

# Exploring Enron Emails via Graphs

A NEO4J Project by:

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The background features several overlapping, semi-transparent geometric shapes in shades of green and blue, primarily on the left and right sides, creating a modern, dynamic feel.

# 1. What is ENRON?

Enron Corporation (\$ENE)

# Enron Corporation

- Largest natural gas seller in North America (1992).
- \$100.7 Bn in revenue in 2000.
  - 750% increase over the last 4 yrs.
- 6th on *Fortune* Global 500.



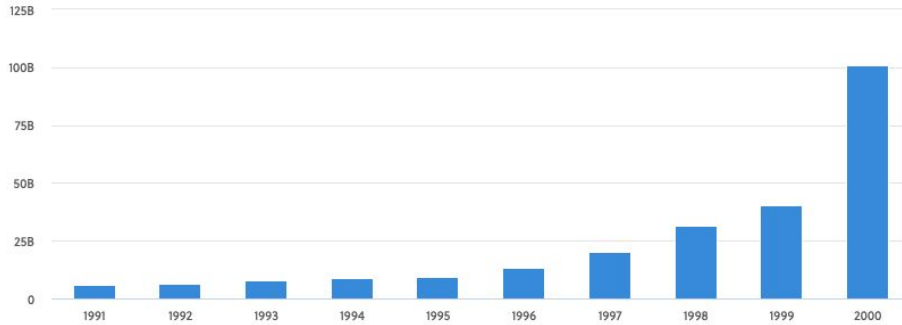
# Enron Corporation

- Stock Price per Share:
  - Dec, 00 - \$80
  - Dec, 01 - \$0.12
- How could such a large company fail in just one year's time?



Source: Wikimedia Commons

## Enron Revenue (1991-2000)



- Between 1996 and 2000 Enron saw a revenue CAGR of 65%.
- The typical growth rate in the energy industry was around 2-3% at the time.

# Timeline of the Downfall of Enron



Source: UMKC School of Law

(A) 1996 to 2001: Enron is the darling of Wall Street; share price rises; Fortune magazine calls Enron "America's Most Innovative Company" for six consecutive years.

(B) 1999 to mid-2001: Enron executives and directors receive \$1.1 billion by selling 17.3 million shares.

(C) April 17, 2001: Enron reports first quarter profits of \$536 million.

(D) August 14, 2001: Jeffrey K. Skilling abruptly resigns as chief executive, citing "personal reasons," Mr. Lay reassume the position of CEO.

(E) August 20, 2001: Kenneth Lay sells 93,000 shares for about \$2 million. At the same time, he urges employees to buy company shares, sends an e-mail to employees assuring them that the company is on solid footing, and predicts "significantly higher stock price."

(F) September 26, 2001: In an online chat with employees, Mr. Lay says that Enron stock is a good buy and that the company's accounting methods are "legal and totally appropriate."

(G) October 16, 2001: Enron reports a third-quarter loss of \$618 million.

(H) October 22, 2001: The Securities and Exchange Commission opens an inquiry into Enron's accounting.

(I) December 2, 2001: Enron files for bankruptcy protection.

# Reasons for Enron's Bankruptcy

- Revenue Recognition:
  - Recorded selling price of energy products as revenue, instead of simply the fees collected.
  - Recorded loan transactions as closing sales, increasing revenue and decreasing debt (liabilities).
- Mark-to-market Accounting:
  - Enron accountants recorded estimated future cash flows as income.
  - Sometimes the cash flows never came due to failed projects, but the income had already been recorded.

# Reasons for Enron's Bankruptcy

- Special Purpose Entities:
  - Enron creates limited partnership shell companies to take on debt for Enron using Enron's assets as collateral.
  - Connections between the companies and Enron were not made public, therein hiding Enron's debt.
- Reckless Auditing:
  - Enron hiring Arthur Andersen's firm to audit and oversee Enron's financial reporting.
  - This partnership presented a conflict of interest as Andersen's pockets were lined by Enron, as they overlooked the aforementioned accounting practices.



## Significance

- At the time, this was the largest bankruptcy in American history.
- 20,000 employees lost their jobs and life savings in stock options and retirement accounts.
- Investors lost Billions of dollars following the bankruptcy in late-2001.

The background of the slide is a dark blue gradient. On the left and right sides, there are several overlapping, slanted rectangular shapes in various shades of green and blue, creating a dynamic, modern look. These shapes are positioned around the central text area.

## 2. Who was Involved?

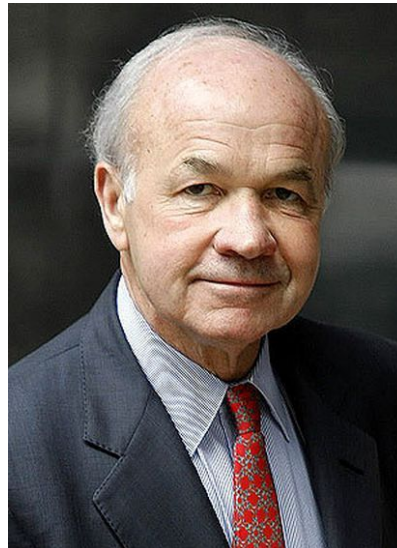
The Key Players

## Focus of our Investigation



Jeffrey Skilling -  
CEO of Enron

- 35 counts of fraud
- 24 years in prison



Kenneth Lay -  
Founder, Chairman,  
CEO of Enron

- 6 counts of conspiracy and fraud
- 4 counts of fraud and making false statements

## Information Collected on Execs

- Hundreds of thousands of emails were collected between company employees, especially between the executive board and Arthur Andersen.
- These emails were made public by the Federal Energy Regulatory Commission.
- Leslie Kaelbling at MIT and Melinda Gervasio at SRI have cleaned the data and prepared it for exploration.
- This is the dataset we used in our exploration.

The background features several overlapping, semi-transparent geometric shapes in shades of green and blue, creating a modern, abstract design. These shapes are primarily parallelograms and trapezoids, some pointing towards the top-left and others towards the bottom-right.

# 3. Extracting Features

The ENRON Emails Dataset

## The Original Dataset

- Comprised of emails sent from 150 Enron Executives & Employees (mostly senior management)
- ~200,000 emails
- Categorized primarily into SENT, DELETED, INBOX, and DISCUSSION THREADS
- Source: <https://www.cs.cmu.edu/~enron/>

Message-ID: <28914982.1075840099786.JavaMail.evans@thyme>  
Date: Fri, 17 Sep 1999 03:45:00 -0700 (PDT)  
From: sherri.reinartz@enron.com  
To: markskilling@hotmail.com  
Subject:  
Mime-Version: 1.0  
Content-Type: text/plain; charset=us-ascii  
Content-Transfer-Encoding: 7bit  
X-From: Sherri Reinartz  
X-To: markskilling@hotmail.com  
X-cc:  
X-bcc:  
X-Folder: \Jeffrey\_Skilling\_Dec2000\Notes Folders\Sent  
X-Origin: SKILLING-J  
X-FileName: jskillin.nsf

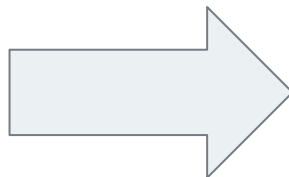
Mark,

I got your nice letter - hope things are going well. I'm really looking forward to seeing you in SF next week. Have a safe trip.

Jeff

Sample Text File

# Data Preparation



	from_email	message_id	to_email	date
0	rosalee.fleming@enron.com	<4353541.1075840278810.JavaMail.evans@thyme>	david.haug@enron.com	Wed, 13 De
1	rosalee.fleming@enron.com	<7918822.1075840279079.JavaMail.evans@thyme>	eaivittor@yahoo.com	Tue, 28 Nov
2	rosalee.fleming@enron.com	<2796536.1075840281350.JavaMail.evans@thyme>	nrsllinda@pplj.com	Tue, 20 Jun
3	rosalee.fleming@enron.com	<25179713.1075840281374.JavaMail.evans@thyme>	philippe.bibi@enron.com	Tue, 20 Jun
4	rosalee.fleming@enron.com	<25179713.1075840281374.JavaMail.evans@thyme>	jay.fitzgerald@enron.com	Tue, 20 Jun
5	rosalee.fleming@enron.com	<25179713.1075840281374.JavaMail.evans@thyme>	steven.kean@enron.com	Tue, 20 Jun
6	rosalee.fleming@enron.com	<6940466.1075840281398.JavaMail.evans@thyme>	Bannantine@ENRON_DEVELOPMENT@ENRON_DEVELOPMENT	Tue, 20 Jun
7	rosalee.fleming@enron.com	<13217776.1075840281421.JavaMail.evans@thyme>	djbryant@insync.net	Tue, 20 Jun
8	rosalee.fleming@enron.com	<20830161.1075840281444.JavaMail.evans@thyme>	redherring-61399@mailsubs.com	Tue, 20 Jun
9	rosalee.fleming@enron.com	<19136225.1075840281467.JavaMail.evans@thyme>	kathy.mayfield@enron.com	Fri, 16 Jun 2
10	rosalee.fleming@enron.com	<19136225.1075840281467.JavaMail.evans@thyme>	sheri.sera@enron.com	Fri, 16 Jun 2
11	rosalee.fleming@enron.com	<19136225.1075840281467.JavaMail.evans@thyme>	pam.benson@enron.com	Fri, 16 Jun 2
12	rosalee.fleming@enron.com	<3308782.1075840281490.JavaMail.evans@thyme>	godwin.carmona@aspeninstitute.org	Tue, 13 Jun
13	tori.wells@enron.com	<11006164.1075840281513.JavaMail.evans@thyme>	maxwells@train.missouri.org	Tue, 13 Jun
14	tori.wells@enron.com	<28638797.1075840281536.JavaMail.evans@thyme>	dhulton@euromoneypic.com	Tue, 13 Jun



```
# starting point
emails_path = 'C:/Users/Aneesha2/Desktop/enron_contents/maildir/lay-k/sent/'

for email in os.listdir(emails_path):

    # lists out every email
    email_path = emails_path + f'{email}'

    # open file
    mail = open(email_path, "r")
    # each line is a line of the text file
    lines = mail.readlines()
    mail.close()

    # Extracting Features|
    message_id = [line for line in lines if 'Message-ID:' in line]
    date = [line for line in lines if 'Date:' in line]
    from_email = [line for line in lines if 'From:' in line]
    subject = [line for line in lines if 'Subject:' in line]
    encoding = [line for line in lines if 'Content-Transfer-Encoding:' in line]
```

Methodology for Extracting Features

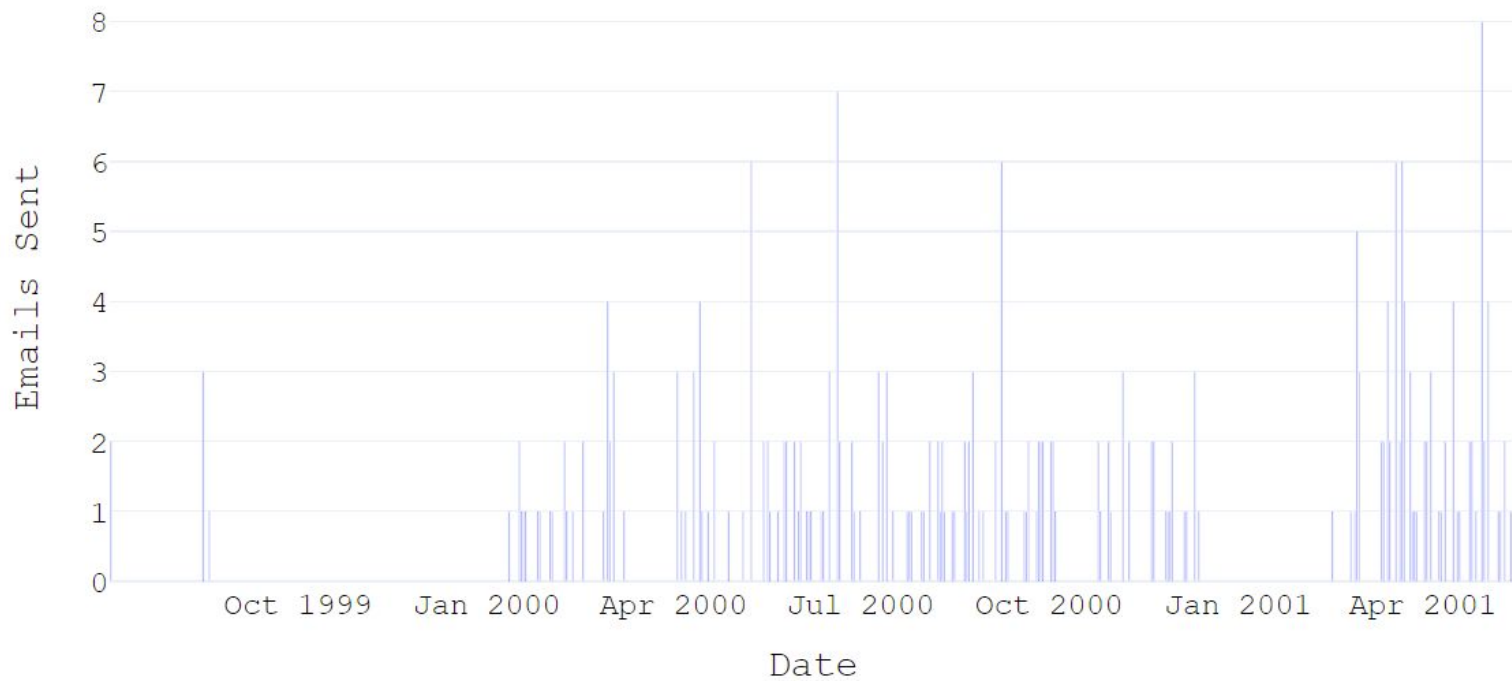


# 4. Data Exploration

Summarizing the Email Statistics



Number of Enron Email Accounts for Each Manager



Emails Sent from Kay's Alternative Accounts

The background features several overlapping, semi-transparent geometric shapes in shades of green and blue, primarily on the left and right sides, creating a modern, tech-oriented aesthetic.

# 5. Generating Networks

Mapping Relationships with Neo4j

## Data Model

Neo4j

### Nodes:

- (s: Sender {from\_email})
- (r: Receiver {to\_email})

### Relationships:

- (s) - [e: Email {message\_id, date, encoding, length, subject, body}] -> (r)



- jeff.skilling@enron.com
- sherri.sera@enron.com
- katherine.brown@enron.com
- joannie.williamson@enron.com
- sherri.reinartz@enron.com

-----Original Message-----

From: [Jeff.Skilling@enron.com](mailto:Jeff.Skilling@enron.com) [mailto:[Jeff.Skilling@enron.com](mailto:Jeff.Skilling@enron.com)]

Sent: Monday, May 14, 2001 2:38 PM

To: Erica Harris

Cc: [Joannie.Williamson@enron.com](mailto:Joannie.Williamson@enron.com)

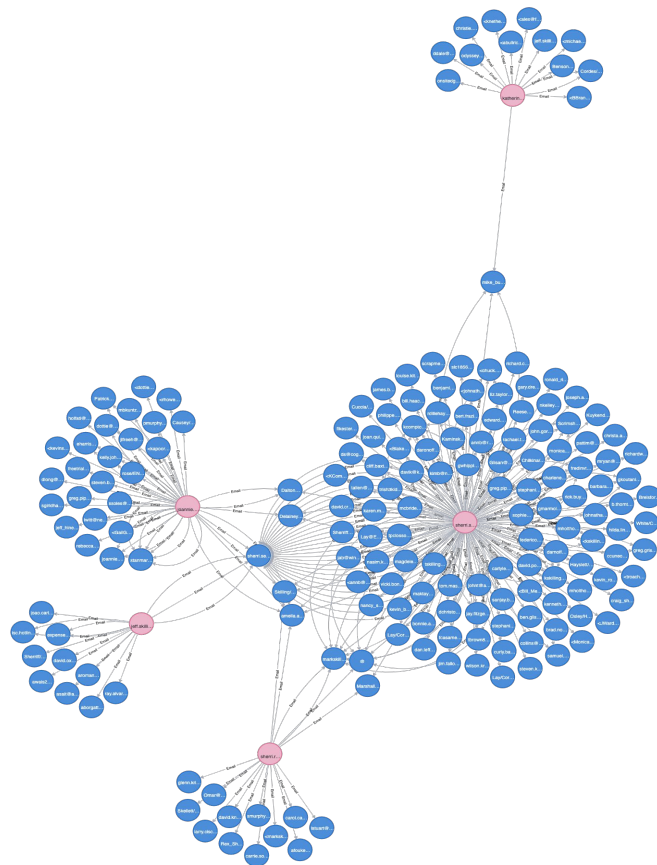
Subject: RE: Telephone Call with Jerry Murdock

Erica, thanks for the note. Joannie has left the office for the day, but will return tomorrow morning.

In the meantime, I'll run this by Jeff to see if he thinks it makes sense. Do you have any dates for future dinners in mind? The vast majority of Jeff's time is committed through February 2002, so knowing what the dates/timeframes are would be most helpful in the event we need to try to free up some time. Thank you.

Regards,  
Sherri Sera  
Assistant to Jeff Skilling  
713.853.5984  
713.646.8381 (fax)  
[sherri.sera@enron.com](mailto:sherri.sera@enron.com)

Jeff's Email Accounts

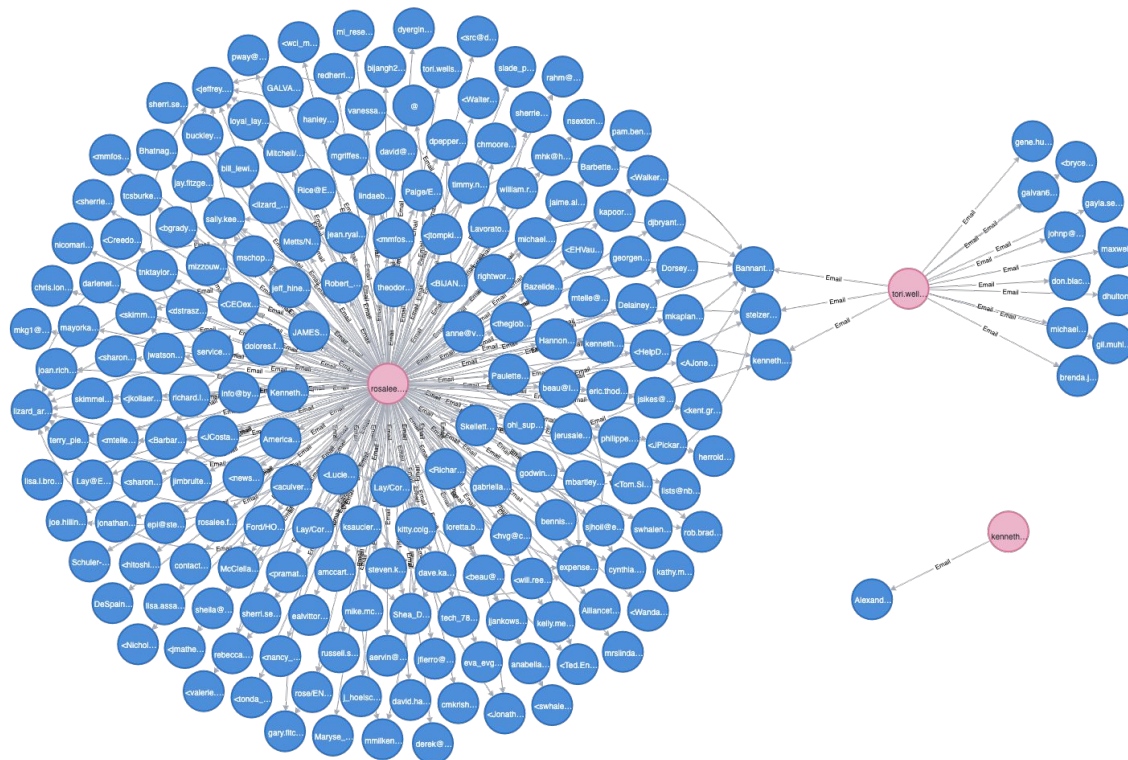


Jeff's Email Accounts and Recipients



	to_email	num_emails
1	"sherri.sera@enron.com"	32
2	"markskilling@hotmail.com"	10
3	"kskilling@ehshouston.org"	7
4	"amelia.alder@enron.com"	6
5	"kcompton@kpcb.com"	6

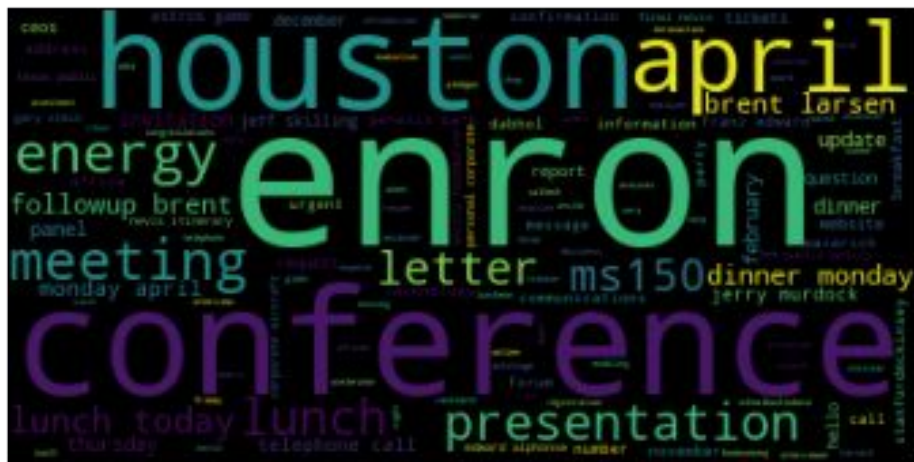
Top 5 Accounts Jeffrey Skilling is Sending Emails to



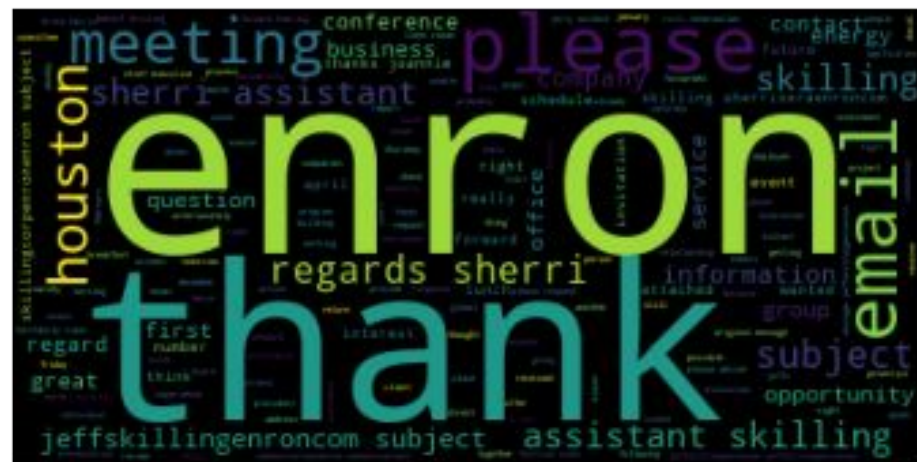
Kenneth's Email Accounts and Recipients

	to_email	num_emails
1	"sherri.sera@enron.com"	34
2	"markskilling@hotmail.com"	10
3	"Lay/Corp/Enron@ENRON"	9
4	"expense.report@enron.com"	9
5	"lizard_ar@yahoo.com"	9

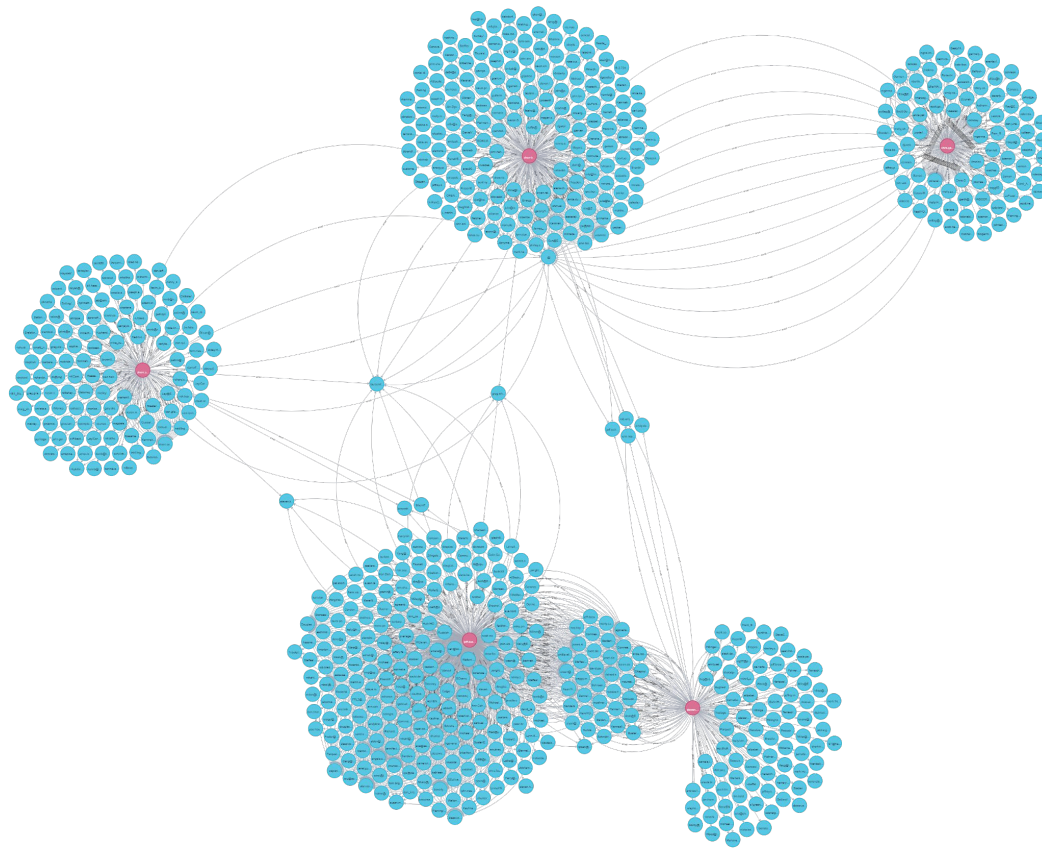
Top 5 Accounts Kenneth Lay is sending emails To



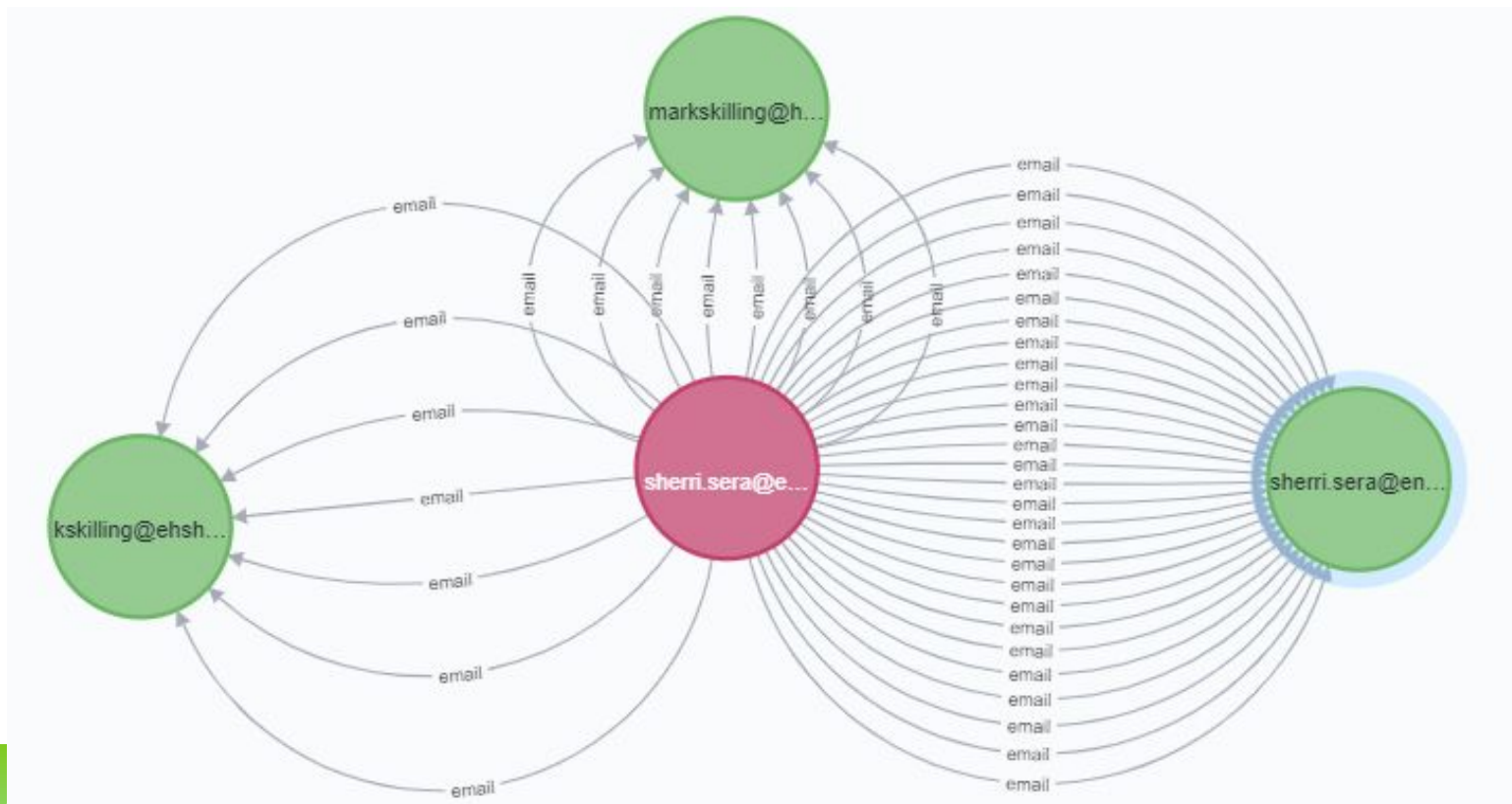
Email Subject



## Most Common Words in Jeff's Emails & Subject Lines



Top Accounts that Sent Emails regarding “Energy”



Skilling's Major Communications regarding "Energy"

## Next Steps

- Create graphs for more executives to compare convicted vs. non-convicted people.
- Compare salaries and bonuses of execs to see if convicted executives did it for the money.
- Shortest path: compare distances of lower employees to executives who were convicted.

## Sources

- Data:
  - <http://cs.cmu.edu/~enron/>
- Information & Charts:
  - <https://www.famous-trials.com/enron/1791-stockchart>
  - <https://www.begintoinvest.com/enron-stock-chart/>
  - [https://en.wikipedia.org/wiki/Enron\\_scandal](https://en.wikipedia.org/wiki/Enron_scandal)
  - <https://fairlyvalued.com/company/ENRNO>