DISPERSAL OR REUSE

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ABSTRACT

Subsurface drip is a tool which can be used in many ways – limited only by the imagination of the user.

I hope that this paper will fire-off the neurons of the audience to result in many more new ideas.

Here are some of the ideas which are either already practical or in the process of studies.

SUBSURFACE DRIP TECHNOLOGY

- The principles of how it works:
- The slow pulsed application of the effluent over many points in the soil - with management - can result in an air, water and nutrient balance which can achieve efficient controlled oxidation of anaerobic bacteria and other pollutants.

How SDI works:

SUSTAINABLE ENVIRONMENTAL REUSE APPLICATIONS

- Nitrogen and phosphorous management
- Methane and CO_2 green house gas management
- Endocrine disruptors, pharmaceuticals etc. – phytoremediation.
- Virus removal
- Green roofs

SUSTAINABLE ENVIRONMENTAL REUSE APPLICATIONS-continued

- Reuse in landscape, golf courses and agriculture
- Polluted groundwater clean-up, and produced water.
- Use in artificial wetlands
- Use in "Wisconsin" type mounds
- Efficient town planning and village development

Nitrogen management - USDA

TABLE 4–11 NUTRIENT UPTAKE FOR SELECTED CROPS - LB/ACRE – YEAR

Forage crops	Nitrogen[b]	Phosphorous	Potassium
Alfalfa[a]	201–482	20–31	156–200
Brome Grass	116–201	36–49	219
Coastal Bermuda Grass	357–602	31–40	20
Kentucky Blue Grass	178–241	40	178
Quack Grass	210–250	27–40	245
Reed Canary Grass	299–401	36–40	281
Ryegrass	178–250	54–76	241–290
Sweet Clover	156	18	89
Tall Fescue	133–290	27	268
Orchard Grass	233–312	18–45	201–281

Phosphorous Management

- Phosphorus immediately attaches (fixes) to the soil and stops moving, If effluent is surface discharged, during a rainfall event soil erosion causes this phosphorus rich topsoil to erode into the streams and lakes where this nutrition causes algae blooms, which in turn depletes the oxygen that in turn leads to fish kills. This has led to the Revised Universal Soil Loss Equation (RUSLE) where the phosphorus contamination is predictable from a surface discharged field.
- Some phosphorus is taken up by the crop as is shown in the table above. The soil's ability to adsorb phosphates is dependent upon the Ph and the concentration of fine particles of soil, iron, aluminum, calcium and other minerals in the soil. Reactions that increase the fixing of P occur in all ranges of soil pH but can be very pronounced in alkaline soils (pH > 7.3) and in acidic soils (pH < 5.5).

Methane and green house gas management

- Methane is a serious green house gas produced by anaerobic digestion and may be developed in large quantities in septic tanks, lagoons, wetlands and landfills. According to the EPA, wastewater treatment processes produce 1.2 Tg (1 Tg = 1 million Mg = 1,000,000,000 Kg) of methane per annum.
- Methane has a GHG equivalent 21 times stronger than carbon dioxide.
- A large part of the methane produced in municipal WWT plants is collected and used. It is not practical to collect and use the methane produced in an on-site septic tank or decentralized system.

continued

- On-site and decentralized septic systems have many environmental advantages over centralized WWT plants; however, GHG emission is the major environmental disadvantage.
- One can inject the methane into a subsurface drip system, thereby oxidizing the methane (CH_4) into C, CO_2, H_2O and H_2. Research into this process is beginning.

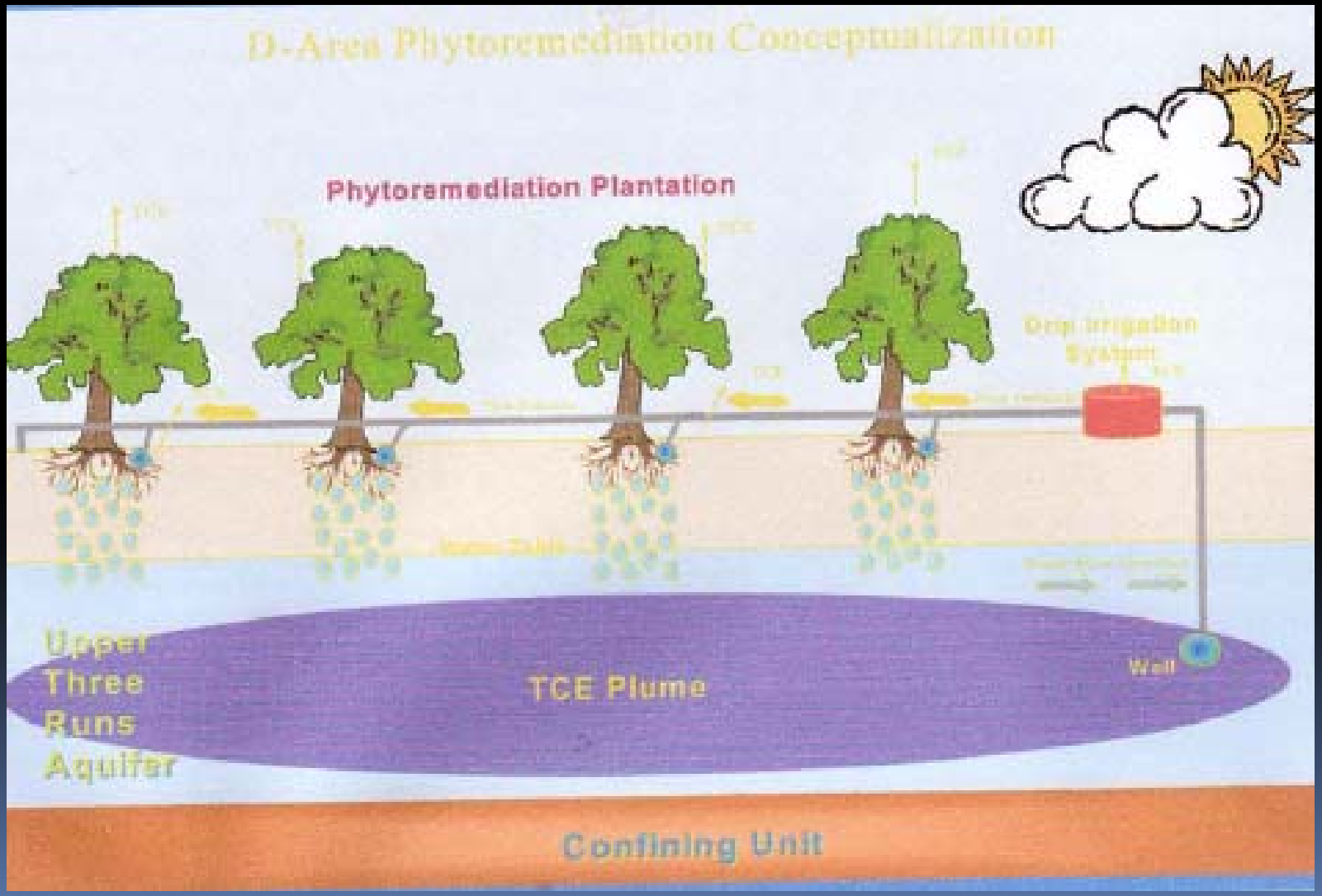
ETHANOL PRODUCTION AND RECYCLING OF CO2 - EMISSIONS

Fig. 1. Tomato crop exposed to ambient (left) vs. enriched (right) CO2 levels

Endocrine disruptors, pharmaceuticals etc.

- …. Fish and wildlife that live in our waters are the familiar "canaries in a coal mine." Scientific evidence is growing that small levels of contaminants, including pharmaceuticals, can damage reproduction and development in fish and wildlife. Science is telling us: be careful.
- Alternating dosing and aeration will oxidize a large part of these materials. Phytoremediation is also a possible solution. There is a need for more research.

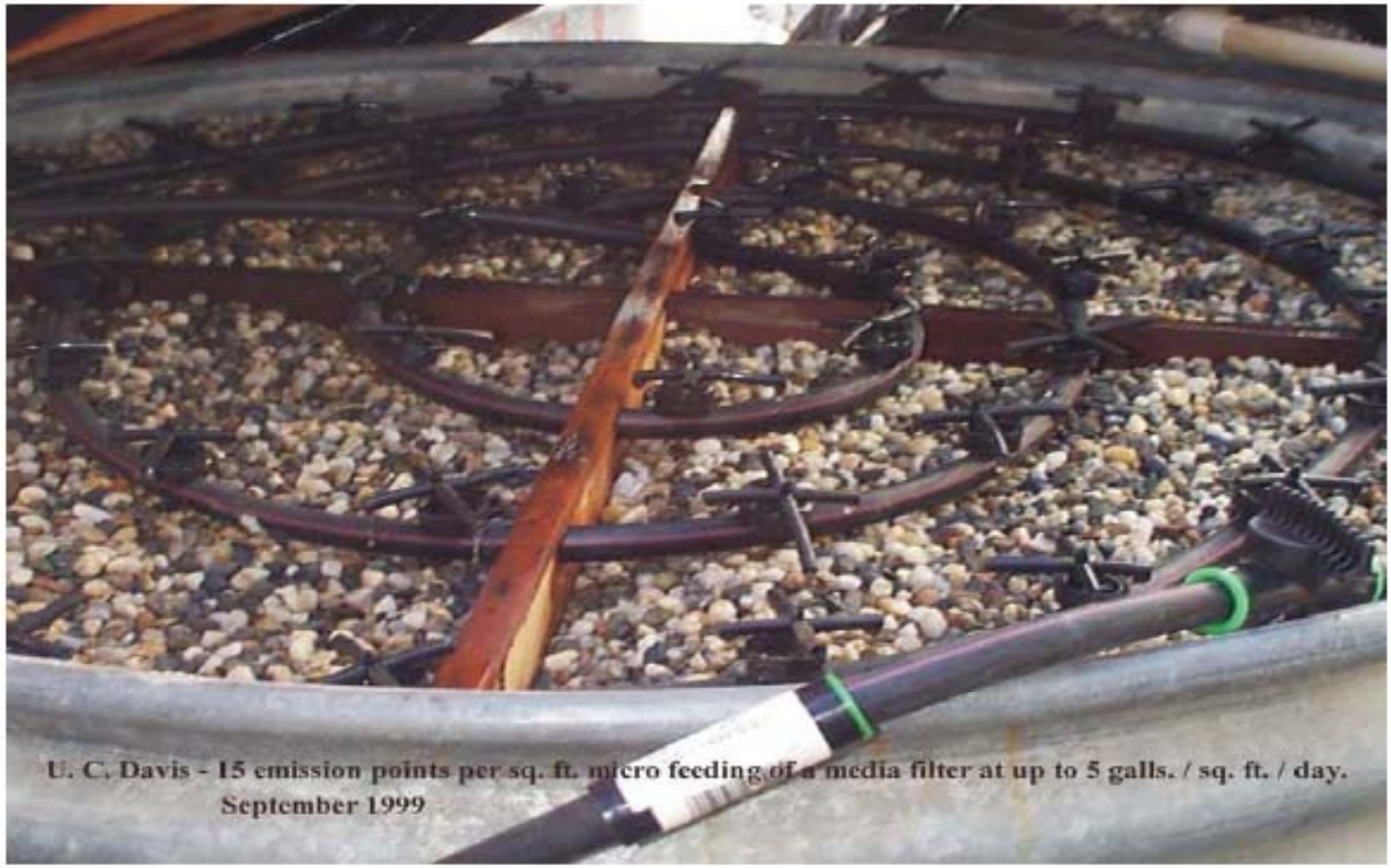
Phytoremediation



Some Chemicals Phytoremediated (E.W. Wilde et. al.):

- hexachloroethane (HCA), perchloroethylene (PCE), trichloroethylene (TCE), trichloroethane (TCA), carbon tetrachloride (CT), DDT, nitrate, ammonium perchlorate, picrate (rocket fuel components), radio-active waste, dump site leachate, etc.

Virus removal – U.C.Davis



Micro-dosing with 15 emission points per square foot at up to 5 gallons per square foot per day resulted in effective removal of virus.

Green roofs

Reuse – Landscape
A home in Malibu

Reuse – Golf course in N.Z.

Omaha Beach Golf Course, N.Z. Designed by URS. See:
http://www.geoflow.com/wastewater/w_pdfs/Omaha%20Beach.pdf

Reuse – Agriculture
Alfalfa with dairy lagoon effluent

Reuse of dairy lagoon effluent at Fresno State University. See http://www.geoflow.com/waste_p2.html

Polluted groundwater clean-up

At a B.P. refinery a 3 million gpd wetland treatment plant was set up to clean up the groundwater. The wetland was aerated with a subsurface drip system (Ruskin et. al. 2004).

Hydrocarbon polluted storm water clean-up

Shown below this 1.9 hectare forced bed aerated wetland system treats up to 4,500 m^3/day of aircraft deicing fluid-containing storm-water, with a design BOD loading of rate of 4,500kg/day.

Figure 1. Vertical subsurface flow (VSSF) engineered wetland under construction at Buffalo, New York.

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Engineered Wetland Design for Produced Water Treatment

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Table 2. Oil field produced water influent chemistry.

Parameter	Concentration (mg/L)	Parameter	Concentration (mg/L)
Total Dissolved Solids	43,048	Phenol (Total)	1.5
Total Suspended Solids	158	Copper	0.031
Iron	2.8	Nickel	0.14
Chloride	10,598	Zinc	0.021
Salinity	32,375	Ammonia	49
Oil/grease (Total)	1,213	Benzene	1.976
BOD	14,693	Toluene	0.789
Cadmium	0.005	Ethylbenzene	0.017
Chromium	0.02	Xylenes	0.289
Mercury (Total)	0.00003	Total BTEX	3.067
Lead	0.010		

Table 5. Gas field produced water VSSF engineered wetland sizing.

Type	Area (m^2)/100 m^3·day
Engineered wetland without pretreatment	3,964
Engineered wetland with pretreatment	1,696

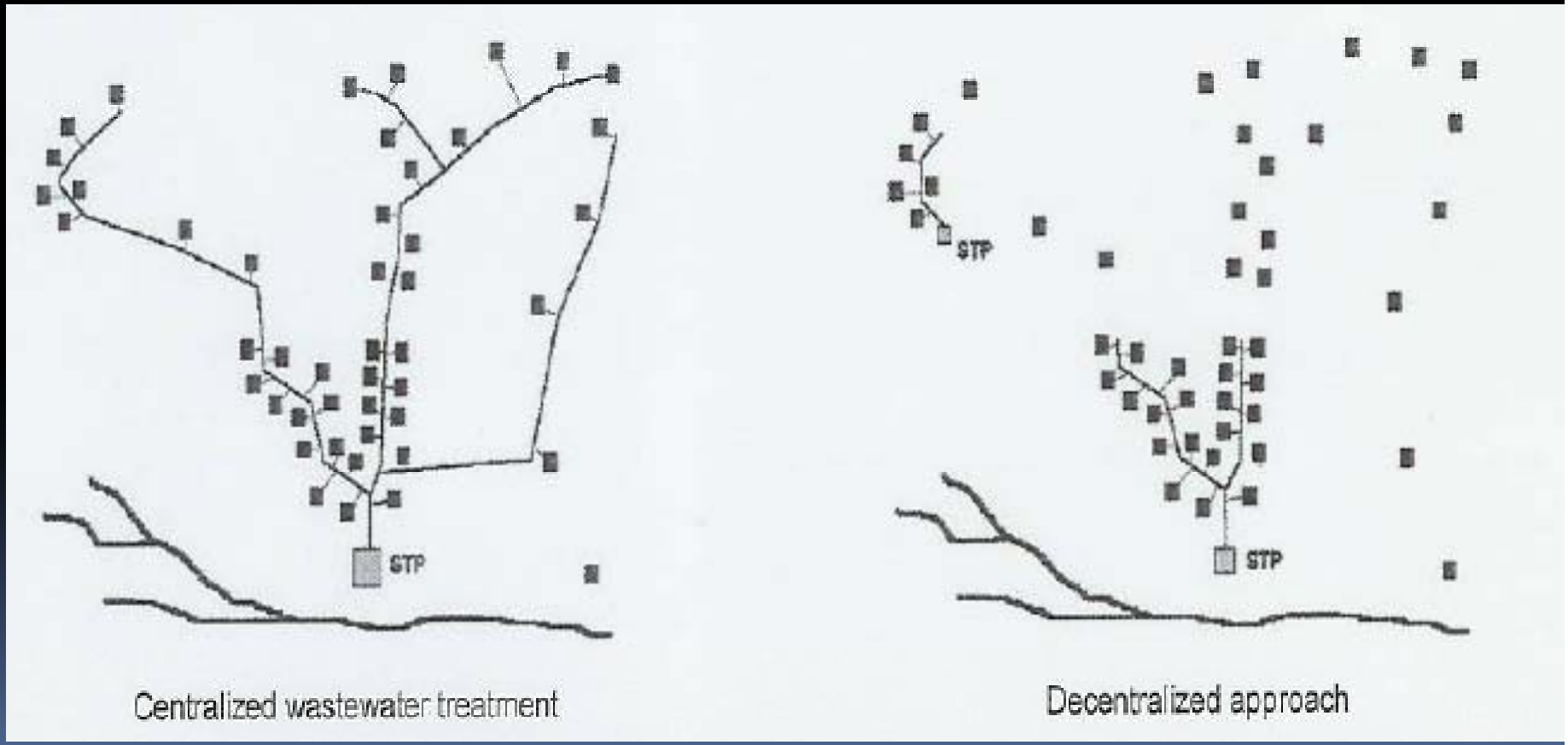
Use in artificial wetlands

Subsurface drip is used to feed effluent to constructed wetlands as well as to aerate constructed wetlands (Ruskin et. al. 2004).

Use in “Wisconsin” type shallow sand mounds

This system uses 500 feet of WASTEFLOW dripline with drippers at six inch spacing. This sand mound design is now accepted in the State of Washington.

Efficient town planning and village development - Decentralized Systems



Centralized wastewater treatment

Decentralized approach

Decentralized Systems vs. Big Pipe Sewer Plants

- A decentralized system using drip dispersal offers the best opportunity for wastewater beneficial reuse and beneficial utilization of the nutrients contained in the wastewater effluent.
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- Point source nutrient loads are eliminated. For example if a treatment plant discharges 1,000,000 Million Gallons Per Day (1.0 MGD) of highly treated effluent with a nitrogen concentration of 2 p.p.m. into a river, that would be numerically equal to about 17 lbs of nitrogen per day or about 6,205 lbs per year. With decentralized wastewater utilities utilizing a drip disposal systems the point source load on the stream would be zero lbs per year
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- Transmission cost (construction and operation) are reduced because the wastewater stays on or near the property that generated it.

- Well engineered decentralized wastewater utilities cost the home-owner about the same as large municipal type system.
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- Spills and overflows are reduced or eliminated.
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- Effluent quality is about the same as large municipal systems (Either type can produce a wide range of effluent quality).
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- Risk due to catastrophic failure is eliminated since the many smaller units do not concentrate the flow into only one system and the odds of all the small systems failing at the same time and producing the same total quantity of failure are miniscule - even if it did occur, the flow would be spread over such a larger area that the relative impact would be much less.
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- No one is left behind, because everyone can economically hook on to a decentralized facility and they can be designed to serve most any environment.
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- Development is un-impaired because a decentralized utility can be created where no city or regional facility exists and time is not lost waiting for the sewer to "catch up" to the development. In other words decentralized wastewater utilities can allow the developer and builders to be first to market.
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- Treated effluent stays in the watershed in which it was generated which reduces watershed water depletion by contributing to the watershed water balance, rather than subtracting from the water balance.
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- Environmental risks are reduced due to non-concentration, i.e. regionalism.
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- Less disruption during installation and for upgrading
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- Expansion is easier to plan and finance
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- Sludge management may be more convenient and less costly

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Thank you for your attention

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