, May 2005

Real World Benefits of Mechanical Insulation

Shannon Global Energy Solutions from New York, documented savings on a 350⁰F steam system with only 48 fittings. By adding just 1.5” of removable/reusable insulation covers to areas such as valves, steam drums, flanges and strainers, Shannon showed a 10-month payback on a $31,000 installed job. Better yet, the CO_2 savings from adding the insulation to those 48 areas was 444 tons a year—every year. (1)



(1) *BIC Magazine*, January/February 2023

Real World Benefits of Mechanical Insulation

Working in conjunction with a major Houston-based midstream energy services company, an analysis was conducted to look at the optimal economic insulation systems for multiple high temperature process piping scenarios.

- Four pipe sizes were modeled: 3”, 8”, 16” and 30”
- Process temperatures from 200ºF to 1,200ºF were analyzed
  - Ambient temperature of 90ºF with 6mph wind speed for personnel protection (PP)
  - Ambient temperature of 55ºF with 6mph wind speed for economic thickness
- Installed costs for calcium silicate insulation with aluminum jacket were averaged across several leading industrial insulation contractors

Real World Benefits of Mechanical Insulation

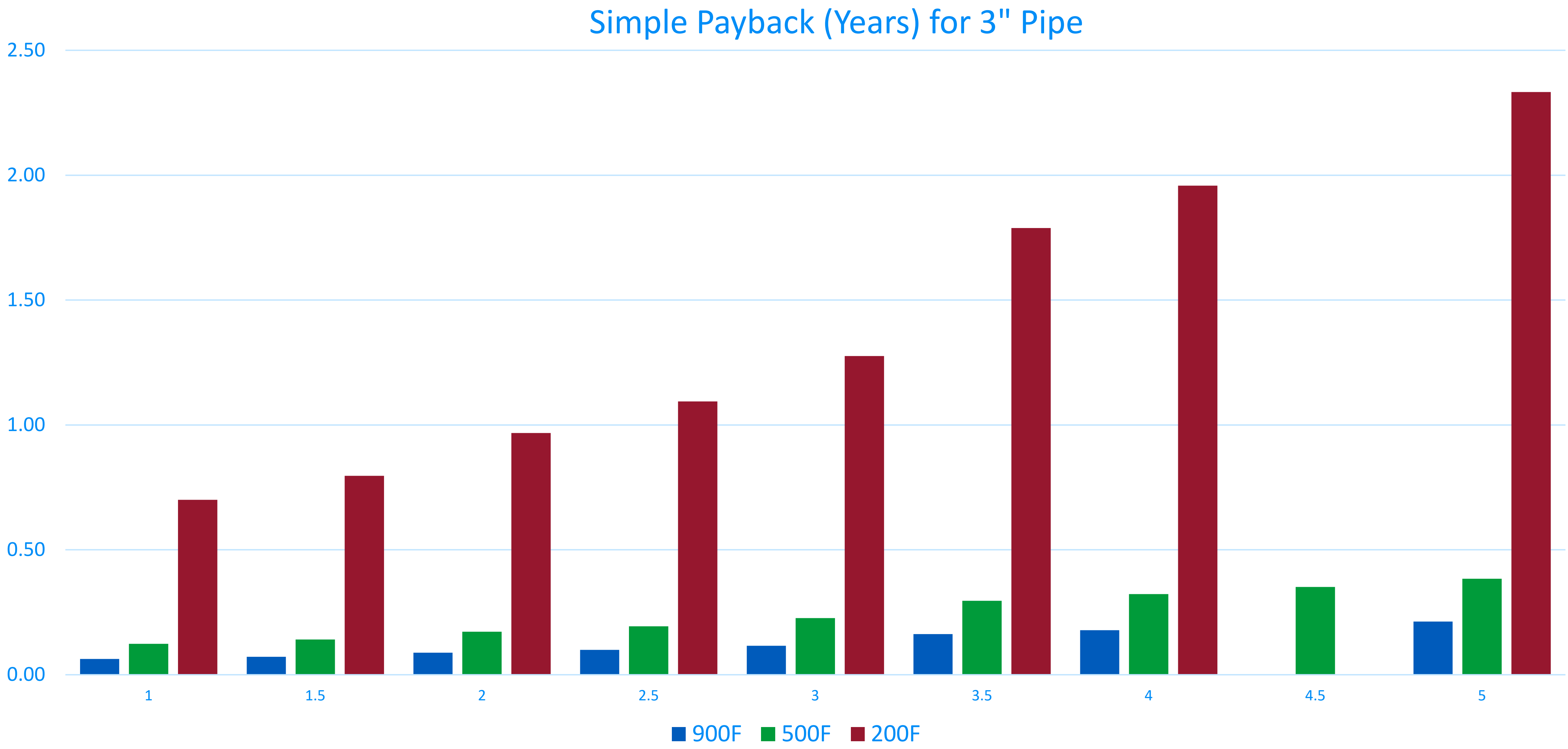
- Costs were based on an effective 100 feet of pipe—two elbows, one block valve, one 1” vent, one 1” drain, and sufficient straight pipe to total 100 equivalent feet of pipe.
- Modeled on a natural gas fuel source at a cost of $4.50/MMBtu, an 80% heater efficiency, and 8,000 hours per year operation
- Heat loss, fuel consumption reduction, energy cost savings, and emissions reductions were calculated using the NAIMA 3E® Plus tool

3” PIPE AT 200°F

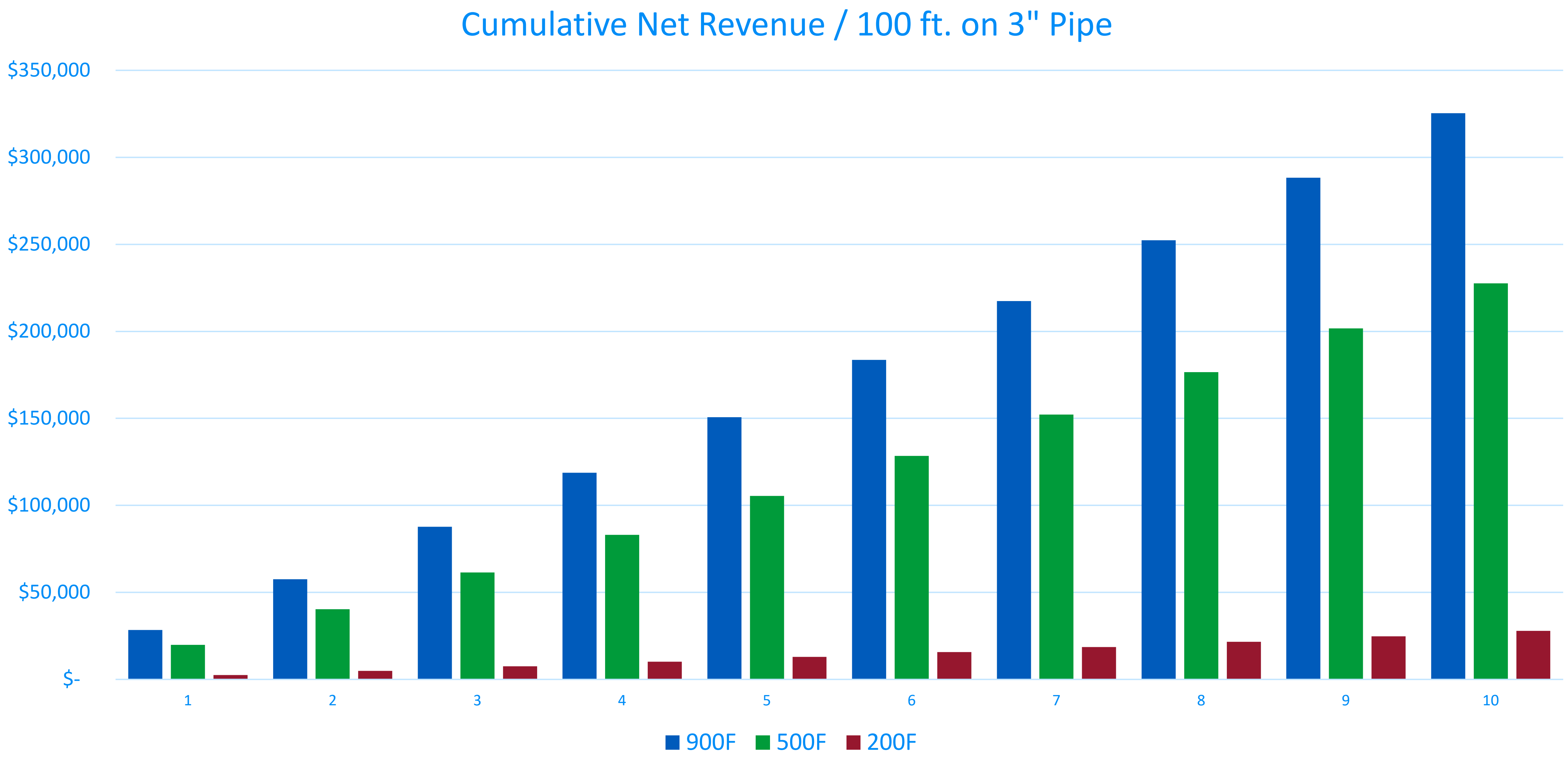
Thickness	Heat Loss	Efficiency	Heat Loss	Cost of Lost	Saving per	Saving per	Cost / 100'	Simple	Incremental	Incremental	Incremental
Inches	BTU/Hr-Ft	(%)	BTU/Ft-Yr	Energy/Ft	Ft per Yr	100 Ft / Yr	($)	Years	Cost	Revenue	Payback
0	611.6		4,892,800	$ 27.52	$ -	$ -					
1	54.52	91.09	436,160	$ 2.45	$ 25.07	$ 2,507	$ 1,755	0.70	$ 1,755	$ 2,507	0.7
1.5	40.49	93.38	323,920	$ 1.82	$ 25.70	$ 2,570	$ 2,046	0.80	$ 291	$ 63	4.6
2	33.52	94.52	268,160	$ 1.51	$ 26.01	$ 2,601	$ 2,517	0.97	$ 471	$ 31	15.0
2.5	29.12	95.24	232,960	$ 1.31	$ 26.21	$ 2,621	$ 2,867	1.09	$ 350	$ 20	17.7
3	26.07	95.74	208,560	$ 1.17	$ 26.35	$ 2,635	$ 3,361	1.28	$ 494	$ 14	36.0
3.5	23.57	96.15	188,560	$ 1.06	$ 26.46	$ 2,646	$ 4,733	1.79	$ 1,372	$ 11	122.0
4	21.88	96.42	175,040	$ 0.98	$ 26.54	$ 2,654	$ 5,196	1.96	$ 463	$ 8	60.9
5	19.18	96.86	153,440	$ 0.86	$ 26.66	$ 2,666	$ 6,219	2.33	$ 1,023	$ 12	84.20

PP and Economic Thickness

3” PIPE

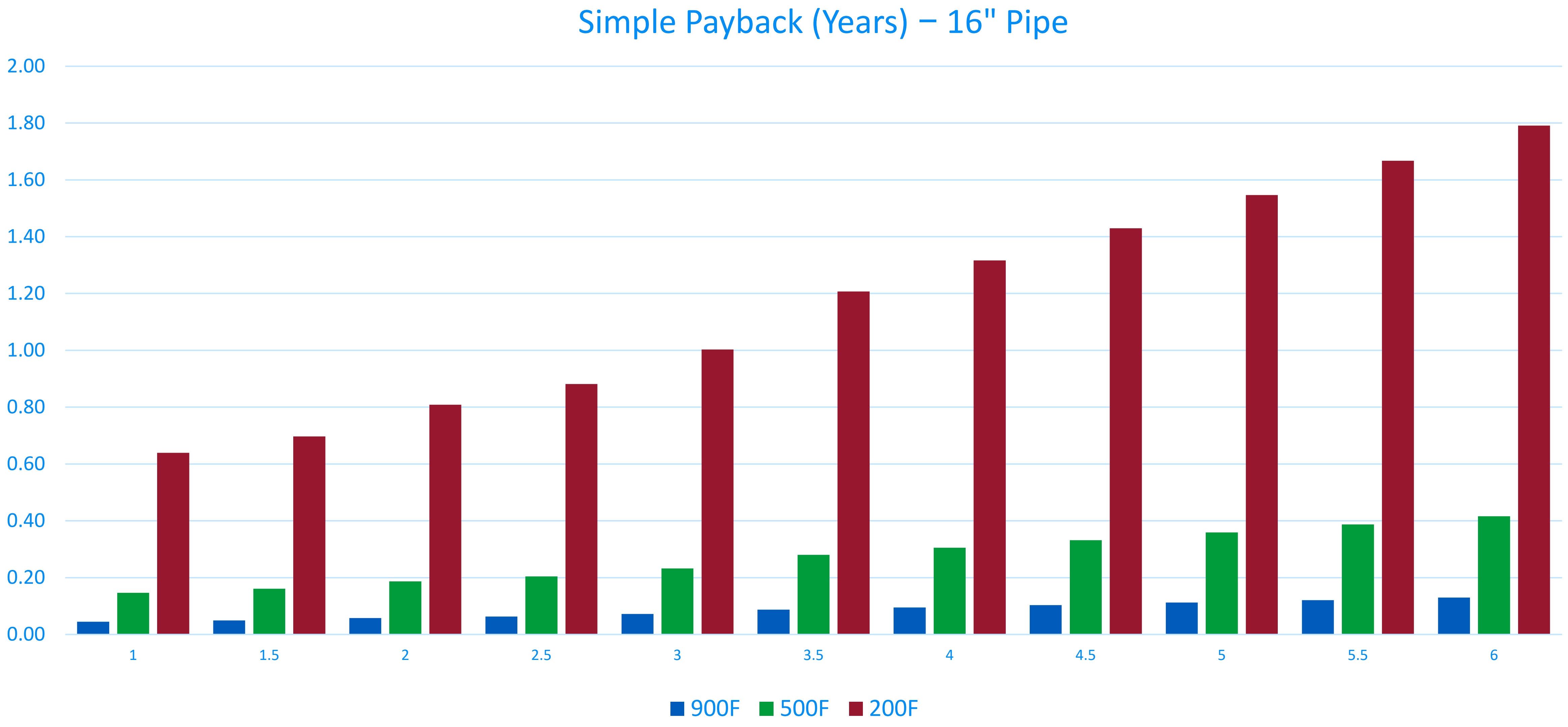

Simple Payback (Years) for 3" Pipe
2.50
2.00
1.50
1.00
0.50
0.00
1
1.5
2
2.5
3
3.5
4
4.5
5
900F
500F
200F

3” PIPE



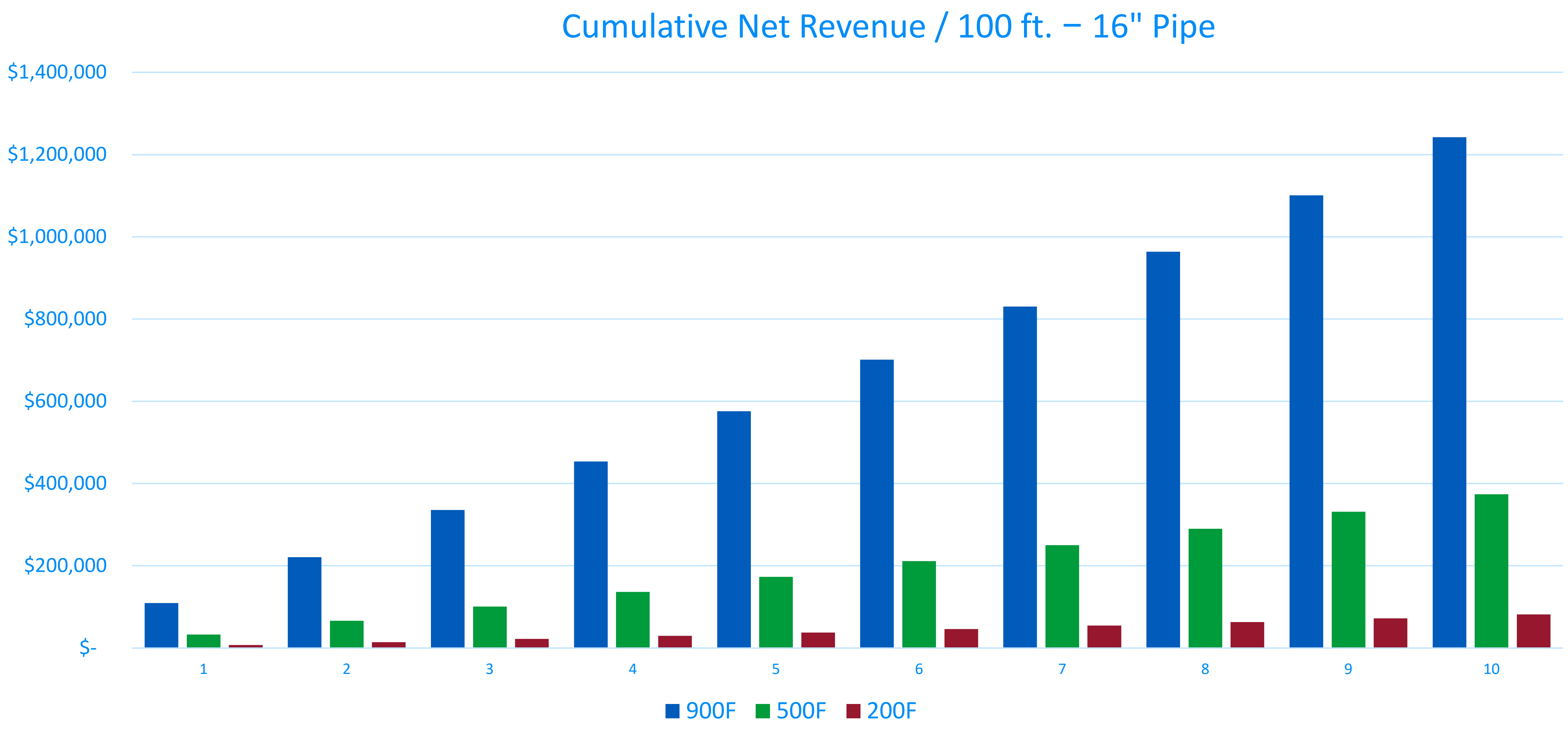
Cumulative Net Revenue / 100 ft. on 3" Pipe
$350,000
$300,000
$250,000
$200,000
$150,000
$100,000
$50,000
$-
1
2
3
4
5
6
7
8
9
10
900F
500F
200F

16" PIPE

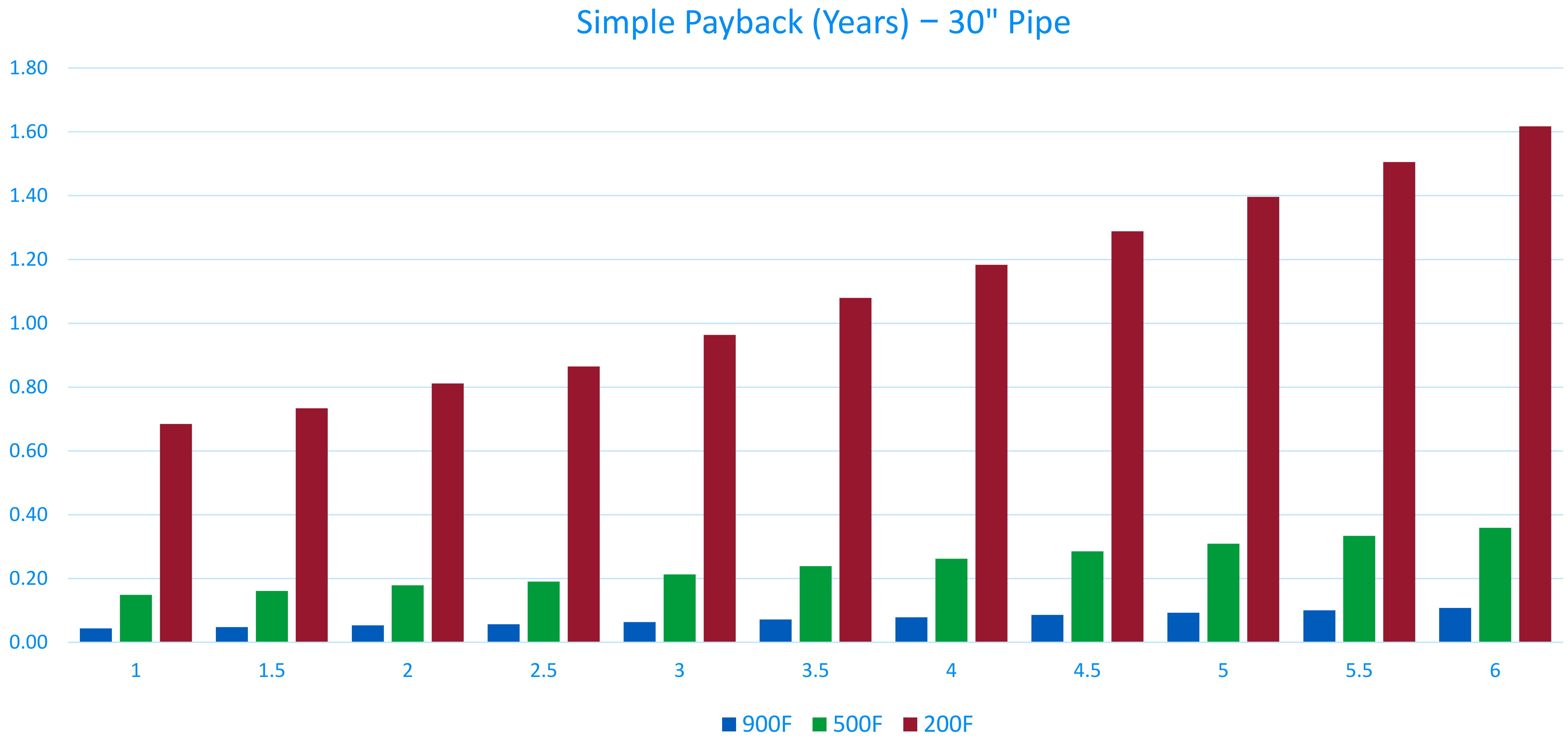


Simple Payback (Years) – 16" Pipe
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
900F
500F
200F

16" PIPE

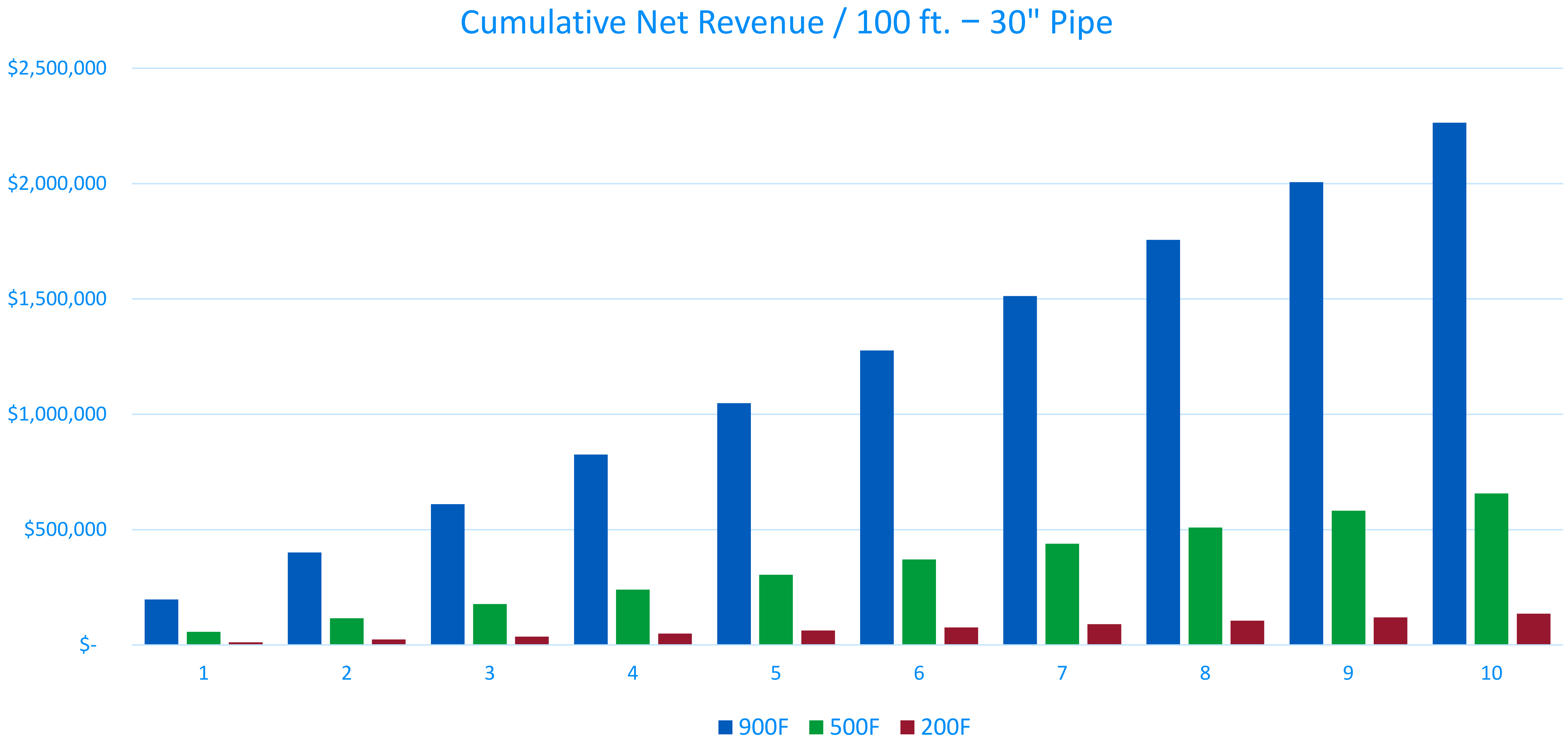

Cumulative Net Revenue / 100 ft. – 16" Pipe
$1,400,000
$1,200,000
$1,000,000
$800,000
$600,000
$400,000
$200,000
$-
1
2
3
4
5
6
7
8
9
10
900F
500F
200F

30” PIPE



Simple Payback (Years) – 30" Pipe
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
900F
500F
200F

30" PIPE

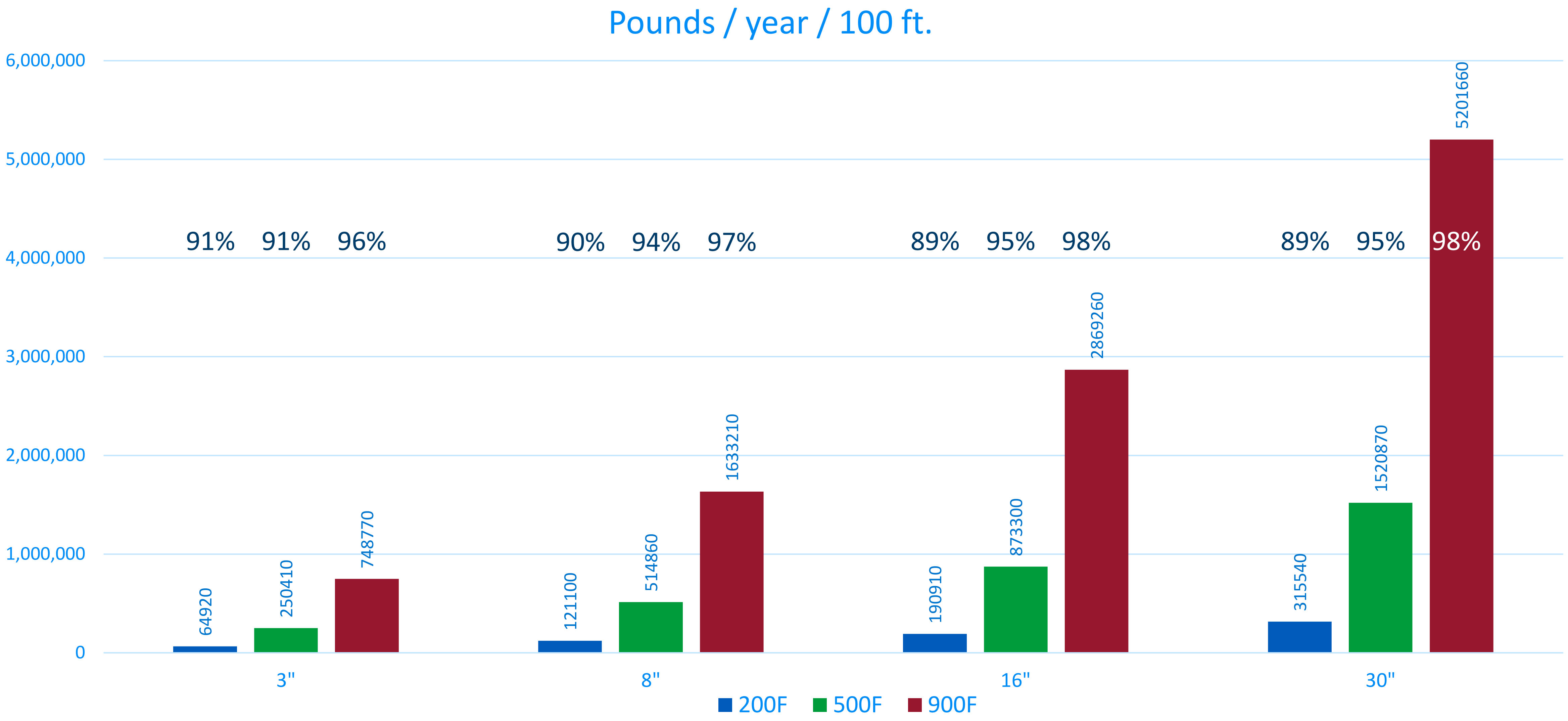

Cumulative Net Revenue / 100 ft. – 30" Pipe
$2,500,000
$2,000,000
$1,500,000
$1,000,000
$500,000
$-
1
2
3
4
5
6
7
8
9
10
900F
500F
200F

16” Pipe, Emissions Reduction

Process Temp (°F)	Insulation Thickness (in)	CO_2 (lb/ft/yr)	NOx (lb/ft/yr)	Process Temp (°F)	Insulation Thickness (in)	CO_2 (lb/ft/yr)	NOx (lb/ft/yr)	Process Temp (°F)	Insulation Thickness (in)	CO_2 (lb/ft/yr)	NOx (lb/ft/yr)
200	Bare	2149.2	4.31	500	Bare	9217.8	18.49	900	Bare	29353.2	58.88
200	0.5	421.7	0.85	500	0.5	1536.5	3.08	900	0.5	3536.4	7.09
200	**1**	**240.1**	**0.48**	500	1	885.6	1.78	900	1	2071.0	4.15
200	1.5	170.5	0.34	500	1.5	630.6	1.26	900	1.5	1481.5	2.97
200	2	130.9	0.26	500	**2**	**484.8**	**0.97**	900	2	1141.3	2.29
200	2.5	110.8	0.22	500	2.5	410.7	0.82	900	2.5	967.7	1.94
200	3	95.3	0.19	500	3	353.3	0.71	900	3	833.0	1.67
200	3.5	84.1	0.17	500	3.5	311.7	0.63	900	3.5	735.0	1.47
200	4	75.5	0.15	500	4	280.1	0.56	900	**4**	**660.6**	**1.33**
200	4.5	68.8	0.14	500	4.5	255.2	0.51	900	4.5	602.1	1.21
200	5	63.4	0.13	500	5	235.2	0.47	900	5	554.8	1.11
Reduction at PP thickness			**89%**				**95%**				**98%**

PP Thickness

CO_2 EMISSIONS REDUCTION



SUMMARY

Insulation projects are low cost.

Project execution is typically weeks to a few months.

Simple payback less than 1 year, often only 1 or 2 months.

All design thicknesses delivered reductions in CO_2 and NO_x emissions of 88 to 98%.

CONCLUSION

Even a relatively small investment in a proper insulation system will deliver major energy savings and carbon footprint reduction, with a simple payback of less than 1 year.

THANK YOU
ANY QUESTIONS

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