Money, Markets and Climate Change[1]

(Revised May 3, 2009, available at http://ssrn.com/abstract=1304083)

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Accepted for presentation to the 11th Conference of the Association for Heterodox Economics, Kingston University, London July 9-12th 2009, with an earlier version presented to the Seventh Annual Conference of the Society for Heterodox Economics, Sydney, December 8, 2008

ABSTRACT

Climate change has been identified as "The biggest market failure the World has ever seen", (Stern 2006). This paper identifies the cost of finance as an influential element of this market failure and how it can be removed. One approach would be to use a renewable energy backed currency to build a complementary more efficient, stable and resilient financial system. The equivalent investment cost per kilowatt-hour (kWh) of generating electrical power from renewable sources is typically a number of times greater than that from burning carbon. This makes the financing cost of renewable electricity generation a number of times greater. However, the operating costs of most renewable electricity sources are significantly less, as the cost of fuel is eliminated and labour costs reduced. The incentive for markets to allocate resources to burning carbon rather than to invest in renewable power would be reduced if the cost of finance for renewable electricity generation was eliminated. Two approaches are considered: (i) Selective monetary policies to introduce interest free Islamic Banking and/or (ii) The introduction of kWh vouchers to pay for renewable electricity that could be used to create an alternative decentralised global currency. The resulting renewable "Energy Dollars" would create a unit of value independent of any increases in the costs of coal, oil, gas or taxes on their consumption.

JEL Classification: D49; E50; G28; N50; Q42.

Keywords: Climate change; Demurrage currency; Energy dollars; Islamic Banking; Monetary policy.

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http://members.optusnet.com.au/~sturnbull/page5.html
Research papers at: http://ssrn.com/author=26239

[1] Acknowledgement is gratefully made for the valuable comments on a 2008 draft of this paper provided by Dr. Mark Diesendorf (2007), Senior Lecture at the University of NSW in the Institute of Environmental Studies. This paper has provided the foundation at the time of it revision for two sequels: 'Options for Rebuilding the Economy and the Financial System' available at http://ssrn.com/abstract=1322210 and 'Electronic Money: Its economic, social, political and environmental impact', available at http://ssrn.com/abstract=1391812.

> When our Federal Government, that has the exclusive power to create money, creates that money and then goes into the open market and borrows it and pays interest for the use of its own money, it occurs to me that that is going too far. I have never yet had anyone who could, through the use of logic and reason, justify the Federal Government borrowing the use of its own money. I am saying to you in all sincerity, and with all the earnestness that I possess, it is absolutely wrong for the Government to issue interest-bearing obligations. It is not only wrong: it is extravagant. It is not only extravagant, it is wasteful. It is absolutely unnecessary (Patman 1941).
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> Congressman Wright Patman, was for 40 years chairman of the US House of Representatives Committee on Banking and Currency and for 20 years tried to repeal the Federal Reserve Act.

1. Introduction

Global warming or climate change has been identified as "The biggest market failure[2] the World has ever seen", (Stern 2006). This paper identifies the cost of finance as an influential element of this market failure and how it can be removed. One result would be to develop a basis for an alternative, more stable and resilient financial system.

The equivalent investment cost to produce each kilowatt-hour (kWh) of electrical power from renewable sources is typically a number of times greater than that from burning carbon. This makes the financing cost of renewable power generation a number of times greater. However, operating costs of most renewable electrical generating sources are significantly less because the cost of fuel is eliminated and labour costs reduced[3].

If the finance costs for renewable sources of electricity generation were eliminated then the incentive for market forces to allocate resources to generate electricity from burning carbon would be reduced.

Two approaches are considered for eliminating the finance cost of generating electricity from renewable sources: (i) Selective monetary policies to introduce Islamic Banking with interest free money and/or (ii) The introduction of kWh vouchers to pay for electricity generation from renewable sources that could be used as a basis to establish an alternative decentralised global unit of account (Turnbull 1977). A renewable "Energy Dollar" currency would create a unit of value whose *price would not increase with increases in the cost of coal, oil, gas or taxes on their consumption.* The relative value of the global unit of account would vary according to the local endowment of renewable energy and resources required for the most efficient technology.

The nature of money has undergone radical changes since its early development. "Free Banking" was widely practiced until the 20th Century (Dowd, 1992, White 1993). There was wide spread "Choice in Currency" as advocated by Hayek (1976a) for controlling inflation. Various commodities were used as currency such as gold, silver, copper, tobacco, cattle, salt and slaves (Galbraith 1976, Davies 1996). Paper money was issued by private banks that could be redeemed into the commodity used to define their unit of value.

Central banking began in 18th Century England and has now spread around the world. Today, governments, not private banks, define what can be used as money or "legal tender" to create a National monopoly of who can issue currency and create non-cash money in the form of bank credits. Alternative forms of money have been made illegal with private note issues being

[2] If CO_2 production from burning carbon is not responsible for climate change as raised by Dr. David Evans (2007), then alternatives to non-renewable resources will still eventually be required as discussed in this paper.
[3] Information from first author of Graham, Reedman, and Coombes, (2007), e-mail of November 11th, 2008.

taxed as introduced in Australia by the Bank Note Tax Act of 1910. To counter this, Hayek (1976b) argued for the "Denationalization of money".

Governments have universally adopted "fiat" money that cannot be defined in terms of anything real since President Nixon took the US off its attenuated version of the gold standard in 1971 (Galbraith 1976: 48). *The Economist* (1990) described fiat money as "funny money" in discussing the introduction of the Euro. It questioned if the Euro should be backed by commodities. Without the need to store and/or insure gold, silver or any other commodity as a "hard" currency, the costs of holding money, described as "demurrage", has been eliminated.

Contemporary central banking has introduced a radically different form of money because: (i) What can be used as money is determined by the government not private interests; (ii) Governments rather than private interests determine who can issue money; (iii) Governments determine the minimum cost of risk-free non-cash money; (iv) The ability of interest rates to indicate the degree of risk is distorted by the cost of risk-free credit; (v) The value of money can no longer be defined in terms of anything real and so money is no longer directly tied to activities in the real economy: (vi) The need and cost of holding a reserve currency has been eliminated; (vii) There is now no common standard of value like a specified commodity to determine the relative value of foreign currencies that are determined by a complex interplay of trade, investment flows, derivatives and the monetary policies of foreign countries.

A basic thesis of this paper is that the relatively recent innovation of central banking accepting monopoly "funny money" has been an exacerbating factor in the market failure responsible for climate change as well as the 2008 financial crisis.

While governments manufacture and issue coins and notes, they have licensed out the manufacture of most non-cash money to private banks[4]. The value of coins and currency notes created by the government represents only minor fraction of the money supply. The difference between the value at which coins and notes are issued and their cost of manufacture creates a profit that is described as "Seigniorage[5]".

In a similar way, the manufacture of credit can create a profit from the interest charged to the borrower being higher than the interest paid on the deposits created by the new credit. The profits created by UK banks from the privilege given to them by their government to create non-cash money has been estimated by Huber and Robertson (2000: 89) to be 15% of the UK GDP. This figure is consistent with UK Banks being responsible for contributing more than 25% of the value of all shares listed on the London Stock Exchange before the financial crisis arose in 2008. Australian Banks likewise represented around 25% in value of all shares traded on the Australian Securities Exchange in 2007.

[4] The US Federal Reserve Act of 1913 created the Federal Reserve Corporation owned by private interests but with its Board appointed by the US President. Its shareholders include investment banks (refer to note 11) and the 12 member Federal Reserve Banks who are in turn owned by private banks in their respective twelve Federal Reserve districts. All profits of the Federal Reserve System represent seigniorage and all such profits are distributed to the private investors who own shares in the system. The profits arise from (a) tax payers who fund the interest cost of the US debt financed by the Federal Reserve System and (b) interest received on other non-cash money created by the Federal Reserve Corporation described as "reserves" that are used to fund the 12 Federal Reserve Banks that in turn are used to create additional non-cash money (Schauf 2008).

[5] In this paper the word "Seigniorage" will be use to describe the net revenue derived from the issue of coins, currency notes as well as non-cash money be it a bank deposit or the facility to drawdown a bank loan.

As the Banking sector does not produce or trade any physical goods, the value of the banking sector represents the value it extracts from the real economy for the financial services it provides. This raises the question: Could financial services be provided without absorbing so much of the GDP? How much more productive in terms of non banking services might the economy become if the banks did not possess the privilege of making private profits from creating non-cash money that is a public good?

How much smaller would the finance sector become if non-cash money was only created by the government, as proposed by Patman (1941) and Friedman (Sennholz 2006)? As the US constitution is supposed[6] to forbid the issue of currency notes without the approval of Congress, an amendment was proposed by Friedman and Friedman (1985) to allow the executive government to do so. Money created by the government would be controlled along the lines described by Friedman (1961), Friedman and Schwartz (1971: 566), Griffin (2002: 573), Huber and Robertson (2000: 9), Marx and Engels (1848) and supporters of the Monetary Reform Act (2008). A compromise proposal that would introduce what this author refers to as "Selective" monetary reform in the US is the "State and Local Government Economic Empowerment Act – HR1452"[7]. Selective money policy provides one way to eliminate finance cost of electricity production from renewable energy sources as considered in Section three.

The basic idea of the money reformers is to remove the power of banks to create non-cash money through increasing the size of their balance sheets by creating loans and deposits. This practice is described as "fractional" banking as the Bank's equity becomes only a fraction of total deposits. Government regulators generally require the degree to which banks can multiply their equity for making loans to follow the guidelines of the Bank for International Settlements (BIS) based in Switzerland.

The termination of fractional banking would mean that commercial banks would only lend funds that they attracted in the manner of credit unions, building societies and savings banks (before savings banks became de-regulated to become merged with commercial banks). Instead, governments would create credit as required by increasing the issue of currency notes or what Friedman and Friedman (1985) describe a "non-interest bearing non redeemable obligations". The reason why non-interest-bearing currency is generally accepted is explained by White (1987).

Shauf (1998) and the Monetary Reform Act (2008) propose that non-interest bearing notes be used to redeem interest bearing obligations of the US government to eliminate the need for tax payers to service the government debt that concerned Patman (1941). As the interest paid on US government bonds represents around 15% of tax revenues in recent years, US taxes could accordingly be reduced.

[6] Galbraith (1976: 68–9) records the issue of non interest paying Treasury notes small enough to become hand to hand currency during the 1812–14 war and the issue of "Greenbacks" during the Civil War.

[7] The objective of the *State and Local Government Economic Empowerment Act* – HR1452, is introduce what is described as a "Sovereignty Loan Plan" to remove the cost of interest/seigniorage in funding local and state government infrastructure assets than can become self-financing from the revenues they produce. Refer to http://www.cbo.gov/doc.cfm?index=4630. As interest payments over 20 or more years can more than double the cost of a project, Sovereignty loans could substantially reduce the cost and so the price charged for such services to reverse inflation (Kennedy 1988).

As the economy expanded and required additional credit, this would be supplied by the government. The profit, or seigniorage, of government created credit would be used to reduce the need to raise tax revenues as calculated by Huber and Robertson (2000: 89).

However, the credit created by commercial banks has been overshadowed by the credits created by investment banks to finance derivatives in recent years. The ability of these "shadow banks" to create synthetic derivative paper assets has arisen through de-regulation of the UK financial markets in the 1980's and the repeal in 1999 of the US Glass Steagall Act.

The Economist (2008) reported that "The derivative markets have grown at a stunning pace" with the total value of derivative contracts increasing from 2.5 times global GDP in 1997 to 11 times global GDP in 2007. The asset bubble created by synthetic assets has been matched by *real* liabilities that reduced the fraction of equity in investment banks to insignificant values. The value of derivative assets is much more volatile than bank loans to introduce instability in the financial system that resulted in a number of commercial, investment and mortgage banks failing in 2008. There exists a need not to just patch up the existing system but to redesign it to make it less costly in servicing the real economy but also more efficient and resilient.

This paper seeks to make a contribution in suggesting how the system could be redesigned. One approach is to modify the existing arrangement by introducing selective monetary policies. The other approach is to introduce a new type of "ecological" currency. It is described as ecological (Turnbull 1992: 96, 2007: 1546, 2008: 123) because its value is defined in physical terms and its properties follows the laws of nature with a limited life.

The next Section considers the structure of money with consideration of the strength and weaknesses of various forms. The Third Section reviews the economics of generating electricity from burning carbon or from renewable sources. It describes how selective monetary policy could be used to reduce climate change without price increases from the use of carbon trading or carbon taxing. The Fourth Section considers the design principles required to introduce an alternative demurrage/ecological currency redeemable into kWh to achieve similar objectives as with selective monetary policy. However, besides mitigating climate change "Energy dollars" create a basis for building an independent, more efficient and resilient financial system to provide a fall back alternative for any further breakdowns in the current system. This alternative depends upon introducing a different structure for money as considered in the following Section.

2. The structure of money

This Section compares contemporary fiat "funny" money with a gold backed currency and a currency whose value is defined in terms of kWh of electrical power *generated from benign renewable sources*.

A currency backed by a basket of commodities consumed in its host community is generally considered the most desirable basis for defining a unit of value whose purchasing power remains constant (Fisher 1911). Former Belgium Central Banker, Bernard Lietaer (2001) has proposed a global currency described as a "Terra" backed by a basket of world commodities. In 1983 a local currency described as a "Constant" based on a basket of commodities was introduced in Exeter, New Hampshire by Ralph Borsodi (Boyle 2002: 202).

As noted by Boyle, the problem of using commodities is that their consumption changes over the seasons and over time as technology changes the composition of goods and services. Some

food commodities would be difficult and/or expensive to store so that any demands to redeem the currency into its constituent commodities might not be met. If the mix of commodities lost its alignment with the value of its constituent parts then an incentive could be created to redeem the currency to profit from selling its components.

Another problem in using a basket of commodities is that many can have considerable variations in quality that can alter its value to users. Some quality characteristics are difficult to define and measure. The purity of metal commodities can be more easily defined, measured and maintained than the characteristics of tea, tobacco or cattle and so on which have in the past been used as money. Another problem is that some commodities can substitute for others. However, there is no substitute for electricity generated from benign[8] renewable sources and its quantity can be measured in kWh as precisely as required.

Besides being a unit of account, money also carries out the role of being a "medium" of exchange and a "store of value". However, fiat money no longer carries out its historical role in providing a physically definable "unit of value" like a pound weight of sterling silver or a defined weight of gold. There is now no contractual connection and so market feedback mechanism between money and the real economy and its environment. A visitor from another planet would be puzzled why our society uses fiat "funny" money as a "message stick" to allocate real resources when information being conveyed is not connected to any real resource?

Advanced economies are highly dependent on the consumption of energy. Energy consumption closely correlates with total economic activity in most countries. It is the production of electricity from burning carbon that is mostly putting the future of civilization at risk. So while defining a unit of value only on kWh has theoretical shortcomings there is a practical survival imperative to accept any shortcomings to help ameliorate market failure that is warming the planet. In any event, as noted above, the ideal theoretical basis for defining a unit value has practical problems in its implementation.

Table 1: 'Comparison of fiat currencies with gold and renewable energy dollars', uses 13 criteria for comparing money defined by governments as legal tender with those defined in terms of gold or benign sustainable sources of electricity. No quality testing is required for fiat currencies as quality is not defined as noted in row 2 of the Table. Tokens of fiat money have negligible intrinsic value while gold can be used in industry to some degree as suggested in row 3 of the Table. Another special feature of energy dollars is that they have an intrinsic use value to pay for electricity that is little shared by gold and not at all with fiat money as indicated in row 4.

The definition of what is considered as fiat money is determined by governments, as noted in row 5. The sources for gold are concentrated in a handful of regions to create inequities between countries as noted in row 6. While commercially exploitable benign renewable energy is site specific it is very much more equitably distributed. Some sort of renewable electricity is available some of the time everywhere from the sun, wind and bacteria[9].

The relative cost of converting renewable energy to electric power could vary according to the location. However, as noted in row 7 around 10% of electrical energy is typically lost in transmission, mostly when distributed at low voltage. A kWh currency would create a global standard unit of account but one that could vary in value relative to other commodities at

[8] Some sources of renewable energy can produce severe environmental impact such as in bio fuel production.
[9] Bacteria can produce electricity directly (Sliwa, 2006) or indirectly by releasing hydrogen from water (NCSU 2008) that can be burnt to power generators.

different locations depending upon its source and the technology involved. As a result, market forces would allocate energy intensive industries to those locations with a comparative advantage in producing renewable electricity most efficiently. The financial and energy cost of distributing energy intensive goods and services would offset to some degree the advantage.

As noted in closely related rows 8, 9 and 10 the volume of national currencies made available is typically controlled indirectly by interest rates, fiscal policies and prudential reserves required by government and/or the BIS. The availability of gold to back a currency in an economy can vary from place to place as noted in the Table. The amount of power available to back a currency on the other hand is closely related to consumer demand. In this way the volume of kWh money automatically becomes closely related to the level of economic activity or GDP. However, not shown in the Table, the volume of gold and energy currencies could also be controlled by political interventions.

Table 1: Comparison of fiat currencies with those based on gold and renewable energy

No	Comparison criteria	Fiat dollars	Gold dollars	Renewable Energy
1	Unit of value	Not defined	Ounces/grams	Kilowatt-hours
2	Quality testing	Not required	Density	Not required
3	Intrinsic value	Negligible	Say 10%	100%
4	Subjective value	100%	Say 90%	Nil
5	Source of currency	Government decree	Few locations	Many & technology
6	Equity of supply	Depends on Gov.	Concentrated	Widely spread
7	Cost of distributing reserve currency	Negligible with electronic transfers	Changes little with distance	Increases with distance
8	Changes in production of money	Controls & interest rates	Little related to consumption /GDP	Usually related to living standards
9	Volume of money controlled:	Indirectly by interest rates	Geography, trade and government	According to economic activity
10	Rate of change in production of money	Fiscal and monetary policies	Fluctuates with region and time	Relatively stable by region and in time
11	Cost of storage	Not required	1% of value p.a.	Not required
12	Cost of insurance	Not required	1% of value p.a.	Not required
13	Ecological features	None	Natural product	Limited life

The use of a physical commodity like gold as the unit of account or "reserve" currency introduces storage and insurance costs as noted in rows 11 and 12. These costs are avoided with fiat money, renewable energy dollars and derivate energy dollars that would need also to be created to introduce hand to hand money. This does not mean that some storage devices are not required for some forms of renewable electricity production.

The production of both gold and renewable electricity depend upon to some degree on the environmental endowment of a region while fiat currencies are not connected to nature in any way as indicated in row 13. Indeed, the ability of modern money to increase its value from earning interest over time without reflecting any increases in real resources is inconsistent with natural processes that results in all living things decaying. Ecological forms of currency have also been proposed and introduced as described later in this Section.

The importance of having an ecological local currency connected to environmental conditions can be profound. The nature of a currency determines how resources are priced and markets allocate resources according to prices. To sustain humanity on the planet it is the environment that should influence how resources are allocated and governed as outlined by Turnbull (1992: 81–110) through "Building a Stakeholder Democracy" (Turnbull 1994: 85–90). In other words society needs to become composed of environmental republics with feedback mechanisms to

influence human activities to sustain both. This cannot occur with fiat currencies controlled by governments and their monetary policies and institutions that are neither flexible nor adaptive to provide resiliency or ecological feedback (Olsson, Folke and Berkes 2004: 75).

The importance of having a decentralized local currency to allocate resources was highlighted by Jacobs (1985: 161) who stated that "Because currency feedback information is so potent, and because so often the information is not what governments want to hear, nations go to extravagant lengths to try and block off or resist the information". Jacobs (1985: 163) went on to explain:

> Individual city currencies indeed serve as an elegant feedback controls because they trigger specifically appropriate corrections to specific responding mechanisms. This is a built-in design advantage that many cities of the past had but which almost none have now. Singapore and Hong Kong, which are oddities today, have their own currencies and so they possess this built-in advantage.

Consider a "mind experiment" that assumes that the consumption of foreign exchange in a region is directly proportional to the population of the region. Let us make two other reasonably realistic assumptions: 1. Ten percent of the Australian population live in Western Australia, thus requiring only 10% of Australian foreign exchange and 2. Western Australians earn around 60% of all Australian foreign exchange through the export of their minerals and primary products. This means that on average each Western Australian is earning six times the foreign exchange they are spending.

Now if Western Australia established its own currency then its value would be determined by its terms of trade with the rest of the World. The other 90% of Australians residing in the Eastern States are earning only 44% (90%/40%) of the foreign exchange that they require.

The result would be a substantial decline in the value of the Australian dollar used in the Eastern States to create a boom in inbound tourism, education exports and manufacturing while the stronger Western Australia currency would attract migrants from the Eastern States and create an even greater strain on their resources. Other larger exporters in the Eastern States, mainly coal miners and farmers would demand that they establish their own non-urban regional currency to allow them to survive.

The mind experiment illustrates just how potent the design of a currency system can be. Currencies can create market forces far more influential than tariffs and taxes in allocating resources.

The problem of misallocation of resources introduced by fiat money was noted in the Soviet economy by *The Economist* (1991). To analyze the price distortions *The Economist* used kWh as a reference unit of value. *The Economist* has also established a "Big Mac index[10]" based on the relative prices of Macdonald Hamburgers in different countries for comparing currencies.

Even more profound changes in market allocation of resources could occur from the use of limited life, perishable, decaying currencies and/or those that introduce a usage or demurrage charge.

Metal based currencies incur a cost of storage and insurance which acts like a demurrage charge. An additional usage cost arises with currencies that are consumed like grain, livestock and tobacco. Grains and livestock have been used as a store of value, medium of exchange and unit of account for thousands of years (Davies 1996). The use of limited life commodities as

[10] Refer to http://www.economist.com/markets/bigmac/index.cfm

legal tender has not been trivial as noted by Galbraith (2001: 48) who observed that tobacco "had nearly twice as long a run as gold" as legal tender in the US from 1642 until it was forbidden by the US constitution.

The idea of introducing a usage charge on paper money was introduced by German speaking Silvio Gesell (1916). It was put into operation in Germany in 1919 after the First World War. A privately issued currency note was issued described as "Wära" a word compounded from "Wäre" and Währung" which mean respectively "Goods" and "Currency". This "merchant currency" influenced the ideas of another German Rudolph Steiner who described it as "decaying" (Preparata 2006) money because the script lost all value unless a stamp was periodically purchased from the issuer and attached to the back of the script. As a result the script change hands very quickly so it became known as "speed money" as well as "Stamped script", "neutral money" (Suhr 1989) or "Frei Geld" (free money).

The script was referred to as "free money" because it was *given* away like the notes issued as a "dividend" by the US State of Maryland in the 18th century (Galbraith 1976: 53). However, unlike the Maryland dividend or the Social Credit distributions proposed by Major Douglas (1924), the notes paid for themselves from the revenues collected from the sale of stamps to keep the script valid. For example, a one dollar note that was redeemed after two years with a demurrage or negative interest charge of 1% per week would generate revenues for the issuer of 52 cents a year. Over the two year life of the script total revenues would be $1.04 to provide a profit of 4 cents after redeeming the script for $1.00. This profit is obtained even though the script was given away!

The average demurrage charge per user becomes smaller the faster the script circulates. If for instance the script was used 20 times in a week then the average cost per transaction would become 1/20 of one cent or 0.05% of the value of the script. The commission on credit card transactions cost 2% or more. The cost of stamped script would represent only 1% of the cost of a credit card commission.

Wära redeemable into coal was used by the owner of a bankrupt Bavarian coal mine to pay his employees to re-commence operations in 1929. Script holders could redeem their notes for coal or pay a 1% fee to the issuer for storing the coal. This was a time of hyper inflation and unemployment. Yale economist Irving Fisher (1933: 20) reported that the script issue "provided work, profits and better conditions for the entire community". Use of the Wära rapidly spread to over 2,000 firms in Germany using various commodities for its backing. This threatened the power of the German Government who introduced an emergency law to stop the issue of Wära in 1931 after they failed to achieve this end through the courts.

However, the idea was then taken up in 1932 by the Mayor of Wörgl in Austria. The local script was redeemable into Austrian Schillings deposited in a Trust Account. Redemption into Schillings would cost 2% but it would only cost 1% to hold the script for another month. The Mayor and other municipal employees had at least half their wages paid in local script. It was a great success with back taxes collected and public works being undertaken valued at many times more than the value of the script issued as reported by Fisher (1933: 24–29). Over 200 cities in Austria soon began issuing their own script. This led the Austrian Central Bank to terminate the use of local privately issued currency notes.

Similar success and government repression occurred in the US after Stamped Script began being introduced at the height of the depression in 1932. Fisher (1933: 30–44) records its spread and describes its various forms in Hawarden, Iowa; Evanston, Illinois; Russel, Kansas; Rock Rapids, Iowa; Albia, Iowa; Granite Falls, Minnesota; Nevada, Iowa; Pella, Iowa;

Mangum, Oklahoma; Eldora, Iowa; Jasper, Minnesota; Merced and Anaheim, California; Lexington Nebraska; Enid Oklahoma and Knoxville, Tennessee.

A Bill was introduced into Congress to issue one trillion dollars of stamped script to revitalize the economy on February 1933 (Fisher 1933: 79–83). The script was to become legal tender and distributed to each State Governor in proportion to their population. Recipients then had to affix a two cent postage stamp to each one dollar note each week. After 52 weeks the notes could be redeemed at any Post Office into currency notes which were then backed by gold. The 4% seigniorage profit from the note issue would have raised $40 million for the government owned Post Office while helping to get the economy going again.

However, there was no role for the Federal Reserve System in the creation of this very substantial credit facility. The issue of ecological notes by the government would have diminished the relevance of the Central Bank and giving encouragement to those seeking to repeal the Federal Reserve Act. The Bankhead-Pettengill Bill of February 17, 1933 would have been of critical concern to the private and very influential shareholders[11] of the Federal Reserve System as it would diminish their income, power and influence.

And so it was that a few weeks later on March 4th 1933, President Roosevelt announced the "New Deal" which temporarily closed all banks and prohibited the issue of all "emergency currencies". By then over 2,000 communities were issuing various forms of stamped script.

John Maynard Keynes (1933: 234) supported the use of stamped script by stating:

> Those reformers, who look for a remedy by creating artificial carrying cost for money through the device of requiring legal-tender currency to be periodically stamped at a prescribed cost in order to retain its quality as money, have been on the right track, and the practical value of their proposal deserves consideration.

Consideration is now appropriate with the current crisis in the financial system. This has created an intellectual climate to reconsider and reappraise deep rooted habits of thinking. The need for a new financial architecture has existed since Patman (1941) raised the question as to why governments should pay interest on the money they can create.

As described above, history provides evidence that ecological currencies can be introduced in parallel with national currencies, even if they are gold backed. So there is no need to make an all or nothing change. Alternative monetary arrangements could be introduced to trial new systems in the spirit of Hayek's arguments for a "Choice in Currency". In this way fall back systems could be developed in case more serious defaults emerge using the existing official fiat or "funny money" system.

The problem is that permission is required by keepers of the existing system to roll back their exclusive status. The history of alternative types of money discussed above indicates that those in authority will resist changes to orthodoxy. A breakthrough to adopting a heterodox system might tragically need to wait until there is breakdown of the existing system.

In recent years there has been a revival of what are described as "complementary currencies", "local currencies", Local Employment Trading Systems (LETs), "Time dollars" and barter schemes.[12] A global map of these initiatives with a description of them is posted on the web

[11] Shareholders included: Chase Manhattan Bank, Goldman Sachs, Lazard Brothers, Lehman Brothers, Rothschild, Warburg and individuals such as J.P. Morgan, William Rockefeller and Paul Warburg (Schauf 1998).

[12] Some of these initiatives, such as "Ithaca Hours" (http://www.ithacahours.org/directory.php) in New York State, and "BerkShares" (www.berkshares.org) in Massachusetts arose from their founders attending one of the five residential six day seminars presented to community activists in various locations in the US by the E.F.

pages of the Complementary Currencies Resource Centre[13]. The tradition of Germany being an innovator in alternative currencies is being maintained with it hosting most initiatives, encouraged by the support of Margrit Kennedy (1988).

From the complementary currency web site it is difficult to determine if any of these initiatives create an independent objective unit of account. While many may be described in terms of a commodity or hours of human time there are none that I am aware except "Liberty Dollars"[14] that have established an independent unit of account. They thus represent a barter system of human labor or "shadow" money that defines value in terms of the local fiat currency. However, besides promoting local community economic activities, self-help and retaining wealth within a community these initiatives have introduced wide spread community awareness and knowledge of alternative exchange systems. In this way citizens have become educated and ready to support alternative currency systems.

Stodder, (2000) analyzed how a complementary "shadow" interest free money system established in 1934 by Swiss businesses has helped stabilize the national money supply through economic cycles over 65 years. Lietaer, Ulanowicz and Goerner (2008) have proposed that the Business to Business (B2b) Swiss "WIR" system be adopted by business interests in other nations. They recommend that governments become involved by accepting the private creation of interest free money to pay taxes. This proposal for managing the 2008 banking crisis needs to be compared with alternative of introducing stamped script that can be used not just by businesses but by individual voters. While stamped script creates an ecological form of hand to hand money it could be redeemed into either a fiat currency or an ecological kWh currency.

The ability of an alternative currency system to reduce climate change provides a basis for obtaining a political mandate to change the existing system. The next Section considers how the economics of producing electrical energy from burning carbon or from renewable sources can be affected by how a currency is structured and/or managed.

3. Economics of alternative sources of electrical power

This Section considers how the cost of finance affects the comparative cost of generating electrical power from burning carbon or from renewable energy sources. The cost of finance becomes an influential factor as the investment/technology cost of renewable energy generation is systemically higher than generating electricity from burning carbon.

A fundamental cause is that the cost of fuel ignores external costs it creates in global warming. This is a major source of the market failure referred to by Stern (2006). The cost of extracting CO_2 from coal generators and burying it underground would increase the cost of electrical power from 5 US cents per kWh to 8 US cents per kWh (*The Economist* 2008: 4). *The Economist* quotes the cost of wind power (p.4) and solar powered system with overnight heat storage (p.8) at the same level of 8 US cents per kWh.

Another related cause of the financial cost differential is that the use of fuel provides a substitute for the use of technology in converting energy from renewable sources. In other words, renewable sources require a greater investment in technology to replace the need for

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Schumacher Society from 1982 to 1984. The notes of the presenters at these seminars provided the contents of Benello, Swann and Turnbull (1997).

[13] Refer to http://www.complementarycurrency.org/ccDatabase/maps/worldmap.php

[14] Refer to http://www.libertydollar.org/

fuel. However, offsetting to some extent the higher investment cost per kWh of output from renewable energy sources is a reduction in operating costs achieved by eliminating the cost of fuel and reducing labor costs. In this way the operating cost savings of renewable energy can offset its higher investment cost per unit of output over the life of the equipment.

The utilization of renewable energy technology or its "capacity factor" can make a substantial difference to the size of the investment required to produce the equivalent amount of electricity over the operating life of the technology. For example if the wind only blows a third of the time the output of kWh per dollar invested will become a third of that from burning carbon. In other words to obtain the same output per dollar invested, the investment and so the finance costs must become three times larger as shown later.

The burning of coal, gas and oil can be continuous to allow the technology to be utilized 24 hours per day except for maintenance and fluctuations in demand to yield a capacity factor of 80%. The utilization of technology converting solar energy without storage to electricity might only yield a capacity factor of 20% so that to produce the same amount of kWh over its operating life would require four times the investment to multiply the cost of finance accordingly. While the wind can blow for 24 hours a day this may not occur every day or even for all of any one day. Wave energy sources can also be intermittent. Generators obtaining their power from hydro, tides, geothermal sources and biological process can be utilized in a way similar to burning carbon. However, hydro-electric sources have become limited, tidal and geothermal possibilities are not conveniently distributed and biological sources using bacteria have yet to be proven.

There are many ways to compare the costs of renewable sources of power. Graham, Reedman, and Coombes, (2007: 44), quote figures separately for centralized and decentralized generation. This is because different technologies are involved and the efficiencies of scale are different.

Table 2: How finance costs change relative prices of electricity from different sources uses indicative figures to illustrate how the cost of finance influences the economics of generating electricity from coal without carbon capture and wind power.

Table 2: How finance costs change relative prices of electricity from different sources

Source of energy	**Coal**		**Wind**	
Capacity cost: $A/Kw	*1,850		*1,925	
Utilisation of capacity	*80%		*29%	
Equivalent cost $A/ kW	2,313		6,638	
Cost of finance: Debt/equity	**8%**	**0%**	**8%**	**0%**
(Australian currency)	¢/kWh	¢/kWh	¢/kWh	¢/kWh
Finance costs over 25 years	2.44	1.06	7.02	3.03
Operations and Maintenance	1.22	1.22	0.25	0.25
Fuel	*1.00	1.00	Nil	Nil
Price of electricity	**4.66**	**3.28**	**7.27**	**3.28**
$US ($A1.00=$US0.66)	3.08	n.a.	4.08	n.a.
$US *The Economist*(2008: 4)	**5.0**	n.a.	**8.0**	n.a

* Figures as quoted by Graham, Reedman, and Coombes, (2007: 44)

The cost of the investment in coal and wind technology to produce each Kw of electricity and the capacity factor of the technology are taken from Graham, Reedman, and Coombes, (2007: 44). Their work was undertaken for the "Cooperative Research Centre for Coal in Sustainable Development" with one of the authors being employed by a Coal supplier. It is unlikely that their data would contain any biases towards the wind energy alternative.

However, in Table 2, the price of coal generated electricity is estimated to be only 3 US cents per kWh in the year 2010. This is 40% below the current price quoted by *The Economist* of 5 US cents per kWh. The low estimate might be explained by Australia having an international competitive advantage in producing coal and/or recent significant changes in the exchange rate. Another source of the low price estimate for coal is that the Capacity cost of coal in 2010 is assumed to be $A1,850/Kw by Graham, Reedman and Coombes (2007: 44). Dr Mark Diesendorf (2007) who has extensively researched the data, advised the author that the current capacity cost for coal is "about $A2,500 to $A3,000 per Kw" (i.e. at least one third higher) with the operating and maintenance costs for wind generators being around ¢1/kWh.

The internationally competitive price of Australian generated electricity from coal shown in Table 2 is after using a higher interest[15] than those of the data source and adopting operating and maintenance costs that made the price equal for either source of energy when there was no cost of money. This was done to allow the cost of energy from either source to become the same when no interest and/or dividend charges were incurred. When there is no interest and/or dividend charge the cost of finance becomes the cost of paying back the funds required to purchase the generating capacity. The adjustments made to the data of Graham, Reedman, and Coombes, (2007: 44) is supported coincidently or otherwise by the ratio between the Australian dollar prices for each alternative being almost the same as the ratio of the two US dollar prices cited by *The Economist* shown in the last row of Table 2.

The data provided by Graham, Reedman, and Coombes, (2007: 44) is for centralized production without carbon capture. It specifies an investment cost of $A1,850 in 2010 to provide the capacity for generating each Kilowatt (Kw). The investment cost for each Kw capacity of wind power is given as $A1,925. However, the kWh generated was assumed to be reduced to 80% of capacity for coal generators to undertake maintenance and to 29% for wind, mostly because the wind does not blow all the time. This means that the capacity required to continuously delivery on average one kWh from coal needs to be increased to $A1,850/80% = $A2,313 and for wind to $A1,925/29% = $A6,638. In other words the equivalent investment required in wind technology is 3.4 times greater than that required for coal to obtain same output over the long run. As a result the finance costs would be multiplied by the same amount as shown in the "Cost of technology" row of Table 2.

For accounting purposes the investment in each type of technology is taken to be written off over 25 years which is equal to 219,000 hours. To amortize the cost of the coal generator a charge of $2,313/219,000=1.06¢/kWh is required while that for wind it is $6,678/219,000=3.03¢/kWh. It is also assumed that the equity and/or debt finance for the technology is paid back with equal monthly principal repayments and dividend and/or interest paid on a monthly basis like for a housing loan over the 25 years. The cost of repaying both

[15] The author was advised by an e-mail of November 11th, 2008 from the first named author of Graham, Reedman, and Coombes, (2007: 44) that a 5% interest rate used in their calculations. But how this rate was used is unclear as is evident from the explanation provided that: "The 5% is calculated as a share of initial capital expenditure. However, the costs represented by this 5% rule may be either ongoing or upfront (fixed). We amortise any upfront payments just to keep it simple. It is not known whether they are debt or equity funded - it would depend on the individual project investor. The 5% rule is not appropriate in all cases."

principal and interest for coal become 2.44 ¢/kWh and 7.02 ¢/kWh for wind using an 8% p.a. cost of finance for either technology.

The price of power is determined by adding to operational and maintenance cost, to the finance cost, and fuel cost where this applies for coal. Using an 8% cost of finance, the cost of electricity from wind becomes 7.27 ¢/kWh being 58% higher than the cost of electricity from coal generation of 4.66 ¢/kWh. This compares closely with the 60% higher cost for wind power reported by *The Economist*. However, if Islamic banking was introduced and finance provided without an interest charge than market forces would become indifferent to allocating resources to either coal or wind.

While one may argue about the individual numbers used in the above analysis, the differences would not change the conclusion that the cost of finance is a significant factor in determining the relative costs of generating electricity from renewable or non-renewable sources.

No carbon taxes or carbon trading would be required to allocate resources to generating electricity from wind if a "selective" monetary policy was introduced along the lines proposed in the US House of Representatives Bill (HR1452). The indicative figures of Table 2 show that without a finance cost the price of electricity would drop by 30% from the 4.66¢/kWh for coal to 3.28¢/kWh produced by wind.

One way of implementing a selective policy is for commercial banks to distribute interest free loans to finance renewable electrical energy generation on the basis that: (a) repayment of the loan was fully guaranteed by a non bank related insurance organization; (b) the insured zero interest loan was sold for its full value to the central bank to become part of the commercial banks' statutory reserves and (c) a small processing fee could be obtained by the commercial bank and (d) the ownership and control of any excess or "surplus profits" (Turnbull 2006) from the electrical generators was distributed to the consumers.

The cost of credit insurance on the interest free loan would reflect the perceived risk of the investment in the wind generators that they would operate sufficiently reliably and for long enough to generate cash to pay back the loan. The insurance premium would indicate risk more accurately then current interest rates that are distorted because central banks create risk free credit at a price that is determined by monetary policy.

As indicated in Table 2 (and as experienced by many who have obtained a long term housing loan) interest charges over 25 years can multiply the cash that has to repaid back two or more times. Table 2 shows how an interest rate of 8% increases the cost of coal power by 44% and wind power by a disproportionally much greater amount of 122%. If access is provided to interest free finance, the cost of wind powered electricity reduces from 7.27¢/kWh to a highly competitive 3.28¢/kWh. If the financing of coal generators are not given access to interest free finance then wind powered electricity becomes 42% less expensive than coal generated power.

The above discussion shows how monetary policy could allocate resources from constructing generators that burn carbon to renewable energy generation without a complicated carbon trading scheme and/or a tax on burning carbon. Carbon trading and/or carbon taxing introduce higher prices and so inflationary pressures. Selective monetary policies decrease costs and inflationary pressures. It achieves this by reducing the cost of the banking system by reducing the cost of Seigniorage. Patman (1941) and the promoters of interest free "Sovereignty Loans", point out that it makes little sense for governments to increase their costs by paying interest on the money that only they have a right to create.

Likewise, it makes little sense for national governments to require State and Local governments to increase the cost of self-financing infrastructure services by charging them an interest rate. The interest does not reflect risk but a tax to further the profits of the banking system that creates the loans. As noted from Table 2, interest charges can double the price of infrastructure services that could include water, sewerage, trains, toll bridges and roadways. Rather than increase inflation, the creation of guaranteed self-liquidating interest free loans would make a direct contribution in reducing the prices of self-financing services. The services financed could in turn counter inflation by increasing productivity of the economy.

The banking system automatically creates credits in any event when it makes loans. It does this on an indiscriminate scatter gun basis that can both exacerbate inflation and the resilience of the banking system. New credits can be used for speculative purposes such as financing second hand shares and derivates or consumable durables that are not self-financing. Selective monetary policies allow credit expansion to be precisely targeted to the formation of self-financing assets that the private sector has guaranteed to become "procreative" (Moulton 1934: 12). Moulton defined procreative assets as those that pay for themselves by increasing productivity to counter inflation by allowing "nature to yield her resources more productively"

Because interest free loans would be guarantee by the non-bank sector they would increase the resiliency of the banking system. Systemic risk is also reduced because the statutory reserves of banks are increased by holding guaranteed loans as reserves. Banks would become more like building societies, credit unions, and old fashioned savings banks with more of their lending financed by the deposits they attract rather than by the deposits they create by making loans.

The introduction of a parallel independent competing currency provides an alternative and/or complementary way to introduce interest-free and/or negative interest money to overcome market failure that is driving climate change. Besides mitigating climate change without increases in taxes and prices, a competing currency of Energy dollars provides a way to counter inflation as proposed by Hayek (1976a, b). In addition, Energy dollars provides another way of rebuilding the financial system on a more resilient and sustainable basis to provide a fall-back position in case there are any further breakdowns in the existing system. These issues are the subject of the following final Section.

4. Mitigating market failure[16]

[16] To correct the failure of the market to generate electricity from renewable sources the Australian Government introduced the The Renewable Energy (Electricity) Act in 2000. Consultation Paper (2008: 5) states: "The Act created tradeable Renewable Energy Certificates (RECs). One REC is equivalent to one megawatt-hour (MWh) of renewable energy. Demand is created by legally obliging parties who buy wholesale electricity (retailers and large users) to source an increasing percentage of their electricity purchases from renewables-based generation in the form of annual targets that ramp up to 9500 GWh in 2010 and remain at that level until the measure concludes. Liable parties can acquire and surrender RECs to demonstrate compliance. Alternatively, they can pay a shortfall charge of $40/MWh. RECs can be created by a number of providers, including pre-existing renewable energy generators, if they provide electricity above an agreed preset annual baseline. The right (or eligibility) to create RECs is separate from the obligation on wholesale electricity purchasers. RECs can be generated both by commercial-scale renewables-based power generators, and smaller-scale wind power, hydro, and rooftop photovoltaic systems and solar water heaters" The scheme is to be phased out from 2020 to 2030 when market failure is expected to be corrected by other measures like carbon trading.

This Section outlines some of the institutional design criteria required for introducing an alternative currency redeemable into kWh to mitigate the market failure creating climate change while also providing the basis for building a resilient financial system.

The lack of resilience in the financial system was demonstrated in 2008 by the need for the US government and those in Europe and elsewhere to provide unprecedented financial support not only to banks, but to investment banks that had become "shadow banks" and to other firms. The failure was anticipated in the 1980's as set out in Chapter 2, 'Root Causes of the World's Economic Breakdown' (Benello, Swann and Turnbull 1997: 11–9) and provides lessons for designing an alternative system[17].

One lesson is that if "the invisible hand" of market forces is to work in weeding out inefficient and/or imprudent firms, then no firm should be allowed to grow so big that it cannot be allowed to fail.

The design criterion for the internet was that it had to be sufficiently resilient to withstand major failures in the case of a nuclear war. For this reason it was designed on a highly decentralized basis so that a failure in one or more parts of the system would not bring down the whole system and there would be a number of ways to replace and/or work around the failed components. For the financial system to become resilient, central banking needs to be replaced by decentralized banking as existed around the world until a few centuries ago.

Government regulators have broken up dominant firms to promote competition. The Bell Telephone company was at one time was the largest corporation in the world but was forced to divide into seven "Baby Bells in the 1980's. Big is not best for consumers. Nor is big best for resilience. Big may be best to achieve economies of scale and scope, but efficient operations are of little use if they are not systemically sustainable. System resilience needs to be added to the criteria for breaking up financial firms to a size that failure can be accepted by the system.

Arguments on how decentralization introduces system resilience are presented by Olsson, Folke and Berkes (2004). Lietaer, Ulanowicz, and Goerner (2008) show how there is a trade-off between efficiency and resilience. The problem is that government regulators are populated by economists who focus on efficiency rather than resiliency. Economists and the rest of us evolved from small ancestors who survived the cataclysmic event that make the dinosaurs extinct.

Many small overseas financial institutions that borrow and lend locally like building societies, credit unions and local banks are surviving the 2008 financial crisis without government support. Ironically their survival depended upon not participating in the sharing of risk by acquiring securities created by other firms. This leads to another lesson from the 2008 financial crisis.

A second lesson is that systemic degradation was introduced by financial intermediaries changing their business model to be inconsistent with their capital structure and role. This problem was seriously exacerbated by financial de-regulation in the 1980's in the UK and in other markets and by the 1992 repeal of the Glass-Steagall Act in the US.

[17] This paper only considers an alternative banking system based on introducing a currency with ecological property rights. Ecological property rights for owning land, buildings and corporations are outlined in Turnbull (1992, 1994, 2006, 2007, 2008).

Before de-regulation banks acted as intermediaries for carrying out the inherently risky role of using short term deposits to finance long term loans. To allow banks to carry out their role of borrowing short and lending long, governments provided them with lender of last resort facility to manage their liquidity risk. In return, governments regulated the degree to which banks could leverage their shareholders' equity and so their profits with depositors' funds.

An implicit assumption in governments providing banks the privilege of a lender of last resort facility was that banks would not only lend prudently but they would also retain and manage their loans closely with diligence. This assumption was made irrelevant with the securitization and distribution of loans to spread the risk of loans of going bad. This also spread the risk of systemic failure as occurred in 2008.

De-regulation and securitization allowed banks to change their business model from being principals issuing and holding debts to becoming both brokers and agents in the game of pass the parcel of debt. Debts sold were not longer being managed by the Bank as a Principal. At the same time, finance brokers like investment banks, which were in the business of being agents in transferring assets between Principals, became Principals themselves. In addition, brokers became "shadow" banks creating credits to finance highly volatile new asset classes described as derivatives. By this means investment banks also fueled an asset bubble with a capital structure that was too highly leveraged even to be a resilient Agent/broker let alone a Principal.

The second lesson is that financial intermediaries need to be regulated to "stick to their knitting". Financial firms need to act as an Agent or as a Principal but not both. Also, financial intermediaries should not accept both liquidity risk and loan loss risk together. Nor should foreign exchange risks be added.

Liquidity risks can be efficiently accepted by banking institutions with equity that is only around 10% of total assets while loan loss risks need to be accepted by insurance institutions with liabilities of less than 10% of their total assets. To achieve systemic efficiency and stability regulation is required so highly leverage banks and/or those reliant on wholesale funding, have their loans insured by institutions with liabilities that are less than 10% of their total assets or with specialized insurance intermediaries that can average[18] risks over regions, time and sub-types of risk like mortgage insurance firms.

To avoid systemic global financial risk, banks need to also avoid accepting foreign exchange risks as either borrowers or lenders. Foreign exchange risks need to be allocated to the non bank sector either directly and/or indirectly through future contracts. The problem of foreign exchange risks can be avoided with currencies convertible into a commodity that can be stored and/or traded. Market forces can then play their role to automatically correct imbalances in foreign currencies by trading in the reserve commodity and/or other goods and services. This

[18] Moulton (1935: 13) describes how US investment banks averaged the risk of new industrial development by holding new shares from different firms in different industries from different regions until they could be listed on a stock exchange to repay the loans created by commercial banks to finance the newly issued shares. This created a "round about method" for financing industrial development without the need for foreign investment or historical savings. Investment was financed by the savings created by the investment by this around about method. This process was restricted by the 1933 Glass-Steagall Act. Japan became independent of foreign finance by credit creation and cancellation in a similar way through what was described as "over loaning" (Ehrilich 1957: 469) by their commercial banks. The loans were collateralized over different industries in different regions by the equity of industrial groups described as a Zaibatsu. Industrial development of Germany in the early 20th century was financed in a similar manner to reduce reliance on foreign investment.

process is facilitated by a decentralized commodity based financial system such as considered in Section two.

The analysis of the operating characteristics of energy-backed dollars in Section two supported it use for a decentralized currency system. From the discussion one can conclude that Energy dollars would meet the three design criteria described by Lietaer (2001). His three criteria were that it would: (i) Allow a country or region to unilaterally establish an internationally recognised convertible currency; (ii) Promote economic activity without inflation, and (iii) Support ecologically sound development.

Design of the institutional arrangements for an alternative currency present a greater challenge. Bob Swann, an associate of Borsodi who issued "Constants" in New Hampshire in 1973 put forward four criteria in a Chapter on "Building a community banking system" (Benello, Swann and Turnbull 1997: 178–83). The criteria were that the system would: (i) Be simple to understand; (ii) Use redeemable currency; (iii) Establish a stable universal unit of account and (iv) Organized and controlled at a local level.

As President of the E.F. Schumacher Society based in Great Barrington, Massachusetts, Swann sought to put these ideas into action. We developed a proposal to introduce Energy dollars redeemable into kWh[19] as first proposed by Turnbull (1977). Swann obtained the agreement in principle to build a wind powered electrical generator on the top of a mountain at a local ski resort. Under US law, the local power distribution company was required to purchase locally generated power. In this way we planned to distribute renewable energy to investors/consumers who purchased their power needs in advance.

Using the data[20] in Table 2 a $US10 million wind power generator would have the capacity to generate 7,871 Kw. Over the 25 years of its operational life equivalent to 219,000 hours and operating only 29% of the time this would yield saleable hours of 500,000,000 kWh or 500 GWh. To raise the $US10 million to acquire the generator, its output would need to be pre-sold for a net present value of not less than US2¢/kWh.

The concept was to fund the $US 10 million by selling pre-payment vouchers denominated in kWh to institutional consumers of electrical power who would use the vouchers to pay their power bills instead of US dollars. A target market was the sinking funds of condominium apartments. The consumers would purchase Energy dollar vouchers redeemable in specified kWh at specified years and acquire a pro-rata share in the equity of the wind generator. The generator would then be owned by its customers who would become residual claimants for any surplus values. The power distribution company would use the vouchers received from its consumers to pay the wind generator company for the power it supplied. In this way the credits created would be cancelled.

The project did not proceed because the billing system of the power distribution company did not possess an extra "field" in its data processing equipment to identify if the payments by its customers were made in US dollars or Energy dollars. A point of interest is that, as a matter of

[19] Permission of the Comptroller of Currency and the Secret Service was required to issue a currency in the US. These permissions were obtained by the chairman of the E.F. Schumacher Society, John McClaughry who in 1982 was working in the White House as President Reagan's Senior Domestic Policy Advisor. It is interesting to note that the Secret Service was originally created to protect the currency rather than the President. "Liberty Dollars" referred to in note12 were shut down by the Secret Service in November 2007.

[20] Australian data was converted at the exchange rate quoted in Table 2 and relative costs in any event may be inappropriate.

practical necessity, the power distribution company would become a liquidity manager averaging out supply and demand much in the same way that central banker becomes a lender of last resort to manage deposits being called. Depending upon the contractual relationships with the power distribution company, it might have also become a de facto guarantor of the notes in the event the wind generator failed to deliver sufficient power to redeem all the vouchers on issue.

If the use of Energy dollars are to be scaled up to create competitive decentralized alternative autonomous[21] financial systems institutional arrangements need to be designed to manage traditional banking risks discussed above. There would also be a need to create additional non-cash credits to finance commerce and/or economic development. The issue of self-liquidating ecological demurrage currency denominated in kWh would avoid the cost of paying seigniorage. The cost of finance and the dead weight cost of the banking system could be substantially reduced. The benefits of Islamic Banking with an ecological currency could become widely shared.

The most profound result of widespread adoption of Islamic Banking is that the opportunity rate for evaluating investment projects would be significantly reduced. Money on its own would no longer create an opportunity cost. Ecological money and currencies would create an incentive to invest in activities in the real economy that would at least maintain value if not have a prospect for increasing their value like investing in young trees.

Environmental costs are created from economic analysis being based on discounting the future from using Present Value analysis. Discounted Cash Flow (DCF) analysis in any event depends upon the assumption that people have both the opportunity and the wish to invest their wealth rather than consume it to sustain their life. This assumption is not valid for many pensioners or when the opportunity for governments to invest depends upon citizens giving up consumption to pay tax.

The E.F. Schumacher Society proposal for issuing renewable energy dollars indicates how ecological money and Islamic Banking could be established on a highly decentralized basis. The experience of Stamped Script being widely and rapidly accepted in Germany, Austria and the US illustrates how highly decentralized ecological currency could become rapidly adopted within a year or so if permitted by governments. Existing initiatives to just save the financial system, let alone introduce reforms, are likely to take much longer.

The current breakdowns in the financial system and the inconvenient truth of global warming provide compelling reasons for governments to not just permit but facilitate the evolution of a more resilient, efficient banking system that could also avoid the time, complexity and uncertainty in the efficacy of carbon trading. It would also reduce the price rises associated with either carbon trading or taxing.

Besides introducing new initiatives to save and reform the current system, governments should recognize they have been the problem from both what they have done and what they have not done. Regulators have failed by allowing the financial system to be become more complex than they are capable of understanding. The most senior government advisor in Australia, Dr. Ken Henry, the Secretary to the Treasurer, stated:

[21] Refer to Chapter 20 by the author on 'Elements of Autonomous Banking' in Benello, Swann and Turnbull (1997: 159–66)

> The array of financial instruments deployed within the global financial system has become so complex that it defies understanding. For decades to come, policy makers around the world are going to be asking why those with sufficient authority didn't, at some point, stand above the buzz of the financial markets and declare, in simple language, that all of this simply doesn't make sense. (Ramsey 2008).

Another problem is that the study of alternative institutional arrangements is a neglected topic. How to design alternative financial and governance systems is also a neglected topic. There is no longer time to fill this gap so the take home message for governments is that there is a need to learn while doing. To facilitate this process, governments should facilitate privately initiated monetary experiments along those described in this paper in the spirit of letting a thousand flowers bloom.

5. References

Benello, C.G., Swann, R. and Turnbull, S. 1997, *Building Sustainable Communities: Tools and Concepts for Self-reliant Economic Change*, Ed. Ward Morehouse, A TOES Book, Revised Second Edition, Bootstrap Press, New York, http://ssrn.com/abstract=1128862.

Boyle, D. 2002, *The Money Changers: Currency Reform from Aristotle to E-Cash*, Earthscan, London.

Consultation Paper, 2008, *COAG Working Group on Climate Change and Water: Design Options for the Expanded National Renewable Energy Target Scheme,* Australian Government, http://www.climatechange.gov.au/renewabletarget/consultation/pubs/ret-designoptions.pdf.

Davies, G. 1996, *A History of money from ancient times to the present day*. rev. ed. Cardiff: University of Wales Press, UK. http://www.ex.ac.uk/~RDavies/arian/llyfr.html.

Diesendorf, M. 2007, *Greenhouse Solutions with Sustainable Energy*, UNSW Press, Sydney,

Douglas, C.H. 1924, *Social Credit*, Eyre & Spottiswoode (Publishers) Ltd. London, http://douglassocialcredit.com/resources/resources/social_credit_by_ch_douglas.pdf.

Dowd, K. 1992, *The Experience of Free Banking*, Routledge, London.

Ehrlich, E.E. 1957, *Review of Economics and Statistics*, 39:4, Nov., pp. 469–71.

Evans, D. 2007, 'My Life with AGO and other Reflections', A presentation to The Lavoisier Group's Workshop 'Rehabilitating Carbon Dioxide' held in Melbourne on 29–30 June: http://www.lavoisier.com.au/articles/climate-policy/science-and-policy/DEvans2007.pdf

Evans, D. 2008, 'No smoking hot spot', *The Australian*, July 18th http://www.theaustralian.news.com.au/story/0,25197,24036736-7583,00.html.

Fisher, I. 1911, *The Purchasing Power of Money: Its Determination and Relation to Credit, Interest, and Crises,* The MacMillan Co, New York.

Fisher, I. 1933, *Stamp Script*, Adelphi Co, New York.

Friedman, M. 1961, *Real and Pseudo Gold Standards*, Mont Pelerin Society, September, http://www.joecobb.com/real-and-pseudo-gold-standards/

Friedman, M. and Friedman, R. 1985, 'Constitutional Amendment to Limit the Growth of Spending', *Academy of Political Science,* Proceedings, 35(4), pp. 132–6.

Friedman, M. and Schwartz, A.J. 1971, *A Monetary History of the United States, 1867-1960,* Princeton University Press.

Galbraith, J.K. 1976, *Money: Whence it came, where it went*, Pelican Books, UK.

Gesell, S. 1916, *The Natural Economic Order*, translated by Philip Pye, 2002: http://www.appropriate-economics.org/ebooks/neo/neo2.htm.

Graham, P., Reedman, L. and Coombes, P. 2007, *Options for electricity generation in Australia: Draft update for Industry Review and Consultation, July,* Cooperative Research Centre for Coal in Sustainable Development, QCAT Technology Transfer Centre, c2008, Pullenvale, Qld., available from link at: http://catalogue.nla.gov.au/Record/4456726.

Griffin, G.E. 2002, *The Creature from Jekyll Island: A second look at the Federal Reserve*, American Media, California.

Hayek, F. A. 1976a, *Choice in Currency: A Way to Stop Inflation*, Occasional Paper 48, The Institute of Economic Affairs, London.

Hayek, F. A. 1976b, *Denationalization of Money: An Analysis of the Theory and Practice of Concurrent Currencies,* Hobart Paper Special 70, The Institute of Economic Affairs, London.

Huber, J, and Robertson, J. 2000, *Creating New Money: A monetary reform for the information age,* New Economics Foundation, London: http://www.neweconomics.org/gen/uploads/CreatingNewMoney.pdf

Jacobs, J. 1985, *Cities and Wealth of Nations: Principles of Economic Life*, Vintage Books, New York.

Kennedy, M. 1988, *Interest and Inflation Free Money: How to create an exchange medium that works for everybody*, Permakultur Institut e.v., Steyerberg, West Germany.

Keynes, J.K. 1936, *General Theory of Employment, Interest and Money,* Royal Economic Society, Macmillan Cambridge University Press: http://www.marxists.org/reference/subject/economics/keynes/general-theory/

Lietaer, B.A. 2001, *The Future of Money: Creating New Wealth, Work and a Wiser World,* Century, London.

Lietaer, B.A., Ulanowicz, R. and Goerner, S. 2008, 'Options for Managing Systemic Bank Crises', presented to the World Academy of Arts and Sciences (WAAS), Hyderabad, India, October 22: http://www.gifthub.org/files/Options_for_Managing_Systemic_Bank_Crises__19Oct.pdf

Marx, K. and Engles, F. 1848, *Manifesto of the Communist Party,* 2nd. rev. ed. Moscow, Progress, 1977.

Monetary Reform Act, 2008: http://www.themoneymasters.com/mra.htm.

Moulton, H. G. 1935, *The Formation of Capital*, The Institute of Economics, Brookings Institute, Washington, D.C., Publication No. 59.

NCSU, 2008, 'NC State Engineer Taps Heat-Loving Bacteria for Hydrogen', North Carolina State University News Release: http://news.ncsu.edu/news/2008/07/116mkkellyhydrogen.php.

Olsson, P., Folke, C. and Berkes, F. 2004, 'Adaptive Comanagement for Building Resilience in Social-Ecological Systems', *Environment Management*, 34:1 pp. 75–90: http://www.springerlink.com/content/mlg2g9dphj4b1a20/fulltext.pdf.

Patman, J.W.W. 1941, *Congressional Record of the House of Representatives*, September 29, pp., 7582–3, Washington D.C.

Preparata, G. G. 2006, 'Perishable Money in a Threefold Commonwealth: Rudolf Steiner and the Social Economics of an Anarchist Utopia', *Review of Radical Political Economics*, 38:4, pp., 619–48.

Ramsey, A. 2008, 'It takes courage to say the f-word: failure', *Sydney Morning Herald*, November 15th: http://www.smh.com.au/articles/2008/11/14/1226318923455.html?feed=fairfaxdigitalxml

Schauf, T.D. 1998, *The Federal Reserve is Privately Owned*: http://www.apfn.org/APFN/fed_reserve.htm.

Sennholz, H.F. 2006, *Milton Friedman, 1912-2006*, Ludwig von Mises Institute: http://mises.org/story/2414.

Sliwa, J. 2006, 'Research highlights how bacteria produce energy', *Press Release, American Society for Microbiology*: http://www.eurekalert.org/pub_releases/2006-05/asfm-rhh051706.php.

Stern, N. 2006, *The Economics of Climate Change: The Stern Review*, Cabinet Office, HM Treasury, London: http://www.sternreview.org.uk.

Stodder, J.P. 2000, 'Reciprocal Exchange Networks: Implications for Macroeconomic Stability', presented to the International Electronic and Electrical Engineering (IEEE) Engineering Management Society (EMS), Albuquerque, New Mexico, August *Conference proceedings*, *IEEE EMS*: http://ssrn.com/abstract=224418.

Suhr, D., 1989, *The Capitalistic Cost-Benefit Structure of Money*. Berlin, Heidelberg, New York: Springer.

The Economist, 1990, 'Currency Reform: A brief history of funny money', January, 5th –12th.

The Economist, 1991, 'When the Price is Wrong', February 2nd–8th.

The Economist, 2008, 'Special Report on the World Economy', October, 11th–17th.

The Economist, 2008, 'The power and the glory: A special report on energy' June 21st.

Turnbull, S. 1977, 'Let the Market Correct Itself', *The Australian,* p.8, May 25, Sydney.

Turnbull, S. 1992, 'Economics and the laws of nature', in *The Other Economy: Economics Nature Can Live With*, Ed. Alan Marston, A TOES Book, Learn by doing publishers, Auckland, New Zealand.

Turnbull, S. 1994, 'Building a Stakeholder Democracy', in *Ambitions for our future*, Economic Planning Advisory Commission, Conference Report 3, Australian Government Publishing Service, Canberra.

Turnbull, S. 2006, 'Grounding economics in commercial reality: A cash-flow paradigm', in Kreisler, P., Johnson, M. and Lodewijks, J. (Eds.), *Essays in Heterodox Economics: Proceedings, refereed papers, Fifth conference of Heterodox Economics*, University of New South Wales, Australia, pp. 438–61, 2006, http://ssrn.com/abstract=946033.

Turnbull, S. 2007, 'A framework for designing sustainable urban communities', *Kybernetes: The international journal of systems, cybernetics and management science,* Special Issue on "Cybernetics and Design", Guest Editor, Ranulph Granville, Emerald Group, pp. 1543–57, October 2007, based on Working Paper: http://papers.ssrn.com/abstract_id=960193.

Turnbull, S. 2008, 'Financing urban communities with sustainable energy dollars', in *Urban Energy Transition*, Peter Droege, (ed.), pp.121-40, Elsevier Science Publishers, Oxford, based on Working Paper: http://papers.ssrn.com/abstract_id=980027**.**

White, L.H., 1987, *Accounting for Non-Interest-Bearing Currency: A Critique of the Legal Restrictions of Money*, *Journal of Money, Credit and Banking*, Vol 19. pp. 448–56.

White, L.H. 1993, *Free Banking, (Volumes I, II, & III)* Edward Elgar Publishing Limited.

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